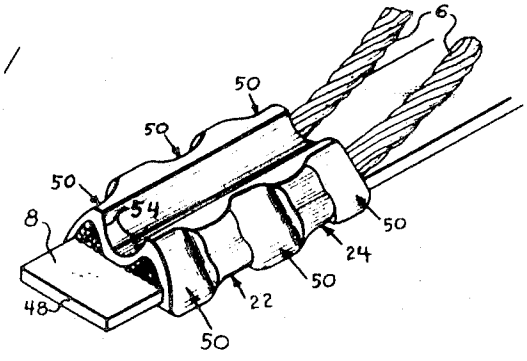
Oct. 7, 1969 M. POLIDORI 3,470,728

ELECTRICAL CONNECTOR CRIMPING TOOL

Original Filed June 22, 1964 3 Sheets-Sheet 1

FIG. 1



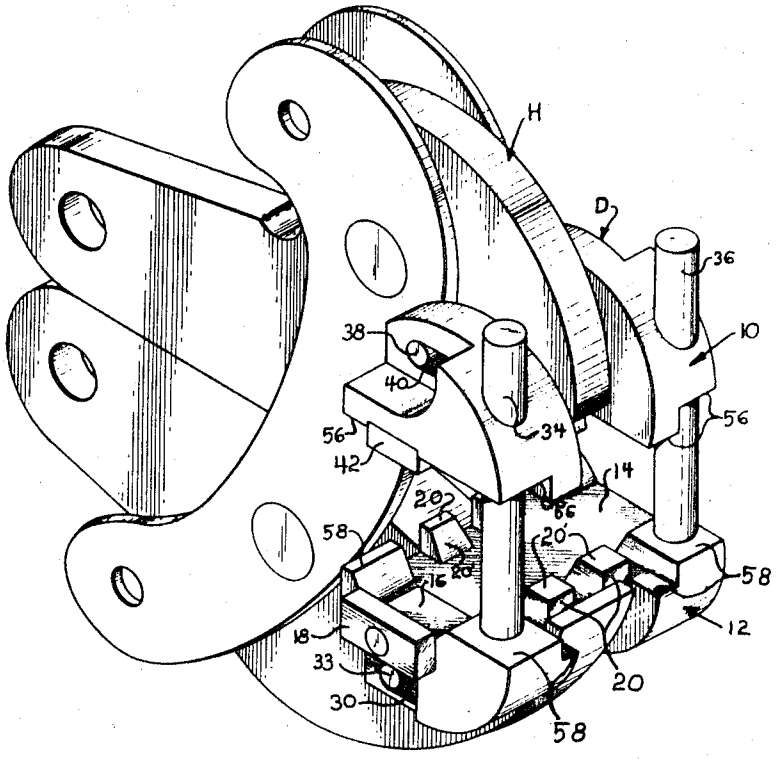


FIG. 2

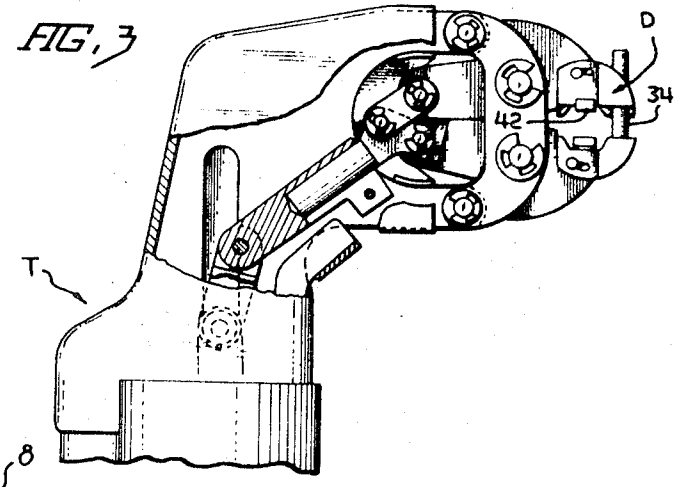
INVENTOR.
MARIO POLIDORI

Oct. 7, 1969 M. POLIDORI 3,470,728

ELECTRICAL CONNECTOR CRIMPING TOOL

Original Filed June 22, 1964 3 Sheets-Sheet 2

FIG. 3



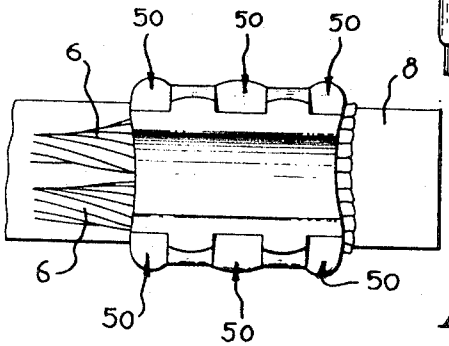


FIG. 4

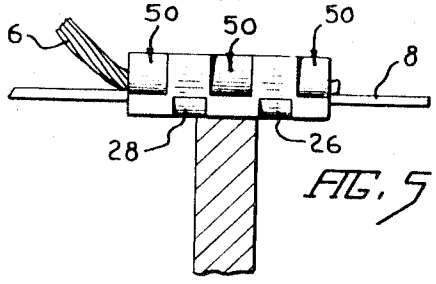


FIG. 5

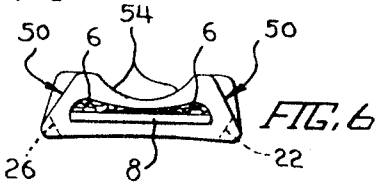


FIG. 6

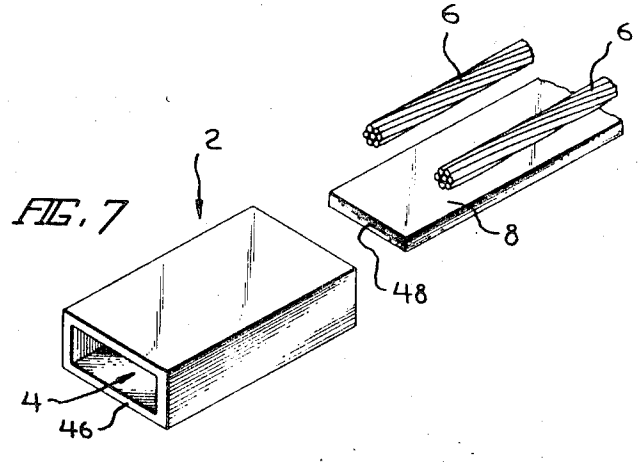


FIG. 7

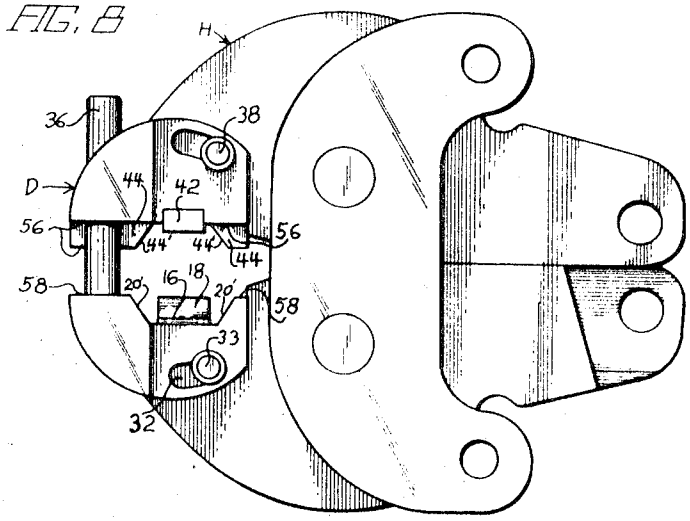
INVENTOR.
MARIO POLIDORI

Oct. 7, 1969 M. POLIDORI 3,470,728

ELECTRICAL CONNECTOR CRIMPING TOOL

Original Filed June 22, 1964 3 Sheets-Sheet 3

FIG. 8



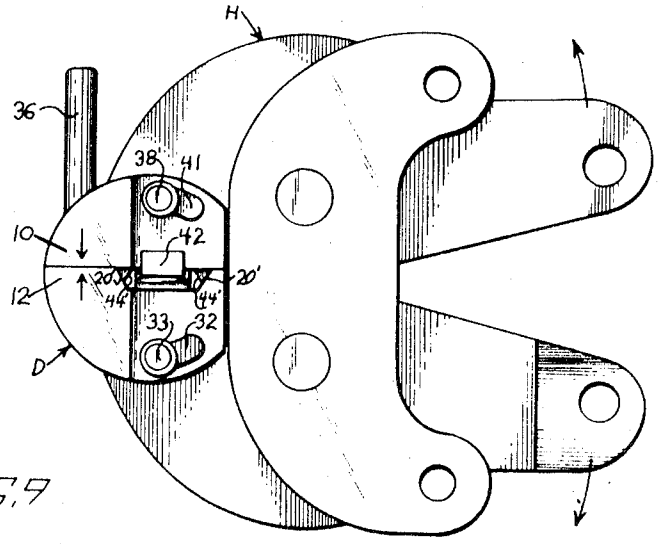


FIG. 9

INVENTOR.
MARIO POLIDORI

United States Patent Office 3,470,728
Patented Oct. 7, 1969

3,470,728

ELECTRICAL CONNECTOR CRIMPING TOOL

Mario Polidori, Pennsauken, N.J., assignor to AMP Incorporated, Harrisburg, Pa.

Original application June 22, 1964, Ser. No. 376,941, now Patent No. 3,322,887, dated May 30, 1967. Divided and this application Apr. 13, 1967, Ser. No. 630,686
Int. Cl. B21f 15/06; B21d 17/02
U.S. Cl. 72—410 4 Claims

ABSTRACT OF THE DISCLOSURE

A crimping tool for crimping an electrical connector onto a support member and a conductive wire, the tool provided with jaw members pivotally connected together for movement toward and away from each other, crimping means carried by the jaw members with each of the crimping means having an elongated crimping area and spaced crimping sections extending outwardly therefrom, the spaced crimping sections of one crimping means being offset with respect to the spaced crimping sections of the other crimping means and these spaced crimping section meshing with each other upon the jaw members being moved into a crimping position by operating means connected thereto with the crimping means being moved toward each other in a substantially parallel manner.

CROSS REFERENCE

This invention is a division of U.S. Patent application, Ser. No. 376,941, filed June 22, 1964, now U.S. Patent No. 3,322,887.

This invention relates to crimped electrical connections, and more particularly to connector elements and tools for the formation thereof. In the formation of electrical connections, it is customary to enclose wire ends in an electrically-conductive metal ferrule. The present invention discloses this type of connector element which simultaneously grips a support means after it has been mechanically and electrically compressed onto wires by a suitable crimping tool.

A spring leaf is used to bias carbon armature brushes against a commutator. One surface of the connector element presses against the brush so that current is carried from the armature through the brush to the connector element and subsequently to the wire.

In the art of armature-brush rigging, and particularly to brushes which are radially applied to the commutator, the brush rigging must fulfill the following requirements:

(1) The brushes must be held firmly against the commutator by a spring member (spring leaf and connector element in this case) but allowed to follow any irregularity in the contour of the commutator without jumping away.

(2) All of the parts involved must be firm and strong so that the brushes will not chatter as a result of excessive vibrations while the machine is running.

(3) The connector element must be capable of remaining mechanically tight at all times although there is a differential in the expansion of steel and the metal of the connector element during temperature changes.

It is, therefore, a primary objective of the present invention to provide a connector element which is capable of being cold-forged onto a spring leaf support means with at least one solid or stranded conductor wire compressed therebetween. A further object is the provision of a connection whereby a softer connector element will deform around a harder support means as a result of crimping pressures from a tool. Another object is to provide a connection having large contact surfaces between the crimped ferrule and the spring leaf so that the ferrule will

frictionally engage the spring leaf and give added tensile strength to the connection. Another object is that of providing the combination of a closed ferrule connector element, large surface engaging area, and a cold-forged connection. Another object is to provide a tool head and die set for crimping the electrical connector. Another object is to provide a die set for crimping the electrical connector, which attaches to a scissor action tool head and which closes into the connector element in a straight-line path. Another object is to provide a new method for obtaining an electrical connection.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration and principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

FIGURE 1 is a perspective view of a connection according to the present invention;

FIGURE 2 is a perspective view of the head of a crimping tool which forms the connection of FIGURE 1;

FIGURE 3 is a view of the present tool head in position in a tool;

FIGURE 4 is a top plan view of the connection of FIGURE 1;

FIGURE 5 is a side elevational view of the connection of FIGURE 1 in engagement with a brush;

FIGURE 6 is an end view of FIGURE 4;

FIGURE 7 is an exploded perspective view of the connection elements before crimping;

FIGURE 8 is a side elevational view of the tool head in the open position; and

FIGURE 9 is a view similar to that of FIGURE 8 but showing the tool head closed.

Referring now to the drawings and particularly to FIGURE 7, the connector element includes a closed rectangular-shaped ferrule **2** formed from electrically-conductive malleable metal, such as, copper, an alloy thereof, or the like. It may be rolled up from a sheet metal blank with its seam brazed, it may be reformed from cylindrical tubing, or it may be formed in any suitable and conventional manner. Ferrule **2** has a passageway **4** therethrough to receive a wire **6** and a spring leaf **8**.

Compacting or crimping of the ferrule **2**, spring leaf **6** and wires **8** is accomplished by a die set D which includes an indenter **10** and a nest **12**. Die set D is appropriately affixed to head H of a preferably air operated tool T, FIGURE 3, of the type completely shown and described in U.S. Patent No. 2,684,003, which is assigned to the present assignee. While an air or hydraulic-actuated tool is preferable in this case because of excessive crimping pressures needed and because of production line techniques, it should be noted that head H may be adapted to fit into a manually-operated tool of the type shown and described in U.S. Patent application, Ser. No. 420,586, filed Dec. 2, 1964, and assigned to the present assignee. Indenter **10** and nest **12** close onto ferrule **2** in a straight-line path (straight action), FIGURE 2, as opposed to the normal arcuate path (scissor action) of a scissor action tool.

Nest **12** constitutes one-half of the die set and includes a floor surface **14** onto which the connector element rests in the tool. On one end of floor **14** is a locating block **16** and another locating block **18** as best seen in FIGURE 8. Ferrule **2** abuts block **16** and the end of the spring leaf **8** abuts block **18** when they are placed into the die set to

be crimped in order to properly locate the ferrule along spring leaf 8.

Two crimping members 20 are positioned along each side of floor 14 in diametrical relationship and they extend outwardly therefrom. Members 20 have angled surfaces 20' which engage limited portions of the bottom outer edges of ferrule 2 when the connector element is crimped. These portions are shown by 22, 24, 26 and 28 in FIGURES 1, 4, 5 and 6. Nest 12 has arcuate-shaped slots 30 and 32 below floor 14 through which a pin 33 passes in order to hold the nest on tool head H. Nest 12 also has two guide posts 34 and 36, the extending ends of which slidably project through corresponding holes in indenter 10 as shown.

Indenter 10 constitutes the other half of die set D and is pinned to the upper jaw of the tool head H by means of a pin 38 passing through arcuate-shaped slots 40 and 41 in a manner similar to that of slots 30, 32 and pin 33. Indenter 10 is located in diametrical relationship with respect to nest 12 and is positioned with respect thereto by means of guide posts 34 and 36. Indenter 10 includes a rectangular member 42 longitudinally disposed in its central section as illustrated in FIGURES 8 and 9. Member 42 engages the top surface of ferrule 2 and compresses that portion of the ferrule onto the wires and spring leaf during crimping.

Three outwardly extending crimping members 44 with angled surfaces 44' thereon are positioned along each side of the crimping area of indenter 10 and they are alternately spaced with respect to crimping members 20 on adjacent nest 12. During crimping, members 20 and members 44 indent ferrule 2 along opposite sides thereof in a staggered manner. The indenting line of force is at right angles to the longitudinal axis of ferrule 2 because of the straight-line die action.

The indenter and nest are converted from scissor action to straight-line action by means of the pin 33 and slots 30 and 32 of the nest and pin 38 and slots 40 and 41 of the indenter in conjunction with guide posts 34 and 36. Surfaces 56 of indenter 10 engage surfaces 58 of nest 12 when the die set has been moved to its closed position in order to limit the movement of these elements toward each other.

OPERATION

Spring leaf 8 and wires 6 are inserted into ferrule 2 in the manner shown by FIGURES 1 and 7. Wires 6 are positoned so that their forward ends are appropriately spaced from the front of spring leaf 8. This sub-assembly is placed into die set D so that lower forward edge 46 of ferrule 2 abuts locating block 16 and forward edge 48 of spring leaf 8 abuts locating block 18. The connection elements are now positioned in the die set D for crimping.

As the tool closes onto the connector element, rectangular member 42 on indenter 10 pushes the ferrule downwardly against nest 12. At this time, the angled surfaces 44' on crimping members 44 engage the top edges of ferrule 2 and compress the ferrule downwardly and inwardly in areas 50 as illustrated in FIGURES 1 and 6. As indenter 10 bottoms into nest 12, angled surfaces 20' on crimping members 20 engage opposite edges of ferrule 2 in staggered relationship to crimping members 44. Crimping members 20 push areas 22, 24, 26 and 28 of ferrule 2 upwardly and inwardly towards the spring leaf as illustrated in FIGURE 4.

The forces of crimping members 20 and 44 in conjunction with the crimping forces from rectangular member 42 and floor 14 compress ferrule 2 onto wires 6 and spring leaf 8. These combined forces also cause the top surface of ferrule 2 to bow inwardly as at 54, FIGURES 1 and 6, and thereby tighten the ferrule onto the wires and spring leaf to effect an excellent mechanical and electrical connection.

The above crimping action causes large interfaces to occur between the connector element and the spring leaf at the top and bottom thereof and interfacial angles between the inside of ferrule 2 and the edges of spring leaf 8. By this means, the ferrule is frictionally held onto the spring leaf especially when the material of the spring leaf is harder than that of the ferrule.

The above crimp features in conjunction with a closed ferrule will cause the ferrule to tighten onto the spring leaf when the connector element is subjected to temperature changes, even though there is a differential of expansion between steel and the metal of the ferrule.

In cases where the material of the spring leaf 8 is capable of being indented, crimped areas 22, 24, 26, 28 and 50, which result from crimping members 20 and 44, will indent the edges of the spring leaf. This causes material of the ferrule to flow into the indents and provide additional tensile for the connection.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiment of the invention, which is shown and described herein, is intended as merely illustrative and not as restrictive of the invention.

The invention is claimed in accordance with the following:

1. A crimping tool for compressing a ferrule member onto a member comprising jaw members, pivot means pivot means pivotally connecting said jaw members together, crimping-die means on said jaw members, one of said crimping-die means defining a nest including a floor surface onto which the ferrule member rests and crimping members positioned along each side of said floor surface in opposed relationship, the other of said crimping-die means having an indenter in alignment with said floor surface and crimping members positioned along each side of said indenter in opposed relationship, the crimping members of said one crimping-die means being offset with respect to the crimping members of the other crimping-die means so that these crimping members mesh with each other, means for moving said jaw members toward and away from each other, and means on said jaw members and said crimping-die means constraining said crimping-die means to straight-line movement when said jaw members are moved about said pivot means.

2. A crimping tool according to claim 1 wherein said one crimping-die means includes locating means to locate said ferrule member on said floor surface.

3. A crimping tool according to claim 1, wherein said crimping members have angled surfaces which are angled away from said floor surface and said indenter.

4. A crimping tool according to claim 1 wherein said constraining means comprises pivot pins and slots in which said pivot pins are disposed between said jaw members and said crimping-die means and guide posts mateable with openings on said crimping-die means.

References Cited

UNITED STATES PATENTS

2,692,384	10/1954	Pollock	72—407
2,992,576	7/1961	Evans et al.	72—410

RONALD D. GREFE, Primary Examiner

U.S. Cl. X.R.

72—456