March 15, 1960 G. A. FULLER 2,928,299

MULTI-ACTION CRIMPING TOOL

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Fig. 2

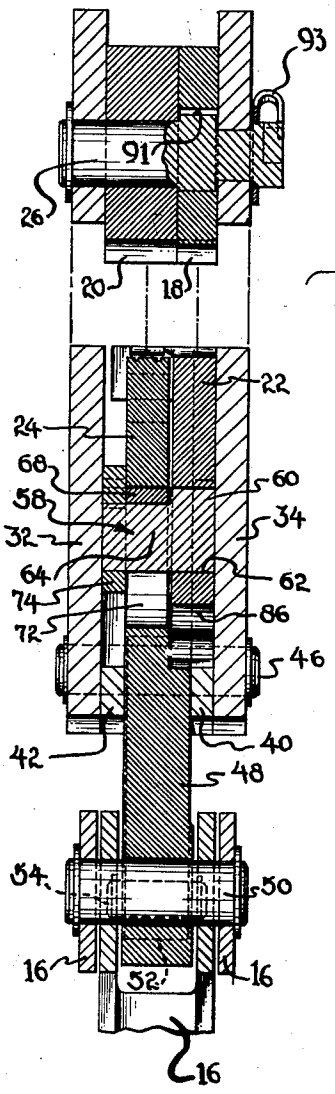
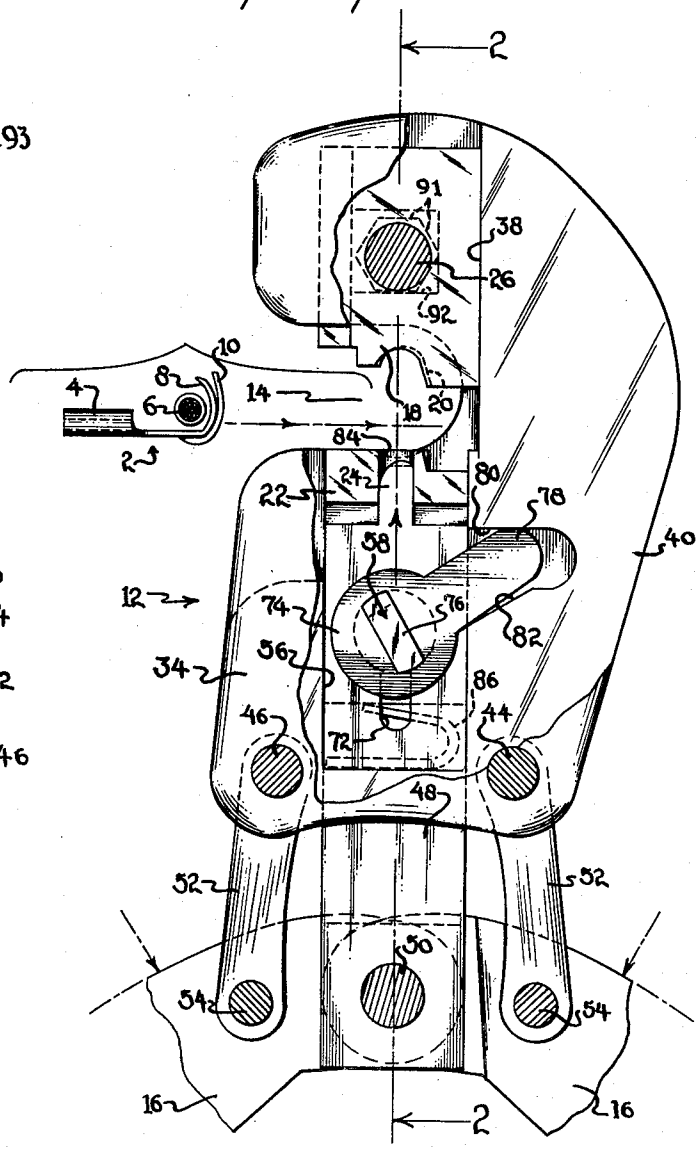


Fig. 1



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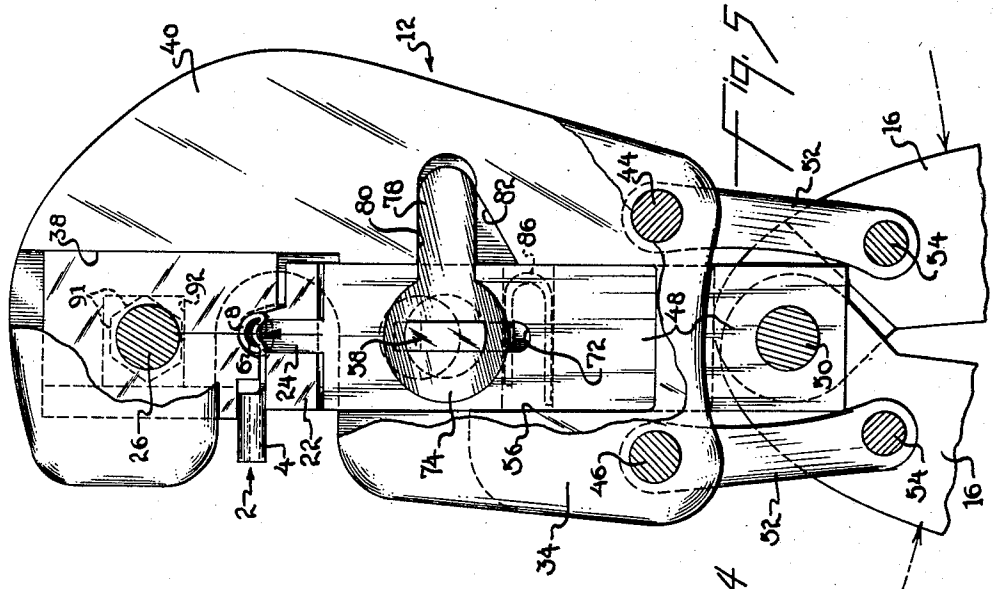


Fig. 5

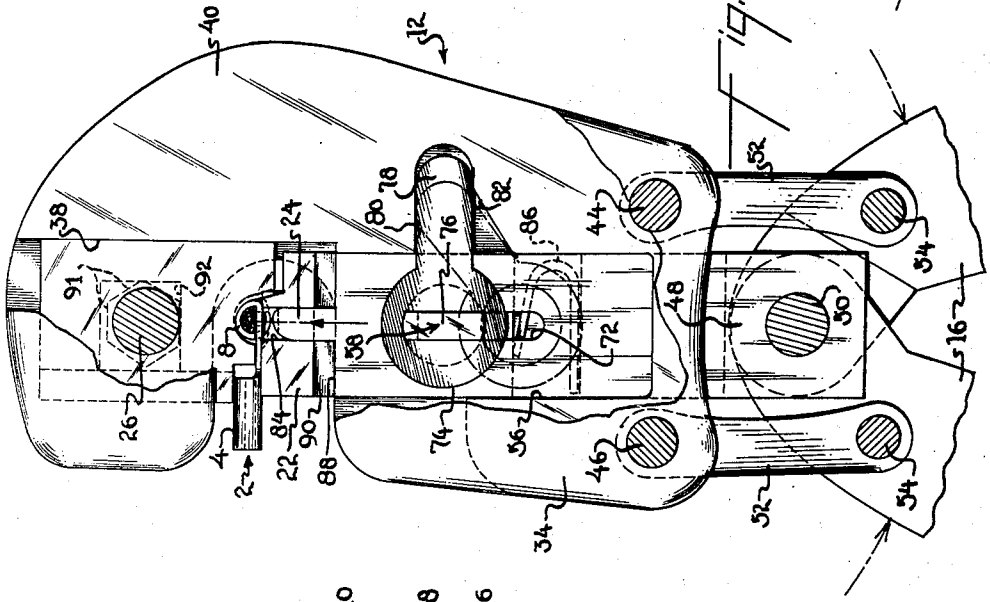


Fig. 4

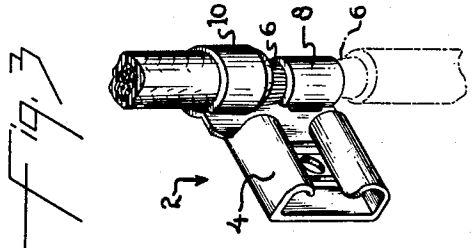


Fig. 3

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MULTI-ACTION CRIMPING TOOL

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Fig. 8

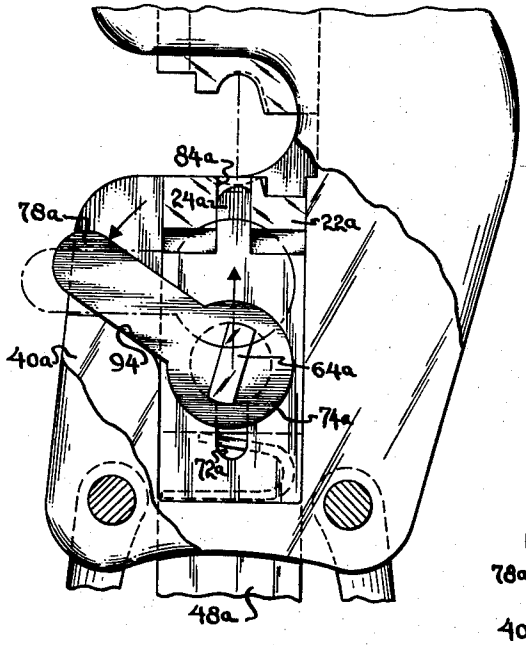


Fig. 9

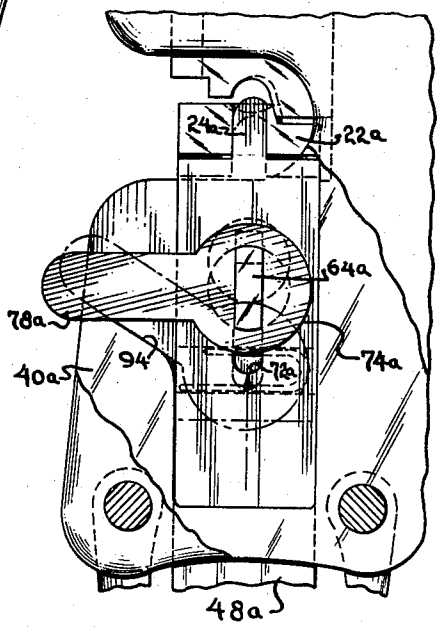
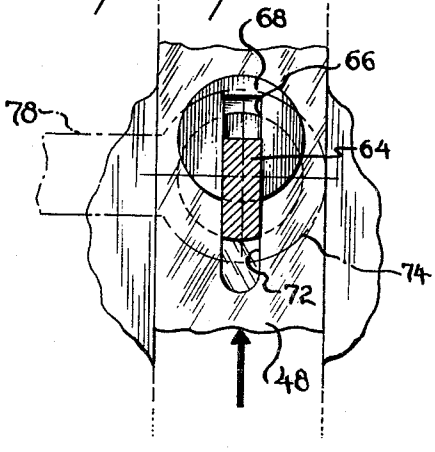


Fig. 6



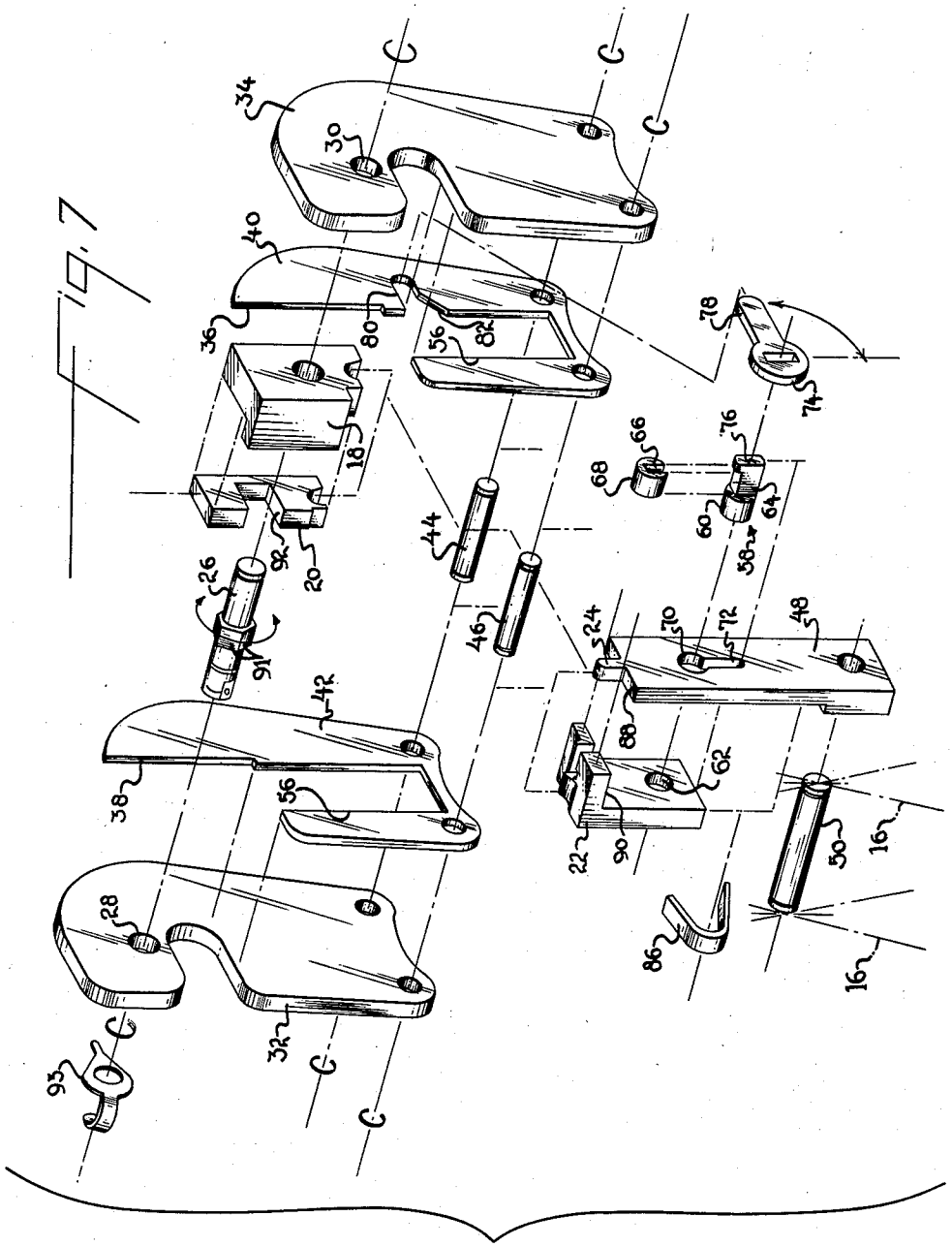
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Fig. 7



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2,928,299

MULTI-ACTION CRIMPING TOOL

Glenwood A. Fuller, Hershey, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

Application January 8, 1958, Serial No. 707,722

7 Claims. (Cl. 81—15)

This invention relates to a hand tool for pressure forming electrical connectors about the ends of wires and more particularly to a hand tool having therein multiple dies that are sequentially operated to secure an electrical connector about the end of an electrical conductor. This application is a continuation-in-part of my copending application, Serial Number 631,867, filed December 31, 1956, and now abandoned.

In the art of applying solderless electrical connectors to the ends of electrical conductors by pressure forming or crimping thereabout various tools have been provided for applying said connectors to said conductors. These have generally been of precision construction and operated automatically by air or electricity but have also included various hand operated tools for limited applications where production did not warrant an expensive, accurate machine. Various hand tools have been devised to apply electrical connectors to conductors with sufficient pressure and precision to form good electrical connection. For certain types of applications the hand tool as described and claimed in Patent Number 2,744,428, issued May 8, 1956, to William R. Evans has been satisfactory.

In tools of this latter type there have been generally an anvil and a crimper which are brought together about the electrical connector with sufficient pressure to crimp the connector about the conductor inserted therein. In certain applications it is necessary to perform a series of operations upon the electrical connector which necessitates multiple dies in the tool. This has generally heretofore presented difficult problems since a hand tool must of necessity be operated with but one hand as the connector to be joined must be held with the other.

According to the present invention I have discovered a hand tool for applying multiple dies which are sequentially operated automatically or semi-automatically in a manner such that an individual may still operate the tool quite readily with one hand.

Accordingly it is an object of the present invention to provide a hand tool for crimping electrical connectors about electrical conductors having multiple dies that are sequentially and automatically operated upon closure of the hand tool. It is another object of the present invention to provide a multiple die hand tool that may be simply and easily operated in a semi-automatic fashion. It is another object of the present invention to provide a multiple die hand tool wherein the dies are sequentially operated in at least a semi-automatic fashion that is of simple and economical construction. It is a still further object of the present invention to provide a multiple die hand tool wherein the dies may be automatically and sequentially operated by one hand without the necessity of any special jigs or other additional fixtures. These and other and further objects will be in part apparent and in part pointed out as the specification proceeds.

In the drawings:

Figure 1 is a side elevation partially broken away of a hand tool according to the present invention;

Figure 2 is a sectional view on line 2—2 of Figure 1;

Figure 3 is a perspective view of a connector of the type with which the present tool is useful, the connector being crimped on a wire;

Figure 4 is a view similar to Figure 1 showing the dies in the first crimping position;

Figure 5 is a view similar to Figure 4 showing the dies in the fully crimped position;

Figure 6 is an enlarged fragmentary sectional view of the control mechanism of the tool for explanatory purposes;

Figure 7 is an exploded view of the head portion of the tool of Figure 1;

Figure 8 is a view similar to Figure 1 of another embodiment of the present invention; and

Figure 9 is a view similar to Figure 8 showing the dies in the fully crimped position.

For illustrating the principles of the present invention and the details of construction that one form may take, the tool of the present invention is described in connection with the electrical connector disclosed in copending application, Serial Number 431,870, filed May 24, 1954, by Kemper M. Hammell, such a connector being exemplary of application where a series of operations are advantageously performed by sequentially operative multiple dies to install the connector on a wire. As shown in Figures 1 and 3, connector 2 includes a contact portion 4 through which wire 6 is coupled in an electrical circuit, and a pair of ferrule forming ears 8 and 10 adapted to be wrapped around a bared section and the insulation of wire 6 for electrical engagement and insulation support respectively.

Referring to Figures 1, 3, 4 and 5, a tool constructed in accordance with the present invention comprises generally a head portion 12 into the mouth 14 of which connector 2 and wire 6 in assembly position are inserted. Head portion 12 contains various die elements which are driven by manually closable handles 16; partial closing of the handles causes the wrapping of ears 8 and 10 around the wire (Figure 4), and final closing of the handles causes crimping of the wire barrel thus formed by ear 8, as by indentation (Figure 5), to complete the installation of the connector in a pressure forged joint with the wire (Figure 3).

With specific reference now to the embodiment illustrated in Figures 1 through 7, the dies for effecting the aforesaid connection include upper dies or crimpers 18 and 20 having curved working surfaces for directing the curling or wrapping of ears 8 and 10 respectively, lower die 22 having an anvil surface supporting the connector during installation, and indentor die 24. Upper dies 18 and 20 are maintained essentially fixed in side-by-side position adjacent the top of head 12 by spindle 26 extending therethrough and mounted in apertures 28 and 30 of outer support and cover plates 32 and 34. Vertical alignment of upper dies 18 and 20 is maintained by abutting the dies against backing edges 36 and 38 of inner plates 40 and 42 secured to outer plates 32 and 34 by pins 44 and 46.

Lower die 22 and indentor 24 are mounted for movement toward and away from the upper die assembly under the driving impulse of the tool ram 48 which is pivotally connected to handles 16 by pin 50. Handles 16 are further joined to head 12 by a pair of connecting links 52 which pivot at one end about pins 44 and 46 and at the other end about pins 54 in handles 16 to complete a toggle mechanism effective to power ram 48 in the crimping stroke of the tool.

Inner plates 40 and 42 each have therein an elongated, rectangular recess 56 forming a vertically aligned channel in which lower die 22 is received and guided in its movement relative to the upper die assembly. Indentor 24

conveniently is formed as an integral part of ram 48 which is slidably received between inner plates 40 and 42 and connected in driving relation to lower die 22 by pin 58.

As alluded to above it is contemplated that lower dies 22 and 24 will move and coact sequentially with the upper die assembly in each upward stroke of ram 48 to effect the desired multiple stage crimping action on connector 2. To this end the connection between lower dies 22 and 24 provides for relative movement therebetween during the power stroke of the tool ram. Thus, one end 60 of connecting pin 58 is of circular cross-section and rotatably fits within aperture 62 of lower die 22. An intermediate key portion 64 of pin 58 is rectangular in cross-section and normally is received in slot 66 of a generally cylindrical bearing block 68 rotatably seated in aperture 70 of ram 48. Communicating with aperture 70 is a vertically aligned keyway slot 72 of a width slidably to receive key portion 64 upon orientation of slots 66 and 72 into alignment. To rotate pin 58, thereby to align and disalign slots 66 and 72, a cam plate 74 is keyed to the other end 76 of pin 58, which plate is provided with a cam finger 78 received within a transverse recess 80 of inner plate 40. The lower edge 82 of recess 80 is tapered downwardly to admit of a combined reciprocatory pivotal movement of finger 78, as can be seen by comparing the finger positions of Figures 1 and 4.

In the illustrative application to which the tool is adapted, it is desired that indentor die 24 be maintained in an inactive position during the first phase of the crimping operation effected by the closing of anvil die 22 and upper dies 18 and 20. As best shown in Figures 1 and 2, indentor 24 is slidably received within a channel 84 intersecting the working surface of anvil die 22, the working surface of indentor 24 initially being maintained at least below the working surface of die 22. As thus constructed, with a terminal and conductor properly disposed on the working surface of die 22, the tool is operated by closing handles 16 which gradually force ram 48 upwardly in Figures 1 and 4. Ram 48 through pin 58 carries hte lower die 22 upwardly until the dies 18, 20 and 22 close about the electrical connector to the position shown in Figure 4. Up to this point ram 48 cannot move independently of die 22 as it is prevented from doing so by virtue of misalignment of key 64 and keyway 72. As die 22 and ram 48 reach the position shown in Figure 4, cam finger 78 has been moved by cam recess 80 to a position such that it is now approximately at right angles to the axis of ram 48. In this position key 64 is in a substantially vertical position and in alignment with keyway 72 which frees ram 48 for movement independent of die 22. Further closure of handles 16 results in key 64 slipping into keyway 72 and thus ram 48 and indentor 24 to continue upwardly to force indentor 24 into the bottom of connector 2, as shown in Figure 5, to complete automatically the sequential operation of the multiple die arrangement. It should be noted that cam finger 78 is stopped from further rotation in the crimping stroke after having aligned the key mechanism by virtue of the end portion thereof projecting into the mating end of recess 80, thus assuring release of key 64 and release of lower die 22.

As key 64 lines up with keyway 72, the holding pressure from ram 48 is removed from anvil die 22. Die 22 is maintained in contact with the electrical connector by spring 86 so that the electrical connector is restrained from movement out of proper position. As the ram and indentor move upward, shoulders 88 of ram 48 engage and forcefully bottom against corresponding shoulders 90 of die 22. Thus a high-pressure crimp is obtained with both the anvil die and the indentor indenting and pressure forming the barrel portion of the electrical connector to the desired extent.

After the electrical connector has been fully crimped handles 16 may be released and drawn apart, and the

mechanism action is reversed, thus to position the parts in the position of Figure 1 whereby the tool is in condition for further use. In this connection the length of key 64 should be such that the full stroke of the ram does not cause the key completely to leave slot 66 of bearing block 68, see Figure 6, to avoid any problems of registration on the return stroke of the mechanism.

Various parts of the tool may be interchangeable or adjustable as desired. For example, a frequently desired adjustment is one to accommodate a range of insulation diameters for a given size wire and connector. To this end spindle 26 may be arranged for rotation between cover plates 32 and 34 thus to bring any one of a series of flat faces 91 on the periphery of spindle 26 into engagement with bearing face 92 of crimper 20 which forms the insulation crimp. Adjacent faces 91 are disposed at an increasing radial distance from the axis of spindle 26 to admit of incremental movements of crimper 20 relative to crimper 18, thus to vary the relative crimp height thereof with respect to anvil die 24. A pointer 93 at one end of spindle 26, cooperating with a scale (not shown) on the outer face of cover plate 32 may be employed for indicating the position to which spindle 26 and faces 91 are adjusted.

Referring now to Figures 8 and 9, there is shown another embodiment of the present invention. In this embodiment there is shown a semi-automatic operation of the multiple dies rather than a fully automatic as shown in Figures 1 through 7. The tools are basically the same except that recess 80 has been eliminated and cam finger 78*a* extended outwardly toward the front of the tool as may be seen clearly in Figures 8 and 9. In the position shown in Figure 8 cam finger 78*a* extends outwardly toward the front of the tool and rests against a shoulder 94 of inner plate 40*a*. In this position ram 48*a* is locked with lower die 22*a* for movement of the whole assembly within the outer cover plates. In operation as the handles of the tool are closed ram 48*a* moves upwardly to a position similar to that shown in Figure 4. In this position cam finger 78*a* may be manually rotated in a counter-clockwise direction in Figure 8 until it is substantially at right angles to the axis of ram 48*a*. This causes key 64*a* to align with keyway 72*a* and permit further independent movement of ram 48*a* relative to die 22*a*. The crimping operation is then continued as previously described until the electrical connector is properly crimped about the conductor therein The tool is then opened, indentor 24*a* being withdrawn downwardly through channel 84*a* of die 22*a* until the cam finger 78*a* is rotated by contact with shoulder 94 to lock the whole assembly and cause withdrawal of the whole assembly of ram 48*a* and die 22*a* back to the position of Figure 8.

While there is given above certain specific examples of this invention and their application in practical use, it should be understood that these are not intended to be exhaustive or to be limiting of the invention. On the contrary, these illustrations and explanations herein are given in order to acquaint others skilled in the art with this invention and the principles thereof and a suitable manner of its application in practical use, so that others skilled in the art may be enabled to modify the invention and to adapt and apply it in numerous forms each as may be best suited to the requirement of a particular use.

I claim:

1. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated to perform sequential operations within the same portion of a connector and conductor placed therebetween, said tool comprising a head portion, first die means in said head portion, a pair of second die means disposed in said head portion in opposed relation to said first die means and defining therewith a crimping zone therebe-

tween, the working end of one of said second die means having a channel intersecting the die face thereof and slidably receiving the working end of the other of said second die means, and power means including handle means connected to said head portion and operatively connected to said die means for driving and closing said first and second die means together into crimping relation, said power means further including means operatively connected between said handle means and said second die means operative upon a predetermined degree of die closing movement of said handle means to release one of said second die means from the driving impulse of said power means.

2. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated to perform sequential operations on a connector and conductor placed therebetween, said tool comprising a head portion, first die means in said head portion, a pair of second die means disposed in said head portion in opposed relation to said first die means and defining therewith a crimping zone therebetween, and power means including handle means connected to said head portion and operatively connected to said die means for driving and closing said first and second die means together into crimping relation, said power means further including releasable key means coupling said pair of second dies together and to said handle means, means for releasing said key means to decouple one of said second die means from said power means after a predetermined degree of die closing movement of said handle means.

3. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated to perform sequential operations upon the connector and conductor placed therein, said tool comprising a head portion, a ram member slidably mounted within the said head portion, a pair of handles pivotally connected to said head portion and ram member, a relatively fixed die member positioned in the upper part of said head portion, a first movable die formed on the upper end of said ram member, a second movable die slidably mounted within the lower part of said head portion, a key member rotatably mounted in and coupling for movement together said second die and said ram, a cam finger connected to and operative to rotate said key member, a fixed cam surface in said head portion for pivoting said cam finger as said handles are closed, a key slot in said ram member adapted to selectively receive therein said key member as said hand tool approaches the closed position, stop means limiting rotation of said cam finger in the open position of said hand tool whereby as said hand tool is operated the dies are brought together to perform a first crimping operation and thereafter said key is released to pass into said key slot to decouple said second die and to permit independent further movement of said ram and first die in a second crimping operation.

4. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated sequentially upon a connector and conductor placed therebetween, said tool comprising a head portion, a ram member slidably mounted in said head portion, a pair of handles pivotally connected to said ram member and head portion and operable to drive said ram member in said head portion, a fixed die mounted in said head, first and second movable dies mounted in said head for independent movement toward and away from said fixed die, the first movable die being positively driven by said ram member, releasable key means connecting the second die to said first die for positively coupling said second die to said ram, and means for releasing said key means to decouple said second die from said ram.

5. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated sequentially upon a connector and conductor placed therebetween, said tool comprising in combination a head portion, a ram member slidably mounted in said head portion, a pair of handles pivotally connected to said ram member and head portion, a relative fixed die member mounted in said head, at least two movable dies mounted in said head for movement toward and away from said fixed die, key means rotatably mounted in said movable dies for controlling the relative movement of said movable dies and ram, said key means being operative upon predetermined rotation to release said movable dies for independent movement, and means for rotating said key means including a cam finger connected to said key means, and a cam slot in said head defined by cam surfaces engaged by and positioned to effect pivoting of said cam finger in a first part of the closing stroke of said handles.

6. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated sequentially upon a connector and conductor placed therebetween, said tool comprising in combination a head portion, a ram member slidably mounted in said head portion, a pair of handles pivotally connected to said ram member and head portion, a relative fixed die member mounted in said head, at least two movable dies mounted in said head for movement toward and away from said fixed die, key means rotatably mounted in said movable dies for controlling the relative movement of said movable dies and ram, said key means being operative upon predetermined rotation to release said movable dies for independent movement, and means for rotating said key means including a lever connected to said key means, said lever extending through said head and arranged for manual pivotal movement.

7. A hand tool for pressure forming electrical connectors about the ends of electrical conductors and of the type having multiple dies adapted to be operated sequentially upon a connector and conductor placed therebetween, said tool comprising in combination a head portion, a ram member slidably mounted in said head portion, a pair of handles pivotally connected to said ram member and head portion, a relative fixed die member mounted in said head, at least two movable dies mounted in said head for movement toward and away from said fixed die, key means rotatably mounted in said movable dies for controlling the relative movement of said movable dies and ram, said key means being operative upon predetermined rotation to release said movable dies for independent movement, and including a pin having a first portion journaled in one of said movable dies and a second portion of rectangular cross-section and rotatable in a circular aperture in the other of said movable dies, said second portion being of rectangular cross-section, said other die having a slot communicating with said aperture of a width corresponding to the lesser dimension of said second portion for slidably receiving said second portion during independent movement of said movable dies, and means for rotating said key means.

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