United States Patent [19]

Wyrick

[11] 3,857,995

[45] Dec. 31, 1974

[54] ELECTRICAL CONNECTOR

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[73] Assignee: AMP Incorporated, Harrisburg, Pa.

[22] Filed: Nov. 24, 1972

[21] Appl. No.: 309,078

[52] U.S. Cl. ..... 174/84 C, 29/193.5, 29/630 F, 339/97 C, 339/98, 339/276 T, 339/276 SF

[51] Int. Cl. H02g 15/08

[58] Field of Search .... 174/84 R, 84 C, 88 R, 94 R; 339/95 R, 95 A, 97 R, 97 C, 276 R, 276 T, 277 R, 98; 287/75, 78, 108, 109; 29/628, 630 F, 193, 193.5; 113/119

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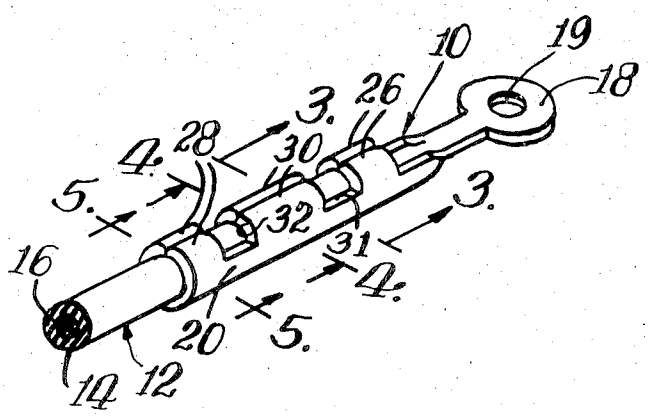
Primary Examiner—Darrell L. Clay

Attorney, Agent, or Firm—AMP Incorporated

[57] ABSTRACT

An electrical connector for use with an insulated electrical conductor, comprises a ferrule having a transversely extending rib which is located in the ferrule. The rib is generally cylindrical in cross section and extrudes the insulation from the conductor without risk of breaking the conductor as the ferrule and rib are deformed around the conductor.

19 Claims, 25 Drawing Figures



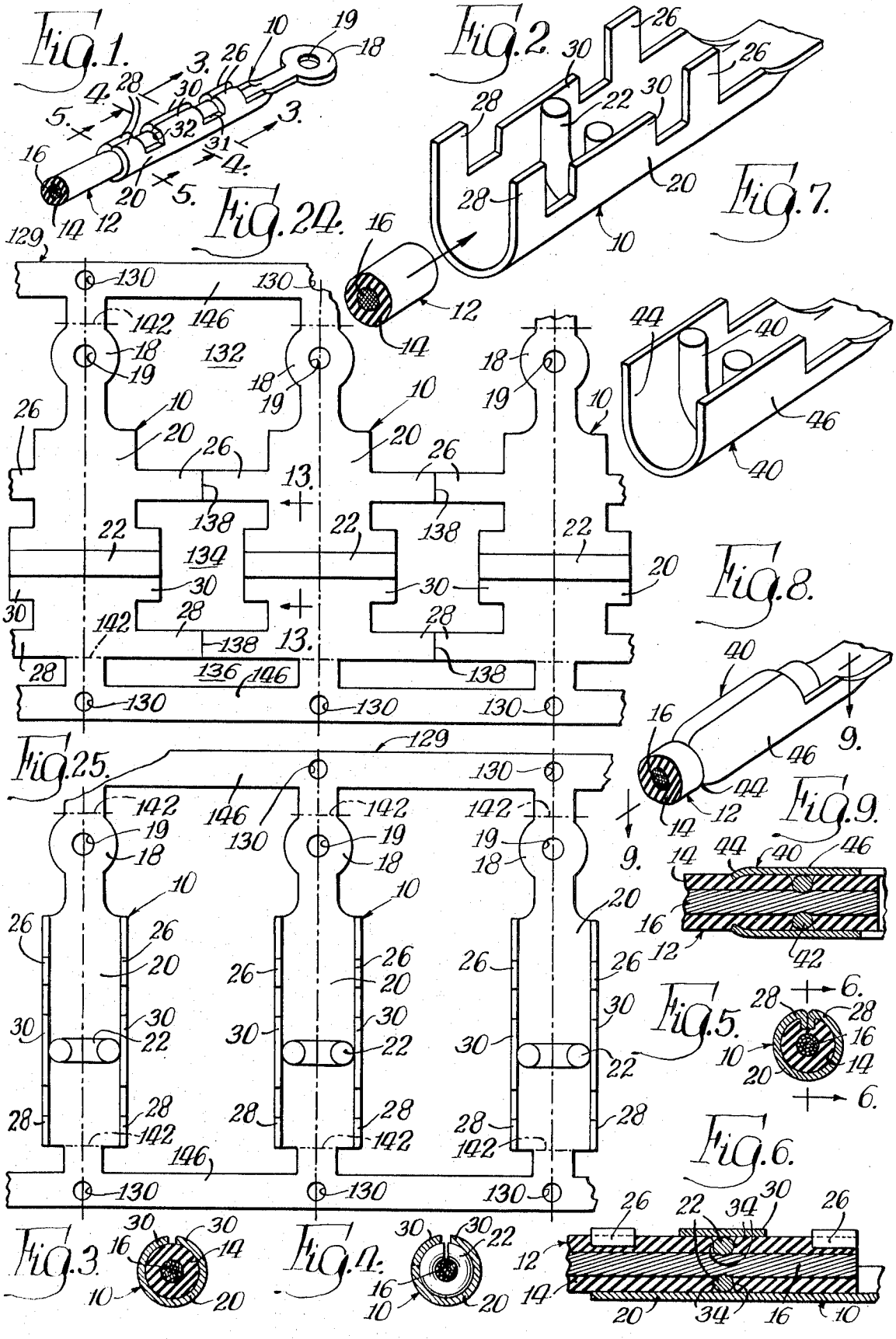

Fig. 1.
Fig. 2.
Fig. 7.
Fig. 2a.
Fig. 8.
Fig. 2b.
Fig. 9.
Fig. 5.
Fig. 6.
Fig. 3.
Fig. 4.

Fig. 10.

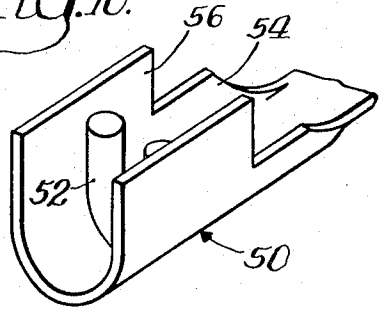


Fig. 11.

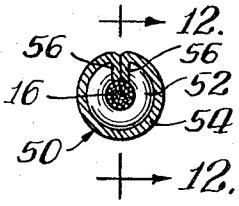


Fig. 12.

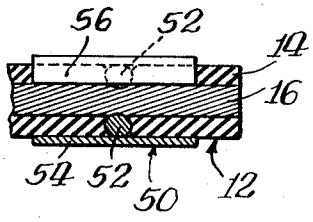


Fig. 13.

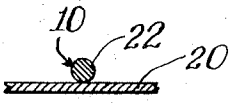


Fig. 19.

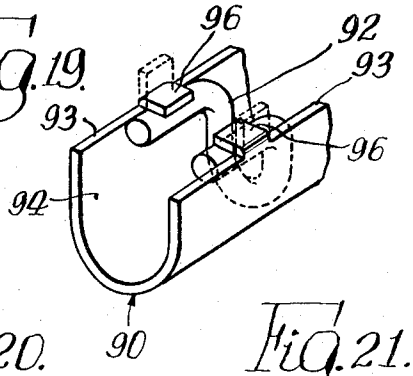


Fig. 14.

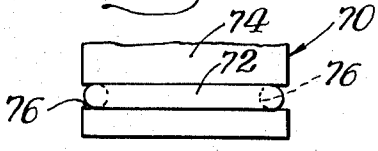


Fig. 20.

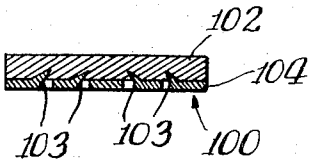


Fig. 21.

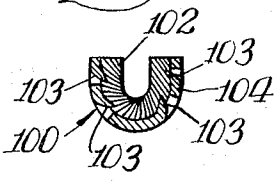


Fig. 15.

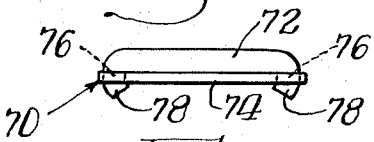


Fig. 16.

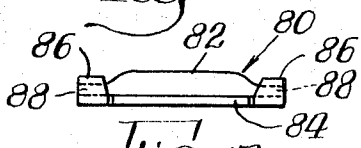


Fig. 17.

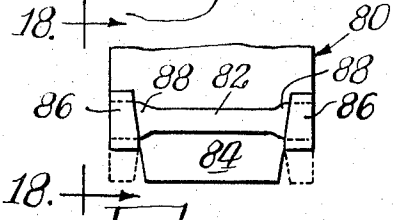


Fig. 18.

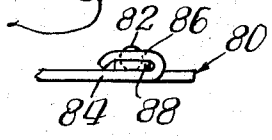


Fig. 22.

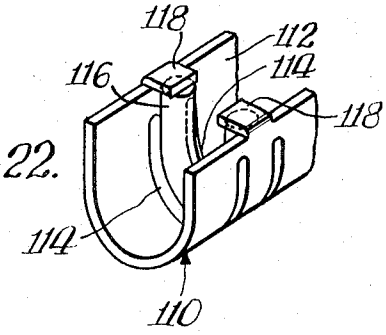
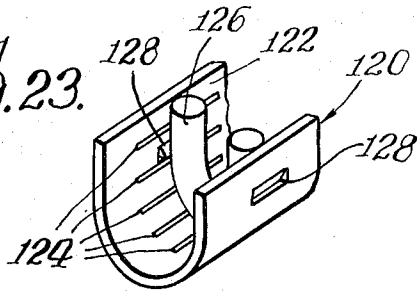


Fig. 23.



ELECTRICAL CONNECTOR

This invention relates to an electrical connector and more particularly to a solderless or crimp-type electrical connector for use with an insulated electrical conductor.

A solderless or crimp-type electrical connector of the prior art for use with an insulated electrical conductor had sharp edged ridges, generally of rectangular shape, for extruding the insulation from the conductor. The sharp ridges were disadvantageous in that when the connector was crimped onto the conductor, the sharp ridges tended to break or weaken the electrical conductor, particularly if of the stranded type. Further, the sharp ridges restricted the flow of the extruded insulation within the connector, which could result in a poor electrical connection since the improperly extruded insulation could hold the connector away from the conductor, preventing it from making of good electrical contact. Even if good electrical contact was made, it often was necessary to use excessive pressure to extrude the insulation, this being particularly inconvenient if the crimping operation was performed with a hand tool. Further, forming of the sharp ridges in the body of the connector itself, was costly since material had to be cut away or removed from the body of the connector.

The electrical connector of the present invention has eliminated the aforementioned disadvantages and comprises a ferrule having a transversely extending rib of generally circular cross section secured to the ferrule. The rib is positioned on the ferrule to extrude the insulation from the conductor and make contact therewith when the connector is crimped onto the insulated conductor. When the cross section of the rib is generally circular, space is provided into which the extruded insulation may flow, to insure good electrical contact without excessive crimping pressure. The connector of the present invention may be easily and economically fabricated from simple rod or wire and sheet metal stock, and expensive machining operations are minimized.

A primary object of the present invention is to provide a solderless or crimp-type electrical connector.

Yet another object of the present invention is to provide an electrical connector which can be economically and easily fabricated.

Another object of the present invention is to provide an electrical connector for use with an insulated electrical conductor.

Still another object of the present invention is to provide an electrical connector which provides space to receive the electrical insulation that is extruded during crimping.

An equally important object of the present invention is to provide a method for economically and easily fabricating a solderless or crimp-type electrical connector.

These and other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying figures of the drawings wherein:

FIG. 1 is a perspective view of one form of an electrical connector, embodying the present invention, shown installed on an electrical conductor;

FIG. 2 is an enlarged perspective view of the connector of FIG. 1 shown prior to installation on the conductor;

FIG. 3 is an enlarged cross-sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is an enlarged cross-sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is an enlarged cross-sectional view taken along the line 5—5 of FIG. 1;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5;

FIG. 7 is a perspective view of a second form of an electrical connector shown prior to installation on the conductor;

FIG. 8 is a perspective view of the electrical connector shown in FIG. 7 installed on an electrical conductor;

FIG. 9 is a sectional view taken along the line 9—9 of FIG. 8;

FIG. 10 is a perspective view of a third form of an electrical connector shown prior to installation on the conductor;

FIG. 11 is a cross-sectional view of the electrical connector of FIG. 10 after the connector has been assembled on the electrical conductor;

FIG. 12 is a sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is a sectional view showing a way of securing components of the electrical connector together;

FIG. 14 is plan view showing a fourth form of an electrical connector;

FIG. 15 is an elevational view of the electrical connector shown in FIG. 14;

FIG. 16 is an elevational view shown a fifth form of an electrical connector;

FIG. 17 is a plan view of the electrical connector shown in FIG. 16;

FIG. 18 is an elevational view taken along the line 18—18 of FIG. 17;

FIG. 19 is a perspective view of a sixth form of an electrical connector;

FIG. 20 is a sectional view of a seventh form of an electrical connector;

FIG. 21 is a view of the connector of FIG. 20 after further forming;

FIG. 22 is a perspective view of an eighth form of an electrical connector;

FIG. 23 is a perspective view of a ninth form of an electrical connector;

FIG. 24 is a plan view of the electrial connector of FIG. 1 shown during one step of manufacture; and

FIG. 25 is a plan view similar to FIG. 24, but showing the connector at a subsequent step of manufacture.

In FIGS. 1–4, is illustrated a solderless or crimp-type electrical connector 10 of the present invention. The electrical connector 10 has a ferrule portion 20 at one end forming an electrical and mechanical connection with an electrical conductor, such as wire 12 having insulation 14 and a stranded electrical conductor 16. The connector 10 also has a terminal portion 18 at the other end. The terminal portion 18 is, in this instance, a washer type terminal having a center opening 19, but can be of another type, as for example an alligator clip, a plug or another such connector for connecting the wire 12 to another electrical conductor.

Ferrule portion 20 is formed from sheet stock having front rear and spaced side edges and is provided with a transversely extending rib 22 (FIGS. 2 and 4). Preferably the rib 22 is an elongated member with a circular cross section, and the rib is attached to the inner sur-

face of the ferrule portion. Both the ferrule portion **20** and the rib **22** are made of electrical conductive material. Since the rib and ferrule portion are separate, it is possible to make each from a material which particularly suits its task. Preferably, the rib is made of 0.005 to 0.035 inch diameter solid copper rod or wire, and the ferrule portion is made of 0.006 to 0.025 inch thick brass. Preferably the height of the rib above the ferrule portion should be not greater than the thickness of the insulation **14** of the wire **12** to insure a good grip on the wire and good extrusion of the insulation. The rib **22** lies transverse, in this instance perpendicular to the axis of the connector. The rib is initially separate from the ferrule portion. In FIG. **13** the rib **22** is bonded to the ferrule portion **20** as by welding, brazing or soldering. The rib may also be bonded by ultrasonic welding which is particularly well suited to welding dissimilar metals.

The ferrule portion **20** of the connector **10** is symmetrical about its longitudinal axis, and each side has two pairs of relatively long rectangular tab portions **26** and **28** located, respectively, at the front and the rear thereof, for holding the connector onto the wire. A shorter rectangular tab portion **30** is provided on each side between the longer tab portions **26** and **28.** The tab portions **30** also assist in holding the wire in place and support the rib **22.** When bent into their final positions the tab portions **26, 28** and **30** form rectangular windows or openings **31** and **32** on either side of the center tab portions **30.** As is shown in FIG. **2,** the ferrule portion **20,** including the rib **22** is given a "U" shape preparatory to being crimped onto the wire.

The connector **10** may be installed on the wire **12,** without removing the insulation **14** from the end thereof. The wire **12** with insulation **14** in place is located in the "U" shaped ferrule portion **20,** across the rib **22.** The ferrule portion **20** and rib **22** are then crimped by a machine or by a hand tool to force the ferrule portion **20** and the rib **22** around the wire so that the spaced side edges of the ferrule portion generally parallel to the longitudinal axis are now closely adjacent each other, the ferrule portion and rib being deformed into cylindrical and ring shapes, respectively.

As shown in FIG. **4,** the shorter tab portions **30** tend to meet circumferentially, and as shown in FIG. **5,** the pairs of longer tab portions **28,** also tab portion **26,** contact each other intermediate their ends, with their outer ends then being bent inwardly toward the center of the wire **12** to pierce the insulation **14** and hold the wire **12** in the ferrule portion **20.**

Upon crimping, the rib **22** makes good electrical contact with the conductor **16** of the wire without breaking or materially weakening the conductor. As is shown in FIGS. **4** and **6,** rib **22** has extruded insulation **14** from the wire **12** and is compressed tightly into electrical contact with the conductor **16.** The circular cross section of the rib **22** provides two spaces on each of the outer sides of the rib for receiving some of the extruded electrical insulation **14,** as indicated at **34** in FIG. **6.** When the rib is ultransonically welded to the ferrule portion, the rib may become embedded in the ferrule, thus reducing or eliminating the spaces on each side of the rib. When the rib **22** is made from a material of a similar hardness as the electrical conductor **16,** both rib **22** and the conductor **16** may be deformed somewhat during crimping.

The connectors of the present invention may be economically and easily fabricated in a continuous strip which may then be formed into rolls or cut into short lengths and may be either hand assembled or machine assembled onto the wire, as was described. A method of forming a plurality of connectors **10** in a strip **129** is shown in FIGS. **24** and **25.** Thus, a length wire forming a plurality of ribs **22** is continuously secured, as by ultrasonic welding, to a length of flat sheet metal. A stamping or punching operation is performed on the wire and sheet metal, cutting out sprocket holes **130** (for machine feeding the completed strip) at the edges, blanks **132,** blanks **134** which include unwanted segments of the wire, blanks **136** and the openings **19** for the washers **118.** Also cuts **138** are made between the adjacent tabs portions **26** and **28** of adjacent connectors **10.** The ferrule portions **20** and ribs **22** of the connectors **10** are then given "U" shapes by bending so that the tab portions **26** and **28** and **30** extend perpendicularly from their original plane, and the strip **129** of connectors **10** is now in the form shown in FIG. **25.** The strip **129** can be then rolled into a coil for easier handling or cut into short lengths. Individual connectors can also be cut off at the dashed lines **142** from the feed strips **146.** The connectors can either be feed into a machine or a hand tool for final assembly onto a conductor.

Additional forms of the connectors embodying the present invention are shown in FIGS. **7–23.** The additional forms are similar to the connector **10,** just described, in that they all comprise a ferrule portion formed of sheet metal and having a transversely extending rib of a round cross section secured thereto and a terminal portion. All the connectors may be given a "U" shape preparatory to being assembled on the wire, and when assembled the ferrule portion and rib will assume generally cylindrical and ring shapes, respectively.

FIGS. **7–9** show a second form of an electrical connector **40** which is somewhat similar to connector **10,** but has no tab portions, such as **26** and **28** for penetrating the insulation. The connector **40** is held onto the wire by the ferrule portion **46,** the rib **42** and by the rear end **44** (FIG. **9**) of the ferrule portion **46** which has been rolled inwardly into the insulation of the wire as shown. Friction between the outer surface of the wire **12** and the ferrule portion **46** helps hold the wire in place.

FIGS. **10–12** show a third form of an electrical connector **50** which is similar to the connector **40** shown in FIG. **8,** but the rib **52** is located in the ferrule portion **54** at tab portions **56** which extend beyond the corresponding ends of the rib **52.** The tab portions **56** may be forced inwardly over the ends of the rib **52** into the insulation **14,** as is shown in FIGS. **11** and **12** to better hold the wire.

The following connectors described differ from the connector already described primarily in the manner of securing the rib to the ferrule portion.

FIGS. **14** and **15** show a fourth form of an electrical connector **70** comprising a rib **72** and a ferrule portion **74.** The rib **72** of the connector **70** is mechanically secured to the ferrule portion **74.** As is shown, the rib **72** extends through two openings or slots **76** near the edges of the ferrule portion **74,** and the ends **78** of the rib **72** are deformed or bent over to hold it in place.

FIGS. 16–18 show a fifth form of an electrical connector 80 which comprises a rib 82 and a ferrule portion 84. The rib 82 is secured to the ferrule portion 84 by small tabs 86 which are bent over the flattened ends 88 of the rib, the tabs 86 being shown in FIG. 16 in their unbent positions by dashed lines.

In FIG. 19 a sixth form of an electrical connector 90 is shown and comprises a rib 92 and a ferrule portion 94. The ends 91 of the rib 92 are shown bent at right angles parallel to the outer sides 93 of the ferrule portion 94. The ferrule portion 94 has small tabs 96, shown in dashed lines in their unbent position, extending from the sides 93. The tabs 96 are bent over the ends of the rib 92 to hold it in place.

FIGS. 20 and 21 show a seventh form of an electrical connector 100 which comprises a rib 102 and ferrule portion 104. The rib 102 is locked in place by pairs of small opposite facing lances or serrations 103 which are formed in the ferrule portion 104 and bite into the rib. The small serrations 103 may be formed by a stamping or punching operation, and their hold on the rib is further strengthened by bending the connector 100 to its "U" shape as shown in FIG. 21.

In FIG. 22 an eighth form of an electrical connection 110 is shown and comprises a ferrule portion 112 and a rib 116. The "U" shaped ferrule portion 112 has a pair of spaced, transverse inwardly extending indentations 114 formed as by stamping to locate the "U" shaped rib 116. At the outer sides of the ferrule portion 112 are small tabs 118 which are bent over the ends of the rib 116 to locate it in place.

In FIG. 21 a ninth form of an electrical connector 120 is shown and comprises a ferrule portion 122 and a rib 126. The ferrule portion 122 is provided with a series of longitudinal grooves 125 which are parallel to the longitudinal axis of the connector. The grooves 124 increase the frictional grip between the rib 126 and the ferrule portion 122. The ferrule portion 122 is also provided with small, facing serrations 128 on each side, which are forced into the rib 126 to hold it in place.

From the foregoing it will be apparent that a novel and useful electrical connector for use with an insulated electrical conductor has been provided. The connector may be economically fabricated from flat sheet metal forming a ferrule portion and round wire forming a rib for making electrical contact with the conductor by extruding the insulation from the electrical conductor without breaking the conductor.

I claim:

1. An electrical connector for use with an insulated wire, comprising a ferrule portion having a wire engaging surface and spaced side edges, a rib on said surface and extending transversely with respect to said side edges and the longitudinal axis of said ferrule portion, and a terminal portion adapted to be connected to an electrical conductor, said ferrule portion together with said rib being adapted to be crimped into a generally cylindrical shape around the wire so that said side edges of said ferrule portion are adjacent each other, said rib being generally circular in cross section to penetrate and extrude insulation on the wire and to make good electrical contact with the wire without cutting into the wire as the ferrule portion and rib are crimped around the wire, and said rib being a separate piece secured to said ferrule portion.

2. An electrical connector as in claim 1, wherein said rib is an elongated member adapted to be crimped into a ring around the wire.

3. An electrical connector as in claim 1, wherein said rib is made from solid electrical wire.

4. An electrical connector as in claim 1, wherein said rib is bonded to said ferrule portion.

5. An electrical connector as in claim 1, wherein said rib is ultrasonicly welded to said ferrule portion.

6. An electrical connector as in claim 1, wherein said rib and said ferrule position are made of different metals.

7. An electrical connector as in claim 1, wherein said rib and ferrule portion are mechanically held together.

8. An electrical connector as in claim 1, wherein said ferrule portion has extending tab portions which are bent over toward the center of the conductor and are adapted to extend into the insulation of the wire.

9. An electrical connector as in claim 8, wherein said rib is located in said tab portions and said tab portions extend beyond the ends of said rib and are bent over the ends of said rib.

10. An electrical connector as in claim 1, wherein said rib is located generally in the center of said ferrule portion and lies in a plane perpendicular to the longitudinal axis of said connector.

11. A method for forming a strip of electrical connectors each having a ferrule portion and a rib for use in extruding insulation from an insulated conductor, comprising the steps of:

locating a generally elongated wire having a circuit cross section longitudinally along a flat elongated sheet metal strip,

bonding said wire to said sheet metal strip; and

stamping said sheet metal strip and said wire to form said ferrule portions and said ribs of the connectors.

12. The method of claim 11, comprising the additional step of bending said ferrule portions and said ribs into "U" shapes.

13. The method of claim 11, wherein the step of bonding comprises ultrasonically welding said wire to said sheet metal strip.

14. A strip of electrical connectors to be used with insulated wire, said strip comprising a plurality of connectors and means for holding said connectors in said strip, each of said connectors having a ferrule portion, each ferrule portion having a wire engaging surface, each connector having a rib on said wire engaging surface, said rib extending transversely with respect to the longitudinal axis of its associated ferrule portion, and each connector having a terminal portion adapted to be connected to an electrical conductor, each of said ferrule portions and each of said associated ribs being adapted to be crimped into a generally cylindrical shape around the wire, each of said ribs being generally circular in cross section to penetrate and extrude insulation on the wire and to make good electrical contact with the wire without cutting into the wire as the ferrule portion and rib are crimped around the wire, and said ribs being separate pieces secured to said ferrule portions.

15. A strip of electrical connectors as in claim 14, wherein said ribs are solid electrical wire.

16. A strip of electrical connectors as in claim 14, wherein said ribs are bonded to said ferrule portions.

17. A strip of electrical connectors as in claim 14, wherein said ribs are ultransonicly welded to said ferrule portions.

18. A strip of electrical connectors as in claim 14, wherein each of said ferrule portions and each of said ribs are generally "U" shaped.

19. A strip of electrical connectors as in claim 18, wherein said ribs are bonded to said ferrule portions.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,857,995 Dated December 31, 1974

Inventor(s) Charles Thomas Wyrick

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, Claim 11, line 32, the word "circuit" should be changed to read ---circular---.

Signed and sealed this 18th day of February 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

AMP 2884

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(5/69)

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