United States Patent

[11] **3,571,888**

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[54] **IN-LINE HAND CRIMPING TOOL**
1 Claim, 9 Drawing Figs.

[52] **U.S. Cl.** **29/203,** 72/421
[51] **Int. Cl.** **H01r 43/04,** B21d 43/02
[50] **Field of Search** ..... 29/203, 200, 203 (H), 200 (H), 203 (HM); 72/421, 416

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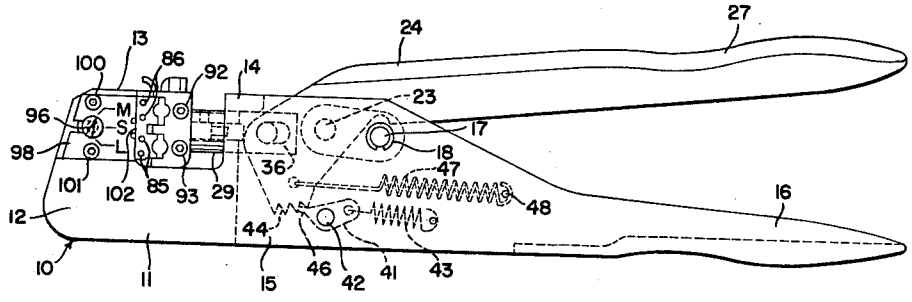
ABSTRACT: An in-line, hand-operated crimping tool having a movable die and a coacting stationary die for crimping the ferrule or barrel portion of electrical terminals and electrical connectors onto electrical wires. The crimping tool is provided with an axial locating assembly which properly positions the barrel axially within the die cavity. A recessed adjustment mechanism varies the distance between coacting insulation crimping dies to allow them to accommodate various thicknesses of wire insulation. A preadvancing mechanism biases the movable crimping die from a fully opened position to a preadvanced position. In the preadvanced position the distance between the faces of the movable and stationary dies is less than the outside diameter of the barrel in order to secure the barrel in the die cavity prior to the crimping operation. After crimping, the movable die may be fully opened against the bias of the preadvancing mechanism to permit removal of the connector or terminal from the die.



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SHEET 1 OF 2

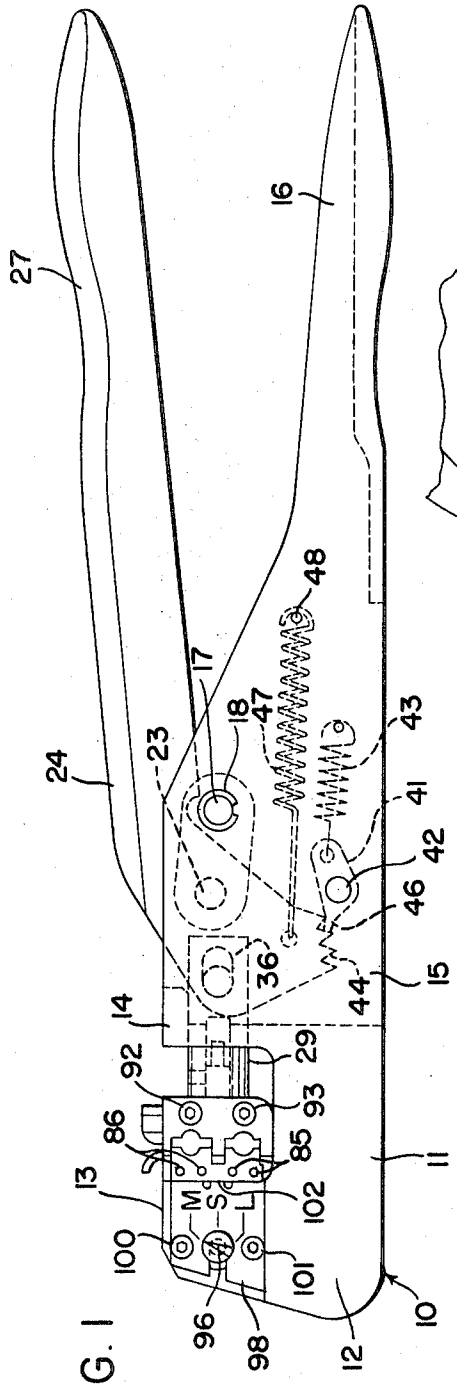

FIG. 1

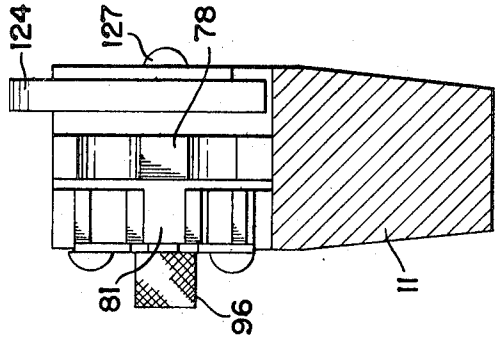

FIG. 3

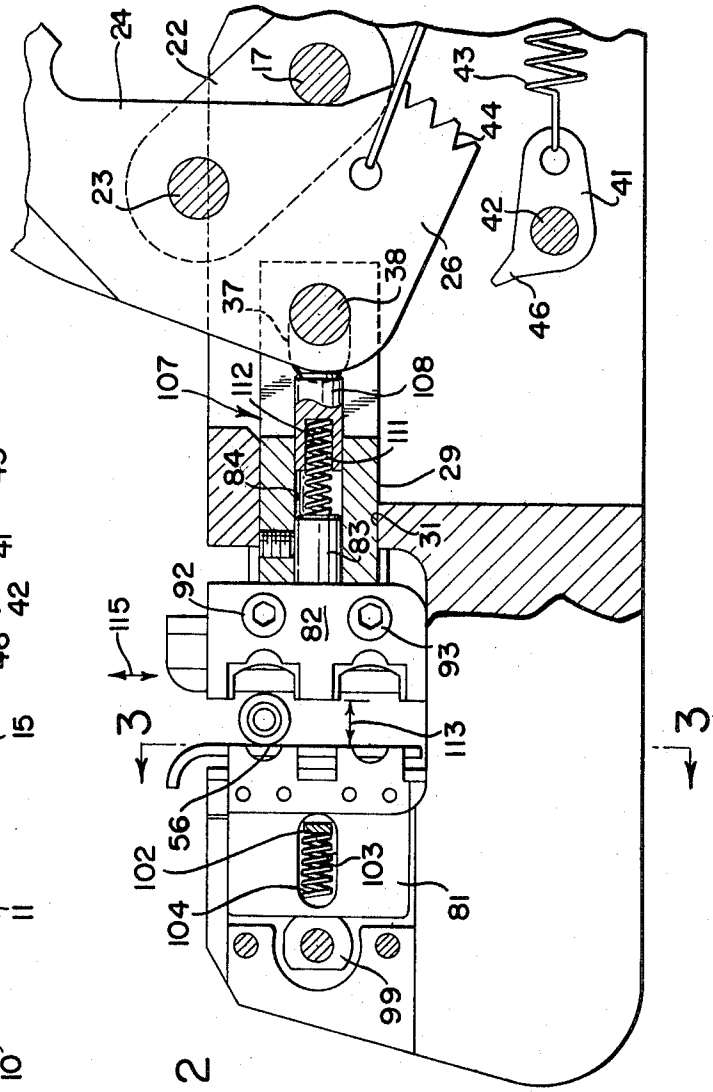

FIG. 2

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FIG. 4

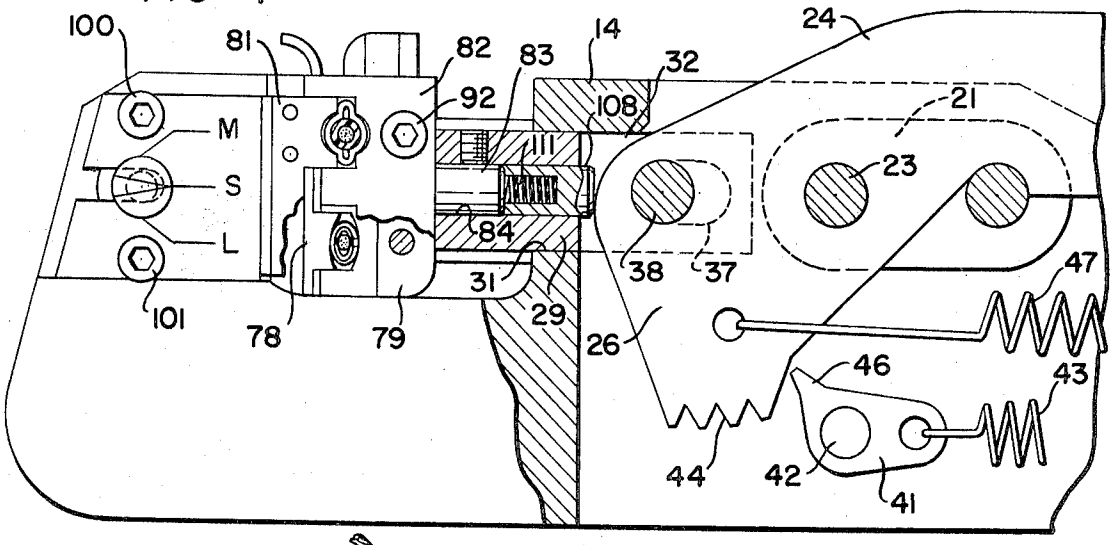


FIG. 5

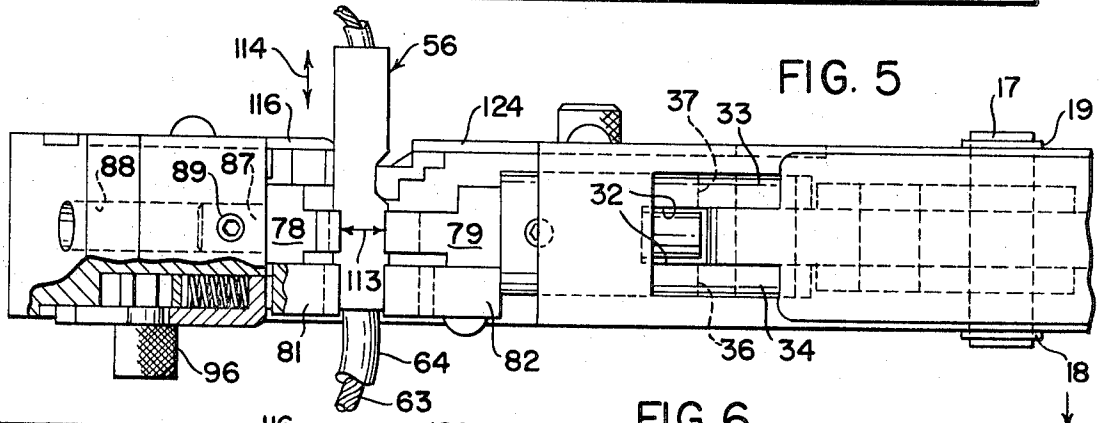


FIG. 6

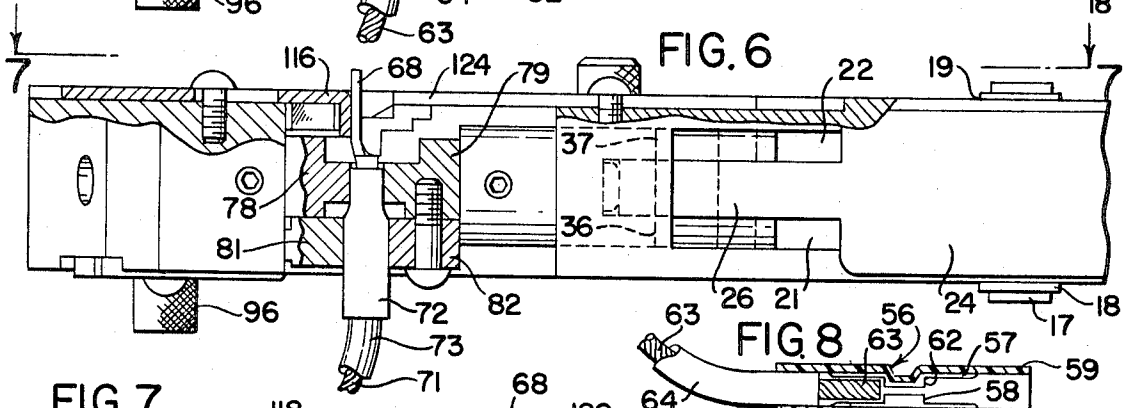
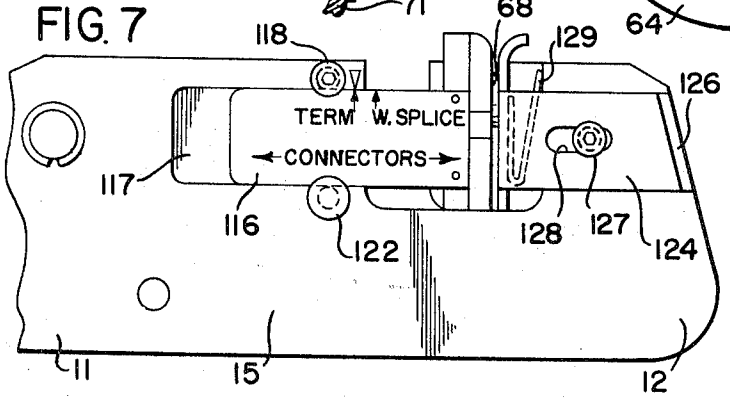


FIG. 8

FIG. 7



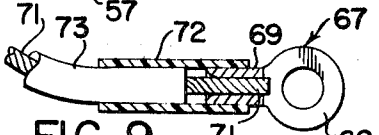


FIG. 9

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IN-LINE HAND CRIMPING TOOL

BACKGROUND OF THE INVENTION

This invention relates generally to tools having coacting dies for applying a force to an article therein, and more particularly to a novel preadvancing mechanism for use on such tools which preadvances the dies from a fully opened position to a preadvanced position to secure the article within the die cavity prior to application of the force.

Force applying tools, ranging from small hand-operated in-line and plier-type tools to large fluid-actuated tools, are commonly employed to deform tubular malleable ferrules or barrels of electrical terminals and electrical connectors into crimping engagement with wire conductors to form mechanically interlocking and electrically perfect connections therebetween. When such force applying tools are employed as crimping tools, it is of course essential that the barrel be properly held within the die cavity and not be allowed to fall out of the tool or into an adjacent die cavity. Since the operator may have to use one hand to operate the crimping tool and the other hand to insert and hold the wire conductor in the proper position within the barrel, it becomes necessary to provide a means for securing the connector or terminal within the die cavity.

Numerous types of auxiliary holding devices to hold the terminal or connector in position within the die cavity prior to and during the crimping operation have been proposed. These auxiliary devices compromise generally a spring biased clamp which engages a small portion of the external surface of the connector or terminal. Although these prior art auxiliary clamps may perform their intended functions, they are nevertheless inherently undesirable since they add to the crimping operation the additional step of opening the clamp and securing the connector or terminal therein.

SUMMARY OF THE INVENTION

The present invention overcomes many of these attendant difficulties by providing a preadvancing mechanism which biases the crimping dies from a fully opened position to a preadvanced position in which the distance between the die faces is less than the external diameter of the portion of the terminal or connector that is to be crimped. This prevents the terminal or connector from falling out of the tool or into another die cavity after it has been properly placed within the die cavity. Then, after the terminal or connector has been crimped and the dies are opened, the operator can push the preadvanced die to the fully opened position to facilitate removal of the terminal or connector from the dies of the tool. In this manner the invention effectively locks the terminal or connector within the die cavity prior to crimping without any auxiliary clamping means yet permits removal of a wire splice connector from the dies of the tool.

The preadvancing mechanism can be made to preadvance the dies to any desired preadvanced position. If a preadvanced position is chosen between a position in which the distance between the die faces is just slightly less than the external diameter of the barrel and a position in which the dies just engage the barrel, the barrel can be inserted axially into the die cavity without having to push the preadvanced die open, and the barrel is still secured against falling laterally out of the tool. However, the barrel is, of course, not secured against axial movement. If, on the other hand, a preadvanced position is chosen between the position in which the dies just engage the barrel and the fully closed position, the preadvanced die has to be pushed open to insert the barrel into the die cavity. However, once inserted, the barrel is spring locked within the die cavity by the preadvancing mechanism and cannot fall out of the die cavity either axially or laterally.

The present invention further provides an axial locating assembly which properly positions the barrel portion of both connectors and terminals axially within the die cavity.

Still another aspect of the invention provides for a recessed adjustment mechanism which varies the distance between coacting insulation crimping dies to allow them to accommodate various thicknesses of wire insulation.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the invention will become more readily apparent upon a full and comprehensive understanding of a preferred embodiment of the invention as shown in the accompanying drawings, wherein:

FIG. 1 is a side elevation of an in-line, hand-operated crimping tool incorporating the present invention, with the dies shown in the almost fully closed position;

FIG. 2 is an enlarged side elevation, partly in cross section, of a portion of the crimping tool shown in FIG. 1 with the dies in the preadvanced position and with a connector barrel in the die cavities;

FIG. 3 is a cross-sectional view taken along reference view line 3–3 of FIG. 2;

FIG. 4 is an enlarged side elevation, partly in section, of the tool shown in FIG. 2, with the crimping dies fully closed and with crimped connector barrels in both of the laterally adjacent die cavities;

FIG. 5 is a top plan view, partly in section, of the crimping tool as shown in FIG. 2;

FIG. 6 is an enlarged top plan view, partly in section, of a portion of the crimping tool shown in FIG. 1 with a terminal barrel held in the die cavities by the preadvancing mechanism prior to crimping;

FIG. 7 is a side elevation of the crimping tool taken along reference view line 7–7 in FIG. 6;

FIG. 8 is a side elevation, partly in section, of a splice connector of the type shown in the cavities in FIGS. 2 and 5; and

FIG. 9 is a side elevation, partly in section, of a terminal of the ring-tongue type shown in the die cavities in FIGS. 6 and 7.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings in greater detail, an in-line, hand-operated crimping tool used for crimping the barrel portion of electrical terminals and electrical connectors onto electrical conductors is designated generally by reference numeral 10. The tool 10 includes a one piece stationary member 11 having a solid head portion 12 forming longitudinally opposed die mounting members 13 and 14. A body portion 15 of the stationary member 11 is slotted to provide two generally flat parallel cheeks extending longitudinally to a stationary handle 16. Two connecting links 21 and 22 are each pivotally connected at one end to the stationary member 11 by a pin 17. The pin 17 extends through the parallel cheeks of body portion 15 and is held in place by snap rings 18 and 19. The other end of each link 21 and 22 is pivotally connected to opposite faces of a movable handle 24 by a pin 23 which is frictionally retained within the handle 24. The movable handle 24 is provided with a generally flat end portion 26 which operates generally within the parallel cheeks of body portion 15 and a gripping portion 27 having a T-shaped cross section.

A generally cylindrical die holder 29 is slidably disposed within a longitudinal bore 31 extending through the mounting member 14. The die holder 29 is provided with a longitudinal end slot 32 forming a yoke having longitudinally extending fingers 33 and 34. The fingers 33 and 34 are provided with longitudinal slots 36 and 37 respectively within which a pin 38 travels. The pin 38 extends through a hole in the end portion 26 of the movable handle 24 and serves to interconnect the handle 24 to the die holder 29. This connection allows both longitudinal and rotational movement between the die holder 29 and the movable handle 24.

The movable handle 24 and the links 21 and 22 in conjunction with the pins 17, 23, and 38 form a toggle which moves the die holder 29 longitudinally within the bore 31 when the movable handle 24 is opened and closed relative to the stationary handle 16. This toggle action is most desirable in crimping tools since, at the end of the crimping stroke when the maximum crimping force is required, the toggle ap-

proaches its dead center position as shown in FIG. 4 and the mechanical advantage of the linkage is maximized at this position.

In order to insure that the tool has traversed a complete crimping stroke before the crimping dies are opened, a full stroke compelling mechanism is provided. The full stroke compelling mechanism includes a two arm lever 41 which is rotatably disposed within the parallel cheeks of the body portion 15 by the pin 42. One arm of the lever 41 is attached to the coil spring 43 to bias the lever 41 in the position shown in FIG. 2. The end portion 26 of the movable handle 24 is provided with a ratchet 44 which cooperates with a pawl 46 formed by the other arm of lever 41 to insure a full crimping stroke. With the movable handle 24 in the fully opened position as in FIG. 2, the pawl 46 is disengaged from the ratchet 44. As the handle 24 is moved toward the closed position, the pawl 46 engages the ratchet 44 as shown in FIG. 1 to prevent the handles from being opened before a full stroke has obtained. Once the full crimping stroke has been completed as in FIG. 4, and the pawl and ratchet are disengaged, the pawl 46 will ride freely back over the ratchet 44 to permit opening of the handles and a return to the position shown in FIG. 2. A coil spring 47 having one end secured to a pin 48 extending through and frictionally retained within the parallel cheeks of the body portion 15, and the other end secured to the generally flat end portion 26 of the movable handle 24 is provided to spring bias the handle 24 in its opened position.

The crimping tool 10 is employed to crimp a wide variety of solderless, insulated and noninsulated electrical terminals and connectors. One such solderless connector is an insulated butt connector 56 used to splice two wires together as shown in FIG. 8. The connector 56 includes a generally tubular malleable metallic barrel 57 having a stop 58 formed therein. The barrel 57 is provided with a plastic insulating sleeve 59 surrounding the connector 56 and extending longitudinally beyond the extremities of the barrel 57. The barrel 57 is provided with a lateral slot 62 into which the plastic insulating sleeve 59 flows to form a stop which acts in conjunction with the stop 58 to longitudinally locate the wire conductor 63 within the barrel 57. If the butt connector 56 were of the noninsulated type, i.e. not provided with the insulating sleeve 59, it would be necessary to crimp only the metallic barrel 57 into crimping engagement with the wire 63. However, when crimping the insulated connector 56, it is also necessary to crimp the insulating sleeve 59 about the wire insulation 64. One of the many types of solderless terminals which may be crimped by the tool 10 is the insulated ring tongue terminal 67 used to connect a wire to a terminal block or other assembly as best shown in FIG. 9. The terminal 67 includes a ring tongue 68 and a generally tubular malleable metallic barrel 69 into which the wire 71 is inserted. The barrel 69 is provided with a plastic insulating sleeve 72 similar to the insulating sleeve 59 of the connector 56 which surrounds the barrel 69 and extends beyond its end to surround a portion of the wire insulation 73.

The crimping of the barrel portion of the terminal or connector is performed by longitudinally opposed crimping dies mounted within the members 13 and 14 of the crimping tool. These dies include a male barrel-crimping die 78 and a coacting female barrel-crimping die 79 which crimp the metallic barrel of the conductor or terminal into engagement with the wire conductor therein. The coacting barrel-crimping dies 78 and 79 are each provided with laterally adjacent die cavities so that barrels of different sizes can be crimped without having to change the dies. A male insulation crimping die 81 and a coacting female insulation crimping die 82 are provided to crimp the insulating sleeve of the barrel about the wire insulation. Each of the coacting insulation crimping dies 81 and 82 is also provided with laterally adjacent die cavities corresponding to the die cavities of the barrel crimping dies for crimping insulating sleeves of different sizes.

Two sets of recessed colored dots 85 and 86 (FIG. 1) are provided in the exposed lateral surface of the male insulation crimping die 81. The color of these dots is coded to correspond to the color of the plastic insulating sleeve, which in turn is coded to correspond to the wire size which may be inserted in the barrel of the terminal or connector. For example, if the color of the recessed dots 85 is yellow, the operator knows that only a terminal or connector having a yellow insulating sleeve may be crimped in the lower die cavities. Furthermore, this tells the operator that only a certain specific size or range of sizes of wire can be used with the connector or terminal having the yellow insulating sleeve.

The female barrel crimping die 79 is provided with a cylindrical projection 83 which is secured within a bore 84 extending longitudinally through the die holder 29 by a setscrew. In a similar manner, the male crimping die 78 is provided with a cylindrical projection 87 which is secured within a bore 88 extending longitudinally through the die mounting member 13 by the setscrew 89. The female insulation crimping die 82 is attached to the female barrel crimping die 79 by the hexagonal socket head screws 92 and 93 so that both female dies 79 and 82 move together.

Since each wire size may have various thicknesses of insulation, it is desirable to be able to easily and quickly adjust the insulation crimping dies independently of the barrel crimping dies to accommodate these various insulation thicknesses. This is accomplished by an adjustment means best shown in FIGS. 1 and 2. By turning the knurled indicator knob 96 so that the embossed arrow indicate the correct relative thickness of the wire insulation (medium, small or large) on the cover plate 98, the male insulation crimping die 81 is moved toward or away from the female insulation crimping die 82. The adjustment means includes a cam 99 having three flat lands. The cam 99 as shown is an extension of the knob 96. The cover plate 98 is rigidly secured to the jaw 13 by the hexagonal socket head screws 100 and 101, and is provided with a laterally extending finger 102 which reaches into a longitudinal slot 103 in the die 81. A coil spring 104 acts between this stationary finger 102 and the movable insulation crimping die 81 to bias the die 81 against the cam 99 so that rotation of the cam 99 will longitudinally position the die 81 toward or away from the die 82.

The force applying tool 10 is further provided with a preadvancing mechanism 107 to secure the connector or terminal in the proper die cavities when the handles 24 and 16 of the tool are fully opened, and for other purposes which will hereinafter become more readily apparent. The slots 36 and 37 in conjunction with the pin 38 provide a connection between the handle 24 and the die holder 29 which permits rotational movement therebetween and which also permits the die holder 29 to move longitudinally relative to the handle 24. This connection permits the aforementioned toggle to apply an actuating force to the die holder 29 from the handle 24. The connection also allows the die holder 29 to be longitudinally preadvanced from its fully opened position prior to closing of the handles 24 and 16.

A generally cylindrical piston 108 as best shown in FIGS. 2 and 4 is slidably mounted within the bore 84 of the die holder 29. A coil spring 111 is disposed within an end bore 112 of the piston 108. The spring 111 effectively acts against the end portion 26 of handle 24 to bias the die holder 29 from the fully opened position to a preadvanced position as shown in FIG. 2. The longitudinal preadvancement of the die holder 29 is determined by the size and location of the slots 36 and 37 since the permissible longitudinal movement of the die holder 29 relative to the handle 24 is limited by travel of pin 38 within these slots. With the dies 79 and 82 in the preadvanced position, the distance 113 between the male and female dies is less than the external diameter of the barrel that is to be crimped. It should be noted that if the connector or terminal is noninsulated, the barrel diameter here referred to is the diameter of the metallic tubular portion rather than the diameter of the insulating sleeve.

By varying the length of the slots 36 and 37, the longitudinal preadvancement of the die holder 29 can be changed. If a

preadvanced position is chosen between a position in which the distance between the die faces is just slightly less than the external diameter of the barrel and a position in which the dies just engage the barrel, the barrel can be inserted axially into the die cavities in the direction indicated by arrows 114 without having to push the preadvanced dies open. However, although the barrel is then secured against falling laterally out of the cavities in the direction indicated by arrows 115 it is not secured against axial movement. On the other hand, if a preadvanced position is chosen between the position in which the dies just engage the barrel and the fully closed position, the preadvanced dies must be pushed toward the opened position before the barrel can be inserted into the die cavity. However, once the barrel is thus inserted, it is spring locked within the die cavity by the coil spring 111 and cannot fall out of the die cavity either axially or laterally.

It is, of course, essential that the connector or terminal be properly positioned axially within the dies so that the barrel-crimping dies 78 and 79 crimp the tubular metallic barrel and the insulation crimping dies 81 and 82 crimp only the insulating sleeve. It is also necessary that the end of the wire conductor be stripped of insulation a proper length as shown in FIGS. 8 and 9. After the barrel has been crimped, the handles 27 and 16 of the crimping tool are opened to open the dies and allow the crimped barrel to be removed. If a terminal, such as ring tongue terminal 67, is crimped, the terminal can be removed from the die cavity in the axial direction 114. However, if a connector having two long wire conductors in both ends is crimped, it may not be possible to remove the connector from the die cavities in the axial direction. In this situation, the female dies 79 and 82 are simply pushed back against the biasing force of the coil spring 111 from the preadvanced position to the fully opened position to allow removal of the crimped connector 56 from the dies of the tool in the lateral direction 115.

The crimping tool 10 is also provided with an axial locating assembly which is best shown in FIGS. 5, 6, and 7. A locator 116 is slidably disposed within a slot 117 in the side of the stationary member 11. The locator 116 is held in position by a hexagonal socket head screw 118 and a knurled thumb screw 122. The thumb screw 122 may be loosened to allow the locator 116 to be longitudinally positioned within the slot 117 at either of the indicated positions for either terminals or wire splice connectors. A spring biased terminal and connector ejector and locator 124 is slidably mounted within the slot 126 in the stationary member 11. The locator 124 is secured in place by the hexagonal socket head screw 127, which permits the locator 124 to freely slide longitudinally within the limits of the slot 128. The leaf spring 129 biases the locator 124 toward the locator 116 to secure the connector or terminal against axial movement and, after a crimping operation, serves to eject terminals and connectors that may become jammed in the dies. With the locator 116 in the wire splice position, the axial locating assembly will prevent a wire splice connector from moving axially within the die cavity as shown in FIG. 5. With the locator 116 in the terminal position, the assembly will prevent axial movement of a terminal as shown in FIGS. 6 and 7. This insures that the connector or terminal will be properly held in position axially to insure that the barrel and the insulating sleeve will each be properly crimped. When a terminal, such as the ring tongue terminal 67, is to be crimped, the locator 116, as best seen in FIG. 6, also prevents the wire 71 from projecting beyond the confines of the metallic barrel 69 to eliminate interference with the ring tongue 68.

Although a preferred embodiment of this invention has been shown and described in detail, it is to be understood that various modifications and rearrangements of parts may be resorted to without departing from the scope of the invention disclosed and claimed herein.

I claim:

1. A crimping tool for crimping a generally tubular, metallic barrel onto an electrical wire and concurrently crimping an insulating sleeve of said barrel onto the insulation of said wire, comprising a pair of coacting barrel-crimping dies, a pair of coacting insulation crimping dies, means for moving said coacting dies between an opened position and a closed position, one of said insulation crimping dies and one of said barrel crimping dies being attached to a fixed jaw member of said tool, and an adjustment means for varying the distance between said insulation crimping dies independently of the distance between said barrel-crimping dies, said adjustment means being substantially recessed into said fixed jaw member of said crimping tool and including a cam having a plurality of substantially flat lands rotatably mounted on said fixed jaw member, said lands varying in distance from the longitudinal axis of said cam, and a spring means biasing the first of said insulation crimping dies against said cam so that rotation of said cam causes said first insulation crimping die to move toward or away from the second insulation crimping die.