

[54] ELECTRICAL CONNECTOR

[75] Inventors: Paul E. O'Donnell, Whitman; H. Vincent Leaf, Marshfield, both of Mass.

[73] Assignee: Ark-Les Switch Corporation, Watertown, Mass.

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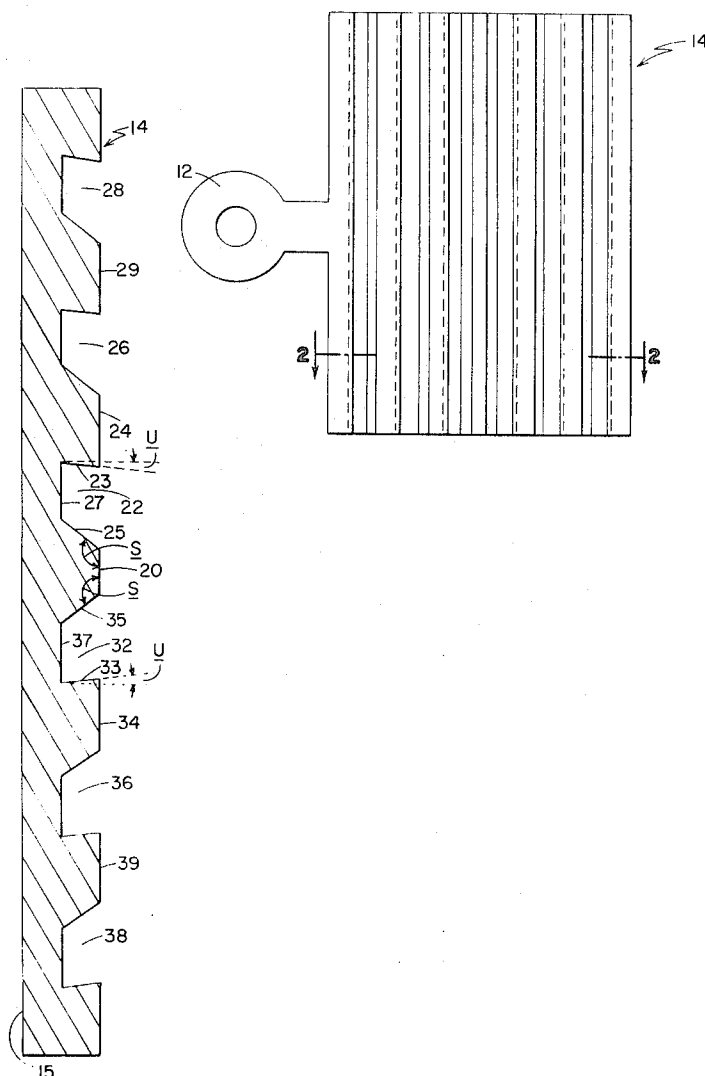
Primary Examiner—Joseph H. McGlynn

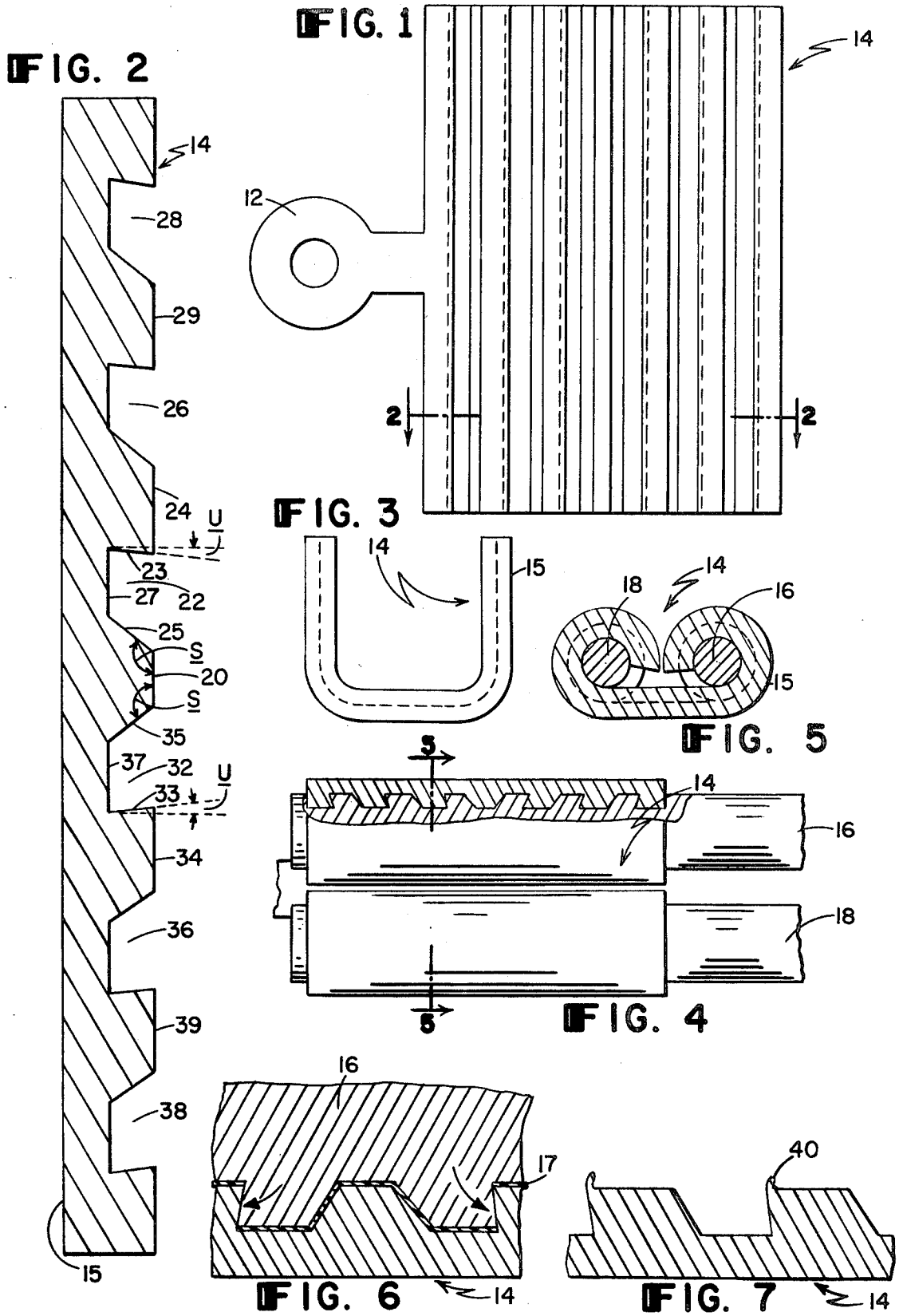
Attorney—Martin Kirkpatrick

[57] ABSTRACT

An electrical connector for crimping onto wires including a ferrule-forming portion having its inner surface formed with a plurality of grooves with generally flat land surfaces therebetween, at least some of said grooves having an undercut side surface, preferably of at least about 1° to 6° for the purpose of shearing portions of wire crimped therein to expose the bare metal underlying any layer of insulation, corrosion, etc. thereon in order to provide the necessary low ohmic electrical path between wire and connector as well as a superior mechanical connection therebetween.

10 Claims, 7 Drawing Figures





ELECTRICAL CONNECTOR

This invention relates to electrical connectors of the type which are adapted to be crimped onto wires, and more particularly to such connectors which are especially suitable for crimping onto wires having a thin insulating coating thereon.

Many types of wires used in making electrical connections have thin insulating coatings thereon, either applied thereto as with so-called magnet wire, or naturally occurring as with aluminum wire which develops an oxide coating. When it is desired to make electrical connection to wires having such coatings it is necessary during the mechanical crimping operation to pierce the insulating coating in order to achieve a connection of suitable mechanical strength and an electrical contact of low ohmic resistance with the current carrying portion of the wire.

Although attempts have been made to achieve the desired results, they have been deficient in some respects, especially as to the necessary low ohmic contact resistance when certain types of insulating coatings are present on the wire.

Accordingly, it is a major object of the present invention to provide an electrical connector to be crimped onto one or more wires having an insulating coating by mechanical methods and which thereby creates a connection of suitable mechanical strength and an electrical contact of low ohmic resistance with the current carrying portion of the wire.

The above and further objects of the invention are accomplished by providing an electrical connector including a ferrule-forming portion having its inner surface formed with a plurality of novel grooves with generally flat land surfaces therebetween, at least some of said grooves having a sharp edged undercut side surface for shearing the wire as it is forced into the undercut. If desired an upset burr may be provided at the sharp edge. Preferably there are at least two grooves parallel to and spaced from one another by the land surface, the grooves having their side surfaces remote from the groove undercut by about 1° to 6° . The side surfaces of the grooves contiguous with the central land are sloped at an obtuse angle of more than 90° . Further grooves have their side surfaces most remote from the central land undercut.

For the purpose of more fully explaining the above and still further objects and features of the invention, reference is now made to the following detailed description of a preferred embodiment of the invention, together with the accompanying drawings, wherein:

FIG. 1 is a plan view of the connector of the invention in flat form;

FIG. 2 is an enlarged cross-sectional view of the connector of FIG. 1, taken along the line 2—2 thereof;

FIG. 3 is an end view of the connector of FIG. 1 bent into ferrule form for receiving wires therein;

FIG. 4 is a plan view, partly in section, of the connector of FIG. 1 crimped onto two solid wires;

FIG. 5 is a cross-sectional view of the crimped connector and wires of FIG. 4, taken along the line 5—5 thereof;

FIG. 6 is an enlarged cross-sectional view of a portion of the crimped connector of FIG. 4, showing the sheared wire portion within the undercut; and

FIG. 7 is an enlarged view of a modification of the connector of FIGS. 1 through 6 showing an upset burr.

Referring to FIGS. 1 through 6, the connector of the preferred embodiment of the invention is of sheet metal such as brass, having a grooved inner surface and a flat outer surface 15 with a conventional ring tongue portion 12 and a ferrule-forming portion, generally designated 14, into which wires 16, 18 having a thin insulating coating 17 (FIG. 6) may be crimped.

According to the invention, the ferrule-forming portion 14 has its inner surface formed with a plurality of parallel grooves with generally flat land surfaces therebetween, with at least some of said grooves having an undercut side surface, preferably of at least about 1° to 6° , for the purpose of shearing portions of wire crimped therein to expose the bare metal underlying any layer of insulation, corrosion, etc. thereon in order to provide the necessary low ohmic electrical path between wire and connector as well as a superior mechanical connection therebetween.

More specifically, as best shown in FIGS. 1 and 2 in its flat form, ferrule portion 14 as illustrated has six parallel grooves separated by five flat surfaced lands, including a central land 20. Grooves 22, 32 on opposite sides of central land 20 are mirror images of one another and have their opposite generally straight side surfaces 23, 33 remote from central land 20 undercut, in accordance with the present invention, at an angle, U, with respect to the perpendicular to the surfaces of ferrule-forming portion 14, of at least 1° to 6° , as shown. A greater undercut angle, U, may also be employed. The undercut side surfaces 23, 33 form an edge contiguous with their respective lands 24, 34 which is relatively sharp for effective shearing of the wire and its insulating coating 17, and may, if desired, include thereon a projection in the form of a burr 40, as shown in FIG. 7, to aid in piercing the wire and its insulating coating 17 (FIG. 6).

The generally straight side surfaces 25, 35 contiguous with central land 20 are sloped at an obtuse included angle of more than 90° degrees with respect to the inner surface of ferrule-forming portion 20, preferably about 140° as shown, plus or minus 20° . Generally flat bottom groove surfaces 27, 37 extend between side surfaces 23, 25 and 33, 35 respectively, although a bottom surface other than flat may be used if desired. The width of grooves 22, 32 is relatively narrow, preferably about 0.01 to 0.02 inches.

Additional grooves with intervening flat lands are preferably provided on ferrule-forming portion 14, with their side surfaces most remote from central land surface 20 undercut as set forth above. Thus grooves 26 and 28, identical in configuration with groove 22, with a flat land 29 therebetween, are provided outwardly of land 24 away from central land 20 and grooves 36 and 38, identical in configuration with groove 32, with a flat land 39 therebetween are provided outwardly of land 24 away from central land 20.

For use, the ferrule-forming portion 14 of the connector of the invention is normally first bent into U shape, as shown in FIG. 3, for receiving the wires, whether solid or stranded, to be crimped thereby. Thereafter, a crimping operation is carried out by conventional apparatus wherein the ferrule-forming portion 14 is forced inwardly against the wires 16, 18 under sufficiently heavy pressure to deform the wire by shearing it and driving it into the grooves, as shown in FIGS. 4 and 5 and particularly in the enlarged view of FIG. 6 wherein is illustrated the shearing of the insulat-

ing coating 17 as the metal of the wire is forced into the grooves and under their undercut side surfaces. This action, unique to the undercut grooves of the present invention, not only provides the necessary low ohmic path between wire and connector, but also provides a superior mechanical connection therebetween in both directions along the axis of the crimped connector by reason of the positioning of undercut side surfaces on opposite sides of the grooves with respect to the central land 20, so that stress in either direction is equally well resisted.

What is claimed is:

1. An electrical connector for crimping onto wires including
 - a ferrule-forming portion having its inner surface formed with a plurality of grooves with generally flat land surfaces therebetween
 - at least some of said grooves having an undercut side surface.
2. An electrical connector as claimed in claim 1 wherein said undercut side surface is generally straight.
3. An electrical connector as claimed in claim 2 wherein said side surface is undercut at an angle of about 1° to 6°.
4. An electrical connector for crimping onto wires including
 - a ferrule-forming portion having its inner surface formed with a plurality of at least two grooves with a land surface therebetween
 - said two grooves being parallel to and spaced from one another by said land surface with their opposite side surfaces remote from said land being undercut.
5. An electrical connector as claimed in claim 4 wherein

the side surfaces of said grooves contiguous with said land are sloped at an obtuse angle of more than 90°.

6. An electrical connector as claimed in claim 5 wherein said undercut is at an angle of about 5°.

7. An electrical connector for crimping onto wires including

a ferrule-forming portion having its inner surface formed with a plurality of at least four parallel grooves with flat land surfaces therebetween

the central two of said grooves being parallel to and spaced from one another by the central one of said land surfaces with their opposite side surfaces remote from said central land surfaces being undercut

the other of said grooves having their side surfaces most remote from said central land surface being undercut.

8. An electrical connector as claimed in claim 7 wherein

the side surfaces of said grooves contiguous with said central land and of said other grooves closest to said central land is sloped at an obtuse angle of more than 90°.

9. An electrical connector as claimed in claim 8 wherein

said undercut has a sharp edge at its contiguous land and is at an angle of about 5° and said obtuse angle is of about 120°-160°.

10. An electrical connector as claimed in claim 9 wherein

the bottom of said grooves is generally flat and of a width from about 0.01 to 0.02 inches.

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