

- [54] **TERMINAL FOR FLAT CONDUCTOR**
- [75] Inventor: **Laurie A. Saunders**, Fleet, England
- [73] Assignee: **ITT Industries, Inc.**, New York, N.Y.
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- [21] Appl. No.: **454,108**

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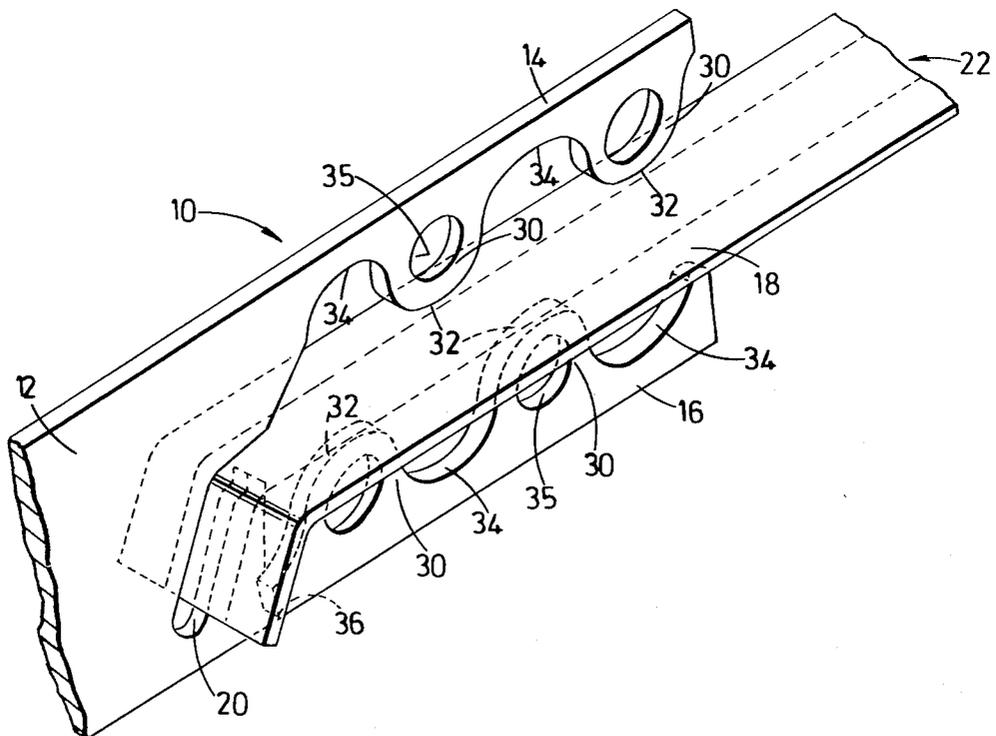
Primary Examiner—Joseph H. McGlynn
Attorney, Agent, or Firm—Peterson, Thomas L.

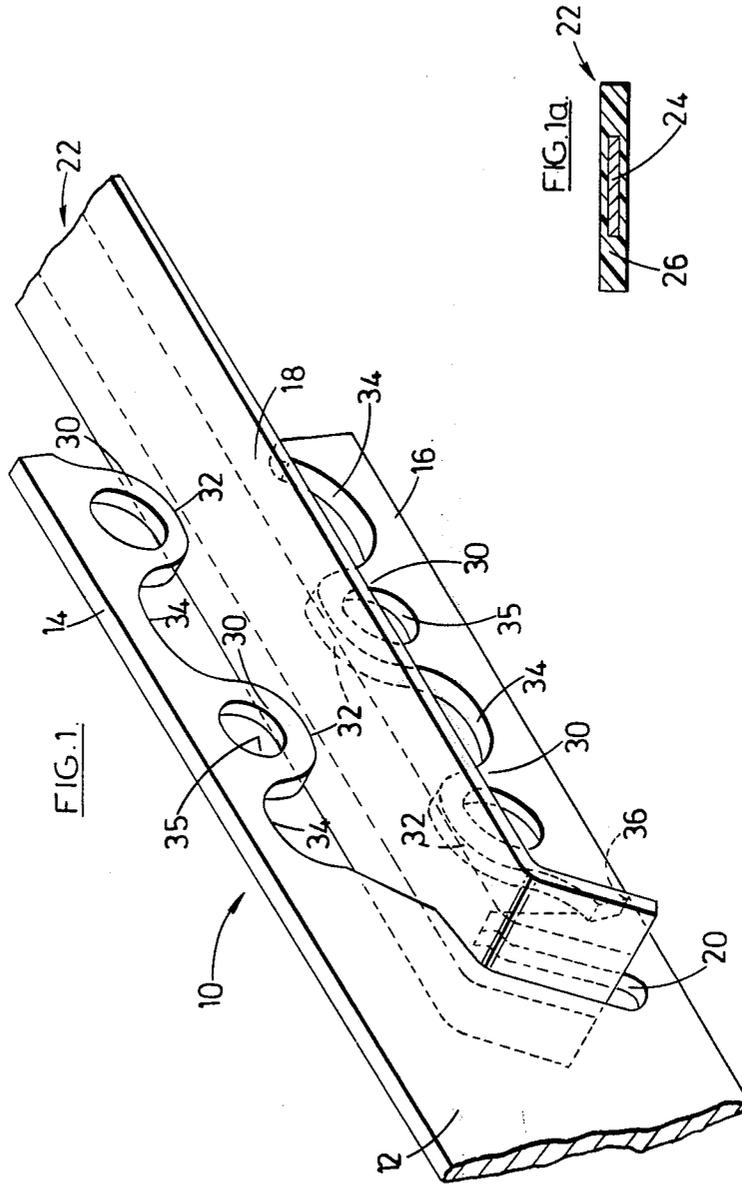
- [30] **Foreign Application Priority Data**
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- [52] **U.S. Cl.**..... 339/97 C; 339/176 MF
- [51] **Int. Cl.**..... **H01r**
- [58] **Field of Search**..... 339/95, 97-99,
 339/176; 174/88 R, 94 R

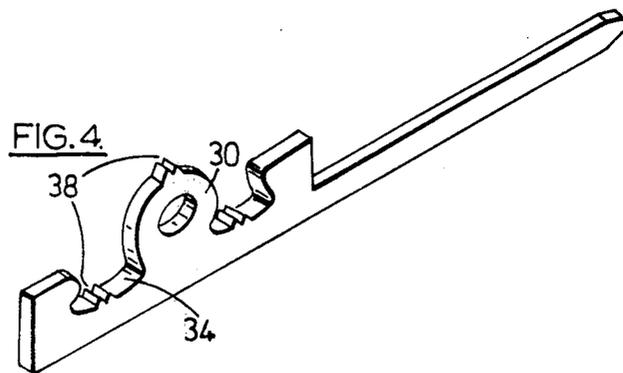
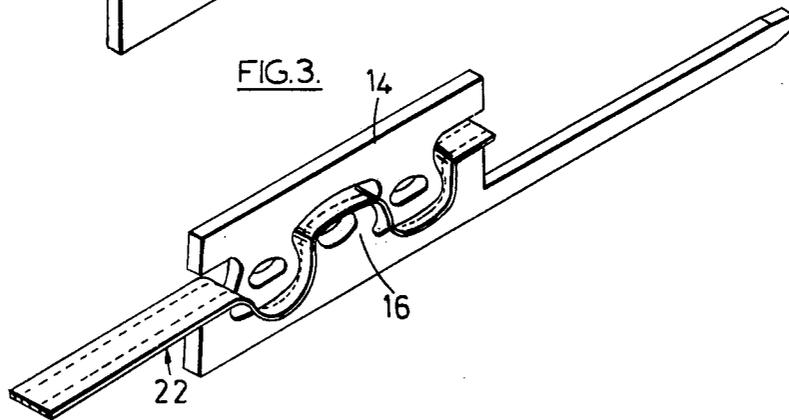
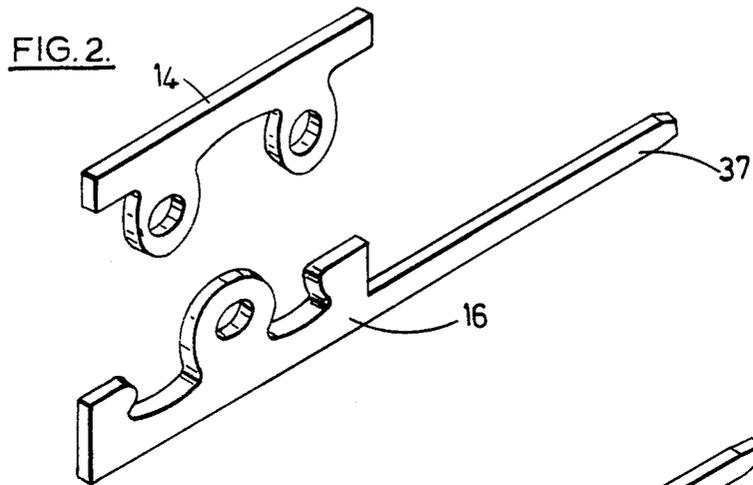
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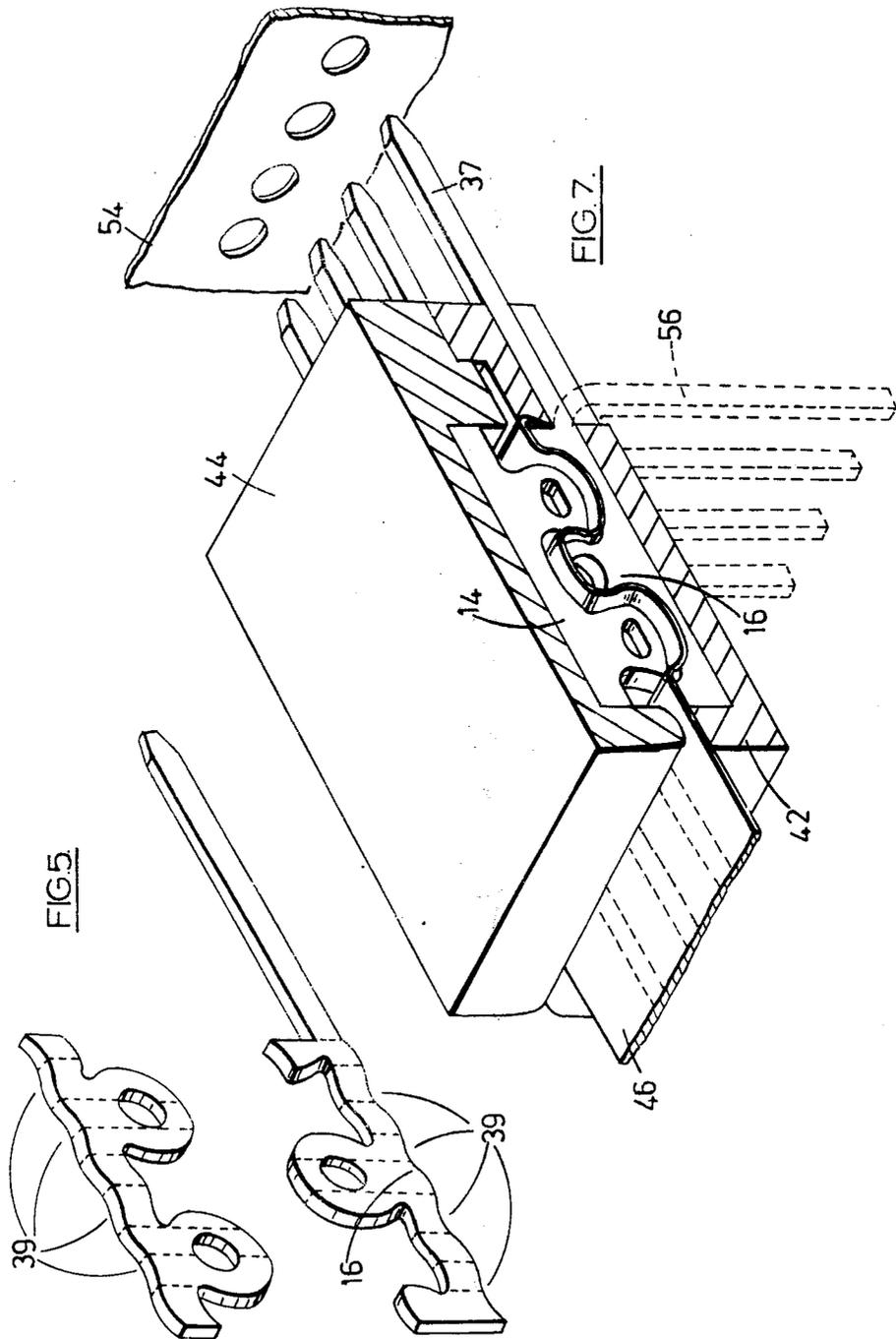
[57] **ABSTRACT**
 A terminal for a flat conductor having insulation on the opposed surfaces, such as a flat cable. The terminal includes a pair of jaws each formed with spaced projections having convex outer surfaces, with concave surfaces formed between the projections. The projections on the two jaws are alternately disposed so that when the jaws are clamped together, with a flat electrical conductor disposed therebetween, the convex and concave surfaces are brought into mating relationship so that the insulation on the conductor is deformed to allow electrical contact between the jaws and the conductor.

10 Claims, 11 Drawing Figures









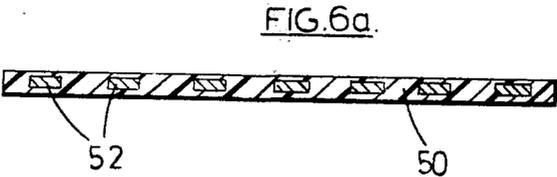
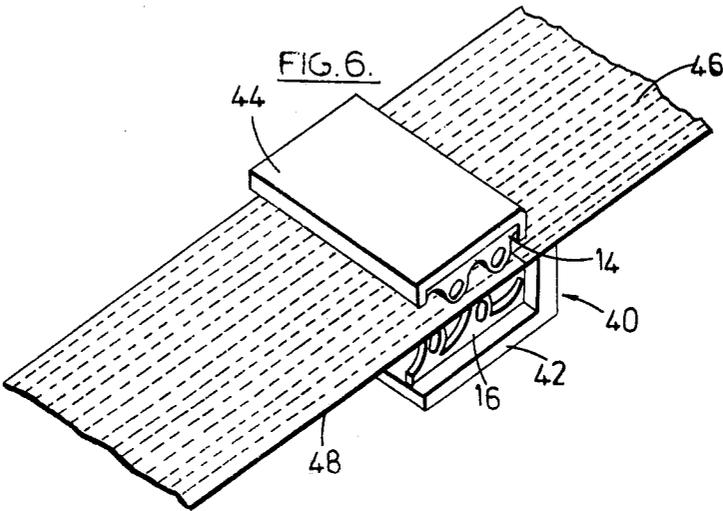


FIG. 8.

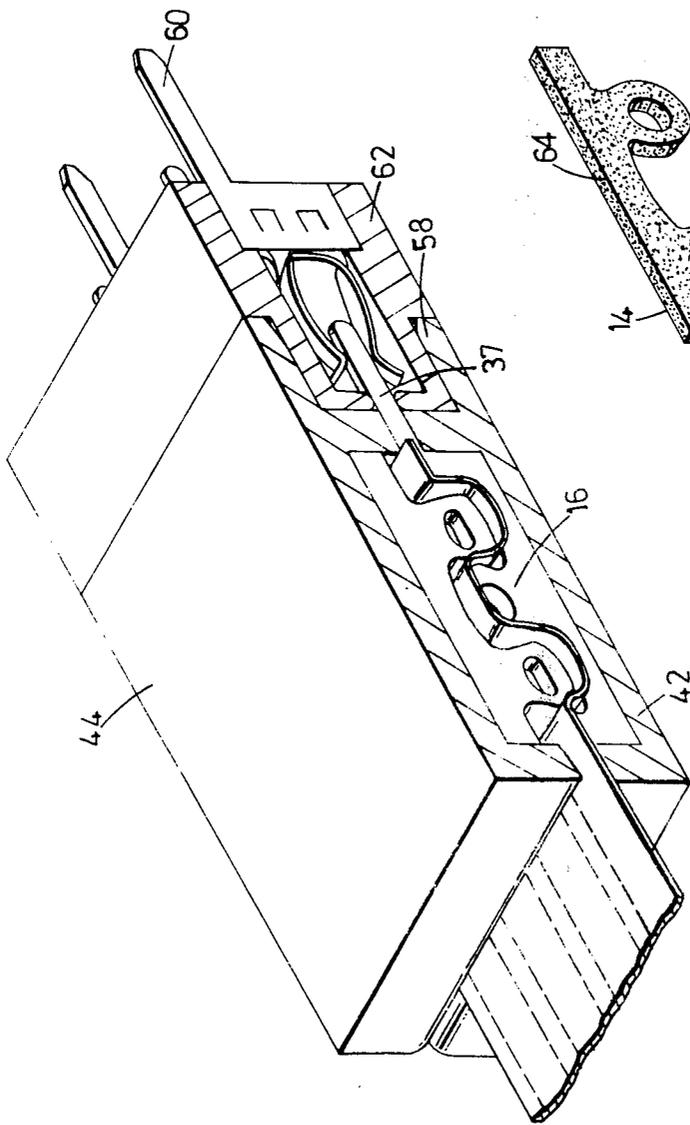
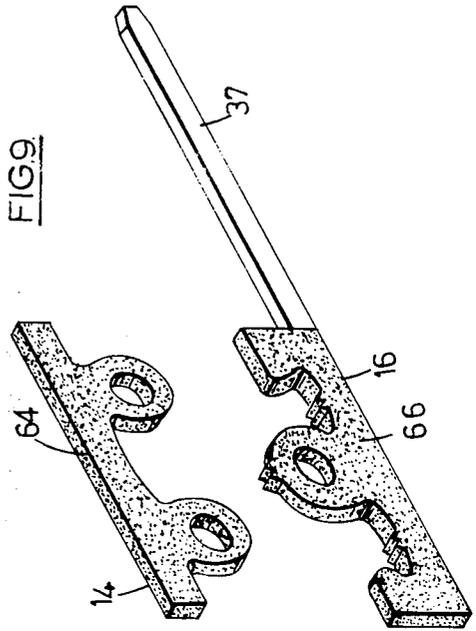


FIG. 9.



TERMINAL FOR FLAT CONDUCTOR

BACKGROUND OF THE INVENTION

This invention relates generally to the termination of a flat conductor and, more particularly, to terminating and jointing devices for use with flat cables or flexible circuits.

The present invention has special utility in the termination of the conductor ribbons of flat electrical cables commonly known as strip cables, although it may be utilized for individual flat electrical conductors as well as flexible circuitry. The invention is also applicable to joining of a pair of flat cables together.

The use of electrical terminals for terminating conductors or ribbons of a flat cable has heretofore required stripping the insulation material from the cable in order to expose the conductors. Thereafter, the terminals were clamped or soldered to the conductors of the cable. Such a procedure was not only expensive, but time consuming, and not completely reliable. To overcome the requirement of stripping, as well as soldering, or gripping of the conductor, improved termination devices were developed utilizing conductor-gripping jaws. The jaws contained teeth which cut through the molded conductor dielectric material to provide connection with the underlying conductor. U.S. Pat. Nos. 3,201,744 and 3,259,873 disclose terminating devices of this type. The teeth of the jaws of these devices are sharp thus resulting in the conductors being completely pierced, on occasions, which is undesirable for some applications.

The purpose of the present invention is to provide means for terminating conductor elements of flexible flat cable or flexible circuitry with contacts appropriate to a wide range of requirements for connecting the cable or circuit to components or other circuits, or alternatively to directly join two flat cables together or flat cables to suitably prepared circuits. The termination arrangement of the present invention does not require that the cable or circuit insulation be stripped prior to assembly, and the conductors are not completely pierced during crimping of the termination device to the conductors.

SUMMARY OF THE INVENTION

According to the principal aspect of the present invention, there is provided a terminal for a flat electrical conductor having insulation on the opposed surfaces thereof. The terminal comprises a pair of jaws which are adapted to receive the flat conductor therebetween. Projections are formed on each jaw facing in the direction of, but alternately disposed with respect to, projections on the other jaw. The projections have convex outer surfaces. The spaces between the projections on each jaw define concave surfaces. The spaces are dimensioned so as to be able to receive the projections so that when the jaws are clamped together the convex and concave surfaces are brought into mating relationship. As a consequence, the insulation covering of a flat electrical conductor disposed between the jaws is deformed during the crimping operation to allow electrical contact between the jaws and the conductor without completely piercing the conductor as results from the use of pointed teeth on jaws as in prior art termination devices.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a one-piece crimp element for terminating a flat cable or like insulated conductor, shown prior to assembly or crimping to the conductor;

FIG. 1a is a transverse sectional view through the insulated conductor illustrated in FIG. 1;

FIG. 2 is a perspective view of a two-piece crimp element for terminating a flat cable or similar conductor, shown prior to assembly or crimping to the conductor;

FIG. 3 shows an element as shown in FIG. 2, but assembled to trap a flat conductor;

FIG. 4 shows the lower portion of an element similar to FIG. 2, but with serrations intended in some cases to enhance the insulation-piercing and electrical characteristics of the element;

FIG. 5 shows an element similar to FIG. 2, but incorporating corrugations perpendicular to the major axes of the two jaws;

FIG. 6 is a perspective view of a jointing device for a pair of flat cables in accordance with the present invention;

FIG. 6a is an enlarged transverse sectional view taken through the flat cable illustrated in FIG. 6;

FIG. 7 shows a typical application of one of the crimp elements in an insulating housing, thus constituting a connecting or terminal block for a flat cable;

FIG. 8 shows an alternative application of a crimp element in a pluggable connection device using, in this case, male and female contact elements; and

FIG. 9 shows a crimp element incorporating an external insulating coating.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in detail, wherein like reference characters designated like or corresponding parts throughout the various views, in FIG. 1 there is shown an embodiment of the crimp element or terminal of the present invention, generally designated 10. The crimp element is one piece and includes a forward body 12 and a pair of rearwardly extending jaws 14 and 16. The crimp element may be formed by stamping or etching a brass sheet for example, of suitable thickness. The jaws 14 and 16 are spaced apart to define a slot 18 which has a bent down portion 20 in the forward body 12. An insulated conductor, generally designated 22, comprising an elongated metallic strip or ribbon 24 covered by an insulation layer 26, is positioned in the slot is with the forward end of the conductor wedged into the slanted groove 20.

Each jaw 14 and 16 is provided with a plurality of longitudinally spaced projections 30, with the projections on one jaw being alternately disposed with respect to the projections on the other jaw. The projections are formed with convex surfaces 32. The spaces on each jaw between the projections define concave surfaces 34 which are dimensioned so as to be able to tightly receive the projections on the other jaw. Preferably, each concave surface on the jaws has the general configuration of a half-ellipse with the major axis of the ellipse extending longitudinally of the jaws while the convex surfaces on the projections are semi-circular. Preferably the projections are perforated, as indicated at 35 in FIG. 1, so that the projections may deform. When the jaws are crimped together the convex and concave sur-

faces are brought into mating relationship with each other. With the insulator conductor 22 disposed between the jaws during this crimping operation, the projections 30 on the jaws will penetrate the insulation 26, deforming the same and thus producing intimate electrical contact between the jaws and the metallic strip 24. In addition, the crimping of the jaws together sandwiches the insulated conductor 22 therebetween thereby forming a good mechanical joint. Although the insulation is ruptured in this operation it is not completely destroyed nor is the conductor 24 pierced as in prior art crimped cable terminations.

In the embodiment shown in FIG. 1, the entire crimp element 10 is produced as a single stamping from a metal sheet. The parallel crimping operation may cause the shorter jaw 16 to be sheared at its original point of contact with the forward body 12, indicated at 36. As an alternative, the jaws 14 and 16 may be produced separately, as seen in FIG. 2, with one jaw formed of metal and the other of a suitable grade of plastic. The lower jaw is formed with an extension 37, which may take the form of a solder or wire-wrap tail as shown, or a male pin element or female socket element, and is metal.

FIG. 3 shows two separate jaws crimped together with conductor 22 sandwiched therebetween. As seen in FIG. 4, serrations 38 may be formed on the projections 30 and concave surfaces 34 on one or both jaws to enhance electrical contact and mechanical locking obtained during crimping.

FIG. 5 shows jaws 14, 16 essentially similar to those of FIG. 2, except that corrugations 39 have been provided in the jaws, which enhance the stability of the jaws during and after crimping. Such corrugations may be supplemented by serrations such as shown in FIG. 4, where appropriate. Corrugations may be of greater or smaller pitch relative to the length of the jaws and may have greater or smaller amplitude, as desired.

Normally a plurality of crimp elements 10 are used together, arrayed in parallel relationship, but in some cases these elements may be used singly as shown in FIGS. 1-5.

FIG. 6 illustrates a cable joint, generally designated 40, incorporating the crimping jaws of the present invention. The joint includes a pair of insulator housings 42 and 44. A pair of flat cables 46 and 48 have their ends overlapping in the region between the housings. Crimp jaws 14 and 16 are fixedly mounted on the opposing walls of the housings 44 and 42, respectively. The crimp jaws may be individual plastic or metal segments as illustrated in FIG. 1 positioned in parallel relationship, or may be wider and extend laterally across the housings 42 and 44 transverse of the cables if formed of insulator material. Upon forcing the two housings 42 and 44 together, the crimping jaws 14 and 16 interlock, deforming the insulation 50 on the cables so that the overlapping metallic strips 52 in the cables come into intimate contact. Thus, a mechanical and electrical joint is provided between the ends of the cables 46 and 48 by the joint assembly 40 illustrated in FIG. 2.

FIG. 7 shows an assembly similar to that illustrated in FIG. 6 for terminating a single flat cable 46. The jaws 14, 16 may be assembled into the housings 42, 44 before crimping, or may be assembled into the housings after crimping. In the former case the crimp is effected through the material of the housings, which is generally

a thermoplastic or thermosetting plastic material. Extensions 37 of one or both of the jaws provide various forms of terminations. That indicated, for example, provides either a direct solder termination to a printed circuit board 54 or a termination onto which wires may be attached. Where appropriate these extensions may be bent before or after assembly in the insulating housings as indicated at 56.

FIG. 8 illustrates an assembly similar to that shown in FIG. 7 except that the housings 42, 44 are shaped to provide a female receptacle 58. The extension 37 of each lower jaw 16 provides a male pin contact. This makes direct contact to a female socket contact 60, in a second male insulating housing 62. Alternative forms of male and female socket contacts may be used.

In either case, regardless of the form of the male and female contact elements, a pluggable, demountable electrical connector is provided. Complete flexibility is provided since any variety of contact type is possible including male or female contacts with wire wrap terminals, printed circuit direct solder terminals, etc.

Note that the crimp applied to the jaws may be effected either prior to installation of the jaws in the insulating housings, or the crimp may be effected through these housings, the jaws having first been assembled into the appropriate housing section.

FIG. 9 shows a typical pair of metal jaws 14, 16 in which the areas 64 and 66 have had applied to their external surfaces an insulating coating. Note that this insulating coating is not applied to the extension or contact area 37. The purpose of this insulating coating is to provide insulation in those applications where no molding insulating housing is provided. When the crimping is effected, these insulating coatings are sufficiently disturbed to ensure that a proper electrical contact is effected with the cable.

The various elements described herein serve to provide a means of terminating conductor elements of flexible flat cable or flexible circuitry with contacts appropriate to a wide range of requirements for connecting the cable or circuit to components or other circuits; alternatively to directly join two flat cables or suitable prepared circuits. All of the devices described herein are constructed such that conductors need not be pierced prior to crimping and cable/circuit insulation need not be stripped prior to assembly. These crimp elements will, nevertheless, also operate if such insulation is stripped prior to assembly.

What is claimed is:

1. A terminal for a flat electrical conductor which may have insulation on the opposed surfaces thereof comprising:

- a pair of jaws adapted to receive said flat electrical conductor therebetween;
- means on said jaws for making an electrical connection with said flat electrical conductor;
- said means comprising longitudinally spaced projections on each said jaw extending toward the other jaw, the projections on one jaw being alternately disposed with respect to the projections on the other jaw, said projections having curved convex outer surfaces;
- the spaces between said projections on each said jaw defining concave surfaces, said spaces being dimensioned so as to be able to receive said projections whereby clamping of said jaws together brings said convex and concave surfaces into mating rela-

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relationship whereby the insulation on a flat electrical conductor disposed therebetween is deformed to produce electrical contact between said jaws and said conductor; and

each said projection being formed with an aperture whereby said projection may deform when said jaws are clamped together.

2. A terminal as set forth in claim 1 wherein: each said convex surface is semi-circular and each said concave surface has the general configuration of a half-ellipse, with the major axis of the ellipse extending longitudinally of said jaws.

3. A terminal as set forth in claim 1 wherein: said jaws are spaced apart in parallel relationship to define a slot therebetween and are integrally joined at one end to a forward body.

4. A terminal as set forth in claim 1 wherein: said projections on each jaw cooperate with the concave surfaces on the other jaw to produce a mechanical joint between said jaws when said conductor is sandwiched therebetween.

5. A terminal as set forth in claim 1 including: a plurality of said pairs of jaws arranged in parallel spaced relationship.

6. A terminal as set forth in claim 1 wherein: one of said jaws embodies an integral electrical contact element.

7. A terminal as set forth in claim 1 wherein said pair of jaws are separate pieces, at least one of said jaws being formed of metal strip.

8. A terminal as set forth in claim 7 wherein each said metal jaw has an insulating material coating thereon which is ruptured when said jaws are clamped together onto said conductor.

9. A terminal for a flat electrical conductor which may have insulation on the opposed surfaces thereof comprising:
 a pair of jaws adapted to receive said flat electrical conductor therebetween;
 means on said jaws for making an electrical connection with said flat electrical conductor;
 said means comprising longitudinally spaced projections on each said jaw extending toward the other

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jaw, the projections on one jaw being alternately disposed with respect to the projections on the other jaw, said projections having curved convex outer surfaces;

the spaces between said projections on each said jaw defining concave surfaces, said spaces being dimensioned so as to be able to receive said projections whereby clamping of said jaws together brings said convex and concave surfaces into mating relationship whereby the insulation on a flat electrical conductor disposed therebetween is deformed to produce electrical contact between said jaws and said conductor; and

one of said jaws being of an insulating material while the other of said jaws is of metal.

10. A terminal for a flat electrical conductor which may have insulation on the opposed surfaces thereof comprising:
 a pair of jaws adapted to receive said flat electrical conductor therebetween;
 means on said jaws for making an electrical connection with said flat electrical conductor;
 said means comprising longitudinally spaced projections on each said jaw extending toward the other jaw, the projections on one jaw being alternately disposed with respect to the projections on the other jaw, said projections having curved convex outer surfaces;

the spaces between said projections on each said jaw defining concave surfaces, said spaces being dimensioned so as to be able to receive said projections whereby clamping of said jaws together brings said convex and concave surfaces into mating relationship whereby the insulation on a flat electrical conductor disposed therebetween is deformed to produce electrical contact between said jaws and said conductor; and

at least one of said projections, and/or at least one of said concave surfaces being provided with serrations which facilitate the rupturing of the insulation on said conductor when said jaws are clamped together.

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