Oct. 8, 1957 B. J. MESCAN 2,809,364

ELECTRICAL CONNECTIONS

Filed May 24, 1954

Fig. 1

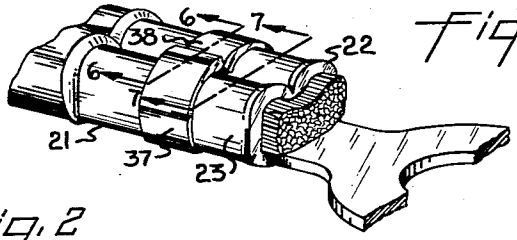


Fig. 2

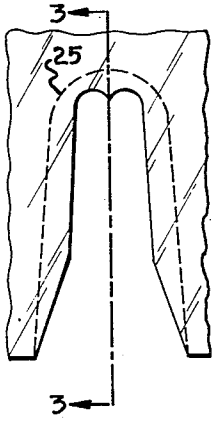


Fig. 3

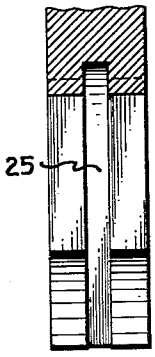


Fig. 4

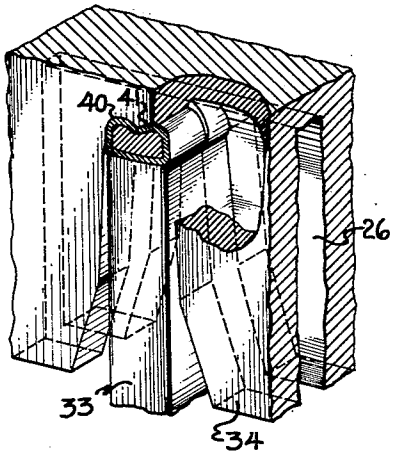


Fig. 5

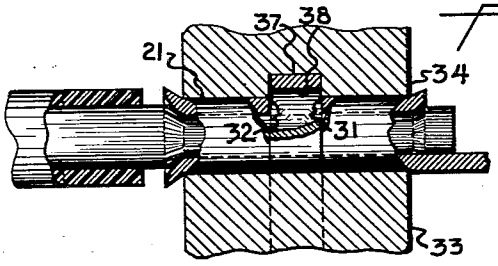


Fig. 6

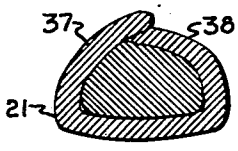


Fig. 7

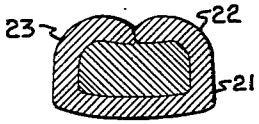
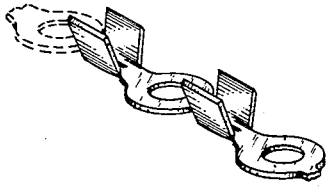


Fig. 8



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ELECTRICAL CONNECTIONS

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5 Claims. (Cl. 339—276)

This invention relates to the field of electrical connections and electrical connectors and the methods and means for making same. More particularly, the invention pertains to solderless, pressure forged (or crimped) connections wherein the connector firmly encloses the conductor to such an extent and in such a manner that a superior electrical connection results.

A serious problem confronting the art of making crimped electrical connections arose from the difficulty in crimping onto solid electrical conductors so that these conductors would be firmly attached and remain firmly attached to an electrical connector. In the past, many combinations of pressures and shapes were used to combat this problem yet there still was a scarcity of connections capable of mass production that would consistently give desired results for solid electrical conductors. The problem has been particularly troublesome in cases where a nontubular conductor-receiving barrel portion has been used.

It is an object of this invention to devise a connection that would not only eliminate the problem but also utilize to advantage a property of the solid electrical conductor that heretofore has contributed to the problem. A solid conductor is difficult to crimp and compress compared to a stranded conductor into which connector prongs may be driven and which can be readily formed into many more configurations than can a solid conductor. Due to the rigidity and relative inelasticity of a solid conductor, it was difficult to make a solderless pressure forged connection with solid wire. Once the solid conductor was compressed, it did not spring back to make tight pressure connection with the connector as would a stranded conductor. This precluded the use of solid wire in many applications where it was desired and made less advantageous the use of solid wire where it was needed. The invention here presented opens up new uses and possibilities for solid wire particularly with nontubular conductor-receiving barrels. This invention takes advantage of the peculiar properties of solid wire to make a firm connection by forcing solid wire up through an opening in the connector barrel during the crimping operation. This wire metal provides a rigid projection the sides of which are pressed against the edges of the opening in the connector barrel and due to the characteristics of a solid wire, this pressure is relatively unyielding, fastly fixing the connector to the wire.

In this specification and the accompanying drawings I have shown and described a preferred embodiment of my invention and suggested various modifications thereof; but it is to be understood that these are not intended to be exhaustive nor limiting of the invention but, on the contrary, are 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 and adapt it in various forms, each as may be best suited to the conditions of a particular use.

Other important features and objects of the invention to which reference has not been made hereinabove will appear hereinafter when the following description and claims are considered with the accompanying drawings, in which:

Figure 1 shows a perspective fragmentary view of the conductor and connector;

Figure 2 shows a fragmentary plan view of a die for crimping a connection embodying this invention;

Figure 3 is a cross section of Figure 2 taken on line 3—3;

Figure 4 is a fragmentary view in perspective showing a connection of this invention being crimped in an anvil and die of this invention;

Figure 5 is a cutaway plan view of a connection being crimped in an anvil and die of this invention;

Figure 6 is a cross sectional view taken at 6—6 of Figure 1;

Figure 7 is a cross sectional view taken at 7—7 of Figure 1; and

Figure 8 is a fragmentary perspective view of a strip of terminals such as may be used in making a connection as shown in Figure 1.

In Figure 1 is shown a completed connection embodying principles of this invention. Barrel 21 may take many forms but here is made from a flat piece of metal stock which has ears 22, 23 U'ed up and formed about the conductor in the manner set forth in Hammell application, Serial No. 410,250, filed February 25, 1954. The dies used in the illustrative form herein are similar to the dies in the Hammell application with the exception that dies incorporating the present invention have a hollow or groove, such as flute 25 in Figures 2 and 3 and slot 26 in Figure 4. Thus, during the crimping operation wire and connector metal will flow into these depressions in the dies and wire metal will provide a lock by exerting pressure against the connector metal edges, such as connector edges 31, 32 shown in Figure 5. In this embodiment there is no opening as such in the connector before crimping through which the wire metal may flow but as anvil 33 moves towards die 34, reliefs 37, 38 are raised from barrel 21 leaving a region into which the metal may flow. The pressure that reliefs 37, 38 exert on the top of the projecting wire metal serve to force the wire metal even tighter against connector edges 31, 32, although there are many embodiments of this invention possible which do not have these reliefs.

As anvil 33 nears the top of die 34, reliefs 37, 38 start to form even before the wire metal exerts a pressure against their inner sides. The rigidity and thickness of the connector metal cause these reliefs to take shape as the sides of the U'ed up connector barrel reach the top of arcs 40, 41. This leaves a space into which the connector metal may flow without a resisting force that might prevent the proper flow, but favorable results may be obtained even with such a resisting force.

As die 34 and anvil 33 move closed together, wire metal is squeezed from the pressure areas to the ends of the connector and towards the center of the connector where the reliefs have started to form. The metal is pushed from each pressure area towards the center at the same time so that metal is forced into the relief area from all directions simultaneously making the contact between the metal and connection edges 31, 32, shown in figure, extremely tight. This is more effective than crimping one area and then another.

The wire metal in the compressed areas on either side of the reliefs is work hardened during the crimping operation and therefore does not substantially spring back away from firm contact with the connector. In this invention these work hardened areas are utilized to hold the extruded wire metal in its position, tight against the connector edges. The work hardened metal forms a hard ring around the extruded portion, which is still resilient

and in compression, keeping it in position so that it will not work free. In effect there is a resilient island of metal surrounded by a work hardened conductor wire which holds said conductor wire firmly in a connector barrel. Here again this invention is designed to utilize a previously undesirable property.

The metal used in the connector is full hard, fine grain, 70–30 cartridge brass. The wire is light annealed ASTM designation B3–52T. These metal properties may of course be varied.

Two of the many possible dies used to form the connection of this invention are shown in Figures 2, 3 and 4. In Figure 2 is shown a fragmentary plan view of a known type of die but with the center portion fluted. This die is relatively inexpensive to make and very sturdy. For crimping American wire gauge number 14, this particular die has a clearance between the tangent of the top of die arcs and the top of the flute of about .030 inch while the distance across both die arcs is about .130 inch. Turning to Figure 3, the depth of the flute is about .050 inch and the depth of the die (also the length of the crimp) is .187 inch. The flute in this embodiment is centered in the die depth. The arc that defines the top of the flute has a radius of about $\frac{5}{32}$ inch. The die shown in Figure 4 has the same dimensions as that shown in Figures 2 and 3 with the exception that the flute is extended to become a slot the entire width of the die.

The end of the connector nearer the wire insulation is bell mouthed to relieve strain on the wire by gradually going from an area of great pressure to one of slight pressure on the wire.

In this embodiment the extruded portion of the wire in the center of the crimp is covered with connector reliefs 37, 38 which serve to protect the wire metal but even without such coverings, the connection would stand up well under corrosive conditions because the crimp on either side of the extruded wire metal is tight enough to prevent water or other matter from entering.

In Figure 6, relief 37 is shown to overlap relief 38. Since the reliefs start to form about the time or slightly before the ends of the U'ed up sides reach the top of the die arcs, the edges of the relief have been separated from said sides by the time they meet near the completion of the crimping stroke. At this point one relief edge will slide over the other with a resultant cross section as shown in Figure 6.

The difference in cross section areas between a crimped section and the relief section may be seen by comparing Figures 6 and 7, the latter being the crimped section cross section and the former being the relief cross section.

Comparing these two views it may be seen how much of the conductor metal in the relief cross section of this embodiment exerts pressure against the connector metal of the crimped cross section.

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. An electrical connection comprising a connector having an elongated base and sidewalls extending from said base, a conductor disposed along said base, said sidewalls being tightly folded about said conductor with the ends thereof meeting in a longitudinal furrow in the connection, an intermediate relief in the connector extending transversely across said folded sidewalls, metal of the conductor extending into said relief and in forceful engagement with the transverse edges of the connector at the relief for firmly securing the conductor within the connector.

2. The connection as defined in claim 1 wherein the portions of the connector sidewalls defining said relief are at least in part raised above the unrelieved sidewalls sufficiently to form an opening through the connection, said unrelieved sidewalls presenting at said opening transverse faces substantially perpendicular to the longitudinal axis of said conductor.

3. The connection as defined in claim 1 wherein the unrelieved sidewall portions adjacent said relief provide transverse faces substantially perpendicular to the longitudinal axis of said conductor.

4. The method of forming a U-shaped connector about an electrical conductor to produce a pressure connection including the steps of: disposing the conductor along the trough of the connector, folding the end portions of the sidewalls of the U inwardly to form a ferrule generally encompassing the conductor, displacing two longitudinally spaced sections of the sidewalls inwardly of the ferrule from an intermediate relief section therebetween to form at the section boundaries transverse faces extending across the end portions of the sidewalls and substantially perpendicularly to the longitudinal axis of the conductor, and compressing the spaced sections tightly about the conductor relatively to raise an intermediate section of conductor metal between and in forceful engagement with the transverse faces of the spaced sections.

5. The method as set forth in claim 4 wherein the spaced sections are displaced at least in part by shearing along transverse lines the sidewall end portions and depressing the spaced section end portion inwardly of the ferrule against the conductor while the intermediate section is substantially relieved from externally applied forces.

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