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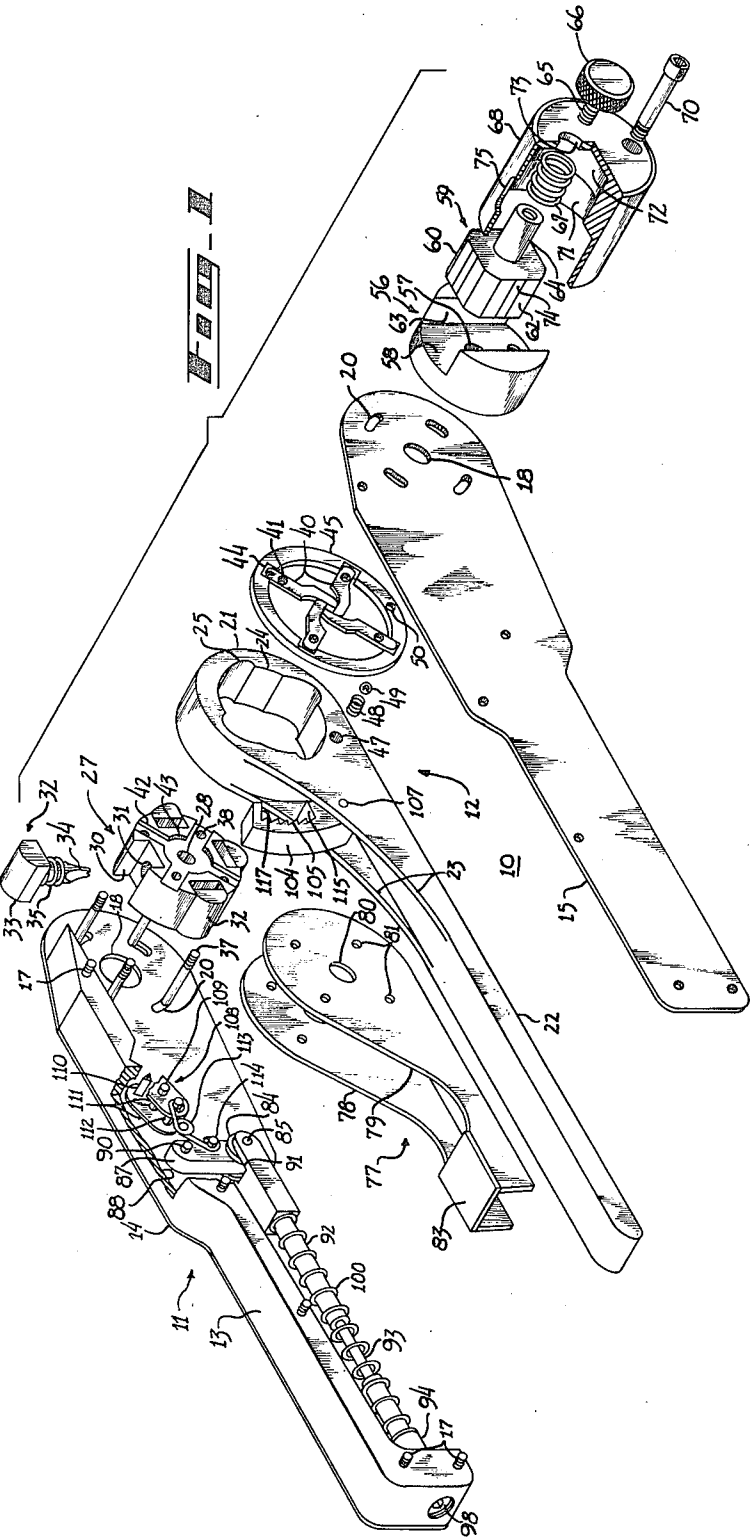
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3,199,334

CRIMPING TOOL

Filed Dec. 11, 1961

2 Sheets-Sheet 1



Aug. 10, 1965

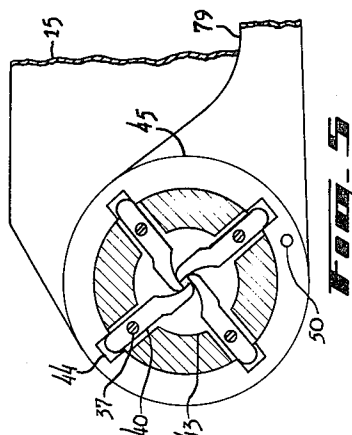
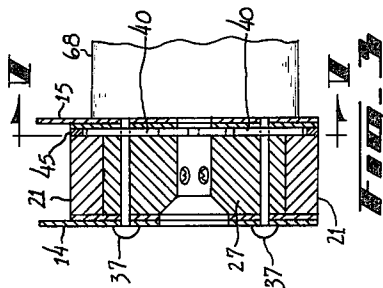
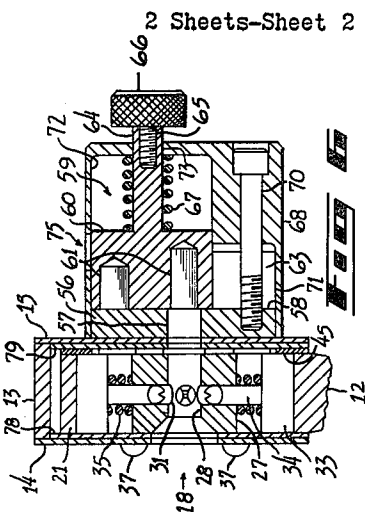
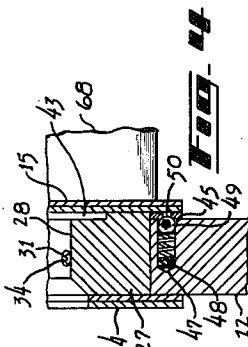
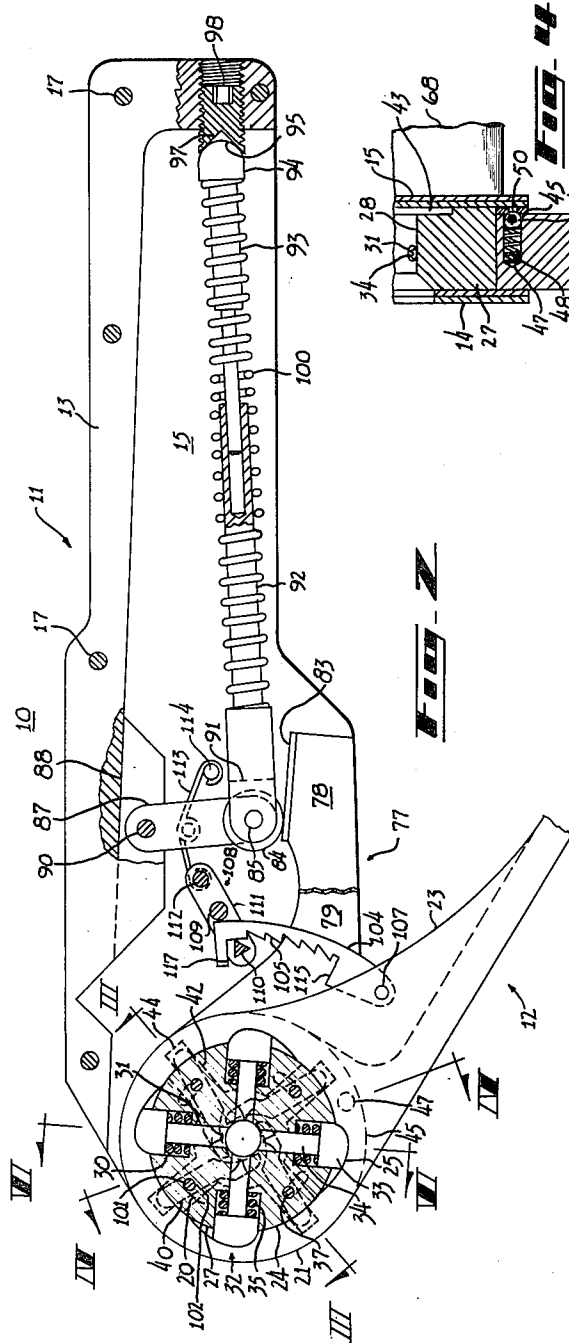
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2 Sheets-Sheet 2



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3,199,334 CRIMPING TOOL

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trix, 6150 Clintonville Road, Clarkston, Mich.
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The present invention relates generally to crimping tools and, more particularly, to a crimping tool which automatically locates a connector in the optimum crimping position with respect to the crimping dies, and which automatically applies the required amount of pressure upon the punches to effect an optimum crimp for a particular connector-conductor combination.

In crimping a connector to the end of an electrical conductor there are two basic criteria by which the quality of the connection is determined. First, there must be no appreciable voltage drop across the connection; and secondly, since the connector may be frequently engaged with, and disengaged from, a matching socket, the connection must exhibit a certain predetermined minimal tensile strength. It has been found that these requirements are best fulfilled by forming the indentations of the crimp at positions symmetrically spaced about the circumference of the connector and at the axial center of the conductor-receiving, or barrel, portion of the connector. The depth of the indentations so formed should be uniform and great enough to provide the required electrical and tensile properties at the connection without unduly distorting, or rupturing, the barrel wall section. It is also desirable that a crimping tool be adapted to accommodate a relatively wide range of connector and conductor sizes.

The crimping tool comprising the present invention incorporates a connector-centering device which automatically positions the connector such that its centerline coincides with the point of intersection of the centerlines of the crimping punches, thereby assuring that the indentations of the crimp are of uniform depth and symmetrically spaced on the connector barrel. The present crimping tool also incorporates means for locating a relatively wide range of connectors axially such that the indentations are formed at the longitudinal center of the connector barrel. In addition there is provided an overload release mechanism which serves to assure that the punch pressure applied to a particular connector-conductor combination is large enough to form indentations whose depth is sufficient to yield the required tensile strength, yet not sufficiently large to rupture the connector barrel. A ratchet mechanism is employed in the tool to assure that the required pressure is applied before the crimping punches are disengaged from the connector. These characteristics of the tool provide for crimped connections which are of consistently high quality irrespective of variations in the size and hardness of the connectors and conductors being crimped.

It is, therefore, the primary object of the invention to provide a crimping tool which will consistently form crimped connections of high quality.

Another object is the provision of a crimping tool incorporating a connector-centering device for automatically centering the connector between the punches of the tool such that the indentations formed thereby are symmetrically spaced about the connector barrel and of uniform depth.

Another object is to provide a crimping tool having a means for locating axially a relatively wide range of connector sizes such that the crimp indentations are formed at the center of the connector barrel.

Another object resides in the provision of a crimping tool incorporating an overload release mechanism which will prevent undue distortion and rupturing of the connector being crimped, while assuring a depth of crimp indentation which will yield the required electrical and tensile characteristics of the connection.

Another object is to provide a crimping tool wherein a predetermined pressure must be applied to the connector before the punches may be disengaged from the connector.

These and other objects and features of the invention will be more apparent to those skilled in the art upon consideration of the following description of the appended drawings wherein:

FIGURE 1 is an exploded isometric view of the crimping tool showing the various components thereof;

FIGURE 2 is a side elevation of the tool with portions thereof removed to better illustrate the operation of the tool;

FIGURE 3 is a sectional view of the tool taken along line III—III in FIGURE 2;

FIGURE 4 is an other sectional view taken along line IV—IV in FIGURE 2;

FIGURE 5 is a view of the connector centering device taken at V—V in FIGURE 3; and

FIGURE 6 is a sectional view taken along line VI—VI in FIGURE 2.

Referring now to FIGURES 1 and 2 of the drawings, the present crimping tool, generally indicated by the numeral 10, includes a pair of handle members 11, 12 adapted for pivotal interconnection at one of their ends. Handle 11 consists of a body portion 13 and a pair of side plates 14, 15 affixed to the body portion by means of a plurality of fasteners 17. Aligned apertures 18 extend through the side plates 14, 15 for receiving the connector to be crimped. Also extending through such side plates are a plurality of slotted apertures 20 which lie on a circle concentric about the openings 18. Handle 12 consists of an enlarged end portion 21 integrally connected with an elongated portion 22 and a pair of spaced reinforcing gussets 23. An enlarged opening 24 extends through the enlarged end portion 21 of the handle 12 and is provided with a plurality of equally spaced cam surfaces 25, preferably four in number. A cylindrical punch holder 27, having a central aperture 28 aligned with openings 18 in side plates 14, 15, is disposed within enlarged opening 24 in handle 12. The width of such punch holder is slightly greater than the width of the enlarged portion 21 of the handle 12, the purpose of which will be explained below. A plurality of equally spaced, transverse grooves 30 are formed in the punch holder. Radial passageways 31 connect the inner surfaces of the grooves 30 with the center aperture 28. Within each of the grooves 30 is positioned a punch member 32 comprising an enlarged head portion 33, having an arcuate outer surface adapted for slidable engagement with the adjacent cam surface 25, and an integral cylindrical body portion 34 which extends into the passageway 31. The inner ends of the body portions 34 of the punches 32 are ground into a substantially pointed shape whereby the crimp indentation are more readily formable. About each of the body portions 34 of the punches is disposed a spring 35 which continually urges the punch head 33 into contact with the corresponding cam surface 25. The punch holder 27 is connected to the side plates 14, 15 of handle 11 by means of bolts 37 which extend through slotted apertures 20 in the latter and through apertures 38 in such punch holder. It may thus be readily seen that closure of the handles 11, 12 will cause the punch heads 33 to slide along the cam surfaces 25, thereby forcing the punches 32 to move inwardly against the action of springs 35.

The connector centering device incorporated in the

present crimping tool includes a plurality of radial finger members 40, pivoted upon bolts 37 extending through apertures 41 therein, and disposed within symmetrically spaced, radial grooves 42 on the end of punch holder 27 nearest side plate 15 of handle 11, the width of such radial grooves 42 being slightly greater than the width of the outer portions of the fingers 40 to allow for slight rotation of the latter. The inner ends of the fingers 40 are offset from the remainder thereof and extend into a counterbore 43 which communicates with radial grooves 42. The outer ends of the fingers 40 extend beyond the periphery of the punch holder 27 and into notches 44 in an actuating ring 45 positioned about the lateral portion of the punch holder which extends beyond the edge of the enlarged portion 21 of handle 12. The lateral relationship between the fingers 40, the ring 45 and punch holder 27 is illustrated in FIGURE 3. It should be noted that rotation of the ring 45 relative to the punch holder 27 is limited to a few degrees because of the interaction of the outer ends of the fingers with the notches 44 in the ring.

At some convenient point near the periphery of the enlarged end portion 21 of handle 12, an aperture 47 is formed therein. Within such aperture 47 is positioned a spring 48 and a small ball 49. Another aperture is formed in the ring 45, as indicated at 50. It is desirable that the aperture 50 be countersunk slightly adjacent the ball 49 to prevent undue wear upon the latter. The aperture 50 is so located on the ring that it is aligned with the ball 49 when the handles 11, 12 are in the fully open position. The diameter of aperture 50 is slightly smaller than that of the ball 49, such that the latter can enter only part way into such aperture 50. FIGURE 4 is a sectional view showing the ball 49 seated in aperture 50. With the handles in the fully open position the notches 44 in the ring 45 abut one side of the outer ends of fingers 40 causing them to rotate to an open position, as indicated by the dotted lines in FIGURE 2. Upon closure of the handles 11, 12, however, the interference between ball 49 and the aperture 50 causes the ring 45 to move with handle 12 relative to punch holder 27. Such movement results in the notches 44 abutting the opposite sides of the outer ends of fingers 40, thereby rotating them about bolts 37 toward a closed position, as shown in FIGURE 5. Thus, as may be readily seen, a connector, originally positioned off-center between the fingers 40, will be forced to a central position relative thereto upon closure of the handles 11, 12. It is to be understood that the crimping tool is so constructed that the axial center of the fingers 40 coincides with the axial center of the punches 32. Once all the fingers 40 contact the connector, further rotation of the ring 45 about the punch holder 27 is prevented by the outer ends of the fingers 40. Continued closure of the handles 11, 12 unseats the ball 49 from the aperture 50, thus allowing the handle 12 to rotate relative to the ring 45 and punch holder 27.

In FIGURES 1 and 6 there is shown the preferred embodiment of the device employed in the crimping tool for locating the connector in the desired axial position with respect to the crimping punches. Such axial locating device includes a cylindrical guide member 56 affixed to handle 11 by means of the bolts 37 such that a central, axial aperture 57 is aligned with connector receiving apertures 18 in handle 11, 12. A transverse key way 58 extends through the outer portion of the guide and serves to receive a depth selector plunger 59. Such plunger 59 includes an inner, enlarged, cylindrical portion 60 having a plurality of recesses 61 of predetermined depths extending rearwardly from its inner face. The centerlines of such recesses lie on a circle whose center coincides with the axis of the plunger 59. A plurality of sets of opposed flats 62 are formed about the periphery of the enlarged portion 60 of plunger 59, the perpendicular distance between the corresponding flats 62 being substantially equal to the separation between the walls 63 of key way 58 in guide 56, such that the plunger

59 can enter the key way 58 only when a set of flats 62 are disposed parallel to the key way walls 63. Thus as may be readily appreciated, upon entering the key way, the plunger is rendered non-rotatable relative thereto. Extending rearwardly from the enlarged portion 60 of the plunger is an integral stem portion 64, the outer end of which is internally threaded to accept the threaded shaft 65 of a knurled knob 66. Disposed about the stem 64 is a spring 67, the purpose of which will be explained below.

The guide 56 and plunger 59 are enclosed within a cylindrical housing 68 which is affixed to the guide 56 by means of a bolt 70. A first cylindrical cavity 71, concentric with the outer periphery of the housing 68, is formed therein to accommodate the guide 56. A second cylindrical cavity 72 eccentric with respect to such first cavity 71, is formed in the housing 68 to accept the plunger 59. The diameter of the second cavity 72 is substantially equal to the diameter of the enlarged portion 60 of plunger 59, so that such cavity 72 serves to define the axis about which the plunger rotates. An aperture 73 extends through the rear wall of the housing 68 through which the stem 64 passes.

The geometrical relationship between the components of the axial locating device is such that the radial distance separating the center of central aperture 57 in guide 56 from the axis of plunger 59 is equal to the radius of the circle on which the centerlines of recesses 61 lie. By rotating the plunger 59 about its axis, a particular recess 61 of desired depth may be brought into alignment with the connector receiving apertures 18 in handle 11. In order to indicate to the crimping tool operator which of the recesses 61 is positioned to accept a connector, the flats 62 are coded by painting a different colored stripe thereacross, as indicated at 74. A suitable opening 75 through the wall of the housing 68 is provided so that the operator may view the colored stripe 74 aligned therewith. At some convenient position upon the tool, a plate or decal (not shown) is applied thereto upon which the color code is explained.

From the foregoing description of the axial locating device of the present crimping tool, it may be seen that in order to crimp a connector of known size, the operator first consults the color code legend to obtain the appropriate setting for plunger 59. Next, by grasping the knob 66, the operator pulls plunger 59 outwardly against the action of spring 67 until the inner face thereof clears the outer end of the guide 56. The plunger 59 is then rotated until the flat having the appropriate color stripe thereon appears in opening 75. The knob 66 is then released, the spring 67 causing the plunger 59 to move inwardly and seat in key way 58, the inner face of the plunger 59 abutting the inner surface of the key way. The connector is then inserted into the crimping tool until the end thereof abuts the end of the selected recess. By controlling the depth of the individual recesses such that the distance between the plane of the punch centerlines and the end of a particular recess is equal to the distance between the end of the connector, which the recess is designed to accommodate, and the center of its barrel, it is apparent that the crimp indentations will be formed at the desired location thereon.

As a result of variations in the materials, or more specifically the hardness of the materials, from which connectors and conductors are made, it is necessary to provide the crimping tool with a mechanism which will compensate for such variations in order to obtain crimped connections of consistently high quality. In the subject crimping tool there is provided an overload release mechanism which includes a plate assembly 77 comprising a pair of spaced face plates 78, 79 disposed, respectively, between side plate 14 and punch holder 27, and between side plate 15 and actuating ring 45 (FIGURES 3 and 6). As shown in FIGURES 1 and 2 the face plates are provided with central apertures 80,

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to permit a connector to be inserted therethrough, and spaced apertures 81, which are aligned with apertures 38 in punch holder 27, through which pass bolts 37. As may be readily seen, the face plates 78, 79 and punch holder are affixed together by such bolts 37 and may be considered to be integrally connected. The face plates 78, 79 extend rearwardly and are interconnected at their terminal ends by a transverse plate 83. Riding upon such transverse plate 83 are a pair of rollers 84 which are free to rotate about a pin 85 extending through the lower end of a linkage bar 87. The upper end of such linkage bar 87 is pivotally interconnected to handle 11, within a clevis 88 formed in the lower surface of body member 13, by means of a pin 90, which is located forward (to the left as shown in FIGURE 2) of pin 85. Extending rearwardly from the lower end of linkage bar 87, and pivotally connected thereto by pin 85, is a clevis 91 to which is integrally connected a first rod 92 which is telescopically engageable with a second rod 93, the latter being provided with an end portion 94 having a substantially hemispherical surface 95 which abuts the surface of a conical recess 97 in the end of an adjustment screw 98. Disposed about the rods 92, 93 is a spring 100 which continually urges such rod 92 forward and thus results in the rollers 84 being positioned on the forward portion of transverse plate 83, as shown in FIGURE 2. This position of rollers 84 relative to transverse plate 83 corresponds to the downwardmost position of the latter, and to a clockwise positioning of face plates 78, 79. The bolts 37, which fixedly interconnect the punch holder 27 to such face plates 78, 79, are thus retained against the clockwise ends 101 of slotted apertures 20 in side plates 14, 15 of handle 11.

In crimping a particular connector-conductor combination, the connector having been properly positioned in the crimping tool as explained above, and the conductor having been inserted into the connector barrel, the handle 11, face plates 78, 79, and punch holder 27 are rotated clockwise relative to handle 12 and the punches 32 move inwardly and contact the outer surface of the connector barrel. Continued clockwise rotation of handle 11 causes the punches 32 to indent the connector barrel and the conductor contained therein. As the depth of indentation increases, the resistance to further indentation increases accordingly, such resistance being dependent upon the hardness of the connector and the conductor. If this resistance exceeds a certain amount, which is predetermined both by the constant of the spring 100, and by the initial axial compression thereof, the spring 100 will be compressed, the rollers 84 will move rearwardly on transverse plate 83, and the face plates 78, 79 and punch holder 27 will cease clockwise rotation relative to handle 12, thereby stopping the inward movement of the punches 32. When this occurs, the punch holder 27 and face plates 78, 79 are essentially in locked positions relative to handle 12. Upon continued clockwise rotation of handle 11 the bolts 37 are unseated from the clockwise ends 101 of slotted apertures 20 in side plates 14, 15 of handle 11 and are moved toward the counterclockwise ends 102 of such apertures, thereby permitting continued handle closure to occur without further inward movement of punches 32.

There are three different crimping sequences which may occur when using the present crimping tool. First, complete closure of the handles may be effected without actuation of the overload release mechanism. This would occur in the case of an extra soft connector-conductor combination. Secondly, the handles may be rotated to within a few degrees of complete closure before the overload release mechanism is actuated. This occurs with a connector-conductor combination of average hardness and is the preferred crimping sequence. It is desirable that the tool be initially adjusted to crimp in this manner. Such adjustment may be effected by varying the initial axial compression of the spring 100 by means

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of the adjustment screw 98. The third type of crimping sequence occurs when an extra hard connector is encountered. In this instance the overload release mechanism is actuated during the first few degrees of handle movement. However, since the angle subtended by the ends 101, 102 of the slotted apertures 20 is only a fraction of the total angular travel of the handles, the bolts 37 seat against the counterclockwise ends 102 of such apertures before full handle closure is attained. Thus by fully closing the handles, a satisfactory crimp is obtained even though the connector and conductor may be exceptionally hard.

In order to prevent premature disengagement of the punches 32 from a connector-conductor combination being crimped, as would occur if the handles were not fully closed before release, a ratchet mechanism is employed in the present crimping tool. Such ratchet mechanism includes a rack 104, having an arcuate inner surface with notches 105 thereon, the lower end of which is pivotally interconnected between gussets 23 of handle 12 by means of a pin 107. A pawl assembly 108 is pivotally mounted on a pin 109 extending between side plates 14, 15 of handle 11. The assembly 108 includes a triangular pawl 110, extending between the inner ends of a pair of side members 111, such pawl 110 being engageable with notches 105 on rack 104. Attached to the outer ends of side members 111, by means of pin 112, is a pawl assembly positioning spring 113. The outer end of such spring is fastened to side plate 15 of handle 11 by means of another pin 114 affixed therein. The spring 113 is of the compression type and continually urges rotation of the pawl assembly 108. With the handles in the fully open position, as shown in FIGURE 2, the spring 113 tends to rotate the pawl assembly in a counterclockwise direction. Thus upon closing the handles, the pawl 110 engages notches 105 on rack 104 to prevent the handles from being opened. It will be noted that such rack 104 is disposed between the pawl 110 and pin 109 and rides again the latter as the handles are closed, thereby preventing disengagement of the rack 104 from pawl 110. As the handles 11, 12 approach the fully closed position, the pawl 110 abuts a flat surface 115 on the lower portion of rack 104, which serves to forcibly rotate the pawl assembly 108 in a clockwise direction. As may be readily seen, when the pawl assembly 108 rotates through a certain position, the spring 113 ceases to urge such pawl assembly toward a counterclockwise position and begins to urge same in an opposite, or clockwise direction. This occurs at the fully closed positions of handles 11, 12. Thus, with the pawl assembly 108 forcibly rotated to a clockwise position, and maintained in such position by spring 113, the handles 11, 12 may now be rotated to the open position, the pawl 110 over-riding the notches 105 on rack 104. At the upper end of rack 104 there is provided another flat surface 117 which serves to abut the pawl 110 as the handles approach the fully open position and forcibly rotate the pawl assembly 108 in a counterclockwise direction, such that the pawl 110 will engage notches 105 during the next crimping operation.

As thus described the present invention is characterized as an improved crimping tool for attaching a connector to the end of a conductor which includes means for precisely positioning the connector in proper relation to a set of punches, which are actuated upon closure of a pair of pivotally connected handles, an overload release mechanism which permits continued closure of the handles without further punch movement when the resistance to crimping offered by the connector-conductor combination exceeds a certain predetermined amount, and a ratchet mechanism for preventing disengagement of the punches before a minimum crimping force has been applied.

Although only the preferred embodiment of the invention has been shown and described herein, it is not to be construed that the invention is limited thereto, as

numerous modifications will be apparent to those skilled in the art; and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What we claim is:

1. A crimping tool adapted for attaching connectors having different diameters to the ends of conductors comprising in combination:

a pair of handle members pivotally connected at one of their ends,

punch means for forming indentations in the barrel of said connectors,

a plurality of fingers pivotally connected to one of said handle members for positively clamping and radially centering said different diameter connectors between said punch means upon closure of said handle members,

actuating means for pivoting said fingers connected to the other of said handle members in a manner which permits continued closure of said handle members without further pivoting of said fingers when a connector is clamped in position,

means for positioning said connectors axially in predetermined relation to said punch means,

means for permitting continued closure of said handle members without further movement of said punch means, and

means connected to said handle members for preventing release of said punch means from said connector barrel until said handle members have been fully closed.

2. A crimping tool adapted for attaching a connector to the end of a conductor and comprising in combination:

a pair of handle members pivotally connected at one of their ends,

punch means carried by one of said handle members for forming indentations in the barrel of said connector,

said punch means being adapted for radial movement in response to movement of said handle members,

a plurality of fingers pivotally connected to one of said handle members for positively clamping and radially centering said different diameter connectors between said punch means upon closure of said handle members,

actuating means for pivoting said fingers connected to the other of said handle members in a manner which permits continued closure of said handle members without further pivoting of said fingers when a connector is clamped in position,

means for positioning said connector axially in predetermined relation to said punch means,

means for permitting continued closure of said handle members without further radial movement of said punch means, and

means connected to said handle members for preventing release of said punch means from said connector barrel until said handle members have been fully closed.

3. A crimping tool adapted for attaching a connector to the end of a conductor and comprising in combination:

a first handle member,

a second handle member,

said first and second handle members being pivotally interconnected at one of their ends,

a set of punches carried by said first handle member for forming indentations in the barrel of said connector,

said punches being symmetrically disposed in radial directions about the pivotal axis of said first and second handle members and adapted for radial inward movement upon closure of said handle members,

a plurality of fingers pivotally connected to said first handle member for positively clamping and radially centering said different diameter connectors between

said punches upon closure of said handle members, actuating means for pivoting said fingers connected to said second handle member in a manner which permits continued closure of said handle members without further pivoting of said fingers when a connector is clamped in position,

means carried by said first handle member for positioning said connector axially in predetermined relation to said punches,

and overload release means for permitting continued closure of said handle members without further radial inward movement of said punches when the crimping pressure exceeds a predetermined amount, and

ratchet means interconnected between said handle members for preventing disengagement of said punches from said connector barrel until said handles have been fully closed.

4. A crimping tool adapted for attaching a connector to the end of a conductor and comprising in combination:

a first handle member,

a second handle member,

a punch holder affixed to said first handle member,

a plurality of symmetrically spaced, radially disposed, spring loaded punches carried by said punch holder for forming indentations in the barrel of said connector,

said second handle member having an enlarged opening extending therethrough for accepting said punch holder,

said opening being provided with cam surfaces for slidable engagement with the outer ends of said punches to move same inwardly upon closure of said handle members,

a connector centering device including a plurality of radially disposed finger members pivotally connected to said punch holder,

the outer ends of said finger members extending beyond the periphery of said punch holder and into notches in an actuating ring disposed about said punch holder,

said ring having an aperture adjacent its edge for engagement with a spring loaded ball carried by said second handle member when said handle members are in the fully open position,

said ball serving to cause rotation of said ring with said second handle member and consequent actuation of said centering device until said fingers have centered said connector,

said ball being disengageable from said aperture in said actuating ring when said connector has been centered,

means for positioning said connector axially in predetermined relation to said punch means,

means for permitting continued closure of said handles without further inward movement of said punches, and

ratchet means connected to said handle members for preventing release of said punches from said connector barrel until said handles have been fully closed.

5. A crimping tool adapted for attaching connectors having different diameters to the ends of conductors comprising in combination:

a pair of handle members pivotally connected at one of their ends,

punch means actuated by closure of said handle members moving radially toward a point of convergence for forming indentations in the barrel of said connectors,

and means for automatically centering said different diameter connectors radially between said punch means at said point of convergence upon closure of said handles.

6. A crimping tool adapted for attaching connectors

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having different diameters within a given range to the ends of conductors comprising in combination:

a pair of handle members pivotally connected at one of their ends,

punch means actuated by closure of said handle members moving radially toward a point of convergence for forming indentations in the barrel of said connectors,

means for automatically centering any of said different diameter connectors radially between said punch means at said point of convergence upon closure of said handles,

and means for positioning said connector axially in predetermined relation to said punch means.

7. A crimping tool adapted for attaching connectors having different diameters to the ends of conductors comprising in combination:

a pair of handle members pivotally connected at one of their ends,

punch means actuated by closure of said handle mem-

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bers for forming indentations in the barrel of said connectors,

a connector centering device including a plurality of radially disposed finger members,

and means for forcing said radial fingers radially and convergingly inward to center any of said different connectors upon closing of said handle members.

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