April 12, 1966 J. R. FILSON 3,245,246

METHOD AND APPARATUS FOR ASSEMBLING TERMINALS AND WIRES

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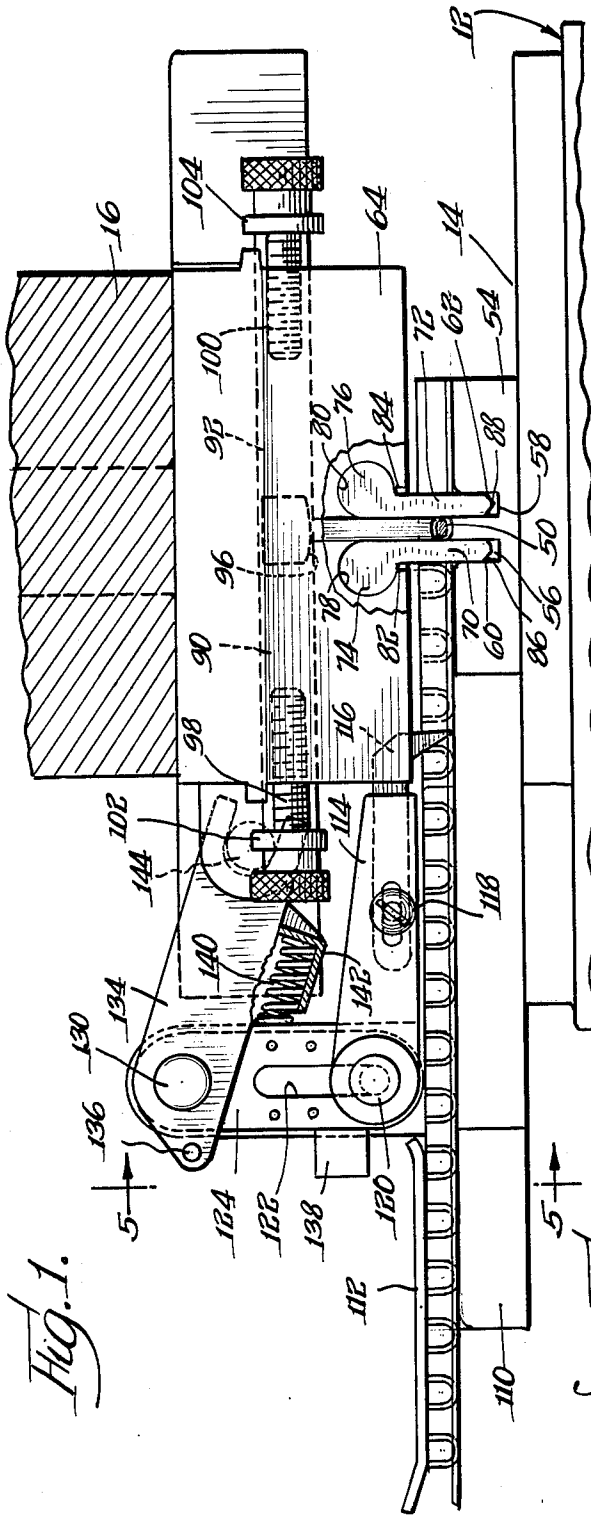


Fig. 1.

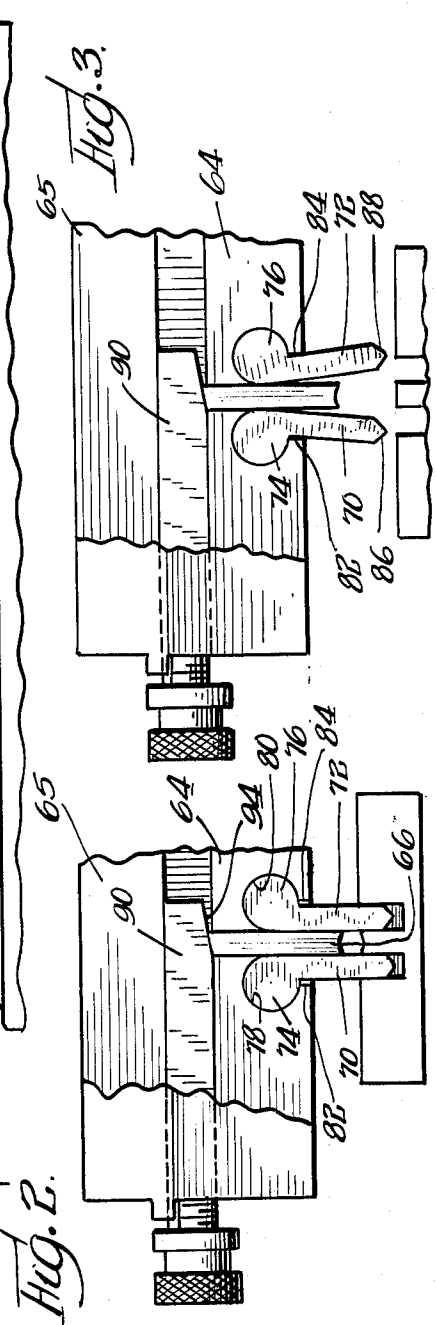


Fig. 3.

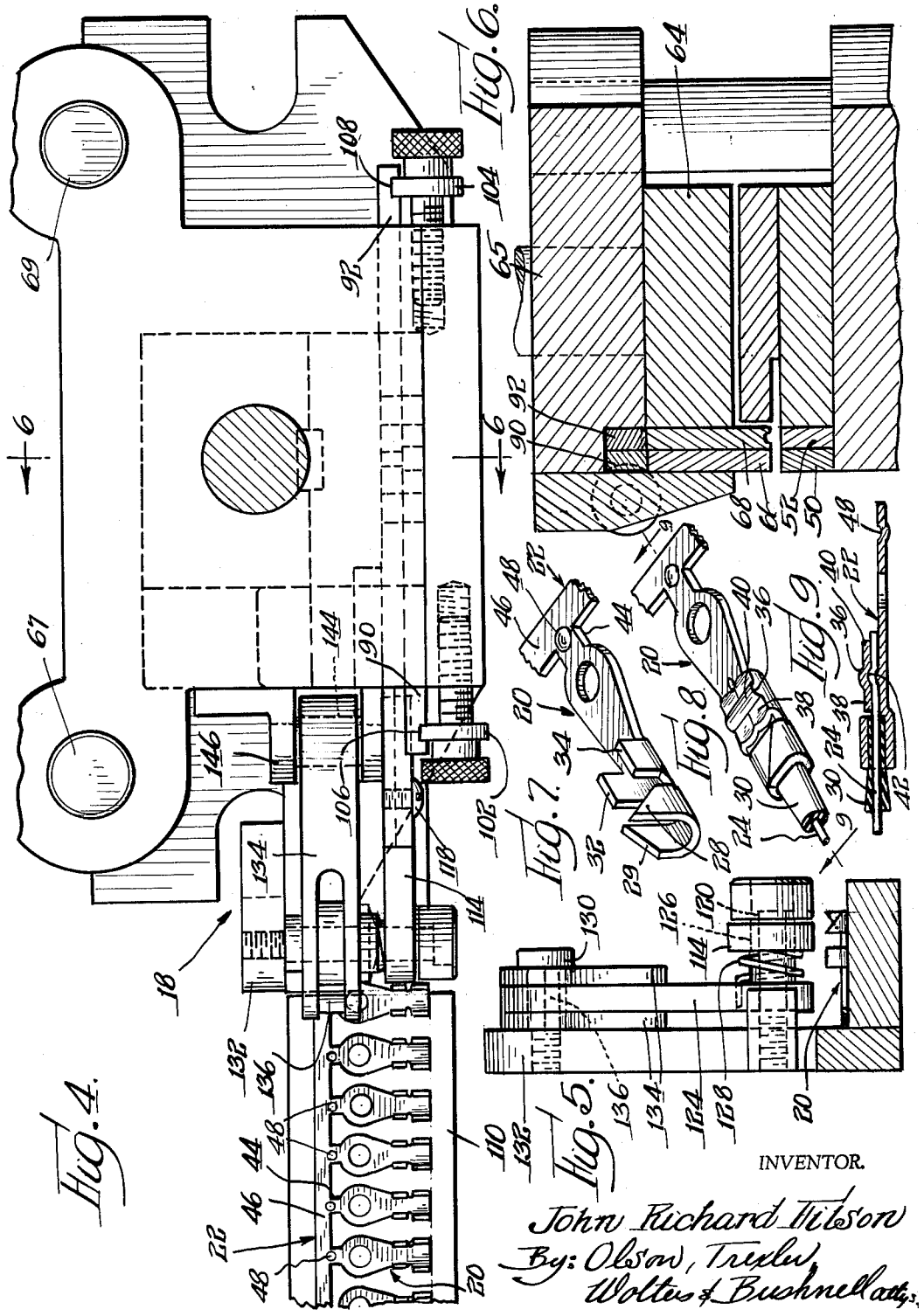
Fig. 2.

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METHOD AND APPARATUS FOR ASSEMBLING TERMINALS AND WIRES

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The present invention relates to a novel method and apparatus for forming sheet material articles, and more specifically to a novel method and apparatus for assembling and connecting articles such as terminals and the like with elongated wires or other similar workpieces.

While it will become apparent that certain features of the present invention may be adapted for forming or processing a wide variety of articles, disclosure of the present invention will be facilitated by describing an embodiment which is especially suitable for forming and securing sheet metal terminal devices or articles to ends of electrical wires. The present invention contemplates the provision of a plurality of terminal devices disposed in side by side parallel relationship and interconnected with each other in a long strip. Each of the terminals comprises a socket portion, fingers or other suitable means adapted to be crimped around an end portion of a wire. It is further contemplated that the strip is to be advanced so that each terminal is successively located at a work station at which a wire or the like is inserted into its socket portion or other corresponding means whereupon the terminal is crimped onto the wire.

An important object of the present invention is to provide a novel apparatus capable of efficiently and effectively forming or crimping a terminal or similar device whereby to promote more economical processing of such articles.

A more specific object of the present invention is to provide a novel method and apparatus for forming or crimping workpieces in a manner such that the workpieces are readily disengaged from the apparatus after a forming or crimping operation.

A still further specific object of the present invention is to provide a novel apparatus for forming or crimping workpieces and having die means constructed for releasing the workpieces after a forming or crimping operation without the need for applying any appreciable stripping force to the workpieces and without the need for utilizing any stripping mechanisms whereby injury to the formed or crimped workpieces will be avoided and the apparatus is simplified and more economical.

Another object of the present invention is to provide a novel method and apparatus for assembling a plurality of terminals or the like in strip form with a plurality of wires, which method and apparatus facilitates control and feeding of the strip of terminals and provides an improved connection with the wires.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings wherein:

FIG. 1 is an elevational view showing apparatus incorporating features of the present invention;

FIG. 2 is a fragmentary view of a portion of the apparatus shown in FIG. 1 partially broken away in order to show certain details more clearly;

FIG. 3 is similar to FIG. 2 but shows the manner in which the apparatus functions for releasing a workpiece after a forming or crimping operation;

FIG. 4 is a fragmentary plan view of the apparatus shown in FIG. 1;

FIG. 5 is a fragmentary sectional view taken generally along line 5—5 in FIG. 1;

FIG. 6 is a fragmentary sectional view taken generally along line 6—6 in FIG. 4;

FIG. 7 is a fragmentary perspective view showing a portion of a terminal strip which may be processed in accordance with the present invention;

FIG. 8 is a perspective view showing a terminal assembled with a wire in accordance with the present invention; and

FIG. 9 is a fragmentary sectional view taken along line 9—9 in FIG. 8.

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, an apparatus **10** incorporating features of the present invention includes a punch press or the like **12** which may be of any known construction. The punch press need not be shown or described in detail and, as will be understood, it may include a base or bolster **14** and a reciprocable ram **16**, only fragmentary portions of which are shown in FIG. 1.

In accordance with a feature of the present invention, a mechanism **18** is associated with the punch press **12** for feeding and crimping successive articles or terminals **20** which are joined together as shown best in FIGS. 4 and 7 to provide a continuous strip **22**. Each of the terminals **20** comprises a socket portion adapted to receive an end of a wire **24** as shown in FIGS. 8 and 9. In the particular embodiment disclosed for the purpose of illustrating the invention, this socket portion includes a first generally U-shaped section having oppositely disposed finger portions **26** and **28** adapted to be wrapped around and crimped against a sheath **30** of insulating material on the wire **24**. In addition the socket means includes a second generally U-shaped section having oppositely disposed finger portions **32** and **34** which are adapted to be formed around and crimped on an exposed end of the wire **24**.

In order to enchance the electrical and mechanical connection between the terminal and a wire, it is contemplated that the finger elements **32** and **34** will be crimped and embossed in a manner such that a rib **36** is formed as shown in FIGS. 8 and 9. The rib **36** traverses end portions of both of the finger elements **32** and **34** and is disposed between opposite margins **38** and **40** which are firmly crimped or compressed against the wire **24**. As shown best in FIG. 9, the inner surface of the rib **36** tends to conform to the outer surface whereby a groove **42** is provided. When the terminal is crimped onto the wire, a portion of the wire will be forced or extruded into the groove **42** for enhancing the mechanical and electrical connection between the terminal and the wire. At the same time there is no pinching or indenting of the wire which might cut or damage the wire and actually weaken the connection.

Each of the terminals **20** has an end portion or connecting section **44** integrally joined to an elongated narrow connecting strip **46**. When a terminal has been crimped onto a wire as shown in FIGS. 8 and 9, it may be separated from the strip **46** by shearing the connection section **44**.

It is contemplated that the terminals 20 in the strip 22 may be formed from a flat band of stock material by utilizing suitable stamping and forming dies, not shown. It has been found that when the band of stock material is stamped and formed to provide the individual terminals 20 joined by the narrow strip 46, stresses are imparted to the strip 46 which tend to cause the strip 46 to curl about its narrow edge to which the terminals are integrally joined. Such curling of the strip makes subsequent handling and feeding of the strip relatively difficult and may cause jamming of the apparatus. It has been found however, that any tendency of the strip 46 to curl may be minimized and substantially eliminated by swaging and slightly embossing areas 48 traversing the integral junctions between the sections 44 and the strip 46. Preferably, the swaged and slightly deflected areas 48 are formed simultaneously with the stamping and forming of the terminals 20.

The mechanism 18 comprises a die structure capable of forming and crimping the socket portion or finger elements 26–28 and 32–34 of successive terminals 20. Thus, in the embodiment shown, the die structure includes a pair of anvil elements 50 and 52 shown in FIGS. 1, 2 and 6 and against which the pairs of fingers 26–28 and 32–34 are respectively adapted to be crimped. The anvil elements 50 and 52 are mounted in a block 54 suitably secured to the base means 14 of the punch press. As shown in FIGS. 1 and 2, the anvil elements have a width substantially equal to the desired width of a crimped socket portion of a terminal. Furthermore, the anvil elements and the die holder or block 54 are formed for providing recesses 56 and 58 at opposite sides of the anvil elements and respectively having guide surfaces 60 and 62 spaced a predetermined distance from opposite sides of the anvil elements.

The die structure further includes a block or holder 64 suitably secured to a head member 65 slidably supported by guide rods 67 and 69 and connected to the ram 16 of the punch press. Vertically disposed die members 66 and 68 are mounted and carried by the block 64 in the manner described more in detail below. The die members 66 and 68 are respectively aligned with the anvil elements 50 and 52 for forming or crimping the socket portions or pairs of fingers 26–28 and 32–34. A groove 71 is provided in the die element 68 for forming the rib 36 on a terminal.

When the ram 16 is in a down position, as shown in FIGS. 1 and 2, a terminal or article will be crimped between the opposing upper and lower die elements. In order to insure a compact final article and good mechanical and electrical contact between the terminal and the entire periphery of a wire, means are provided for engaging and confining opposite sides of a terminal socket portion while the socket portion is being formed and crimped between the aforementioned opposing pairs of die elements. This means comprises a pair of blade members 70 and 72 carried by the block 64 at opposite sides of the die elements 66 and 68 as shown best in FIGS. 1–3. Lower end portions of the backup blade members 70 and 72 project below the lower ends of the upper die elements 66 and 68 and are adapted to enter the recesses 56 and 58 as will be described more in detail below. In accordance with an important feature of the present invention, upper end portions of the blade members 70 and 72 are formed with circular enlargements 74 and 76 respectively. The enlargements 74 and 76 are pivotally disposed in complementary circular recesses 78 and 80 formed in the block 64. The blade members 70 and 72 extend downwardly from the recesses 78 and 80 through passageways which are partially defined by stop or abutment surfaces 82 and 84, which abutment surfaces are respectively offset from opposite sides of the die elements 66 and 68 a distance slightly greater than the width of thickness of the downwardly extending portions of the blade members 70 and 72. With this structure, the blade members 70 and 72 are adapted to pivot between the parallel position shown in FIG. 2, or the spread apart or flaring position shown in FIG. 3.

When the ram 16 of the punch press moves downwardly at the start of a workpiece forming or crimping operation, the lower ends of the blade members 70 and 72 enter the recesses 56 and 58 as shown in FIGS. 1 and 2. Such entry is facilitated by providing the lower ends of the blade members with beveled cam surfaces 86 and 88. These cam surfaces in combination with the stop or abutment surfaces 82 and 84 which limit outward pivotal movement of the blade members, assure entry of the blade members into the recesses without undue interference with the upper edge of the block 54. The blade members 70 and 72 have a thickness substantially equal to but slightly less than the width of the recesses 56 and 58. As a result, the blade members will be held by the guide surfaces 60 and 62 substantially against opposite sides of the die members for positively confining opposite sides of a workpiece during a forming or crimping operation.

It is important to note that when the ram returns toward its upper position, upon the completion of a forming or crimping downwardly stroke, the lower end portions of the blade members will be completely withdrawn from the recesses 56 and 58 and disengaged from the guide surfaces 60 and 62 sufficiently to enable the blade members to pivot outwardly to the position shown in FIG. 3. Upon such pivotal movement which may occur freely and which, in fact, will be positively urged by pressure from a workpiece, the workpiece will be immediately freed and will drop from between the blade members. In other words, the construction is such that a workpiece will automatically be freed at the end of a forming or crimping operation so that it may be easily removed by an operator without forcing and without the need for any ejecting mechanism.

It is understood, of course, that between each downward stroke of the ram 16, one of the workpieces or terminals 20 is advanced to a position on the anvil or lower die elements 50 and 52, and a wire 24 is inserted either manually or by means not shown into the socket portion of the terminal. In certain instances it may be desirable to assemble wires of different diameters with the terminals. Therefore, in accordance with another feature of the present invention, means is provided for selectively positioning the upper die elements 66 and 68 for adapting the structure to crimp the terminals around wires of different diameters. As shown in FIGS. 1–4 and 6, this means comprises cam members 90 and 92 disposed in complementary slots formed in the block 64 transversely of and intersecting upper ends of vertical slots in which the upper die elements 66 and 68 are disposed. The cam member 90 is provided with an inclined surface 94 engageable with a complementary upper end surface of the die element 66, and the cam member 92 is formed with a similar inclined surface 96 which engages and backs up a complementary upper end surface of the die element 68. With this structure, the die elements 66 and 68 may be selectively and independently adjusted downwardly and upwardly when the cam members 90 and 92 are advanced or retracted. In order to enable adjustment of the cam members 90 and 92, adjustment screws 98 and 100 are provided, which screws are threaded into suitable aperture means provided adjacent the cam members. Flanges 102 and 104 are provided on the adjustment screws, which flanges project into notches 106 and 108 respectively in outer end portions of the cam members 90 and 92 for interconnecting the adjustment screws with the cam members.

The means for feeding the strip 22 to the die structure is shown best in FIGS. 1, 4 and 5. This means comprises an elongated guide 110 to which the strip is fed from a suitable source of supply such as a reel, not shown, supporting a coil of the strip 22. A guide bar

112 shown in FIG. 1 is adapted to overlie the strip and hold the strip down on the guide 110.

A pusher element or pawl 114 having an adjustable and downwardly projecting pointed end member 116 is provided for engaging each successive terminal 20 in the strip 22 and pushing or feeding the strip forwardly a distance equal to the spacing between the terminals 20 during each upward stroke of the ram 16. As shown in FIGS. 1 and 4, the end member 116 of the pawl is adjustably secured by a screw 118 to the main portion of the pawl so that the over-all effective length of the pawl can be adjusted for accommodating different strips 22 having articles or terminals spaced apart different distances.

The pawl 114 is pivotally carried by a pin 120 which in turn extends through a slot 122 in a link 124. Preferably, a sleeve or bearing element 126 is assembled over the pin or screw 120 for pivotally supporting the pawl member 114 on the screw. As shown best in FIG. 5, a spring 128 is coiled around a portion of the bearing member 126 and has opposite end portions fixed respectively to the pawl member 114 and to the link 124 in a manner which resiliently biases the pawl member downwardly or in a clockwise direction as viewed in FIG. 1. Thus, the pawl member is continuously resiliently biased downwardly for engagement with the terminals 20 of the strip 22 so that the pawl will be effective for pushing the strip when the pawl is moved toward the right as viewed in FIG. 1 in the manner described below. At the same time the pawl is adapted to slip back over the terminals in the strip 22 when the pawl member is moved toward the left as viewed in FIG. 1 during the non-feeding stroke.

An upper end of the link 124 is pivotally supported by a pin 130 which is mounted on an upstanding bracket 132. Another link 134 is provided with a bifurcation which is also pivotally supported on the pin 130. As shown in FIGS. 4 and 5 the bifurcated end portion of the link 130 embraces the upper end of the link 124. Furthermore, the bifurated end portion of the link 130 extends laterally beyond a side of the link 124 and carries an abutment element or pin 136 which is slightly spaced from but engageable with the adjacent side or edge of the link 124. The arrangement is such that when the link 134 is in the position shown in FIG. 1, the abutment element or pin 136 is substantially disengaged from the edge of the link 124. However, upon pivotal movement of the link 134 in an upward or counterclockwise direction as viewed in FIG. 1, the pin 136 will move downwardly into engagement with the link 124 for pivoting the link 124 in a counterclockwise direction and thereby shifting the pawl member 114 toward the right as viewed in FIG. 1 for feeding the strip 22. In order to return the link 124 to the position shown in FIG. 1 against a fixed stop member 138 upon the completion of a feeding stroke, a spring 140 is provided, which spring is mounted between the link 124 and a tubular abutment 142 carried by and depending from the underside of the link 134.

The link 134 is operated in timed relationship with the ram 16 so that the strip 22 is intermittently fed in time with the terminal crimping or forming operations. In order to actuate the link 134 in this manner, a pin 144 is mounted on a bracket 146 secured to the head member 65. This pin extends through an elongated slot 148 provided in an end of the link 134.

While it is believed that the operation of the above described apparatus is clear, a brief resume of the method of forming and assembling articles such as terminals and wires in accordance with the present invention is as follows. A blank strip of stock material is first stamped to the strip 22 which comprises a plurality of individual articles or terminals integrally joined together in side-by-side relationship by a narrow connecting strip and having junctions with the narrow connecting strip cold worked and slightly indented or embossed for causing the strip to remain substantially straight. Then the strip 22 is intermittently fed for successively positioning the articles or terminals 20 at the work station between the lower die elements or anvils 50–52 and the upper die elements 66–68. When a terminal is properly positioned at the work station, a wire is inserted into the socket portion of the terminal whereupon the apparatus is actuated to move the ram 16 downwardly through a work stroke. As the ram moves downwardly, the backup or side blades 70 and 72 enter the recesses 56 and 58 so that the sides of the terminal are positively confined and then the upper die elements 66 and 68 engage the terminal for forming and crimping the terminal into the condition shown best in FIGS. 8 and 9. If desired, the die structure may be provided with an element for severing a terminal from the strip during the crimping operation, or the terminal may be separated at a later work station. When the ram is subsequently raised, the side or backup blade members 70 and 72 are free to spread apart for immediately releasing the formed and crimped article which is then removed as the next terminal is automatically fed to the work station.

While the preferred embodiment of the present invention has been shown and described herein, it is obvious that many details may be changed without departing from the spirit and scope of the appended claims.

The invention is claimed as follows:

1. An apparatus for processing a workpiece comprising means for feeding a workpiece along a predetermined path of travel to a work station, first and second opposing relatively reciprocable workpiece engageable die means at said work station for engaging and processing a workpiece positioned therebetween, said first die means being reciprocably disposed at one side of said path of travel and said second die means being disposed at an opposite side of said path of travel, side means at opposite sides of said first and second die means for confining opposite sides of a workpiece being engaged by said first and second means, said side means being reciprocable with said first die means, at least one of said side means being relatively movable away from the other for releasing a processed workpiece from therebetween, said side means including portions extending across said path of travel and along said second die means when said workpiece is being engaged by both of said first and second die means, and abutment means adjacent said second die means for engaging said portion of said one side means and retaining said one side means against moving when said die means are engaging a workpiece.

2. An apparatus, as defined in claim 1, which includes means pivotally mounting both of said side means for movement toward and away from each other.

3. An apparatus as defined in claim 1 for crimping a terminal onto a wire, wherein one of said die means includes a groove means thereon for forming an outwardly projecting rib having a concave inner surface in said terminal and for simultaneously forming a portion of the wire against said concave surface.

4. An apparatus for processing a workpiece comprising first and second opposing relatively reciprocable die means for engaging and processing a workpiece positioned therebetween, side members respectively disposed at opposite sides of said first and second die means for confining opposite sides of a workpiece being engaged by said first and second die means, means pivotally supporting said side members for movement toward and away from each other, means for retaining said side members against movement away from each other when said first and second die means are relatively moved toward each other for processing a workpiece and for releasing said members for movement away from each other when said first and second die means are relatively moved away from each other after processing a workpiece, means adjustably supporting one of said die means,

said adjustable supporting means including a member having an inclined surface engaging and backing up said one die means, and means for adjustably positioning said last mentioned member.

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