

[54] **WIRE CONNECTOR**
 [75] Inventors: **James E. Golden**, Evanston; **James F. Taylor**, Chicago, both of Ill.

[73] Assignee: **Reliable Electric Company**, Franklin Park, Ill.

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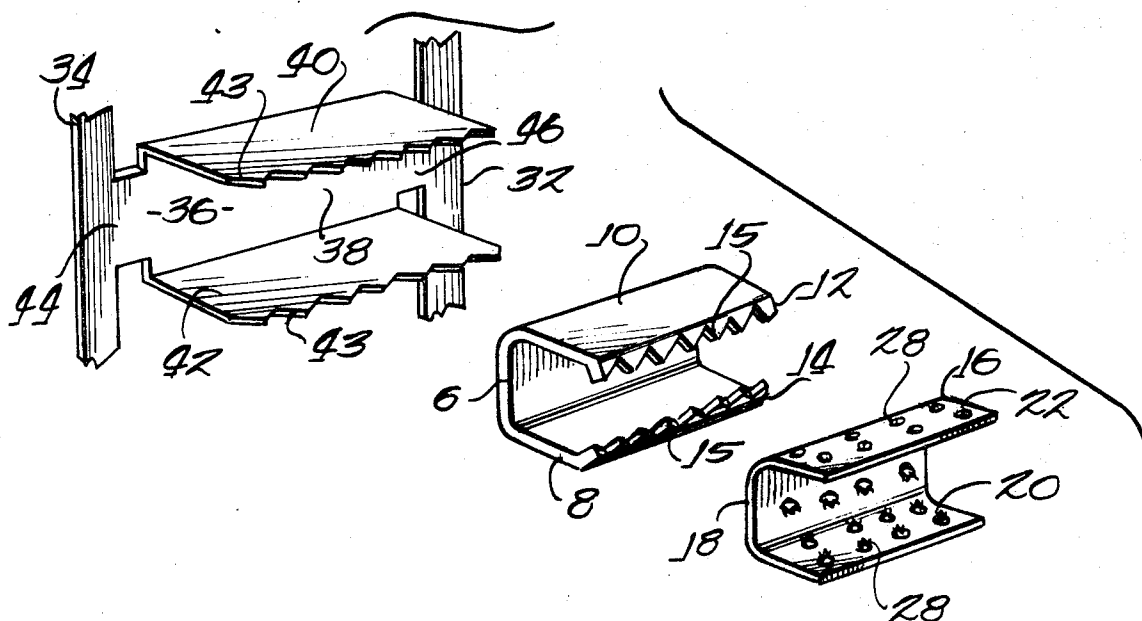
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Primary Examiner—Darrell L. Clay
Attorney—Roy H. Olson et al.

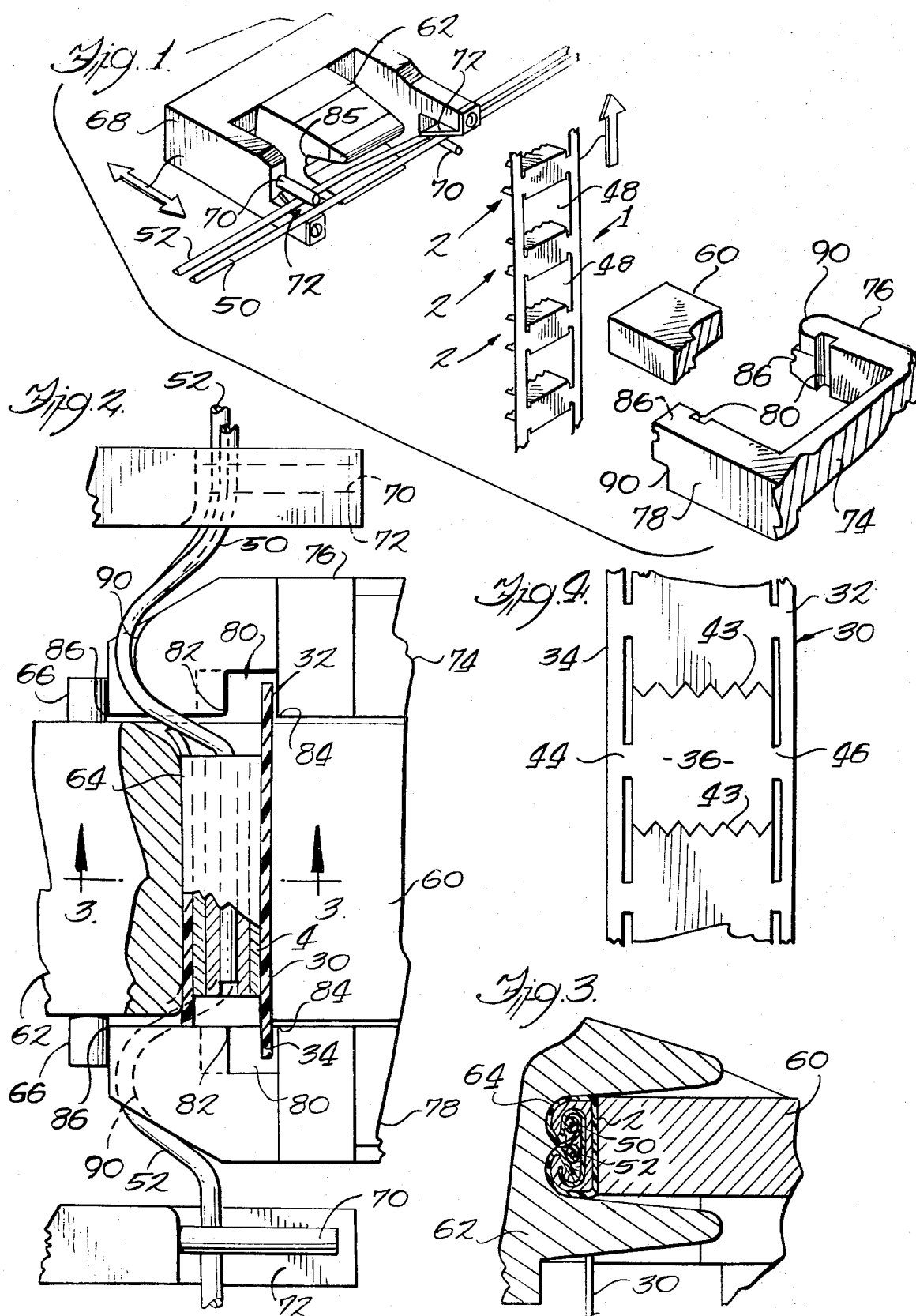
[57] ABSTRACT

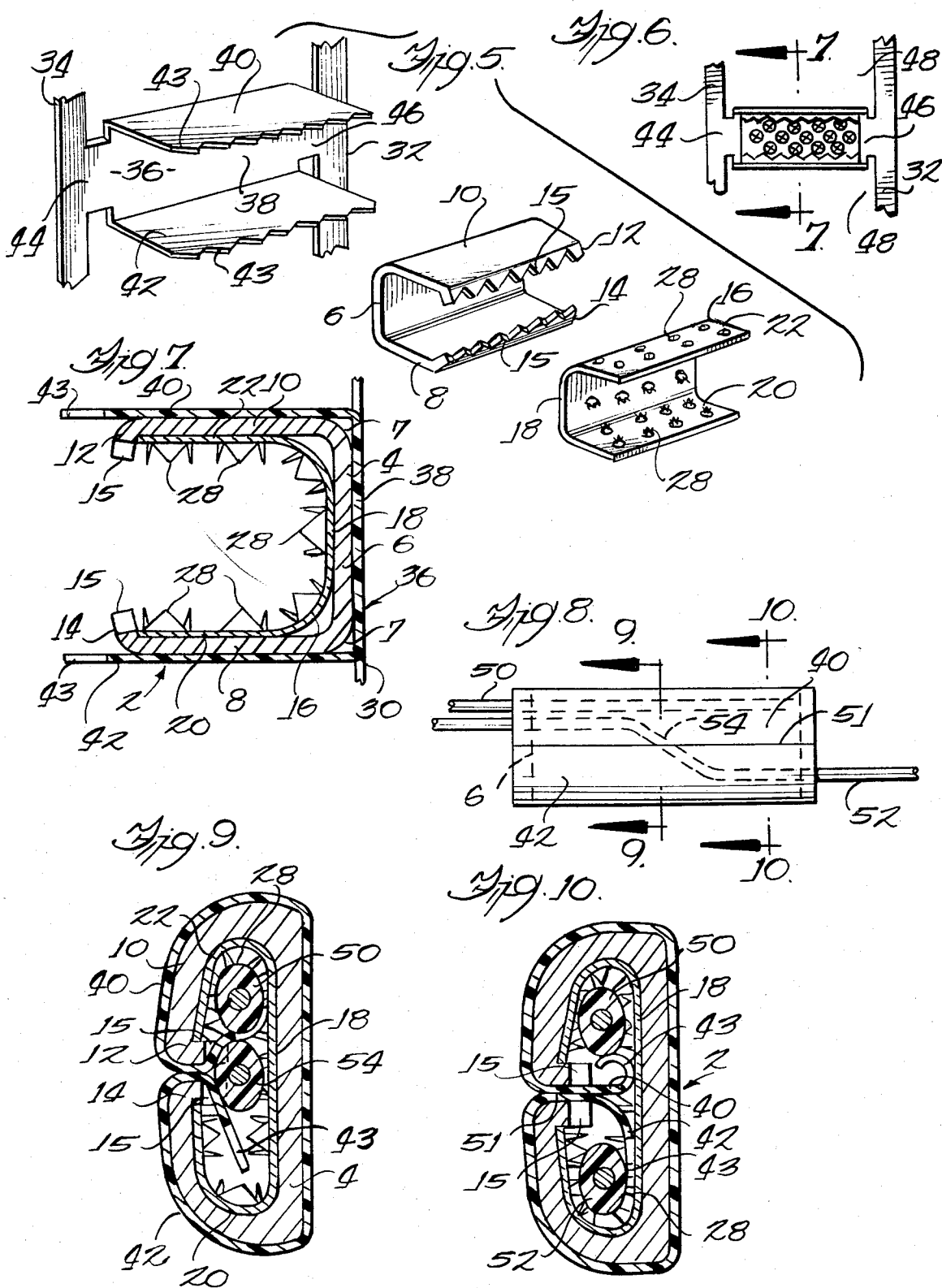
An electrical connector for splicing insulated wires comprises a U-shaped dead soft outer shell and a U-shaped resilient insert or inner shell with inwardly projecting, insulation-piercing prongs. An outer insulated tape is disposed over the base and opposed sides of the outer shell and has portions extending beyond those opposed sides and terminating in serrated edges. The outer shell has opposed end flanges on the opposed sides that project toward each other and are serrated. The free edges of the sides of the insert terminate short of the serrated edges of the opposed flanges. When the connector is crimped over the wires, the prongs pierce the insulation thereon and the serrated edges of the in-folded tape portion provide clearance for some of the prongs. The serrated flange edges permit a wire, such as a crossover wire, to fall between the teeth of the serrations or the teeth may pierce the insulation.

7 Claims, 10 Drawing Figures



2 Sheets-Sheet 1





WIRE CONNECTOR

BACKGROUND OF THE INVENTION

This invention relates to improvements in wire connectors, more particularly channel-shaped connectors of the type used for splicing insulated wires without the need for first removing the insulation thereon.

It is generally known to provide a U-shaped splicing connector of a type having an outer dead soft shell, an insert in the shell with prongs for piercing the insulation of the wires, and a covering of insulation tape over the shell that acts to insulate the splice from others in a bundle or cable of such splices. When such a connector is crimped, the free ends of the shell and insert are in-folded along with portions of insulation tape, causing the latter to form a seal at the joint formed by the aforesaid in-folded free ends. In some kinds of splices the wire may cross over from one side of the connector to the other. For example, there is a conductor crossover in a tap splice. In addition, a wire might have a kinked portion in the connector causing it to be partially disposed laterally within the connector. In either case, the in-folded edges of the shell and insert, depending upon their respective configurations, may tend to either interfere with proper closing of the connector during crimping, or of proper piercing of the insulation by the insert prongs. Furthermore, the insulation tape portions that end up within the connector upon crimping may underlie a conductor and serve as a barrier that inhibits piercing by the prongs.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide an electrical splicing connector of U-shaped configuration that includes an outer shell, an inner insulation-piercing insert, and an insulation tape covering, and wherein the configuration of the shell, the insert and the tape are such that proper penetration of the insulation and contact with the conductor wires results regardless of whether or not the splice involves a crossover conductor, a kinked wire, or the like.

It is a further object of this invention to provide a connector of the type stated in which the shell has end flanges that are serrated so that a crossover wire either falls between the teeth of the serrations to reduce interference with the crimping action or, alternatively, is pierced by the teeth to provide electrical contact.

Another object of this invention is to provide a connector of the type stated in which the insert has free ends extending to regions spaced from the serrated edges of the shell whereby the ends of the insert do not tend to obstruct crimping, but, on the contrary, results in a configuration that permits increasing the number and positions of the prongs for making better contact with the wires.

It is a still further object of the present invention to provide a connector of the type stated in which the edges of the insulation tape that lie within the crimp connector are serrated to reduce possible obstruction of the prongs of the insert in the regions underlying the conductors.

In accordance with the foregoing objects the connector comprises a dead soft metallic outer shell having a base with opposed sides extending respectively from opposed margins of the base to provide a generally U-shaped configuration. The opposed sides each have an end flange remote from said opposed margins. Each

end flange forms an angle with the adjacent part of its associated side, and the end flanges project generally toward each other and terminate in opposed edges defining an opening into the shell opposite to its base. The opposed edges are serrated to form a series of teeth. A resilient, somewhat harder metallic insert is telescoped within the shell. The insert is also of U-shaped configuration and has a base adjacent to the base of the shell and opposed sides adjacent to the respective sides of the shell. The sides of the insert terminate in edges that are spaced apart a distance that is greater than the distance between the serrated edges of the end flanges. More particularly, the edges of the insert terminate adjacent to where the end flanges begin. The insert has inwardly struck prongs for piercing the insulation on a conductor and biting into the conductor to form electrical contact therewith when the connector is crimped onto conductors. The crimping is done by bending the opposed sides of the shell and insert toward each other and over the conductors such that the end flanges of the shell are juxtaposed and project toward the shell base. Since the insert is devoid of end flanges it does not interfere with a conductor (e.g. a crossover conductor) directly therebeneath. The serrated edges of the end flange provide conductor relief spaces and/or insulation-piercing edges. The connector also includes dielectric tape on the exterior of the shell which have portions projecting beyond the end flanges and terminating in serrated edges. Upon crimping of the connector, the tape portion will be confined between the juxtaposed flanges and lie within the insert. The serrated edges of the tape sometimes may underlie a conductor will provide spaces for passage of some of the prongs of the insert that might otherwise be obstructed.

A series of connectors that includes a shell and the insert may be mounted on the tape in spaced parallel relationship whereby a supply of the connectors may be fed one-by-one into a suitable crimping machine. The machine may be of a known type, for instance that shown in Taylor and Golden U.S. Pat. application Ser. No. 234,113, filed Mar. 13, 1972 and wherein the inventors therein are the same as in this application, both applications being assigned to a common assignee. In any event, the tape has marginal strip portions and spaced parallel transverse sections joining the marginal strip portions, the tape also having openings between said transverse sections. Each transverse section is bonded to a base of the shell and to opposed sides of the shell and with portions of the transverse sections extending outwardly beyond the end flanges of the shell. The connectors have opposite transverse ends that are spaced from the marginal strip portions of the tape to leave regions wherein the transverse sections may be severed during the crimping operation to remove the connectors from the marginal strip portions.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is an exploded perspective view showing in part an arrangement for crimping a connector of the present invention to insulated wires to form a tapping splice;

FIG. 2 is a fragmentary top plan view, partly broken away and in section, of apparatus including the parts of FIG. 1 for crimping the connector;

FIG. 3 is a fragmentary sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a fragmentary top plan view of the connector tape after it has been slit;

FIG. 5 is an exploded perspective view of a portion of the "ladder" that forms a series of connectors and showing exploded one of such connectors;

FIG. 6 is a front view (unexploded) of the arrangement of FIG. 5 but on a smaller scale;

FIG. 7 is a sectional view, on an enlarged scale, taken along line 7—7 of FIG. 6;

FIG. 8 is a front view of a connector crimped over the insulated conductors; and

FIGS. 9 and 10 are sectional views taken along lines 9—9 and 10—10, respectively, of FIG. 8.

DETAILED DESCRIPTION

Referring now in more detail to the drawings, which illustrate a preferred embodiment of the present invention, there is shown a "ladder" arrangement 1 of channel-shaped connectors and insulating tape. Each connector 2, comprises a U-shaped shell 4 having a base 6 with opposed longitudinal margins 7, 7 from which extend opposed, generally parallel sides 8, 10. At the free ends of the sides 8, 10 are opposed flanges 12, 14 which project generally toward each other, terminating in saw tooth or serrated edges each made up of a series of teeth 15. Each end flange 12, 14 forms a slightly obtuse angle with the adjacent part of its associated side. The serrated edges formed by the teeth 15 define an opening into the shell that is opposite to the base 6. The shell is preferably formed of a soft deformable material, such as copper or annealed brass.

Telescoped within the shell 4 and of slightly shorter length is a U-shaped insert 16 having a base 18 adjacent to the base 6 and opposed sides 20, 22 adjacent to the respective sides 8, 10 of the shell. The insert sides 20, 22 terminate substantially at the respective junctions of the end flanges 12, 14 and their associated sides 8, 10. Thus, the insert does not have flanges corresponding to the end flanges 12, 14. The insert is preferably formed of a resilient harder material, such as spring-tempered phosphor bronze, and includes clusters of inwardly projecting prongs 28 that are formed by striking the insert material from the base 18 and sides 20, 22. The pattern of prong clusters is such as to achieve reasonably close spacing consistent with strength. Prong clusters may be placed relatively close to the free edges of the insert sides 20, 22.

The connectors 2 are in spaced parallel relationship and are disposed along a carrier or tape 30. Preferably this tape is a thin flexible sheet of polyethylene terephthalate resin, commonly sold under the trademark Mylar. The tape has parallel marginal strip portions 32, 34 that are joined by parallel transverse sections 36. Each transverse section has a portion 38 that is bonded to a base 6 of a shell. Also, each transverse section 36 has parallel projecting portions 40, 42 which are bonded to the exterior surfaces of the sides 8, 10 and extend a substantial distance beyond the flanges 12, 14. These projecting portions 40, 42 terminate in serrated edges 43, 43 that each form a saw-tooth shape.

The connectors 2 are spaced from the marginal strip portion 32, 34 to leave parallel regions of severance 44, 46 which are of reduced width as compared to the adjacent portion 38 and at which the tape is severed parallel to the strip portion 32, 34 in the crimping operation. The outwardly projecting portions 42, 40 are formed by cutting or punching the tape with a tool of serrated

configuration to provide the tape structure shown in FIG. 4. Thereafter the tape portions 40, 42 are bent out of the plane of the tape for securement to the sides of the shell. The result is a series of openings 48 being formed between the respective connectors and their transverse sections 36. Since the projecting portions 40, 42 are formed by slitting the tape, there is little waste of tape material, and it is a relatively simple matter to bond the portions 38, 40, 42 to the outer shell in any suitable manner. Generally speaking, the tape comes with one side provided with a heat-bondable adhesive.

When insulated conductors 50, 52 are inserted into the connector 2, the crimping machine deforms the connector to the shape shown in FIGS. 3, 9 and 10. The crimping deforms the sides of the shell and the sides of the insert 16 and brings the flanges 12, 14 together and with the tape portions 40, 42 clinched in the seam 51 therebetween. The prongs 28 pierce the insulation and bite into the wires to form the electrical connection between the wires.

Many types of splices result in a crossover of one or more of the insulated conductors. A typical situation is shown herein in which the tapped conductor 52 crosses over at the region 54 (FIGS. 8 and 9) from one side of the connector to the other. The effect of this crossover is to cause the conductor portion 54 to underlie the flanges 12, 14. Under such conditions the conductor region 54 may fall between the points of the teeth 15 whereby interference to crimping from the flanges 12, 14 is reduced. It is also possible that one or more of the teeth 15 could engage the conductor in the region 54, and under such conditions the sharp teeth 15 would penetrate the insulation and make contact with the wire just as do the prongs 28.

The fact that the insert 16 is devoid of end flanges corresponding to the end flanges 12, 14 precludes the presence of an edge of the insert being directly presented to a conductor. The presence of such an edge would tend to interfere with crimping the connector if a crossover condition were present. In fact, if one or more of the wires are kinked, there might be more than one crossover, which would only aggravate the situation. In the present invention, however, only the surface portions of the insert 16 are presented to a conductor together with prong clusters 28 so that crossover or not an adequate piercing of the conductor at a number of places is effected.

In the crimping operation it sometimes happens that one or more of the tape portions 40, 42 will fall between the insert base 18 and the insulated conductor. The occurrence of this is a random possibility and may take place regardless of the nature of the splice. However, when it does occur the tape portion 40 or 42, as the case may be, constitutes a barrier through which one or more of the clusters of prongs 28 may not penetrate. This reduces the number of prong contacts with the wire. Accordingly, the serrated or saw toothed configuration at the edges 43, 43 tend to provide clearance areas minimizing tape obstruction by about half of what would ordinarily be the case without the serrations. Consequently, the number of prongs which are unobstructed is significantly increased and a greater number of prongs can engage the wires.

As pointed out above, the connector 2 may be crimped to the wires by a machine of the type disclosed in the aforesaid copending U.S. Pat. application Ser.

No. 234,113, the disclosure of which may by reference be incorporated herein. Suffice it to say, however, that the tape "ladder" 1 is fed into the machine whereby the connectors may be crimped one by one, to form the splices.

Referring now to FIGS. 1-3, portions of the machine of the aforesaid copending application are herein shown to illustrate generally the manner in which the connectors are crimped. It will be understood, however, that other types of machines may be used and the following description is merely exemplary of the manner in which the connector is crimped about the wires.

The crimping machine includes a suitable feed mechanism for feeding the tape 30 to an anvil 60 which cooperates with a power driven ram 62 having a crimping die face 64 and laterally projecting pins 66, 66. The ram 62 carries with it a wire retainer 68 having suitable wire retaining structures thereon. Each wire retaining structure preferably comprises a pin 70 and a leaf spring 72 such that the wire is gripped between the pin 70 and spring 72. The wire retaining structures are on opposite sides of the ram 62 whereby the tapped conductor 52 is gripped by both wire retainer structures 70, 72 while the tapping conductor is gripped by only one wire retainer structure, for example, the right hand structure 70, 72 of FIG. 1. It will also be noted that the wire retainer structures are offset when viewed normal to the plane of the openings 48 (FIG. 1) when a connector is being backed by the anvil 60. Thus, the manner in which the tapped conductor 52 is held results in the cross-over condition at 54.

The machine also includes a shear block 74 which is biased by springs (not shown) in the direction toward the ram 62. The shear block 74 has arms 76, 78 on opposite sides of the anvil 60, and ram 62. The arms have vertical slots 80, 80 for receiving the marginal strip portions 32, 34 of the tape 30. The shear block 74 also has cutting edges 82, 82 which cooperate with cutting edges 84, 84 to slit the tape in the region 44, 46. Additionally, the opposite forward side edges 85 of the ram 62 provide cutting edges that cooperate with shear block cutting edges 86, 86 to sever the projected ends of opposed conductors in the ordinary type of splice. The cutting edges 86, 86 are offset like the wire retainer structures but in mirror-image or opposite relation. In the present example utilizing a tap splice, however, only the end of the tapping conductor 50 will be cut off since the ends of the tapped conductor by reason of the crossover 52, are not in position to be cut by the cutting edges 85, 85, 86, 86. Finally, the shear block arms 76, 78 have arcuate abutments 90, 90 which tend to draw the cut end of the wire into the connector. Where a tapping splice is used only the cut end of the tapping conductor 50 will be drawn into the conductor. While the tapped conductor 52 is offset from both cutting edges 86, 86, it is not offset from the arcuate abutments and does get curved about them during the crimping operation. However, since there is no cutting of the tapped conductor there is no drawing into the connector as with the tapping conductor.

With the connector 2 in position by being backed by the anvil 60, the ram is advanced toward the anvil causing the die face 64 to bend the opposed sides of the shell and insert toward each other, and along with the tape portions 40, 42, crimp the connector around the conductors 50, 52. Initially the end of the tapping conductor 50 is cut off while the tapped conductor 52 is

left uncut. Subsequently, the pins 66, 66 move the shear block 74 to cut the tape at the region 44, 46. Finally, the die face 64 comes into full-crimping position to complete the crimp as shown in FIGS. 3 and 8-10.

The invention is claimed as follows:

1. An electrical connector for splicing insulated conductor wires comprising a metallic shell having a base with opposed margins, opposed sides extending respectively from said opposed margins to provide a shell with a generally U-shaped configuration, said opposed sides each having an end flange remote from said opposed margins, each said end flange forming an angle with the adjacent part of its associated side, said end flanges projecting generally toward each other and terminating in opposed edges defining an opening into the shell opposite to said base, said opposed edges being serrated forming series of teeth, a metallic insert telescoped within said shell, said insert having a base adjacent to the base of the shell and opposed sides adjacent to the respective sides of the shell, the sides of the insert terminating in edges that are spaced apart a distance that is greater than the distance between said serrated edges, said insert having inwardly projecting prongs for piercing the insulation on the conductors and biting into the conductors when the connector is crimped onto the conductors by bending the opposed sides of the shell and of the insert toward each other and over the conductors such that the end flanges are juxtaposed and project toward said shell base and the serrated edges provide conductor relief spaces and insulation-piercing edges.

2. An electrical connector according to claim 1 including dielectric tape on the exterior of said shell and having portions projecting beyond said end flanges and terminating in serrated edges such that upon said crimping said tape portion will be confined between said flanges and lie within said insert, and the serrated edges of the tape will provide spaces for receiving prongs of said insert.

3. An electrical connector comprising a U-shaped shell formed of a dead soft metallic material, the shell including opposed sides terminating in end flanges projecting generally toward each other, each said end flanges being serrated forming a series of teeth therealong, and a U-shaped insert telescoped in said shell and being formed of a resilient metallic material that is harder than the material of said shell, said insert having opposed sides terminating short of said serrated edges, said insert having sharp inwardly projecting prongs therein.

4. An electrical connector according to claim 3 including dielectric tape on the exterior of the shell, said tape having portions projecting beyond said end flanges and terminating in serrated edges.

5. A combination that comprises a series of connectors, each connector having a U-shaped metal shell, the shell including a base and opposed sides, said opposed sides terminating in end flanges projecting generally toward each other and having serrated edges, an insert with each shell and having insulation piercing means, a continuous tape of non-conducting material having marginal strip portions and spaced parallel transverse sections joining said marginal strip portions, the tape having openings between said transverse sections, each transverse section being bonded to a base and opposed sides of said metal shell and with portions of the trans-

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verse section extending outwardly beyond said end flanges.

6. A combination according to claim 5 in which said portions of said transverse section terminate in free edges that are serrated.

7. A combination according to claim 5 in which the

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connectors have opposite ends that are spaced from said marginal strip portions to leave regions wherein the transverse sections may be severed to remove the connectors from said marginal strip portions.

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