

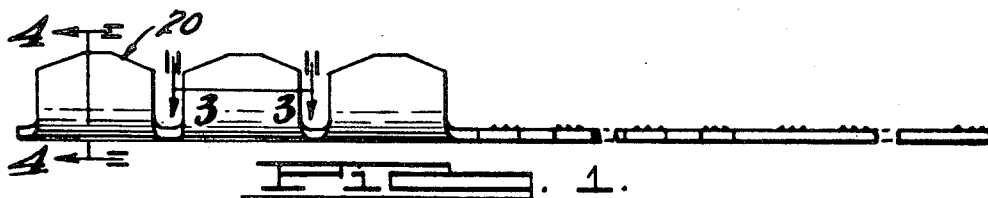
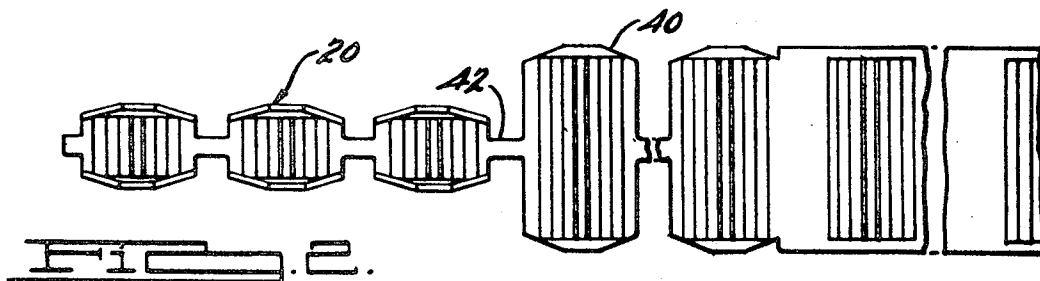
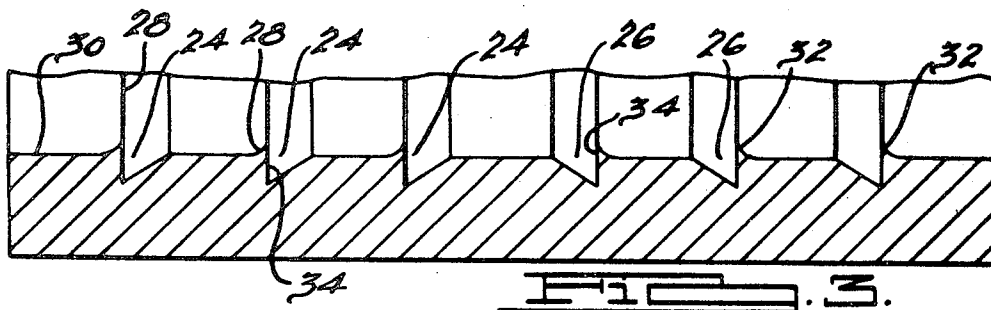
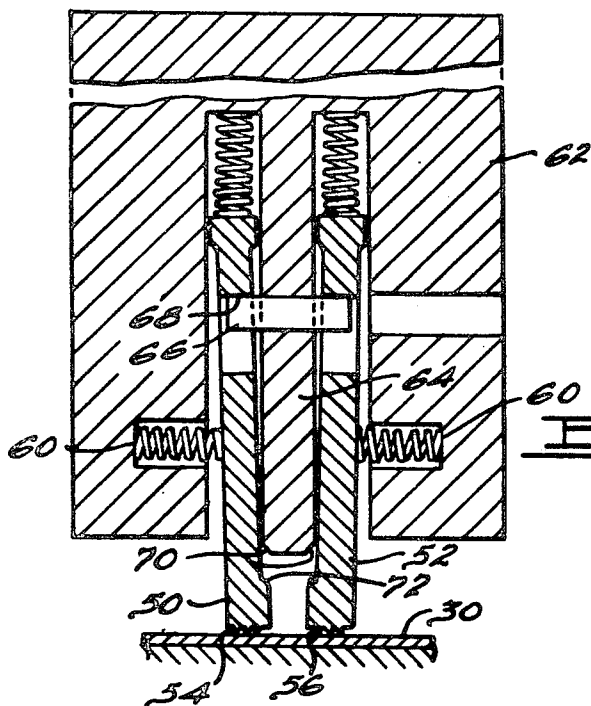
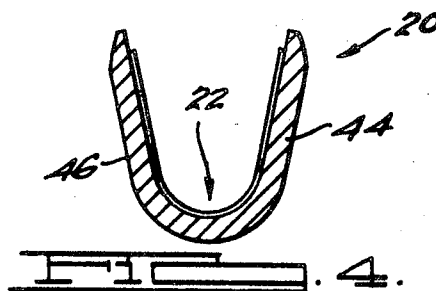
April 8, 1969

W. E. GROPP ET AL
METHOD OF AND APPARATUS FOR MAKING TERMINALS
FOR MAKING ELECTRICAL CONNECTIONS

3,436,946

Original Filed Feb. 6, 1964

Sheet 1 of 2



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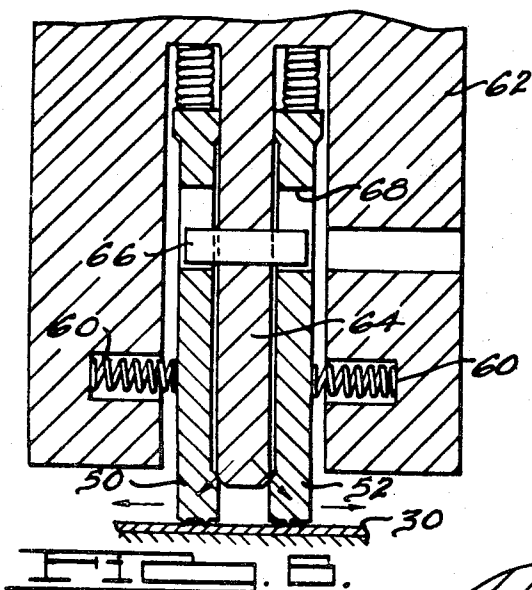
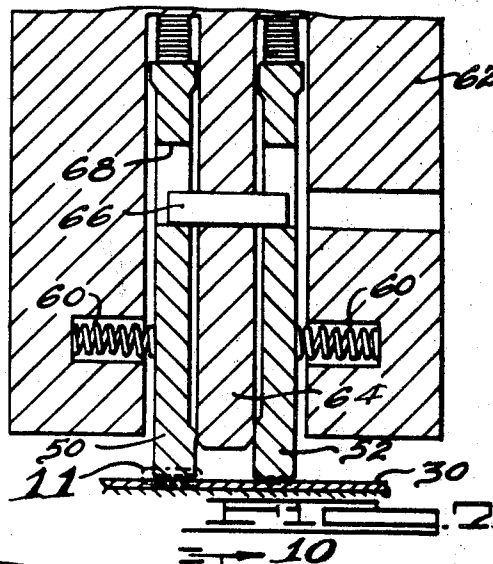
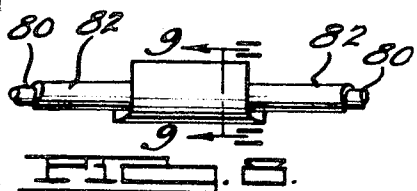
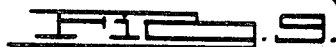
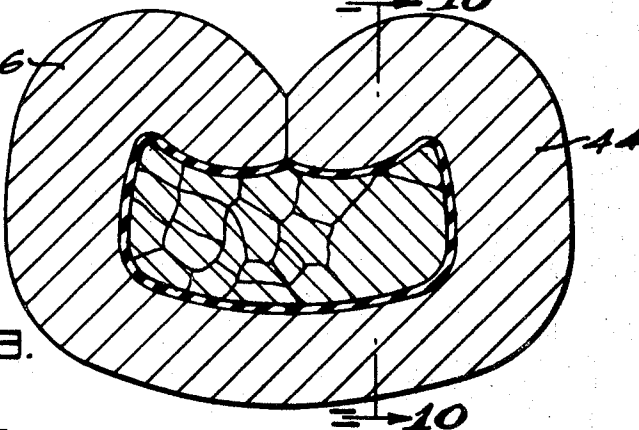
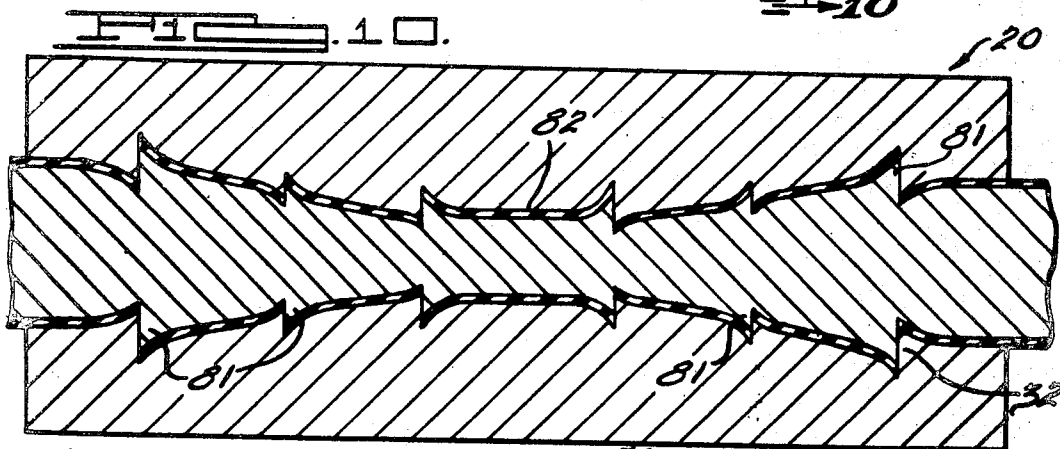
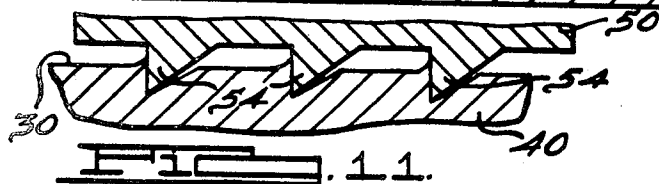
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Sheet 2 of 2



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2

3,436,946

METHOD OF AND APPARATUS FOR MAKING TERMINALS FOR MAKING ELECTRICAL CONNECTIONS

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Original application Feb. 6, 1964, Ser. No. 343,042, now
Patent No. 3,293,355, dated Dec. 20, 1966. Divided and
this application Oct. 12, 1966, Ser. No. 586,154

Int. Cl. B21d 43/28; B21k 27/06; B21c 37/02
U.S. Cl. 72—324

4 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for making a splice type electrical connector by simultaneously forcing two oppositely oriented sets of teeth against the surface of a connector blank and away from each other to displace metal from the blank and form oppositely disposed ribs projecting above the surface of the blank.

This application is a division of our previous U.S. patent application for "Electrical Connector," Ser. No. 343,042, filed Feb. 6, 1964, and now Patent No. 3,293,355, issued Dec. 20, 1966.

This invention relates to electrical splice connections and to a method of and apparatus for making terminals for making such connections. The terminal or connector of our invention is particularly adapted for splicing one or more varnish-insulated solid magnet wires to one or more stranded leads. Splicing connectors known to the art are exemplified by U.S. Letters Patents Nos. 1,646,660, 1,836,497, and 2,800,638.

An object of the invention is to provide a new and efficient method of and apparatus for making terminals for making electrical splice connections.

Other and further objects of the invention will be apparent from the following description and claims and may be understood by reference to the accompanying drawings, of which there are two sheets, which by way of illustration show a preferred embodiment of the invention and what we now consider to be the best mode of applying the principles thereof. Other embodiments of the invention may be used without departing from the scope of the present invention as set forth in the appended claims.

In the drawings:

FIG. 1 is a side elevational view of a strip of connectors illustrating certain steps in the method of making a strip of connectors;

FIG. 2 is a plan view of the strip shown in FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view of a connector taken along the line 3—3 of FIG. 1;

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

FIG. 5 is a somewhat schematic elevational view of tooling useful in forming ribs on the connector blank;

FIGS. 6 and 7 are views similar to FIG. 5, illustrating how the tooling operates to form the ribs on the surface of the connector blank;

FIG. 8 is a side elevational view of a splice connection between two electrical conductors made with the splice connector of this invention crimped on such conductors;

FIG. 9 is an enlarged cross sectional view of the crimped connector taken along the line 9—9 of FIG. 8;

FIG. 10 is an enlarged fragmentary sectional view taken along the line 10—10 of FIG. 9; and

FIG. 11 is a fragmentary view illustrating the manner in which the ribs of the connector are embedded in the

conductor metal during the crimping of the connector around the conductor.

As shown in FIGS. 1, 2, 3 and 4, a splice connector embodying our invention comprises a U-shaped metal ferrule 20 forming a channel 22, the surface of which is relieved by two series of like grooves 24 and 26 disposed transversely of the channel with the groover 24 of one series oriented oppositely relative to the groove 26 of the other series, and with the grooves 24 of one series spaced longitudinally of the channel from the grooves 26 of the other series. Each of the grooves 24 and 26 is asymmetrical in cross section. One side of each of the grooves 24 forms a sharp-edged transverse rib or tooth 28 which projects above the inner surface 30 of the channel. Similarly, one side of each of the grooves 26 forms a sharp-edged transverse rib or tooth 32 which projects above the inner surface of the channel and the opposite sides of the grooves 26. The ribs 28 of one series are inclined toward the ribs 32 of the other series, and the spacing between adjacent grooves in each series is substantially greater than the width of each groove. Preferably the ribs or teeth 28 and 32 are formed with each having one surface 34 perpendicular to the longitudinal axis of the channel 22.

We have found it advantageous to make the connectors from strip stock which is subjected to a series of operations to form a plurality of blanks 40 serially connected by connecting strips 42, and which blanks are subjected to metal forming operations as hereinafter described to form the grooves 24 and 26 and the ribs 28 and 32, and then formed into U-shaped cross section to form a series of open ferrules 20. Preferably the sides 44 and 46 of the ferrules taper in height as shown in FIGS. 1 and 2 so as to increase in height in the direction of the inclination of the ribs 28 and 32. Thus the sides 44 and 46 are higher at the longitudinal center of the channel than at the ends.

In forming the grooves and ribs, the oppositely oriented sets of teeth of the punches 50 and 52 are forced against the surface and into the metal of the blank as illustrated in FIGS. 5, 6 and 7, with the cutting edges of the teeth 54 of one set facing away from the cutting edges of the teeth 56 of the other set while the punches 50 and 52 are moved laterally apart so that the teeth 54 and 56 move in their cutting direction to form the grooves 24 and 26 and to displace metal from the blank above the surface 30 thereof to form the two series of oppositely disposed ribs projecting above such surface 30.

In practice the blank is moved across a suitable supporting surface and a tool carrying the punches 50 and 52 is moved toward the surface 30 of the blank so as to bring the teeth 54 and 56 into contact therewith, the punches 50 and 52 being spring biased to their extended position and also biased by the springs 60 toward each other.

The tool holder 62 includes a tongue 64 which carries a cross pin 66 that projects into slots 68 in the punches 50 and 52. As the tool holder 62 and the punches 50 and 52 descend, the teeth 54 and 56 first contact the work and then continued movement of the tool holder 62 brings the wedge or cam surfaces 70 on the tongue 64 into engagement with the cam or wedge surfaces 72 on the punches 50 and 52, thereby first forcing the teeth 54 and 56 into the metal of the blank and then forcing the sets of teeth 54 and 56 apart while forcing the same further into the blank metal. The teeth 54 and 56 are thus simultaneously driven into the blank metal at an angle (that can be from 10° to 80°) to simultaneously produce the grooves 24 and 26 and the ribs 28 and 32. The number of ribs and the spacing between the adjacent ribs of each set are not critical, and while we prefer

that the edges of the ribs be sharp, they may be provided with a relatively small land area if desired.

The electrical conductors to be spliced are positioned in the channel 22 in overlapping relation and the open ferrule is then crimped around the wires under metal-deforming pressure so as to integrate the same into a unitary mass as shown in FIG. 9 whereby extrusions 81 of the conductor metal fill the cavities provided by the grooves 24 and 26 and the ribs 28 and 32 are embedded in the conductor metal. Where the conductors 80 are varnished or otherwise insulated as indicated at 82, the teeth or ribs 28 will pierce the insulation so that the conductor metal may be brought into intimate metal-to-metal engagement with the metal of the connector as illustrated in FIG. 10. When the sides 44 and 46 of the connectors have tapered upper edges as shown in FIGS. 1 and 2, a higher crimping force will be created in the center of the connector than at the ends, causing extrusion or metal flow of the conductor metal. Since the connector material is harder than the conductor material, the latter will flow more readily, providing a good metal-to-metal contact along the surface 34 of each rib. The crimping operation may be carried out with crimping dies of the type generally illustrated in Berg Patent No. 3,020,520.

We have obtained excellent results using three-quarter hard brass strip stock for the connectors of .018 inch nominal thickness.

While we have illustrated and described a preferred embodiment of our invention, it is understood that this is capable of modification, and we therefore do not wish to be limited to the precise details set forth but desire to avail ourselves of such changes and alterations as fall within the purview of the following claims.

What we claim as our invention is:

1. That method of making an electrical connector adapted for crimping around one or more conductors which comprises forming a sheet metal blank, simultaneously forcing two oppositely oriented sets of serrating teeth against the surface and into the metal of the blank without piercing the blank and with the cutting edges of the teeth of each set facing away from the other set while moving said sets of teeth laterally apart so that said teeth move in their cutting direction whereby to displace metal from the blank above the surface thereof to form

two series of oppositely disposed ribs projecting above the surface of the blank.

2. Apparatus for simultaneously forming two series of ribs out of and above the surface of a metal blank which comprises a plurality of cutting tools arranged for simultaneous metal working operation on the same surface, each tool having a set of serrated teeth extending in the same direction but with the cutting edges of the teeth of each set facing away from the teeth of the other set, and camming means cooperable with said tools for simultaneously forcing said sets of teeth in the direction in which they extend into the metal of said blank while moving said sets of teeth oppositely away from each other.

3. That method of simultaneously forming two series of inclined parallel ribs out of and above the surface of a metal blank which comprises simultaneously forcing two oppositely oriented sets of serrating teeth against the surface and into the metal of a blank without piercing the blank and with the cutting edges of the teeth of each set facing away from the other set while moving said sets of teeth laterally apart so that said teeth move in their cutting direction whereby to displace metal from the blank above the surface thereof to form two series of oppositely disposed ribs projecting above the surface of the blank and with the ribs inclined toward each other.

4. Apparatus for simultaneously forming two series of inclined ribs out of and above the surface of a metal blank which comprises a plurality of punches, each having a set of serrated teeth with the cutting edges of the teeth of each set facing away from the teeth of the other set, said punches having oppositely disposed camming surfaces and camming means cooperable with said camming surfaces for simultaneously forcing the teeth of said punches into the metal of said blank while moving said sets of teeth oppositely away from each other.

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RONALD D. GREFE, *Primary Examiner.*

U.S. Cl. X.R.

72—379; 83—2, 11