

March 19, 1957

H. O. WOOLLEY, JR
ELECTRICAL CONNECTOR

2,786,192

Filed April 9, 1952

2 Sheets-Sheet 1

Fig. 1.

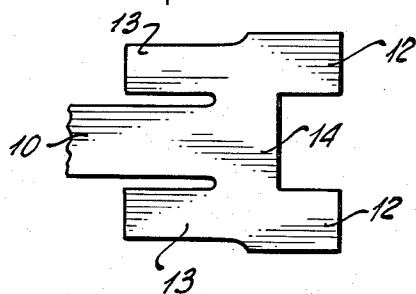


Fig. 2.

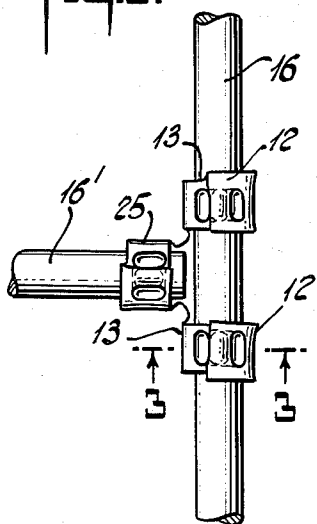


Fig. 4.

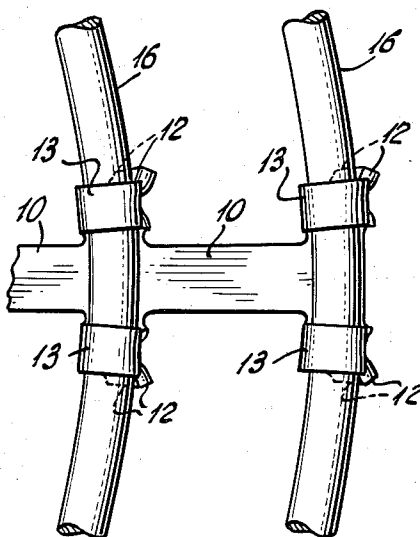


Fig. 3.

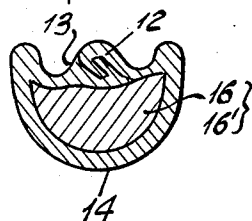
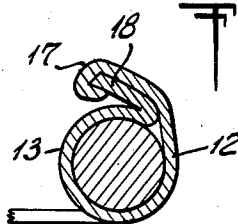


Fig. 5.



INVENTOR.
HAROLD O. WOOLLEY JR.
BY
Curtis, Morris & Safford.
ATTORNEYS:

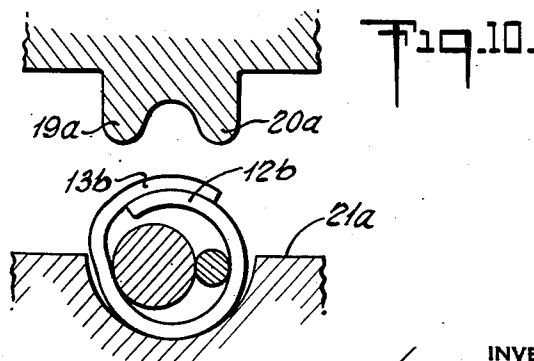
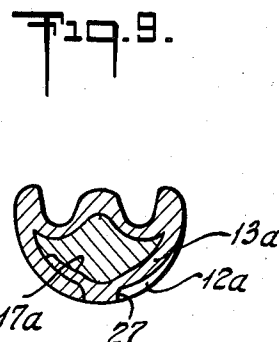
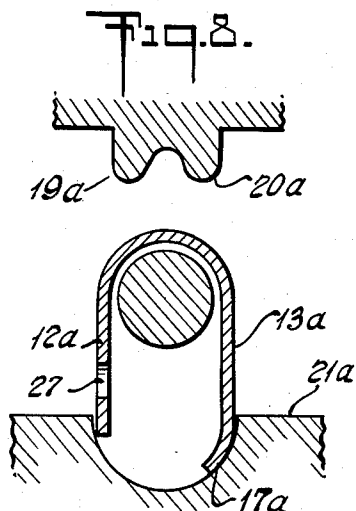
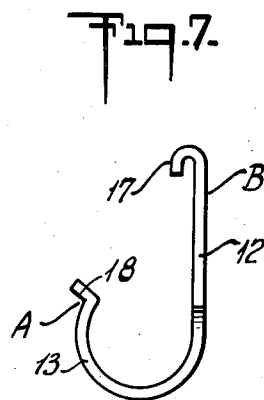
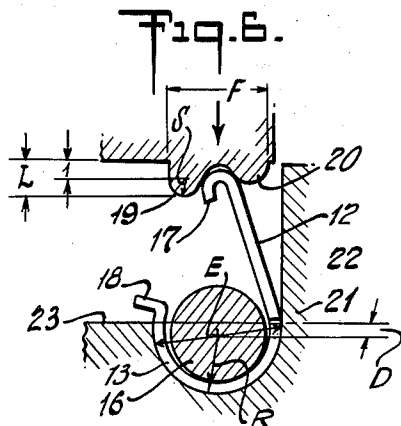
March 19, 1957

H. O. WOOLLEY, JR
ELECTRICAL CONNECTOR

2,786,192

Filed April 9, 1952

2 Sheets-Sheet 2



INVENTOR:
HAROLD O. WOOLLEY JR
BY
Curtis, Morris & Clifford
ATTORNEYS:

1

2,786,192

ELECTRICAL CONNECTOR

Harold O. Woolley, Jr., Lemoyne, Pa., assignor to AMP Incorporated, a corporation of New Jersey

Application April 9, 1952, Serial No. 281,302

1 Claim. (Cl. 339—276)

This invention relates to electrical connectors and particularly to so-called T-connectors or line-tapping connectors.

It is an object of the present invention to provide a connector adapted to make a mechanically secure and electrically efficient connection with a portion of a wire intermediate its ends and without cutting it or seriously weakening it. It is further an object of the invention to make such connection without the necessity of soldering or need for use of machined parts.

The making of electrical connections by cold forging a ferrule with a wire by a crimping die so that a metal is subjected to cold flow under the die is now well established. It has been obvious that such connections, especially with solid (as distinguished from stranded) wire, have required closed ferrules, i. e., seamless tubing or with edges secured together in the seam so that a lateral stress cannot pull the ferrule open. This is particularly so when designed for heavy duty to withstand heavy mechanical stresses such as encountered in power line applications. For connections which are to be made on the end of a wire this presents no serious problem since seamless ferrules or ferrules made by brazing a butt seam have proven entirely satisfactory. Where, however, the connection is to be made at an intermediate point in a long wire, without severing the wire, such ferrules are useless because it is not feasible to thread them onto the wire.

I have now found that it is possible to make an intermediate connection to such a long wire with satisfactory mechanical and electrical characteristics by providing an open or U-shaped ferrule forming portion having elongated ear portions which may be wrapped around the wire in interlocking relationship and then crimped to forge the overlapped ears into a securely interlocked substantially solid cross section. Although my invention in its broader aspects is not related to the twin barrel indent type of crimp, I have found it desirable to use an indent type to give an interlocking of the overlapped ends.

In the accompanying drawings:

Figure 1 shows a portion of a connector blank of a type adapted for embodying the present invention;

Figure 2 shows in elevation one use of the invention for making a tap connection between two conductors;

Figure 3 is a cross-section taken on line 3—3 of Figure 2;

Figure 4 is a view in elevation, like that of Figure 2, showing a bridge connection between parallel wires.

Figure 5 is a cross-section taken on the same line as Figure 3 after the wrapping is done but before crimping the connection;

Figure 6 is an end view of the crimping dies showing the connector in process of being wrapped around the wire;

Figure 7 is a view of the connector of Figure 5 but showing the connector before crimping is begun.

Figure 8 is a view similar to Figure 6 showing another form of the invention;

2

Figure 9 is a view similar to Figure 3 showing the connector of Figure 8 in the crimped condition, and;

Figure 10 is a view similar to Figure 6 of a still further embodiment of the present invention.

The invention resides in the crimped connection and is best exemplified by Figure 4. Because of its particular applicability to a T-connector, it is shown in conjunction therewith. However, it is to be understood that this merely constitutes a preferred embodiment and should not be considered to be limited to such usage. Each connector may be formed from one or more units, a unit being defined as a conductor-embracing portion. Each unit is comprised of a ferrule having two interlocked ears 12 and 13, which are crimped onto the conductor, as shown in Figure 3.

The connector shown in Figure 1 is composed of a central web portion 10, short broad ear portions 12 and longer and narrower ears 13 on each side of and parallel to the web portion and integral therewith through a root portion 14 between the ears 12 and 13. As shown, portions of substantial width have been stamped out from between the central tongue portion 10 and the ears 13, and the ears 13 are cut back from root portion 14 also on the outer edge. This lessening of the width of ears 13 as compared with ears 12 is of advantage to assure proper curling of the ears in the crimping die.

This blank is formed to a channel, ordinarily at the same time that the blank is stamped from the sheet or strip stock. To this end the ear portions are turned up from the plane of the web to form a U-section into which the wire 16 or 16' (see Figure 2) may be inserted for making the connection.

The ends 17 and 18 (see Figures 5 through 7) of the ears 12 and 13 are advantageously turned back as best shown in Figure 7 so that when the wire 16 or 16' is inserted into the U between the ears 12 and 13 and the ears are wrapped around the wire, closing the U and overlapping their ends, the hooked portions 17 and 18 are locked together.

These overlapped ends of the ears 12 and 13 are then crimped with an indenting tool locking the overlapped ends together and to the wire 16. As shown, the indenting tool is of the type described in the Freedom Patent No. 2,535,013 but advantageously has the peculiar form of indentors 19 and 20. The indentations not only interlock the metal of the overlapped portions of the ears 12, 13 by pushing the latter down into the former, but also form the metal of the wire and interlock the ears 12 and 13 with the wire, again by pushing portions down into depressions formed in the wire, thus making both a secure mechanical connection and an efficient electrical connection in which the surface oxide film on the wire and connector metal has been broken and actual metal brought into pressure contact due to the extrusion and flow of the metal under the die.

As shown in Figure 2, the connector has been secured to a mid-point in a long wire 16 and to the end of a tap 16'. This type of connector may also be made with a number of the units connected together by a tongue 10 but without ferrule portion 25. Such units may be extended indefinitely to connect as many wires as is convenient.

In Figure 4 the invention is shown in such an embodiment with two units each crimped onto a long wire at a midpoint. If desired, a tap may be connected at either or both ends by a ferrule portion 25 or other standard type ferrule forming portion.

As indicated in Figure 7 the form of the open connector as supplied is such that the hook 18 at one end engages the face at one side of the crimping die and at the other end of the hook 17 engages between the indentors 19 and 20 of the crimping die and thus, when the

dies are closed together a longitudinal compressive stress is exerted on the vertically upstanding ear 12 which at first tends to rotate the entire connector about the wire, bringing the hook A up away from the face of the die and then to wrap the ear B around the wire, bringing the hook 17 down over the hook 18 before the final crimping by the indenters begins. The fact that the ear 13 is substantially narrower than ear 12 facilitates this wrapping action since it is more susceptible to the sharp bending necessary about the wire 16 within the crimping dies.

It will be observed in Figure 6 that the two indenters 19 and 20 are of different lengths to promote the folding over of the lock joint formed by the hook portions 17 and 18 and to provide room for the extra thickness of the metal at the joint.

It will be observed also that the nest or female die 21 has one side 22 higher than the other, as at 23. This feature aids in the curling of the longer ear around the wire.

A typical die set is as shown in Figure 6. In this, taking the outside diameter of the ferrule to be crimped as E, the radius of the nest as R, the radius of the ends of the indenters and also of the bottom of the groove between them as S, the length of the indenters from the shoulder at the base to the tip measured in the direction of movement being L and the length from the plane at the base to the center of curvature of the ends of the indenter being 1, the relations are as follows:

$$R \text{ equals } \frac{1.14D}{2}$$

S equals .1166D; L equals .266D; 1 equals .178D; F equals .856D. The dimension D is the depth below the upper surface of the lower die of center of the radius of curvature of the cavity in the lower die. Dimension F is the over-all distance across the indenters of the upper die.

In Figs. 8 to 10 I have shown other embodiments of the broad invention.

In Fig. 8 is shown a simpler form of connector for engaging on one or more conductors which are to be laterally inserted into the ferrule forming portion of the connector. In this case the ferrule forming portion is pre-formed into a U shape as shown in Fig. 8 with one end bent over and/or swedged so that as it is pushed around the semi-cylindrical nest 21a and curled thereby, this tip 17a of the longer ear 13a is lifted inward away from the face of the die and thus readily overlaps the shorter ear 12a when the two meet at the bottom of the die. Spaced a short distance from the end of the ear 12a are a transverse series of openings one of which is shown at 27 in the sectional view of Fig. 9. As shown in Fig. 9, during the final crimping of this connection the metal of the ear 13a is extruded in these openings 27 of the ear 12a and thus the two ears are securely inter-

locked, thus preventing any relaxation of the grip which they are given by the crimping. The crimping dies in this case may be substantially as set forth in the above Freedom patent and preferably have the indenters of the same length.

In Fig. 10 another modification is shown in which the blank as supplied has the end 12b curled substantially as shown and the bottom of the connector extending in a cylindrical form for about 225° to 250° with the ear 13b extending out tangentially somewhat as ear 12 does in Figure 7. After the wire or wires are inserted the ear 13b is wrapped over the ear 12b as shown in Fig. 10 and placed in the nest of the crimping die 21a with the overlapped portion under the indenters 19a and 20a. When the dies are closed together the overlapped portions are so indented and intermeshed that they are locked together and do not relax their grip after the dies are removed.

Although I have shown in the accompanying drawings and described above a preferred form of my invention and two modifications thereof, these are illustrative of the numerous modifications which will be made by those skilled in the art and are set forth in order to enable others skilled in this art to best adapt the invention to, and most fully utilize its benefits in, the various particular applications.

I claim:

An electrically conductive joint between a connector and a conductor comprising a metallic ferrule having a longitudinal seam including a pair of edges, said ferrule surrounding the conductor so that inner surfaces of the ferrule are in contact with the conductor, an edge portion of the ferrule being folded back upon itself, another edge portion of the ferrule overlapping the folded edge portion, said overlapping edge portion being folded inwardly, so that it lies between the ferrule and the first folded edge portion, said ferrule being crimped onto the conductor in the area of the edge portions.

References Cited in the file of this patent

UNITED STATES PATENTS

1,070,948	Dodd	Aug. 19, 1913
1,482,888	Converse	Feb. 5, 1924
1,575,656	Stratford	Mar. 9, 1926
2,347,713	Rogoff	May 2, 1944
2,398,504	Pavelka	Apr. 16, 1946
2,557,126	Macy	June 19, 1951
2,600,012	Macy	June 10, 1952

FOREIGN PATENTS

884,641	France	May 3, 1943
25,053/99	Great Britain	Dec. 18, 1899
609,061	Great Britain	Sept. 24, 1948