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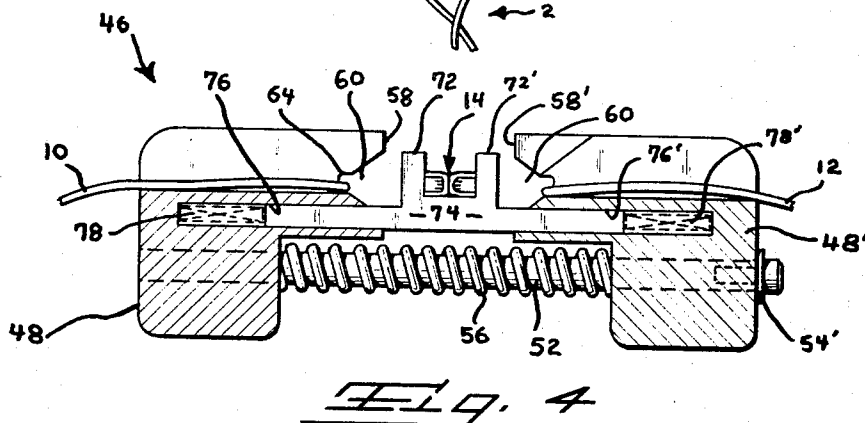
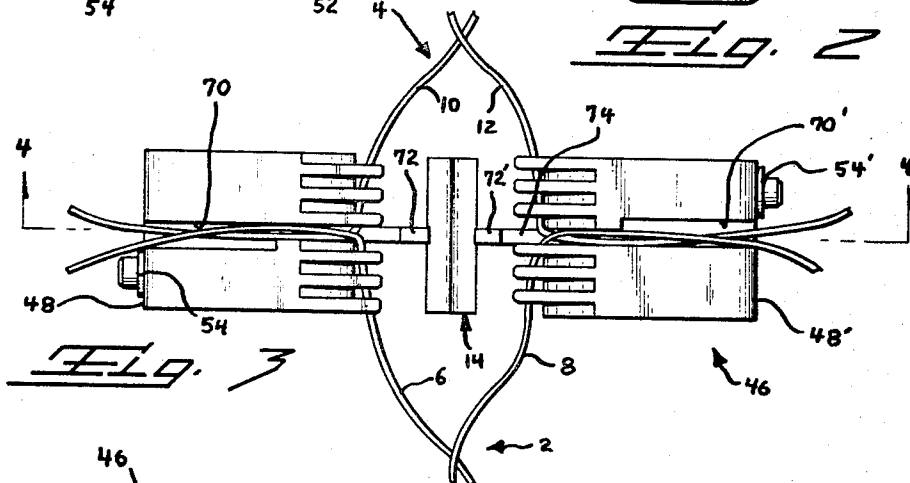
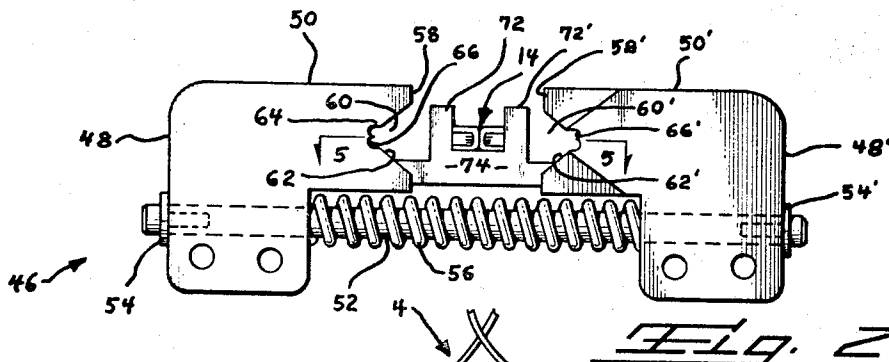
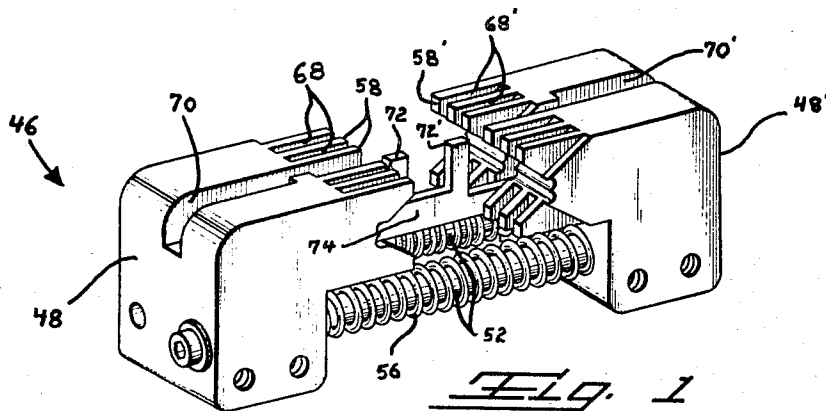
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ELECTRICAL CONNECTIONS FOR PAIRS OF CONDUCTORS

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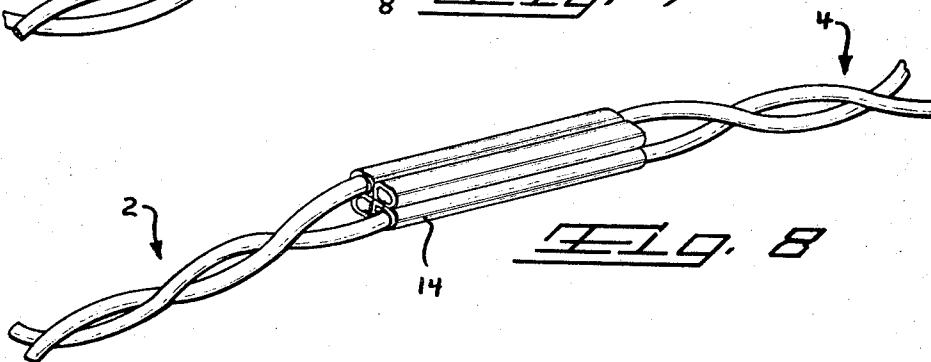
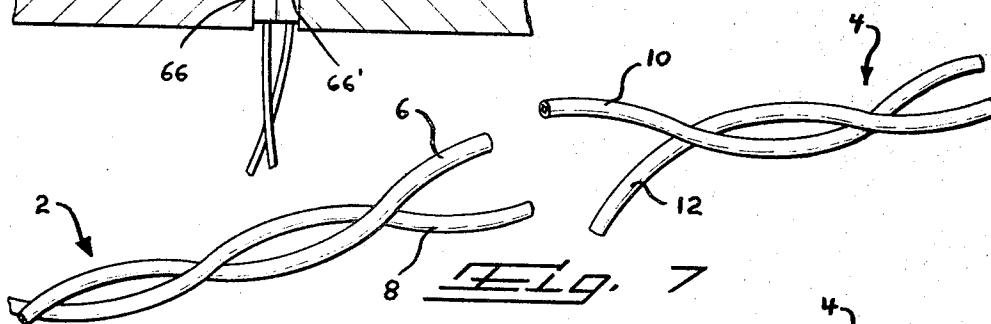
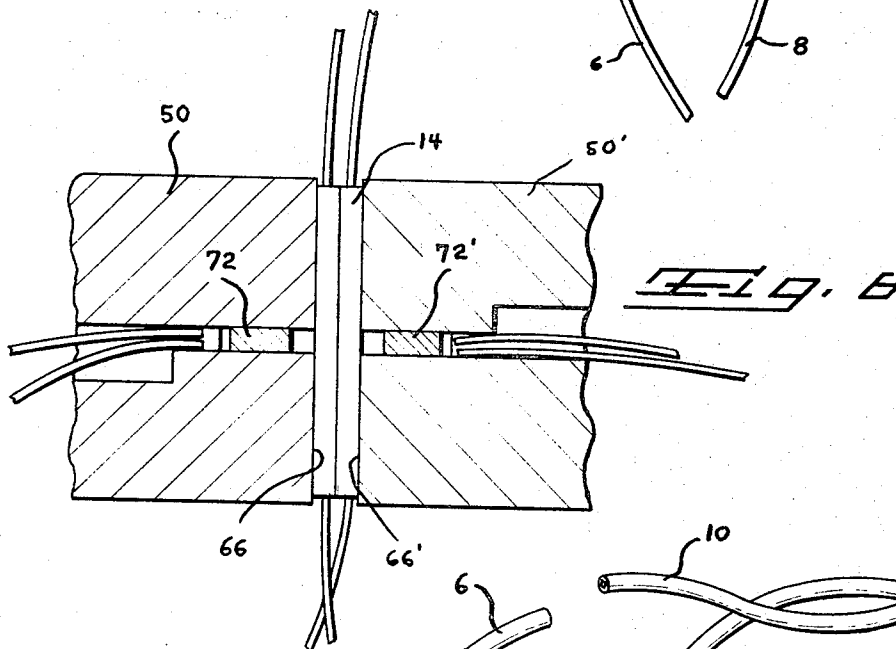
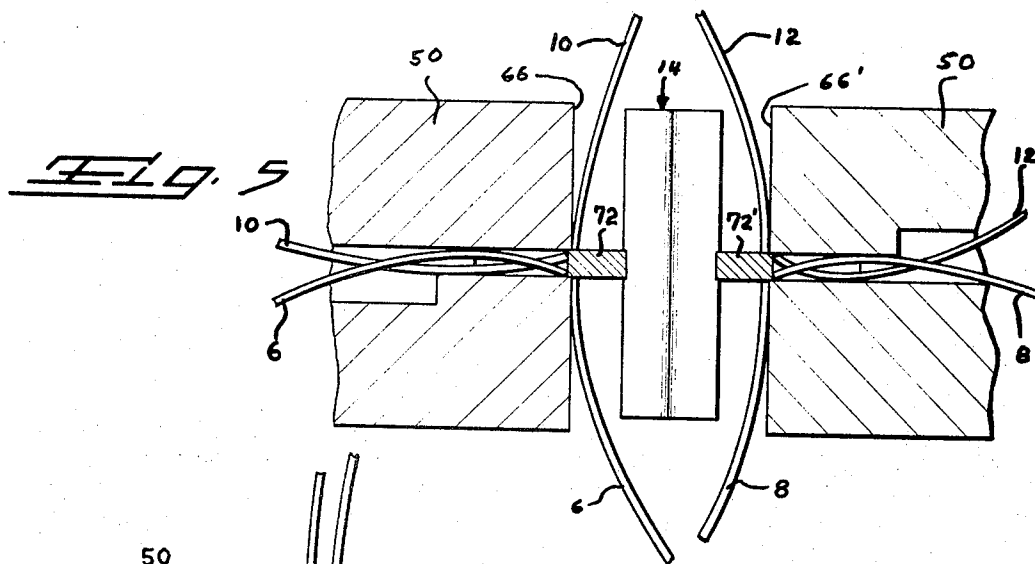
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ELECTRICAL CONNECTIONS FOR PAIRS OF CONDUCTORS

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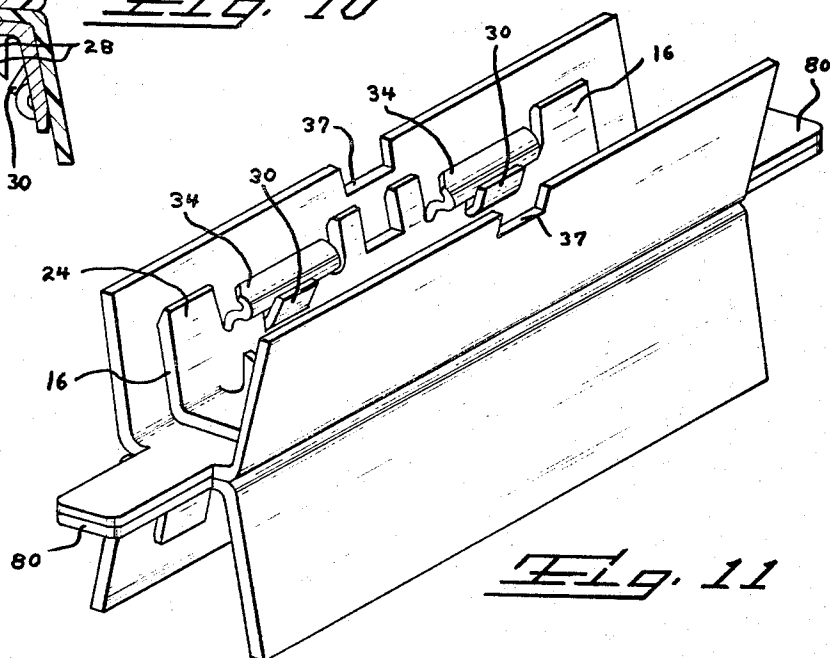
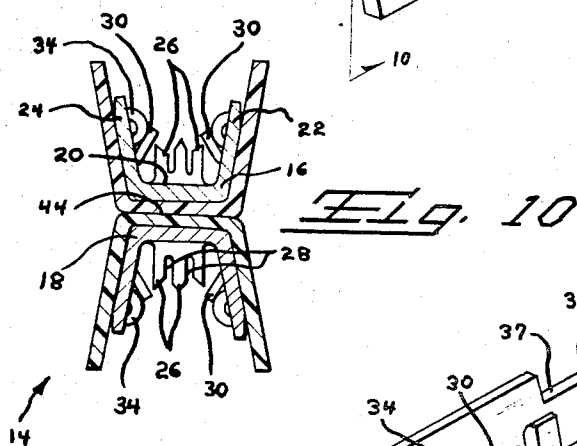
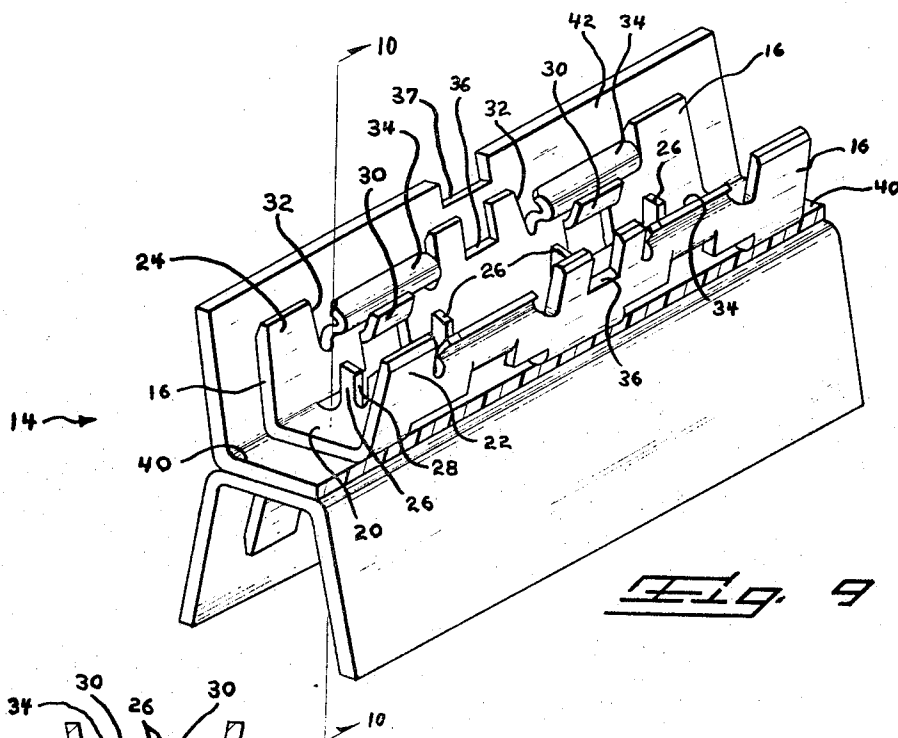
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ELECTRICAL CONNECTIONS FOR PAIRS OF CONDUCTORS

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6 Claims. (Cl. 174—88)

ABSTRACT OF THE DISCLOSURE

Electrical connecting device for connecting pairs of conductors comprises two open U-type metallic connectors secured to each other in back-to-back relationship with their open sides facing in opposite directions. Connectors are separated by insulating material to which connectors are secured and which maintain the two connectors as a single structural entity but as separate electrical entities. Crimping apparatus for this connecting device comprises a pair of opposed crimping dies which are movable relatively towards and away from each other. Connector holding means is located between the crimping dies when they are in their open positions and is adapted to support the connecting device with its open sides facing the forming surfaces of the dies. Each crimping die has an inwardly extending slot intermediate its ends into which wires are threaded or laced prior to crimping. During crimping, wire-cutting members move into these slots prior to crimping of the connecting device onto the trimmed wire ends.

The present invention is directed generally to the problem of forming two electrical connections among four or more conductors in a single operating cycle and by means of a single electrical connecting device. The invention is herein disclosed with particular reference to the splicing of telephone conductors which are commonly provided as pairs of conductors in a telephone cable. It will be understood, however, that the principles of the invention are generally applicable wherever it is desired to connect the corresponding wires of two pairs of conductors to each other.

In the telephone industry, the conductors used for individual telephone circuits are provided as twisted pairs of conductors, that is to say, two insulated wires helically intertwined along their lengths. One of these wires serves as a signal conductor and the other wire or conductor serves as a ground conductor for an individual telephone circuit. Telephone cables may contain large numbers of twisted pairs of insulated conductors, for example, one of the larger sizes of cables currently being used contains 2,700 pairs of conductors or 5,600 individual conductors.

It is frequently necessary to splice the end of a telephone cable containing several hundred or several thousand twisted pairs of conductors to the end of another cable. When a new telephone cable is being installed, the cable is provided in lengths of several hundred feet so that every several hundred feet along the length of the cable, a splice must be made. It is also necessary to make splices between cable ends if the cable is accidentally severed or it is broken as a result of a natural phenomenon such as a hurricane or an earthquake.

The splicing of telephone cables is essentially a manual operation and must be carried out in the field, that is, in a manhole or on a suspended aerial cable. Telephone cable splicing operations are time consuming, tedious, and expensive because of the large number of splices which must be made and because of the large numbers of pairs of conductors in an individual cable.

The present invention is directed to an improved connecting device which is capable of forming two separate electrical connections to connect the corresponding wires

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or conductors of two pairs of conductors to each other. The structure of the connecting device and the structure of the apparatus for crimping the connecting device in accordance with the invention are such that the lineman engaged in the operation of splicing telephone cable ends deals with the conductors as pairs rather than as individual wires as has been common practice in the past.

It is accordingly an object of the invention to provide an improved electrical connecting device for electrically connecting pairs of conductors to each other. A further object is to provide a connecting device capable of forming two electrically separate crimped connections among four wires, the two connections being mechanically integral with each other. A still further object is to provide an improved crimping apparatus for forming two electrical connections in a single operating cycle. A still further object is to provide an improved crimping device for electrical connectors of the type which trims the wire ends concomitantly with the operation.

These and other objects of the invention are achieved in a preferred embodiment thereof in which the connecting device comprises a pair of channel-shaped metallic connectors disposed in parallel back-to-back relationship so that their open sides face in opposite directions. The two metallic connectors are separated from each other by insulating material to which they are secured. The two connectors are thus maintained as separate electrical entities but constitute a single mechanical entity. A preferred form of crimping apparatus for crimping this device comprises a pair of opposed dies which are movable relatively towards and away from each other. Upon locating the connecting device between the dies with the open sides of the connecting device facing the opposed surfaces of the dies, and upon movement of the dies towards each other, the four side-walls of the connecting device are inwardly formed and the two separate metallic connectors are crimped onto wires positioned between the dies. In accordance with my preferred embodiment, the two dies are provided with transversely extending slots intermediate their ends which are adapted to receive the end portions of the conductors which are to be connected. Wire-cutting members are moved into these slots during crimping and the end portions of the wire are thereby severed while the dies are moving relatively towards each other. The preferred embodiment of the invention thus eliminates the necessity of trimming the wire ends prior to forming the electrical connections.

In the drawings:

FIGURE 1 is a perspective view of a crimping apparatus in accordance with the invention showing the positions of the parts at the beginning of the operating cycle;

FIGURE 2 is a side view of the crimping apparatus of FIGURE 1;

FIGURE 3 is a top plan view of the apparatus of FIGURE 1 illustrating the manner in which the conductors are positioned in the apparatus when a crimped connection is to be made;

FIGURE 4 is a view taken along the lines 4-4 of FIGURE 3;

FIGURE 5 is a fragmentary top view, on an enlarged scale, of the apparatus of FIGURE 1 showing the positions of the parts at the time the wires are severed;

FIGURE 6 is a view similar to FIGURE 5 but showing the positions of the parts at the end of the crimping operation;

FIGURE 7 is a perspective view of two twisted pairs of conductors;

FIGURE 8 is a perspective view showing a connecting device in accordance with the invention crimped onto the wires of the conductors of two twisted pairs;

FIGURE 9 is a perspective view with parts broken away of one form of connecting device in accordance with the invention;

FIGURE 10 is a view taken along the lines 10-10 of FIGURE 9; and

FIGURE 11 is a perspective view of a modified form of connecting device.

FIGURE 7 shows two twisted pairs 2, 4 of electrical conductors, the pair 2 comprising individual insulated conductors 6, 8, and the pair 4 comprising individual insulated conductors 10, 12. Insulated conductors of this type are commonly used in the telephone industry and it is frequently necessary to connect the pair 2, to the pair 4 by means of two electrically separate connections. In other words, the conductor 6 is connected to the conductor 10 and the conductor 8 is connected to the conductor 12.

In accordance with the present invention, the two separate electrical connections required to join the pair 2 to the pair 4 are made by a single connecting device 14, FIGURES 9 and 10. This connecting device comprises two separate channel-shaped connector members 16, 18 which are identical to each other so that a description of one will suffice for both. The connector 16 comprises a generally flat web portion 20 having sidewalls 22, 24 extending from its longitudinal edges. A plurality of tongues 26 are struck-up from the web 20 of the connector and notches 28 extend downwardly from the upper edges of these tongues. As explained in U.S. Patent 3,320,354, the width of the notches is such that when a conductor is forced downwardly into a notch, the edges of the notch penetrate the insulation and establish electrical contact with the conducting core of the conductor. In the disclosed embodiment, two tongues 26 are provided adjacent to each end of the connector. Flaplike members 30 are struck-up from the sidewalls 22, 24, the length of the flaps being somewhat less than the distance between the two tongues at each end of the connector. These flaps function as stuffers when the connector is crimped and force the wires into the slots as more fully explained in the above-identified Patent 3,320,354. Additionally, the sidewalls are notched as shown at 32 and the portions of the sidewalls between these notches are inwardly formed as indicated at 34, these inwardly formed sections of the sidewalls functioning to force the stuffers further into the space between the tongues upon crimping. The sidewalls are also notched at 36 intermediate the ends of the connector to facilitate bending of the sidewalls when the connector is crimped.

Each channel-shaped connector member 16, 18 is provided with a film of insulating material on its external surface, this film extending axially beyond the ends of the connector as shown at 40 and upwardly beyond the upper edges of the sidewalls as shown at 42. The film may be of any suitable insulating material, Mylar (polyethylene terephthalate) being a preferred material because of its toughness and its good dielectric properties. The insulated connector members are disposed back-to-back with the portions of the film on the web portions of the connector members being bonded along the interface indicated at 44 (FIGURE 10). The complete connector device, as shown in the drawing, thus comprises two individual connector members of the type described in U.S. Patent 3,320,354 bonded together so that they constitute a single mechanical entity but remain as separate electrical entities. Alternative forms of connector devices will be described below.

One form of crimping apparatus 46 for crimping the connector device 14 comprises a pair of blocks 48, 48' mounted in face-to-face relationship on a pair of guide rods 52 which extend freely through the lower portions of the blocks and which have washers 54, 54' on their ends to hold the blocks in assembled relationship. Springs 56 surround the rods 52 and bear against the opposed sides of the blocks to normally maintain the two blocks

in spaced-apart relationship as shown in FIGURES 1-3 while permitting relative movement of the blocks towards and away from each other. The crimping apparatus 46 as shown in the drawing can be mounted on any suitable tool head or other actuating mechanism capable of moving the blocks 48, 48' relatively towards and away from each other. For example, an apparatus in accordance with the invention can be provided in the form of a hand tool having a linkage of the general type shown in application Ser. No. 596,672, filed Nov. 23, 1966, by William R. Over. Alternatively, and where large numbers of twisted pairs of conductors are being connected, it will prove feasible to provide power actuator for moving the blocks 48, 48' towards each other.

The blocks 48, 48' have arm portions 50, 50' which project towards each other and which have opposed faces 58, 58'. Trough-like die cavities 60, 60' are provided in these opposed faces, these die cavities having generally convergent sidewall portions 62, 62' that merge with generally parallel sidewall portions 64, these parallel sidewall portions being reversely curved to define cusps 66, 66'. As best shown in FIGURES 1 and 3, slots 68 are provided in the block 48 and complementary slots 68' are provided in the block 48', the slots 68' being offset from the slots 68 so that the two arm portions 50, 50' can move past each other to fully crimp the connector as is illustrated in FIGURE 6. Additionally, each block is provided with a central slot 70, 70', the width of these slots being somewhat greater than the slots 68, 68' and being sufficient to permit placement of the individual wires in the slots as shown in FIGURE 3 and as will be described more fully below.

A combined wire trimming member and connector device supporting member is disposed between the opposed faces 58, 58' of the blocks and comprises a pair of upwardly extending arms 72, 72' which are integral with a support and guide bar 74. The horizontally extending arms of this guide bar 74 project into blind recesses 76, 76' in blocks 48, 48' and bear against springs 78, 78' mounted in these recesses. It will be apparent from FIGURE 4 that when the two blocks 48, 48' move relatively towards each other, the springs 78, 78' will be compressed and the arms 72, 72' will recede into the slots 70, 70'. The distance between the opposed inner edges of the arms 72, 72' is substantially equal to the distance between the notches 37 on the opposite sides of the connecting device 14. The arms 72, 72' and the central portion of the bar 74 thus function as a support for the uncrimped connector as illustrated in FIGURES 2-4. The arms 72, 72' also function as wire shearing members in co-operation with the sides of the slots 70, 70' as explained below in the description of the operation of the disclosed embodiment.

The operation of the disclosed embodiment is as follows. The operator first positions an individual connecting device 14 in the pocket between the arms 72, 72' with the edge portions of these arms extending into the notches 37 in the insulation of the connecting device. He then separates the end portions of the conductors of the pair 2 and locates the conductors 6, 8 in the die cavities 60, 60' with the end portions of these conductors extending through the slots 70, 70'. He then positions the conductors 10, 12 on the opposite side of the support bar in the die recesses with their ends extending through the slots 70, 70' beside the previously positioned conductors 6, 8. The tool is then actuated to cause the blocks 48, 48' to move relatively towards each other. During the initial stage of the crimping operation, the blocks 48, 48' will move relatively past the arms 72, 72' and these arms will, in effect, move relatively into the slots 70, 70'. At this stage in the cycle (FIGURE 5) the end portions of the wires will be trimmed by the shearing action of these arms 72, 72' in co-operation with the sides of the slots 70, 70'. Upon further relative movement of the blocks 48, 48' towards each other, the arms 72, 72' will move entirely into the slots and the forming surfaces of the die cavities will move

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over the sidewalls of the connector, bend these sidewalls relatively inwardly and toward the connector webs as shown in FIGURE 6. During such bending of the connector sidewalls, the individual wires will be pressed down into the notches 28 of the tongues 26 and the insulation of the conductors will be penetrated by the edge of these notches. After completion of the crimping operation, the wires 6 will thus be electrically connected to the wire 10 by means of the metallic connector member 16 and the wire 8 will be connected to the wire 12 by means of the connecting device 18. When the blocks 48, 48' return to their initial positions, the completed connection can then be removed from between the arms 72, 72'.

A significant advantage of the invention is that the pairs of conductors 2, 4 are handled and dealt with as pairs when the corresponding wires of these two pairs are connected to each other by a lineman. In other words, when the pair 2 is connected to the pair 4 (FIGURE 7) the pair 2 is handled at only one time and the two individual conductors of the pairs 6, 8 can be placed in the slots 70, 70' in a single operation. Similarly, the pair 4 need only be selected from the wire bundle and its two conductors 10, 12 positioned in the slots 70 in a single operation. Only one connecting device need be positioned in the tool in preparation for an operating cycle and only one operating cycle is carried out, that is, one cycle of movement of the blocks towards and away from each other, to form both of the electrical connections required. This feature of the invention results in substantial time saving as compared with twisted pair splicing methods in which the two electrical connections are made in separate steps.

A further significant advantage of the invention is that after the connections have been made by crimping the single connecting device 14, the wires of the pairs 2, 4 are held mechanically together by virtue of the fact that two separate electrical connectors constitute only a single structural entity. In a cable having several hundred or perhaps several thousand pairs of conductors, this feature of the invention results in a more compact splice between cable ends and prevents the individual wires of different pairs from becoming tangled with each other in the vicinity of the splice.

Under some circumstances, the connecting device 14 may have a tendency to curl or bend along its axis during crimping and the resulting crimped connecting device will be arcuate rather than straight. This may happen, for example, if the forces applied during crimping are not the same on the opposite sides of the connector. This tendency can be overcome by a number of methods. For example, FIGURE 11 shows a modified form of connector in which tongues 80 of insulating material extend from each end of the connector. The crimping apparatus can be modified to grip and hold these tongues while it is being crimped. If the connector is thus held, the curling tendency will be overcome and the connector will be straight after crimping. As an alternative method of overcoming the curling tendency, the opposed faces 58 of the crimping apparatus can be provided with resiliently mounted connector engaging members extending from the die blocks 48 toward and against the sides of the connector positioned between the arms 72, 72'. Upon crimping, these connector holding members will recede into the blocks and will hold the connector while it is being crimped. The curling tendency can also be obviated by forming the connector out of relatively heavy stock capable of standing crimping without curling or bending.

It will be apparent that many alternative types of connectors might be used in the practice of the invention, the only requirement of the connector being that it have an open side into which the wires are placed upon crimping. For example, each metallic connector might be provided

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with a single sidewall on only one side of the connector rather than two sidewalls as in the disclosed embodiment. While the disclosed embodiment of the connecting device 14 comprises two insulated connectors bonded to each other, it would be obvious to manufacture the connecting device by providing an H-shaped extrusion of insulating material and positioning the metallic connectors 16, 18 on opposite sides of the cross-member of the extrusion.

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.

What is claimed is:

1. An electrical connecting device for making two separate electrical connections among at least four conductors, said device comprising:

a pair of crimpable metallic connector members, each of said connector members having a web and at least one sidewall and having an open side adapted to receive a wire, said connector members being disposed in parallel spaced-apart relationship with said open sides facing in opposite directions, insulating material between said connector members, said connector members being secured to said insulating material

whereby said connector members can be simultaneously crimped onto said four conductors to make said two separate electrical connections.

2. A device as set forth in claim 1 wherein each of said connector members has a pair of sidewalls, the sidewalls of said connector members extending in opposite directions on opposite sides of said connecting device.

3. A device as set forth in claim 1 wherein said insulating material extends over the external surface of said sidewalls.

4. A device as set forth in claim 1 wherein each of said connector members has a tongue struck from its web portion, said tongue having a slot therein adapted to receive a conductor upon crimping.

5. A device as set forth in claim 1 wherein each of said connectors has a film of insulating material on its external surface, the film on the web portions of said connectors being bonded to each other and constituting said insulating material between said connectors.

6. An electrical connecting device for making two separate electrical connections among at least four wires, said device comprising:

a pair of open U-type electrical connectors, each of said connectors having a web and a pair of sidewalls, said connectors being in parallel spaced-apart relationship with their sidewalls extending in opposite directions,

insulating material between said connectors and extending over the external surfaces of said sidewalls, said connectors being secured to said insulating material whereby said insulating material maintains said connectors electrically separate from each other and structurally integral with each other,

whereby said pair of connectors can be simultaneously crimped onto said four wires to make said two separate electrical connections.

No references cited.

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