ELECTRIC WIRE CONNECTOR

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This invention relates to connectors of the type that are fastened by soldering or otherwise to the ends of electric conductors. More particularly, it relates to means for positioning the end of the wire in the ferrule of a terminal or connector and to methods of making the positioning means.

When an electrical conductor, stripped of its insulation, is inserted into a barrel-type connector ferrule by a machine or by hand operation, some means must be provided for positioning the end of the wire at the end of the ferrule. If the wire is not pushed far enough into the ferrule, the current-carrying capacity of the connector will be decreased; if it is pushed too far into the ferrule the protruding end of the wire may interfere with the terminal-portions of the connector. For example, if the end portion of the connector is a spade lug the protruding wire would prevent the connector from being placed around a screw or binding post. If the connector is of the type used for connecting together the ends of two electrical conductors, each of the wires must be positioned correctly or the current-carrying ability of the connector will be reduced. This step means can be built into each of the connectors or, if automatic machinery is used for applying the connectors, the machine can be constructed to position the wire and connector precisely in the correct relationship. However, the positioning is accomplished much more readily and with greater assurance that the wire will be positioned exactly in the right place in each connector if the stop means is built into the connector.

There are, however, a number of difficulties which must be overcome. In the first place, the arrangement must add so little to the cost of a connector, that the price does not become prohibitive in applications where hundreds of thousands of terminals are used. Any arrangement that increases appreciably the cost of the connector is no solution at all to this problem. Thus, in connectors of this type, the attachment of a plug or other external device to the end of the ferrule is prohibited by cost considerations alone.

In addition, the stop means must not result in weakening the mechanical strength of the connector. Thus, longitudinal cuts into or along the body of the ferrule are undesirable. The construction of the stop also should not decrease the minimum current-carrying cross section of the connector or decrease the heat-radiating surface of the ferrule. In addition, the stop must have sufficient strength to withstand the force of the wire. Thus, in connector-applying machines, it is necessary to force the wire into the connector barrel with sufficient force to make sure that the movement of the wire is not stopped by an irregularity or indentation in the barrel. Thus, with many types of connectors the thin metal of the barrel would not provide sufficient strength where the operation of the stop means depends upon the resistance to bending forces applied to the ferrule metal in a direction parallel to the thickness of the metal.

The present invention provides a connector wire-stop that is particularly low in cost and which meets all of the requirements set forth above. In a preferred embodiment of the invention, the ferrule is made of a terminal having a barrel-shaped ferrule portion the wire-stop is formed by the following series of steps: A transverse semi-circular cut is made in the ferrule near the terminal end of the connector. The relatively narrow semi-circular strip of metal defined by this cut is then curled inwardly to form two generally U-shaped oppositely-disposed portions extending across and blocking the wire-receiving opening through the ferrule. The stop member may be cut cross-wise near its midpoint to form two spaced wire-stop members extending inwardly from each side of the ferrule.

The principles and details of construction of this particular embodiment and other objects and advantages of the invention will be apparent from the following description considered in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of a terminal having a connecting tongue and a barrel-shaped ferrule;

Figure 2 shows the same terminal after the formation of a wire-stop on the end of the connector and ready to be placed on the end of a piece of wire;

Figure 3 shows the same terminal with its ferrule cramped to the wire;

Figure 4 shows another wire stop formed of a continuous portion of the ferrule extending from one side of the ferrule to the other; and

Figure 5 is a perspective view of a connector for coupling two pieces of wire together and having a centrally-positioned wire stop.

The terminal shown in Figure 1 is of conventional construction and may be formed from flat sheet metal. After being cut to shape, the metal is punched to form the tongue, generally indicated at 2, and ferrule 4 is formed by rolling the metal upwardly and positioning the edges of the metal in abutting relationship as indicated by the longitudinal section 6.

In order to form the wire-stop, a cut is made in the ferrule 4, for example along the path as indicated by the broken line 8. This cut is transverse to the longitudinal axis of the ferrule and extends about half-way around the ferrule. This cut in the metal of the ferrule can be made either before or after the metal is rolled up to form the barrel-shaped ferrule 4.

The metal of the ferrule 4, defined by the end of the ferrule and the cut 8, now comprises two strips 10 and 12 each joined integrally with the ferrule and with their ends abutting. Each of these strips is then bent inwardly by curling its free end downwardly across the face of the ferrule opening into the shape shown in Figure 2.

The cut 8 which was made in order to form the stop members 10 and 12 is made a distance from the end of the ferrule somewhat greater than the thickness of the metal of the ferrule. By this means, the stop members may be made as strong as necessary for the particular use, the force which they are required to resist being in a direction parallel with the width of these strips 10 and 12. Where the metal of the ferrule is sufficiently thick, or resistant to bending, the cut 8 may be made nearer the end of the ferrule and yet provide stop members of sufficient strength.

If desired, the terminal may be brazed or soldered along the junction line 6, but if this is done it is best to do it after the formation of the stop members 10 and 12 as this makes it unnecessary to cut the stop members 10 and 12 apart.

The curled U-shaped stop members 10 and 12 as shown in Figure 2 are to be preferred to linear stop members, for example, extending radially inwardly of the ferrule,
because they provide a larger abutting surface for the end of the wire, as best shown in Figure 3. When stranded wire is used, as shown by wire 14, this eliminates the possibility of the stop members spreading and penetrating between the strands.

The terminal is assembled in the usual manner as shown in Figure 3, the wire 14 being inserted into the ferrule until its further movement is prevented by the stop members 10 and 12. The ferrule is then fastened to the wire in any desired manner, as by crimping, soldering, etc.

Figure 5 shows a wire stop arrangement in which the ferrule strip defined by the cut 8a is continuous and not cut cross-wise near its mid-point. Thus, the wire-stop is formed of two portions 10A and 12A which are continuous and extend between opposite sides of the ferrule across the end opening. The shape of each portion 10A and 12A is curved as are the members 10 and 12 of the resulting Figures 1 to 3 so that sufficient abutting area is provided for the end of the wire.

It will be apparent that a tongue 2, as shown in Figures 1 to 3, or any other connecting means can be formed integrally with or attached to the ferrule 4A. The ferrule can be formed of seamless tubing or it may be brazed along the top, as in Figures 1 to 3, or along any other portion of its periphery.

It will be noted that because the cut 8 is made before the wire stop is bent inwardly, it results in leaving a ferrule portion that is cylindrical throughout its length. Thus, the wire is not impeded in its movement through the entire length of the ferrule. This results would not be achieved by merely bending inwardly a portion of the ferrule without first severing it from the ferrule.

The connector shown in Figure 5 is for the purpose of connecting two pieces of wire in end-to-end relationshio in order to prevent one of the wires from being pushed too far into the connector so that the other one cannot be pushed in far enough, two stop members 10B and 12B are provided at the center of the connector. These stop members are formed by making two spaced semi-circular cuts near the center of the connector, each centered on the longitudinal slit or seam 6B. The two stop members 10B and 12B are then curled inwardly as described in connection with Figure 2. The stop members can be curled by any suitable means. One of the best ways is by use of appropriate die stages in a single stage die.

It is not necessary to form two wire stop members and a single continuous segment of the ferrule may be partially separated from the ferrule and then indented to extend partially across the opening. Such an arrangement is particularly desirable on ferrules which are rolled and brazed along their entire length. Thus, the ferrule shown in Figure 5 may be slit as shown and indented inwardly by applying a downward force to the wire stop member on the brazing line 6 in the manner indicated in Figure 4. The strip defined by the slits is then continuous across the opening of the ferrule.

From the foregoing, it will be apparent that the connector invention may be adapted for the attainment of the ends and objects set forth above, the construction being economical of material and requiring a minimum number of operations. The connectors require no additional material; and the minimum current-carrying cross sections and the heat-radiating surface are not altered significantly by the fabrication of the stop members. It will be apparent also that the sequences and series of steps of my new method are such that they can be performed rapidly and economically by means of conventional apparatus and techniques.

I claim:

1. In the manufacture of a connector having at least one tubular ferrule portion with an opening therein adapted to receive a wire, the method of blocking the opening in said ferrule portion by a wire stop comprising the steps of cutting a slit in said ferrule near one end thereof transversely of the longitudinal axis of said ferrule and extending about half-way around its periphery, forming two metal strips defined by said cut and said one end of the ferrule portion and curving the ends of the strips forward thereby inwardly to extend substantially across the opening through said ferrule so as to form two wire-stop members.

2. In an electrical connector, a tubular ferrule portion having a longitudinal opening adapted for receiving and making electrical connection with a piece of wire, and at least one stop member integral at its base with said ferrule, the opposite end of said member being free and extending transversely across and blocking the face of the longitudinal opening of said ferrule portion, the cross-section of said stop member being substantially rectangular throughout its length, the longest dimensions of said rectangular cross-section being substantially parallel with the longitudinal axis of said ferrule portion throughout the length of the stop member, said stop member being adapted to abut the end of a wire inserted into said longitudinal opening.

3. A tubular connector comprising a tubular metal ferrule portion having a longitudinal opening therein for receiving and making electrical connection to a conductor, said ferrule portion having a longitudinal seam therein along one side, said ferrule having a cut transverse to its longitudinal axis intersecting said seam and extending about half-way around the ferrule, said cut extending about equal distances on either side of said seam to form two metal strips with these bases integral with said ferrule on opposite sides of said seam, the ends of said strips being curved inwardly across and blocking the opening through said ferrule.

4. A connector for application by crimping to the end of an electrical conductor comprising a tubular metal ferrule for receiving and making connection to the end of the conductor and a stop member comprising a curved metal strip extending across one end opening of said ferrule, said member being integral at each end with said ferrule, and assuming near one end a curvature equal to and coincident with the curvature of said ferrule portion, said stop member being rectangular in cross-section, the longest dimensions of said rectangular cross-section extending in the lengthwise direction of said ferrule.

5. In the manufacture of an electrical connector having a tubular ferrule portion with an opening therein adapted to receive a wire, the method of blocking the wire opening in said ferrule portion by wire stop comprising the steps of cutting one slit through a part only of the circumference of said ferrule transversely of the longitudinal axis of said ferrule, cutting a second slit parallel to and longitudinal spaced from said first slit leaving a severed strip integral at its base with said ferrule, bending said strip inwardly across and substantially blocking the opening through said ferrule while leaving the remaining part of the tubular ferrule undeformed.

6. The method of claim 5 wherein the central portion of the metal strip is bent inwardly by radially depressing an intermediate section of it to curl it inwardly across the opening in the ferrule.

7. An electrical connector adapted to be pressure forged onto an electrical conductor comprising a tubular metal ferrule defining an aperture for receiving a wire, a wire stop means within the ferrule fabricated integrally by the fabrication of the stop members, said means comprising an inwardly extending, longitudinal section of the ferrule, substantially blocking the aperture whereby the wire may be inserted into the ferrule until it abuts said inwardly extending section, in which position it is properly located within the ferrule.

8. The connector as set forth in claim 7 wherein the inwardly extending section is located between one end of the ferrule and a partially slit portion of said ferrule, said slit extending between the inwardly extending section and...
the rest of the ferrule and the plane of the slit intersecting the longitudinal axis of the ferrule.

9. The connector as set forth in claim 7 wherein the inwardly extending section is located between a pair of slits in the ferrule, the plane of each slit intersecting the longitudinal axis of the ferrule.

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