Sept. 13, 1960 W. F. BROSKE 2,952,174

CRIMPING TOOL

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Fig. 1

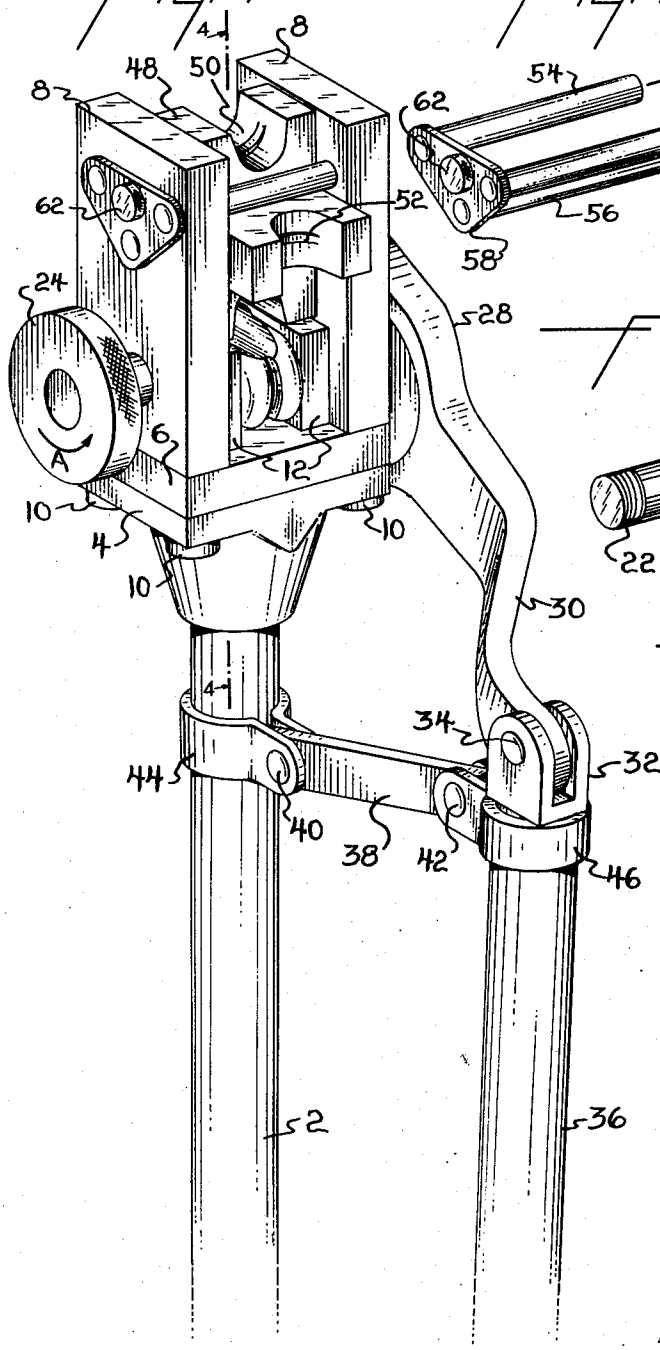


Fig. 2

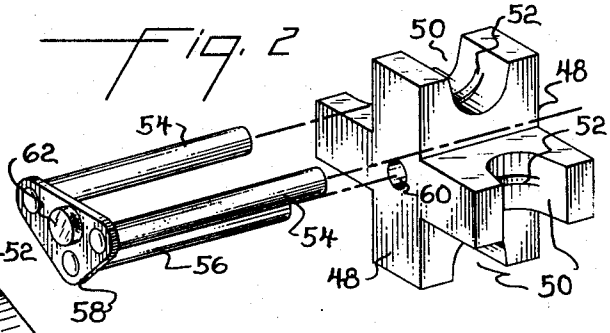


Fig. 3

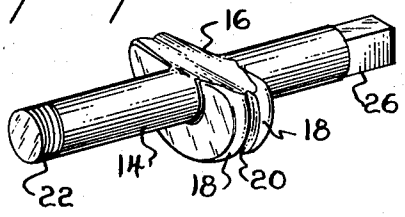
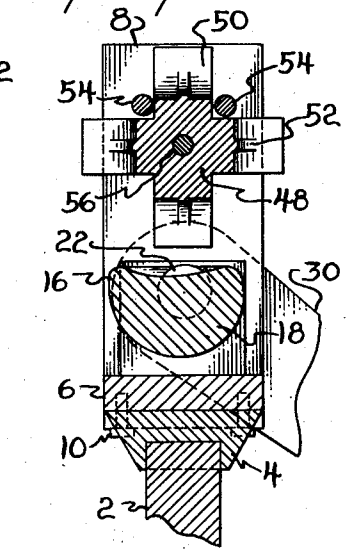


Fig. 4



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Fig. 5

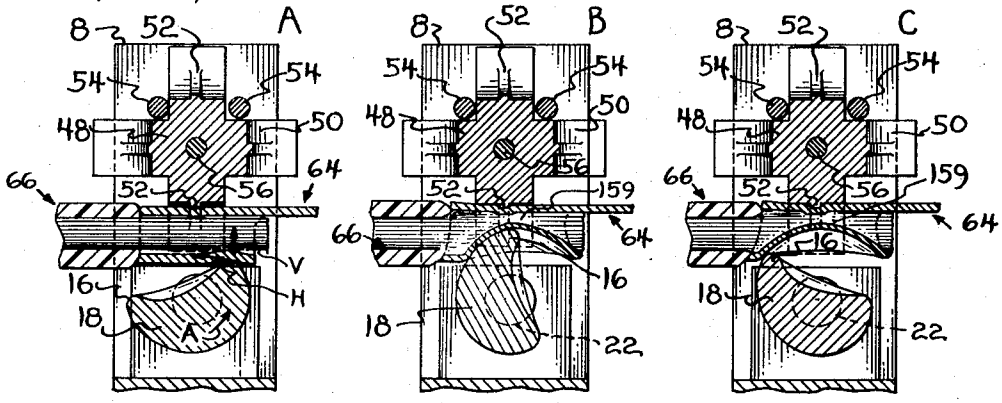


Fig. 6

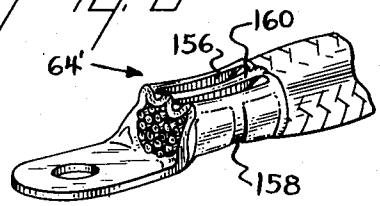


Fig. 7

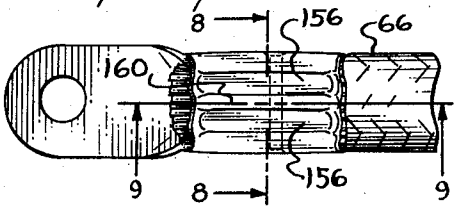


Fig. 8

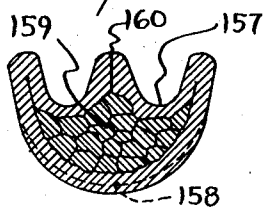


Fig. 9

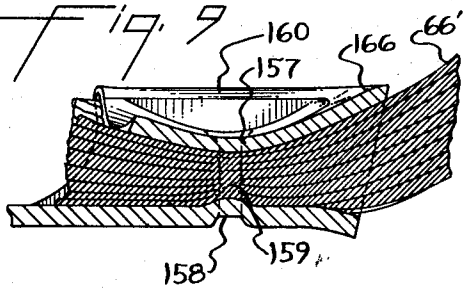
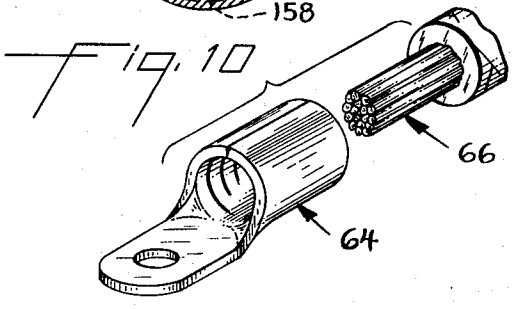


Fig. 10



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Fig. 11

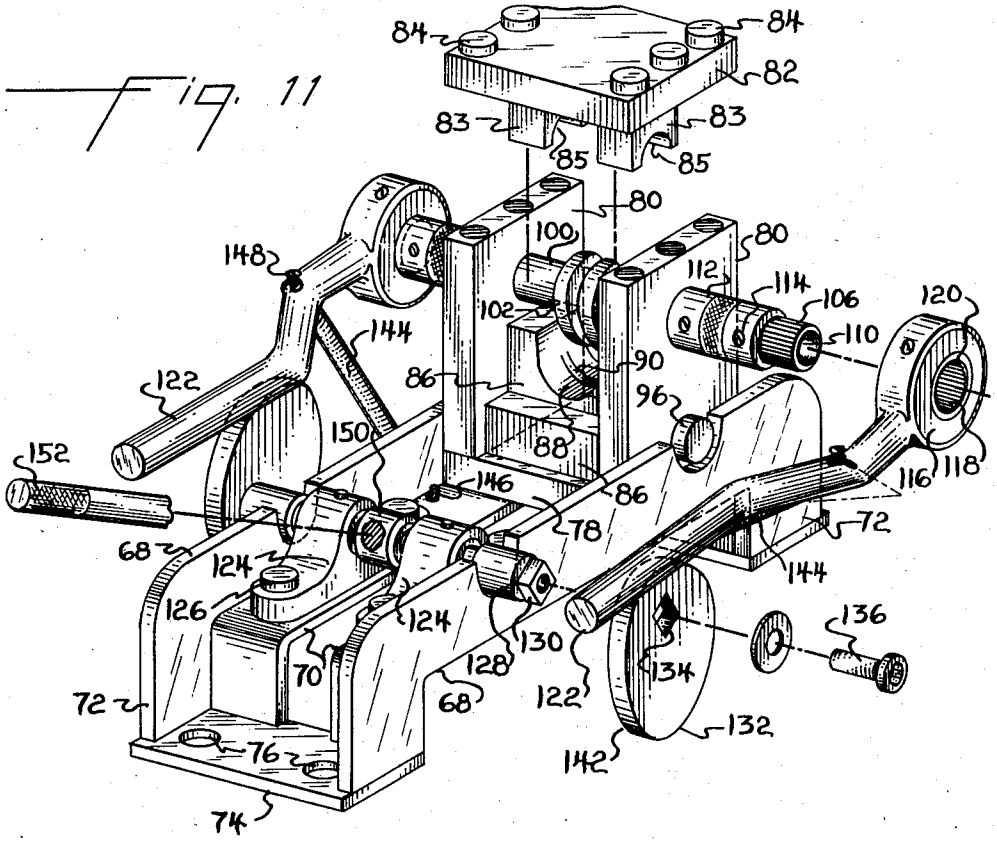
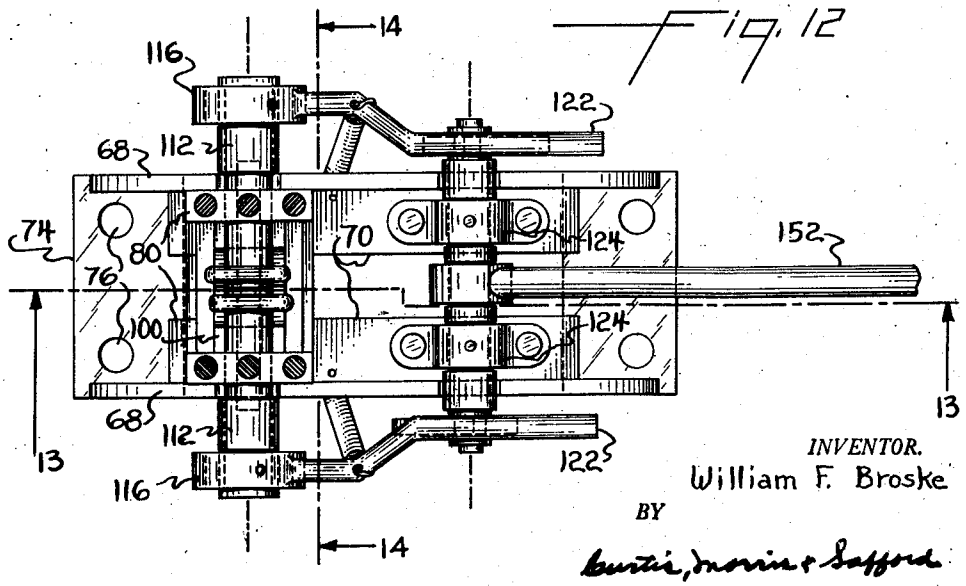


Fig. 12



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Fig. 13

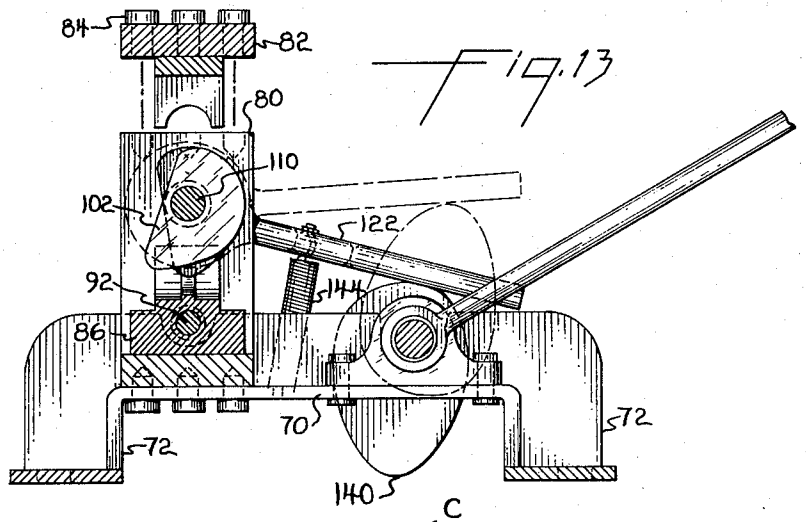


Fig. 14

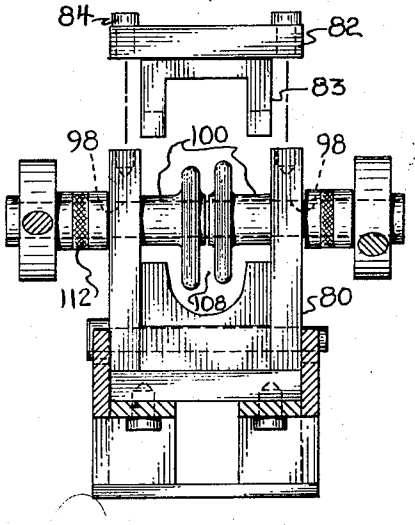
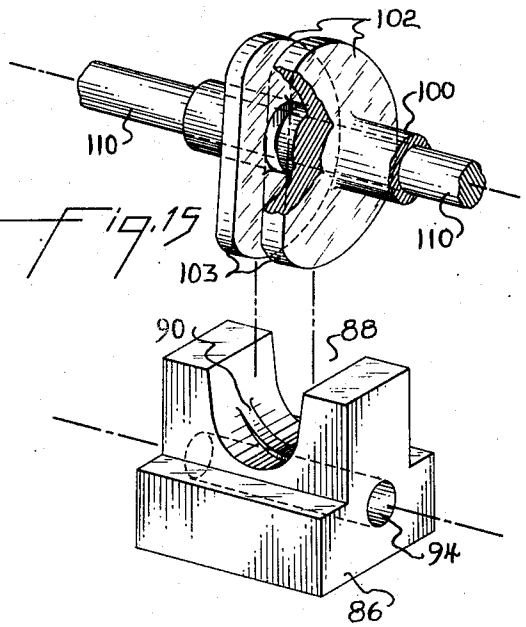


Fig. 15



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United States Patent Office 2,952,174 Patented Sept. 13, 1960

2,952,174

CRIMPING TOOL

William F. Broske, Camp Hill, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

Continuation of application Ser. No. 553,944, Dec. 19, 1955. This application Feb. 12, 1957, Ser. No. 639,829

11 Claims. (Cl. 81—15)

This invention relates to crimping apparatus for making electrical connections.

It is an object of the invention to provide an improved crimping apparatus capable of progressively indenting the ferrule of an electrical connector by rotation of a cam-like indentor.

It is a further object of the invention to provide apparatus for making an electrical connection by progressively indenting a ferrule upon itself by applying an indenting force thereto and simultaneously applying a force component extending axially along the ferrule and normally of the indenting force thereby to effect displacement of the metal of the ferrule relative to the conductor received therein and thus achieve a wiping or galling effect between the two.

It is a further object of the invention to provide apparatus for making an electrical connection by indentation of a conductor-receiving ferrule in which the necessary indenting force is developed by a relatively simple mechanical force multiplying means thereby obviating the need for complex fluid actuated indenting means or relatively ponderous presses.

These and other objects of the invention are achieved in one preferred embodiment in which the indentor is in the form of a cam having a spiraliform indenting edge. Suitable ratchet means are provided to rotate this cam and progressively indent an electrical ferrule which is held between the cam and a supporting nest or anvil. Since the cam during rotation has its indenting edge in physical contact with the surface of the ferrule, an axial force component is applied to the ferrule along with the radial indenting force component. This axial force component has the effect of assisting in the axial extrusion of the ferrule and the wire during the crimping and thereby exposes fresh metal surface for the ferrule-wire interface of the electrical connection.

Other important features and objects of the invention to which reference has not been made hereinabove will appear hereinafter when the following description and claims are considered with the accompanying drawings, in which:

Figure 1 is a perspective view of one embodiment of the tool of the invention with the lower portions of the handles omitted;

Figure 2 is a fragmentary view showing a crimping nest and a crimping nest locking means which form part of the tool of Figure 1;

Figure 3 is a perspective view of an indentor shaft which forms part of the tool of Figure 1;

Figure 4 is a sectional view taken along the lines 4—4 of Figure 1;

Figures 5A, 5B and 5C are fragmentary views similar to Figure 4, illustrating the operation of the tool of Figure 1;

Figure 6 is a perspective view of an electrical connection of the present invention;

Figure 7 is a top plan view of the connection of Figure 6;

Figure 8 is a view taken along the line 8—8 of Figure 7;

Figure 9 is a view taken along the line 9—9 of Figure 7;

Figure 10 is a perspective exploded view of a terminal and a conductor prior to crimping;

Figure 11 is a perspective view, with parts broken away and with some parts exploded in the interest of clarity, of an alternative embodiment of the invention;

Figure 12 is a top plan view of the embodiment of Figure 11;

Figure 13 is a view taken along the line 13—13 of Figure 12;

Figure 14 is a view taken along the line 14—14 of Figure 12; and

Figure 15 is a fragmentary perspective view showing the construction of the indentors of the embodiment of Figure 11, their relationship to the shaft on which they are mounted, and their relationship to a ferrule receiving nest.

In the hand-tool embodiment of Figures 1 to 4, the reference numeral 2 indicates a handle providing a pedestal 4 to which is secured a frame consisting of a base portion 6 and side walls 8, the base portion and side walls being retained in assembled relationship by means of a plurality of machine screws 10 which are threadedly received in apertures in the pedestal, base portion and side walls. Bearing blocks 12 are provided on the opposed faces of side walls 8 and an indentor shaft 14 (Figure 3) is journalled within these blocks and within the side walls. Mounted on the shaft 14 and extending partially therearound is an indentor 16 having an indenting face which in the disclosed embodiment provides a pair of projecting surfaces 18 separated by a depression 20. As best shown by Figure 4, the indentor is cam shaped in cross-section and the indenting face follows a spiraliform path, i.e., a path of increasing distance from the center of rotation.

The ends of shaft 14 extend externally of side walls 8 and one of these ends 22 is threaded to receive a turning knob 24 while the other end 26 is non-circular and is received by a ratchet mechanism 28 providing a ratchet lever 30. Ratchet 28 is not disclosed in detail here since such devices are commonly known and readily available. It is sufficient to say at this point that the ratchet mechanism is so arranged that oscillation of lever 30 will cause rotation of shaft 14 in the direction of the arrow A. Rotation of the shaft in the reverse direction is, of course, prevented by the ratchet pawl (not shown).

The end of lever 30 is received within ears 32 of a ratchet handle 36 and pivotally secured thereto by a pin 34. Frame handle 2 and ratchet handle 36 are connected by a link 38 pivotally secured by pins 40 and 42 to collars 44, 46 disposed around the frame handle and ratchet handle respectively. As is apparent from the foregoing description, oscillation of handle 36 towards and away from handle 2 causes oscillation of lever 30 which in turn effects stepwise rotation of shaft 14. This shaft can also be rotated independently of the ratchet and set in any desired position by means of knob 24.

Mounted between the side walls 8 and in spaced relationship to indentor 16 is a ferrule-receiving nest 48 having four arms each of which provides a cavity 50, each of these cavities being of a different size in order that the tool be adaptable to operation on different sized ferrules. In my preferred embodiment I provide a fixed indentor or projection 52 upstanding from each cavity surface which projection at each end merges with the cavity wall and rises to a maximum height at the deepest point in the cavity. Nest 48 is maintained in its position between the side walls by means of a locking device consisting of three prongs 54, 54, 56 each secured at one end to a plate 58. Prong 56 extends through apertures in side walls 8

and through a central aperture 60 in nest 48. Prongs 54 extend through aligned apertures in the side walls and across the two horizontally extending arms of nest 48 as shown in Figure 4. A finger piece 62 is provided on plate 58 to facilitate removal of the locking device. When it is desired to bring a particular one of the cavities into position to receive a ferrule for making a connection, it is merely necessary to remove the locking device, place the nest between the side walls with the desired cavity facing the indentor and re-insert the locking device through the side walls.

In the operation of the tool of Figure 1, the shaft 14 is rotated to the position of Figure 4 by rotation of knob 24, and rest 48 is positioned and locked between side walls 8 with the proper sized one of the cavities 50 facing indentor 16. The barrel or ferrule portion of the uncrimped electrical connector or terminal with a conductor disposed therein is then placed in the cavity and against fixed indentor 52. In the drawings (Figures 5A to 5C and 6 to 9) the invention is disclosed with specific reference to a ring tongue terminal having a ferrule 64 (Figure 10) and a multi-stranded conductor 66, although the invention is equally applicable with single-stranded conductors and connectors of the type which receive, and are crimped to, the ends of two conductors which are to be connected to each other.

With the ferrule and conductor end positioned in the cavity 50 it is only necessary to oscillate handle 36 towards and away from handle 2 thereby to effect gradual rotation of shaft 14 and indentation and crimping of the ferrule as shown in Figures 5A to 5C. Such indentation produces the crimp shown in Figures 6 to 9, the details of which are set forth in detail hereinbelow along with a description of the action of the indentor on ferrule 64 and conductor 66 during the crimping operation. However, it should be particularly pointed out at this juncture that the process of making the crimp of Figure 6 requires relatively deep indentation of the ferrule, as shown in Figures 5B and 5C, and that a considerable amount of energy must be expended to effect this relatively extreme deformation of the ferrule and conductor, particularly for rather large ferrules such as those adapted to be crimped onto conductors of about 200,000 circular mils cross-sectional area. It is possible with the apparatus of Figure 1 to supply this energy manually since (1) the indentation is effected gradually and by rather small increments as shaft 14 is rotated and (2) the ratchet 28 and handle 36 permit force multiplication to a very high degree. Thus, upon one oscillation of the handles 36, 2 towards and away from each other the force manually developed is applied in such manner as to rotate the indentor through only a relatively small arc so that the force is concentrated to effect a relatively small amount of indentation.

Figures 11 to 15 show an alternative apparatus particularly adapted for crimping rather larger sized ferrules and conductors than the embodiment of Figure 1. In Figure 11 the reference numerals 68 denote the side walls of a bed frame providing inwardly extending ledges 70 and integral legs 72 at each end. Preferably a plate 74 having apertures 76 therein is secured to each of the legs to permit mounting of the device on a suitable bench or stand.

Adjacent one end of the bed frame there is provided an open crimping frame comprising a base member 78, a pair of side walls 80 and a cap member 82. Base member 78 and side walls 80 are permanently secured to each other and to the bed frame by any suitable means such as by welding and cap member 82 is removably secured to the side walls by means of machine screws 84. A nest 86 providing a ferrule-receiving cavity 88 is removably mounted between side walls 80 by means of a pin 92, Figure 13, received within a through aperture 94 in the nest and in aligned apertures in the side walls. Pin 92 provides a knurled finger piece 96 to facilitate removal thereof when it is desired to substitute a nest of a different size. Cavity 88 provides an upstanding fixed indentor 90 tapering at its ends and rising to a maximum height above the surface of the cavity at the lowest portion of the cavity.

Each of the side walls provides an aperture 98, each aperture being axially aligned with the other. Hollow stub shafts 100 are rotatably mounted in these apertures and extend externally of side walls 80. Each of these two stub shafts provides an indentor 102 at one end thereof having a spiraliform indenting surface 103. Indentors 102 are substantially similar to indentor 16 of the embodiment of Figure 1 as is evident from a comparison of Figures 4 and 13 and are separated by a narrow gap 108 corresponding to the depression 20 of indentor 16. The embodiment of Figure 11 differs from the embodiment of Figure 1 in that the indentors 102 are independently rotatable as explained below.

A single bearing shaft 110 extends through the hollow centers of stub shafts 100 and provides bearing surfaces for the stub shafts during rotation. Preferably, the stub shafts should fit rather closely over the bearing shaft and the finishes of the shafts and the lubrication should be such that free rotation of the stub shafts relative to the bearing shaft is permitted. Collars 112 encircle each of the stub shafts externally of the side walls 80 and are secured to their respective stub shafts for rotation therewith by means of set screws 114. A pair of bearing blocks 83 secured to the underside of cap 82 provide semi-circular bearing recesses 85 against which the portions of the stub shafts betwen indentors 102 and side walls 80 bear when the cap is in assembled relationship to the side walls.

The ends of stub shafts 100 are splined as shown at 106 for reception of ratchet mechanisms 116 having complementary internal splines 118, on collars 120. Ratchet mechanisms 116 are not shown or described in detail inasmuch as these devices are commonly known and readily available. Each of the ratchet mechanisms provides a ratchet lever 122 adapted to be oscillated in a manner described below, the ratchet mechanisms being arranged in such manner that upon rotation of their levers in a counter-clockwise direction (i.e., raised) as viewed in Figure 13, the respective stub shafts are rotated through a minor arc in a counter-clockwise direction, as viewed in Figure 13. Levers 122 are independently oscillatory and when simultaneously oscillated 180° out of phase with each other, the shafts 100 will alternately be rotated through a minor arc.

Bearing blocks 124 are mounted by means of fasteners 126 on each of the ledges 70 adjacent the opposite end of the bed frame from the end upon which the crimping frame is mounted. A shaft 128 rotatably mounted in these blocks provides non-circular ends 130 externally of the side walls. Cams 132 are secured to shaft 128 by means of an aperture 134 which conforms to the non-circular shaft end 130 and are locked in place by means of machine screws 136 threadedly received in the shaft ends, a washer 138 being interposed between the head of each screw and the surface of each cam.

Cams 132 function to raise ratchet levers 122 and are shaped as shown in Figure 13 as to provide a lever raising portion 140 which is spaced from the center of rotation of the shaft by the amount the levers are oscillated. The two cams are mounted on shaft 128 in such manner that levers 122 are 180° out of phase with each other as indicated in Figure 13 which shows one of the cams and its associated lever in phantom.

A ratchet 150 is provided on shaft 128 in that portion of the shaft between bearing blocks 124. A handle 152 extends from this ratchet to permit manual rotation of the shaft in the direction of the arrow C of Figure 13. As with the previously mentioned ratchets, the ratchet 150 is not described in detail since such devices are commonly known to the art.

Levers **122** are resiliently biased against the wear surface **142** of the cams by means of helical springs **144** attached at one end to the bed frame and at the other end to the one of the levers by means of an aperture **146** and a screw **148**. In the embodiment shown levers **122** are offset intermediate their lengths in order that their ends will bear against the wear surfaces of the cams.

In the operation of the embodiment of Figures 11 to 14, the ferrule portion of the terminal or connector with the conductor received therein are placed in the cavity **88** and the two stub shafts **100** are rotated by turning collars **114** until the indentors are brought to bear against the ferrule. The handle **152** is then oscillated thereby to rotate the shaft **128** and the cams **132**. Since the cams **132** are 180° out of phase, the ratchet levers **122** are oscillated in out of phase relationship. In other words, during any given stroke of the handle **152** one of the levers **122** is raised and the other is lowered under the influence of its spring **144**. As a result the stub shafts **100** are rotated through a minor arc in alternating relationship. This effects alternating incremental rotation of the indentors **102** with resulting indentation of the ferrule.

As in the case with the hand tool embodiment of Figure 1, the embodiment of Figure 11 provides for substantial force multiplication. The embodiment of Figure 14 is capable of indenting somewhat larger sized ferrules than the embodiment of Figure 1 by virtue of the fact that the two indentors are alternately actuated so that the force applied at the handle **152** is concentrated to a greater extent than is the case with the hand tool of Figure 1. As mentioned above, hand tools of the type shown in Figure 1 are capable of indenting ferrules of such size as to accommodate wires of 200,000 circular mils area. The bench tool of Figure 11, on the other hand, is capable of crimping ferrules as large as those adapted to receive wires of 600,000 circular mils cross-sectional area or greater.

Although I herein disclose the apparatus aspect of my invention as embodied in a hand tool and a bench tool, each including ratchet mechanisms for developing the necessary force, it is understood that I do not consider my invention so limited. It is contemplated that the concept of crimping a ferrule by incrementally rotating either one indentor (as in Figure 1) or two indentors (as in Figure 11) might be accomplished by means of an electric motor, for example, coupled with the shaft on which the indentors are mounted through a suitable speed reducer and a Geneva wheel. It is also contemplated that any suitable terminal feeding means and wire feeding means can be provided to feed a terminal and/or wire during the interval when the indentor is in the position of Figure 4. It is thus apparent that the apparatus aspect of the invention is readily adaptable to the automatic crimping of ferrules as well as to the hand tool and bench tool illustrated.

Referring now to Figures 5A to 5C which show various stages in a crimping operation with a tool of the type shown in Figure 1 (i.e., a tool having a single indentor providing two indenting edges **18**), it can be seen that the indenting edges initially contact the ferrule at a point intermediate its ends. As the shaft **16** is progressively rotated in the direction of the arrow A, the initial contact points are elongated and deepened, Figure 5B. During such rotation of the shaft the force applied against the ferrule by the indentor comprises a vertical indenting component V and a horizontal component H as indicated by the vectors of Figure 5A. The horizontal component H has several beneficial effects which contribute to both the strength and the electrical conductivity of the finished connection. In the first place this horizontal component causes a displacement of the metal of the ferrule over the surface of the conductor while the conductor and ferrule are pressed tightly against each other and this in turn causes a wiping and galling action between the ferrule and the conductor. One result of the wiping effect is that the metal surfaces are cleaned of oxide and other foreign matter to produce metal-to-metal contact between the ferrule and the conductor to a greater extent than is possible where the indentation is formed with a reciprocating crimping die. Such metal-to-metal contact is, of course, highly desirable from the standpoint of electrical conductivity. The galling effect (i.e., the tendency of the metal of the ferrule and the metal of the conductor to bind as their surfaces are moved over each other while they are pressed closely together by indenting force component V) contributes to the mechanical strength of the finished connection by virtue of its binding effect and also contributes to the electrical conductivity of the connection by virtue of the extremely close contacting which is brought about.

During the indenting process horizontal force component H also causes some extrusion of the metal of the ferrule along the path of travel of the indentor. This unidirectional extrusion results in the formation of a bell mouth or lip **166** at one end of the ferrule and prevents extreme reduction of the thickness of the ferrule wall in the immediate vicinity of the indentations by virtue of the fact that during the indenting process, metal is displaced along the path of travel of the indentor. In Figures 5A to 5C, the horizontal force component H causes extrusion of the metal of the ferrule toward and into the zone of maximum construction **159** while the indentations are being formed. This unidirectional extrusion also causes some removal of metal to the left in Figures 5A to 5C and from the zone of maximum constriction, however, the net effect of the rotary motion of the indentor is to produce a crimped connection having a substantially greater ferrule wall thickness than is the case with many prior art devices. This fact can be clearly perceived if it is remembered that when a crimped connection is formed by a reciprocating die (as in prior art teachings) the die causes extrusion in all directions as it bottoms on the ferrule and there is no displacement of metal toward the zone of maximum deformation to replace the metal removed.

During the crimping operation as the indentations formed by indentor **16** are progressively deepened and elongated the ferrule is forced against the fixed indentor or rib **52** and the crimp is made by constricting the ferrule on opposite sides. The fixed indentor functions to prevent displacement of the ferrule and conductor to the left as viewed in Figures 5A to 5C and the resulting indentation made by the fixed indentor contributes to the integrity of the connection as explained below. After the shaft **16** has been rotated to bring it into the position of Figure 5C, the formation of the crimp is complete and it only remains to remove the crimped ferrule from the nest.

The crimped ferrule **64'** provides a pair of parallel axial indentations **156** providing floors **157** which follow an arcuate path. The indentations extend axially along the surface of the ferrule for a substantial portion of the ferrule length and have a maximum depth at a point substantially midway between their extreme ends. On the underside of the ferrule as viewed in Figures 6 and 8, a circumferential indentation **158** extends partially around the ferrule. This circuferential indentation, formed by fixed indentor **52**, is of a maximum depth at a point directly beneath the rib **160**, which separates the two indentations **156**. As shown in Figure 9 the internal surface of the ferrule beneath the axial indentations **156** tapers gradually toward the zone of maximum constriction **159** of the conductors **66** which zone, of course, is directly beneath the deepest point of indentations **156**. This feature of the finished connection is distintcly advantageous for the reason that the strands of the conductor are not maintained against a relatively

abrupt or sharp corner as is the case with some prior art crimps produced by a reciprocating indentor or die. In the crimp of Figures 6 to 9, the gently sloping ferrule walls provide an elongated bearing surface for the conductor strands.

The rib 16 is of substantial height as shown by Figures 6, 8 and 9 and functions to prevent relaxation of the ferrule after the indentations are formed and the connection is removed from the tool. Such relaxation is highly undesirable in that it results in a lessening of the grip of the ferrule on the conductor and also results in the opening of minute voids between the conductor strands and the ferrule. The tendency toward relaxation is suppressed by rib 160 which reenforces floors 157 of the indentations against upward movement as viewed in Figure 9.

The bell mouth or lip 166 is formed on that end of the ferrule toward which the metal comprising the ferrule is extruded by the horizontal force component H. In the practice of the invention then, the ferrule is inserted into the nest in such manner that the bell mouth is formed on that end of the ferrule which the conductor enters. The internal surface of the lip thus provides additional curved bearing surface for the wire strands which bearing surface serves as a continuation of the internal curved bearing surface which is gently curved or tapered as described above. This is highly desirable where the conductor must be flexed or curved along a portion of its length immediately adjacent the crimp since the bell mouth or lip provides a curved surface over which the conductor strands can be curved. Figure 9 shows the conductor 66' as being curved to illustrate this point.

In the operation of the apparatus of Figure 11 the two separate indentors are independently and separately actuated as explained hereinabove. However, the foregoing description relating to the progressive indentation, wiping of the ferrule, extrusion of the ferrule, etc. is equally applicable to the crimp effected by the embodiment of Figure 11 and the crimps produced are substantially the same in both instances.

In this specification the apparatus of Figure 1 is shown as being vertically oriented with the handles projecting downwardly while the embodiment of Figure 11 is shown in the orientation it would have if mounted on a horizontal plane. Also, in the interest of facile description, some of the elements of the two embodiments have been described and their relative positions defined with the aid of such expressions as "above" or "below" etc. Similarly, the crimp shown in Figures 6 to 9 have been described with particular reference to its orientation in the drawing. It is understood that it is not intended that the apparatus embodiments be limited to usage in the orienation of the drawing or that the connection is usable only as shown in Figures 6 to 9.

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.

This application is a continuation of my copending application Serial Number 553,944 filed December 19, 1955, and now abandoned.

I claim:

1. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a fixed ferrule-receiving nest, indentor means rotatable about an axis spaced from said nest, said indentor means providing an indenting edge on the periphery thereof and extending along a spiraliform path around said axis, portions of said indenting edge being spaced from said axis by a distance greater than the distance separating said axis and a ferrule disposed on said nest, and means for rotating said indentor means about said axis thereby to indent a ferrule positioned on said nest upon itself.

2. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a nest, rotatable shaft means spaced from said nest by an amount sufficient to permit placement of a ferrule on said nest, and indentor means having a spiraliform indenting edge, said indentor means being integral with and extending from said shaft means, whereby upon rotation of said shaft means said indentor means indents said ferrule upon itself thereby to crimp said ferrule onto a conductor received therein.

3. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a nest, rotatable shaft means spaced from said nest by an amount sufficient to permit placement of a ferrule on said nest, indentor means extending radially from and partially around the circumference of said shaft means, said indentor means providing spiraliform indenting edge portions radially spaced from said shaft means a distance greater than the distance separating said shaft means and a ferrule disposed on said nest whereby upon rotation of said shaft means, said indentor means progressively indents said ferrule upon itself thereby crimping said ferrule onto a conductor received therein.

4. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a nest providing a ferrule-receiving cavity, fixed indentor means integral with said nest and within said cavity, rotatable shaft means spaced from said nest by an amount sufficient to permit placement of a ferrule in said cavity and against said fixed indentor means, movable indentor means integral with and extending from said shaft means a distance greater than the distance separating said shaft means and said ferrule as disposed in said cavity whereby upon rotation of said shaft means said movable indentor means indents said ferrule and forces said ferrule against said fixed indentor means thereby to crimp said ferrule onto a conductor received therein by indentation of said ferrule from opposite sides thereof, and said fixed indentor means functioning to prevent displacement of said ferrule from said cavity during rotation of said shaft means.

5. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a nest providing a ferrule-receiving cavity, fixed indentor means integral with said nest and within said cavity, rotatable shaft means spaced from said nest by an amount sufficient to permit placement of a ferrule in said cavity and against said fixed indentor means, movable indentor means extending radially from and partially around the circumference of said shaft means and providing spiraliform indenting edge portions radially spaced from said shaft means a distance greater than the distance separating said shaft means and a ferrule disposed in said cavity whereby upon rotation of said shaft means said spiraliform edge portions of said movable indentor means progressively indents said ferrule and forces said ferrule against said fixed indentor means to thereby crimp said ferrule onto a conductor contained therein by indentation of said ferrule on opposite sides thereof, and said fixed indentor means functioning to prevent displacement of said ferrule from said cavity during rotation of said shaft means.

6. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a frame, a nest providing a ferrule-receiving cavity mounted within said frame, a shaft journalled within said frame and spaced from said nest by an amount sufficient to permit placement of a ferrule in said cavity, an indentor integral with said shaft and extending partially around the circumference thereof, said indentor providing spiraliform in-

denting edge portions radially spaced from said shaft a distance greater than the distance separating said shaft and a ferrule disposed in said cavity, and a ratchet for rotating said shaft thereby to indent said ferrule progressively upon itself and crimp said ferrule onto a conductor received therein.

7. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising, an open frame providing a base portion having a pair of side walls extending therefrom, a nest providing a ferrule-receiving cavity mounted within the open portion of said frame and contained between said side walls, fixed indentor means integral with said nest and within said cavity, a shaft journalled in said side walls and extending across said open portion, said shaft being spaced from said nest by an amount sufficient to permit placement of a ferrule in said cavity and against said fixed indentor means, movable indentor means extending radially from and partially around the circumference of said shaft and providing spiraliform indenting edge portions spaced from said shaft a distance greater than the distance separating said shaft and a ferrule disposed in said cavity, a frame handle secured to said frame, ratchet means including a ratchet lever for rotating said shaft, said ratchet lever being pivotally secured to a ratchet handle, and link means pivotally connected at one end thereof to said ratchet handle and pivotally connected at the opposite end thereof to said frame handle whereby upon movement of said ratchet handle towards and away from said frame handle, said shaft is incrementally rotated thereby to force said spiraliform edge portions of said movable indentor means propressively against said ferrule and force said ferrule against said fixed indentor means whereby said ferrule is indented upon itself from opposite sides thereof and crimped onto a conductor contained therein, and said fixed indentor means functioning to prevent displacement of said ferrule from said cavity during rotation of said shaft.

8. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a fixed ferrule-receiving nest, indentor means rotatable about an axis spaced from said nest, said indentor means providing an indenting edge portion on the periphery thereof and extending along a spiraliform path around said axis, portions of said indenting edge being spaced from said axis by a distance greater than the distance separating said axis and a ferrule disposed on said nest, and means for rotating said indentor means about said axis thereby to indent a ferrule positioned on said nest upon itself, said indentor means comprising a pair of indentors in side by side relationship and mounted on separate stub shafts, the axes of said stub shafts coinciding with said axis, and said means for rotating said indentor means comprising repetitively operable means for alternately rotating first one of said stub shafts and then the other of said stub shafts through a minor arc.

9. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a fixed ferrule-receiving nest, indentor means rotatable about an axis spaced from said nest, said indentor means providing an indenting edge portion on the periphery thereof and extending along a spiraliform path around said axis, portions of said indenting edge being spaced from said axis by a distance greater than the distance separating said axis and a ferrule disposed on said nest, and means for rotating said indentor means about said axis thereby to indent a ferrule positioned on said nest upon itself, said indentor means comprising a pair of indentors in side by side relationship and mounted on separate stub shafts, the axes of said stub shafts coinciding with said axis, each of said stub shafts being provided with ratchet means including a ratchet lever, and said means for rotating said indentor means comprising repetitively operable means for oscillating said ratchet levers in alternating order whereby said stub shafts and said indentors are alternately rotated through a minor arc.

10. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a fixed ferrule-receiving nest, indentor means rotatable about an axis spaced from said nest, said indentor means providing an indenting edge portion on the periphery thereof and extending along a spiraliform path around said axis, portions of said indenting edge being spaced from said axis by a distance greater than the distance separating said axis and a ferrule disposed on said nest, and means for rotating said indentor means about said axis thereby to indent a ferrule positioned on said nest upon itself, said indentor means comprising a pair of indentors in side-by-side relationship and mounted on separate stub shafts, the axes of said stub shafts coinciding with said axis, each of said stub shafts being provided with ratchet means including a ratchet lever, and said means for rotating said indentor means comprising a pair of cams, each of said cams engaging one of said levers, said cams being out of phase with each other and being operable upon rotation to oscillate said levers in alternating order whereby said indentors are alternately and incrementally rotated.

11. Apparatus for crimping a ferrule onto an electrical conductor, said apparatus comprising a fixed ferrule-receiving nest, indentor means rotatable about an axis spaced from said nest, said indentor means providing an indenting edge portion on the periphery thereof and extending along a spiraliform path around said axis, portions of said indenting edge being spaced from said axis by a distance greater than the distance separating said axis and a ferrule disposed on said nest, and means for rotating said indentor means about said axis thereby to indent a ferrule positioned on said nest upon itself, said indentor means comprising a pair of independently rotatable identors, and said means for rotating said indentors means comprising means for alternately and incrementally rotating first one of said indentors and then the other of said indentors through a minor arc.

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