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2,684,003

SEQUENTIALLY ACTING MULTIPLE SAW CRIMPING TOOL

Filed Aug. 11, 1950

3 Sheets-Sheet 1

Fig. 1.

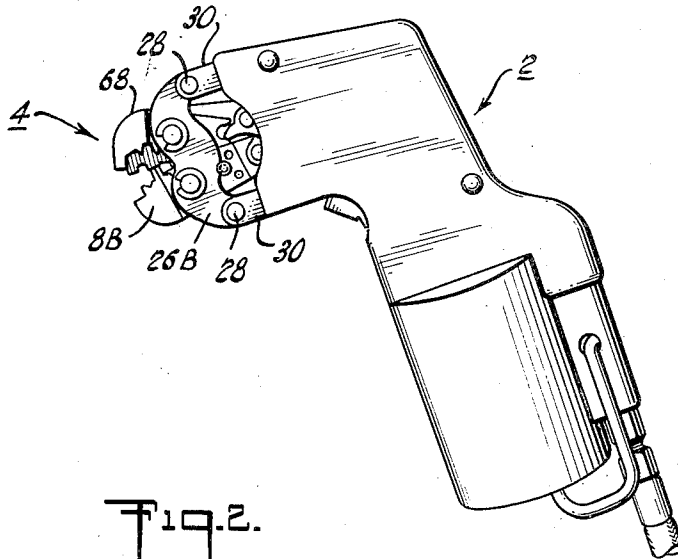
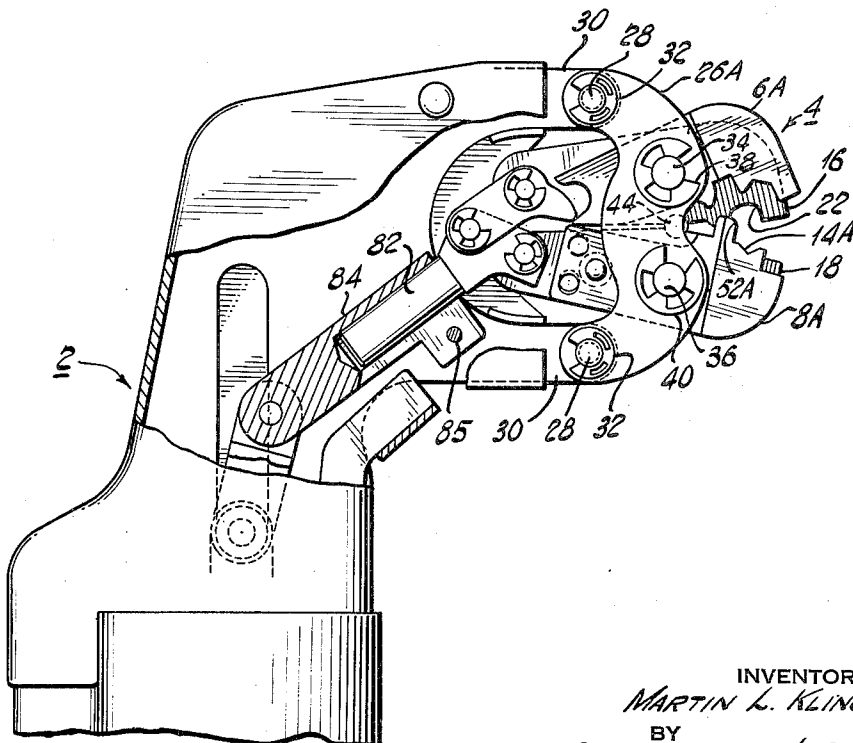


Fig. 2.



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Fig. 3.

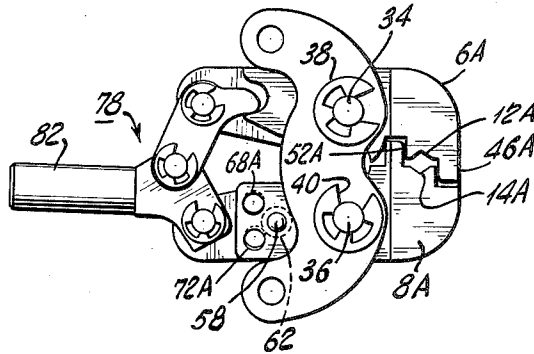


Fig. 4.

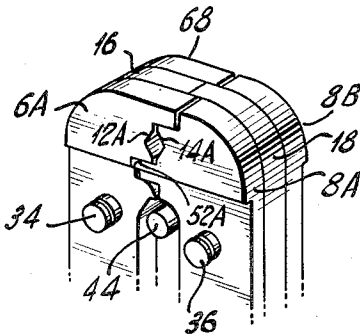


Fig. 5.

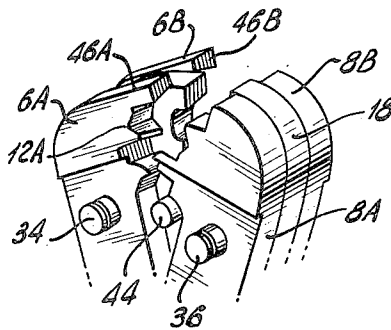


Fig. 6.

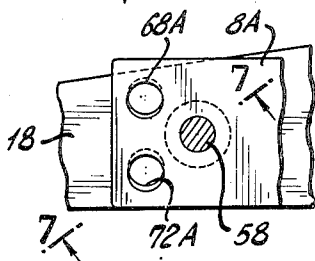
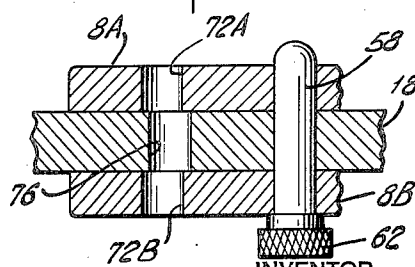


Fig. 7.



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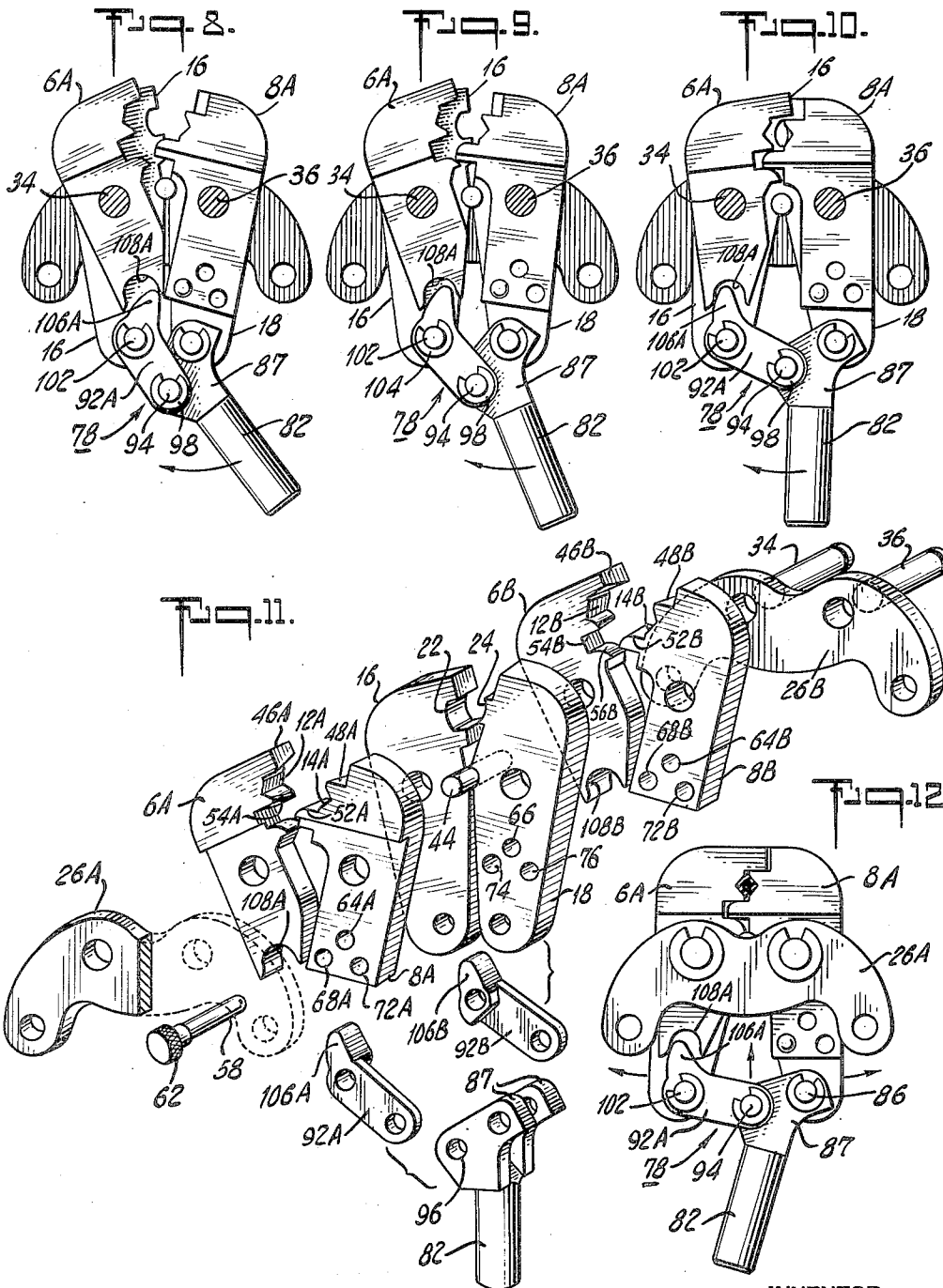
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UNITED STATES PATENT OFFICE

2,684,003

SEQUENTIALLY ACTING MULTIPLE JAW
CRIMPING TOOLMartin L. Klingler, Hershey, Pa., assignor to Air-
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Application August 11, 1950, Serial No. 178,825

6 Claims. (Cl. 81—15)

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This invention relates to crimping tools and is illustrated and described particularly as embodied in a tool for applying solderless connectors to electric conductors.

Solderless connectors are fastened to electric wires by crimping the connector to the wire, for example, by compressing the connector between pivoted jaws carrying suitably shaped die surfaces. These connectors sometimes have portions with different diameters, so that two or more sets of crimping jaws are required, each having its own properly shaped die surfaces. For example, connectors are often made with a thin metal or plastic ferrule portion intended to be crimped around the insulating covering of the wire, and a substantially smaller portion intended to be crimped directly around the inner conductor of the electric wire. However, if these two sets of jaws, which ordinarily are operated from a single driving means by which the crimping force is applied to the tool, are opened simultaneously the same amount, it will be necessary to open the jaws intended to crimp the smaller part of the connector substantially farther than is required to insert this portion of the connector. Moreover, it is desirable to make use of overlapping dies for crimping the thinner ferrule portion, in order to prevent extrusion of the plastic into the space between the die surfaces, and this overlapping construction makes it necessary to open the insulation-crimping jaws an even greater distance. This wide opening of the connector-crimping jaws makes it difficult to hold the connector in position between the jaws, and reduces the mechanical advantage of the jaw-operating system so that it is more difficult to obtain the necessary crimping force. Ordinarily, the thin material which forms this ferrule portion is more easily crimped and does not require the high pressures which are necessary for the smaller heavier portion of the connector which is crimped directly to the center conductor of the wire, and it is possible to utilize a leverage system having less mechanical advantage to crimp the larger portion of the connector.

It has been proposed, therefore, to provide for differential movement of the two sets of jaws, so that they open and close simultaneously at different rates so that the insulation-crimping jaws open wider than the connector-crimping jaws. Such a crimping tool is described in an application of Clyde N. Holzapple, Serial No. 178,827, filed August 11, 1950.

The present invention is an improvement on the tool proposed by Holzapple and provides for sequential closing of the jaws whereby the wire-

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gripping portion of the connector is crimped before substantial pressure is exerted by the insulation-crimping jaws. The arrangement is such as to insure that a good connection will be made between the wire and the metal portion of the connector before the insulation-crimping action occurs, so that it is impossible for the insulation-crimping jaws to prevent complete closure of the connector-crimping jaws. An improved jaw-operating structure is provided, and is arranged to permit relative adjustment between the position of the connector-crimping jaws and the insulation-crimping jaws.

The invention is described as embodied in a tool for crimping plastic-metal connectors for joining together the ends of two lengths of insulated wire, but it is to be understood that the illustration is for the purpose of setting forth the principles and structural arrangements of a now preferred embodiment so that others can modify and adapt the invention to meet the conveniences and requirements of each particular use, and not for the purpose of limiting the claims short of the true and most comprehensive scope of the invention in the art.

The various features, objects, and advantages of the invention will be in part pointed out in, and in part apparent from, the following description considered in connection with the accompanying drawings, in which:

Figure 1 is a side view of a pneumatic hand tool embodying the invention;

Figure 2 is an enlarged partial elevational view of the tool shown in Figure 1, with a portion of the tool housing cut away to show the manner in which the tool head is operated by the pneumatic driving mechanism;

Figure 3 is an elevational view of the removable head portion of the tool shown in Figures 1 and 2;

Figures 4 and 5 are enlarged partial perspective views of the crimping jaws of the head shown in Figure 3, with certain parts removed to better illustrate the relative positions of the jaws when in open and closed positions;

Figure 6 is an enlarged view of a portion of the tool head shown in Figure 3;

Figure 7 is an enlarged sectional view taken along line 7—7 of Figure 6;

Figures 8, 9, and 10 are elevational views of the tool head with the jaws in different relative positions, certain exterior parts being removed to better illustrate the operation;

Figure 11 is an exploded perspective view showing certain parts of the tool head; and

Figure 12 is an elevational view showing the

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positions of the crimping jaws and driving mechanism at the end of a crimping operation.

As shown in Figure 1, the tool comprises a body or operating portion, generally indicated at 2, and a head portion, generally indicated at 4, in which the connectors are placed to be crimped. The body portion 2 of the tool may for example be of the type described in patent application Serial No. 769,381 of Thomas C. Freedom, filed August 19, 1947, in which a pneumatically-operated mechanism is described, but any other suitable mechanism or device may be utilized which is capable of applying the proper operating forces to the head portion 4.

As best shown in Figures 2 to 5, the head portion 4 includes outer insulation-crimping jaws 6A and 8A which are provided, respectively, with die surfaces 12A and 14A, and a second pair of insulation-crimping jaws 6B and 8B (see also Figure 11) positioned on the opposite side of the head and having similar die surfaces 12B and 14B. Positioned between these two sets of jaws, which are adapted to crimp the ferrule portion of the connector around the insulation or covering of the wire, are the inner connector-crimping jaws 16 and 18, which are provided with die surfaces 22 and 24 for crimping the heavier and smaller metal portion of the connector to the center conductor of the insulated wire. In this example, the die surfaces are formed integrally with the crimping jaws, but it is to be understood that separate or removable dies can be used if desired.

In order to support these jaws and position them properly in the body 2, two jaw-supporting yokes 26A and 26B are connected to the frame of the body 2 by pins 28 (Figure 2) which pass through openings in the yokes 26A and 26B and frame members 30 of the tool body 2, the pins 28 being retained by U-shaped lock rings 32 in grooves around the pins 28. The crimping jaws are supported from the yokes 26 by means of pins 34 and 36 (see Figure 11), the jaws 6A, 16, and 6B being pivotally supported by the pin 34 which extends through openings in these jaw members and is retained in position by lock rings 38, positioned in grooves near each end of the pin. The opposing jaws 8A, 18, and 8B are pivotally supported by the pin 36 which extends through openings in these jaw members and in the jaw-supporting yokes 26A and 26B and is held in position by lock rings 40.

To further guide the movement of the connector-crimping jaws to obtain proper opening and closing movements, a movable pivot pin 44 is positioned between semi-cylindrical bearing faces formed on the inner edges of the jaws 16 and 18. When the jaws are opened, this pin is positioned loosely between them, and as the jaws are closed is gripped between them to provide a movable bearing surface for the rotary closing movement. This alignment pin 44 does not make contact with the outer insulation-crimping jaws 6 and 8, and is prevented from falling out of the tool head 2 by the jaw-supporting yokes 26A and 26B.

The particular head described herein is specially adapted for crimping connectors of the type used for joining the ends of two lengths of insulated wire. A connector of this type has a center metal portion adapted to be crimped around the inner wire core of the two conductors, and is covered by a plastic or thin metal sleeve that extends beyond the ends of the central metal insert, the plastic sleeve being compressed by the

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crimping operation around the insulating covering of the wire on each end of the central portion of the connector so as to provide a secure insulation support.

In order to crimp the insulation-gripping portion of the connector, which is a thin shell of plastic or metal, overlapping jaws are used advantageously to prevent extruding the plastic or metal shell into the space between the insulation-crimping jaws. Thus, jaws 6A and 6B are provided with overlapping portions 46A and 46B (Figure 11) which nest with step surfaces 48A and 48B on jaws 8A and 8B. Beneath the die surfaces, overlapping projections 52A and 52B on jaws 8A and 8B are arranged to nest with step surfaces 54A and 54B. The lower surfaces of projections 52A and 52B are arranged, respectively, to ride on cam surfaces 56B formed on jaws 8A and 8B which serve to align the jaws as they are closed into crimping position.

The insulation-crimping jaws 8A and 8B and the connector-crimping jaw 18 are locked in fixed relative positions, so as to move together as the jaws are opened and closed, by a pin 58 (Figures 7 and 11) having a knurled head 62 which, for example, may extend through a hole 64A in jaw 8A, hole 66 in jaw 18, and hole 64B in jaw 8B.

In order to provide relative adjustment between the positions of the insulation-crimping jaws and the connector-crimping jaws, alternative alignment holes are provided for the locking pin 58. Thus, holes 68A and 72A in jaw 8A are aligned, respectively, with holes 68B and 72B in jaw 8B. The corresponding holes 74 and 76 in jaw 18 are offset slightly relative to the hole 66 (Figures 6 and 7) so that the connector-crimping jaw 18 will assume any one of three positions relative to the insulation-crimping jaws 8 depending upon which of the three sets of holes is occupied by the locking pin 58. The opposing insulation-crimping jaws 6A, and 6B, are not locked to the connector-crimping jaw 16, but are free to pivot relative to each other about the pin 34.

In order to open and close the connector-crimping jaws 16 and 18, a toggle joint, generally indicated at 78 (Figures 8 to 11) is connected to these jaws and to a shank 82 which is releasably clamped into a split rocker arm 84 (Figure 2) by a screw 85 which is connected to the driving mechanism of the tool in such manner that the shank 82 is moved thereby along an arcuate path indicated by the arrow in Figures 8 and 9.

The shank 82 is provided with an off-set forked portion 87 (Figure 11) which straddles and is pivotally connected to the end of jaw 18 by a pin 96 retained by lock rings. This off-set portion forms one branch of the toggle and its other branch is formed by two parallel links 92A and 92B extending between the shank 82 and the other connector-crimping jaw 16. Each of the links 92 is pivotally connected to shank 82 by a pin 94 which extends through a hole 96 in shank 82 and is retained by lock rings 98. Near their opposite ends the links 92A and 92B are positioned on opposite sides of connector-crimping jaw 16 and are pivotally connected thereto by a pin 102, which is retained by lock rings 104. Thus, when the shank is moved in the direction of the arrow of Figures 8 and 9, the toggle joint 78 spreads the lower end of jaws 16 and 18, causing them to pivot about the pins 34 and 36, to bring the connector-crimping die surfaces 22 and 24 into closed position, the jaw 18 carrying with it the insulation-crimping jaws 8A and 8B.

In order to close the opposing insulation-

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crimping jaws 6A and 6B, the links 92A and 92B are provided, respectively, with bell-crank extension portions 106A and 106B which extend at an angle from direction of the body of the toggle link. The end of the bell-crank extension 106A extends into a U-shaped depression 108A in the lower end of jaw 6A and the end of the other bell-crank extension 106B extends into a similar U-shaped depression 108B on the lower end of jaw 6B. A camming action between the bell-crank portions 106A and 106B and the lower surfaces of the jaws 6A and 6B closes these jaws into crimping position, and produces the differential rate of movement between the insulation-crimping jaws and the connector-crimping jaws.

Figures 8, 9, and 10 show the relative positions of the jaws, when no connector is present between the jaws, with the shank 32 in different angular positions. Figure 8 shows the jaws in open position. It will be noted that jaws 6A and 6B, and also jaws 6B and 6B, are opened wider than the connector-crimping jaws 16 and 18, so that ample room is provided for inserting the connector without interference by the overlapping portions of the insulation-crimping jaws.

Figure 9 shows the jaws in partially closed position, the insulation-crimping jaws having advanced toward the closed position at a faster rate than the connector-crimping jaws. The reason for this differential movement is apparent from Figures 8, 9, and 10, where it is seen that the distance between the point where jaw 16 is pivoted on pin 34 and the pin 102 where the closing force is applied, is substantially greater than the distance between the pivot point of jaw 6A on pin 34 and the point where force is applied to it by the bell-crank extension 106A.

However, as the shank is moved in the same direction beyond the position shown in Figure 9, no further closing force is applied to the jaw 6A by the bell-crank 106A, because of the shape of the bell-crank portion 106A, and the shape and position of the adjacent surface of the U-shaped opening 108A, until the connector-crimping jaws 16 and 18 are substantially closed.

Figure 10 shows the connector-crimping jaws in closed position, but no substantial crimping force has been applied to the insulation-crimping jaws. Thus, the operation by which the heavy metal portion of the connector is crimped to the bare wire may be fully completed before the insulation-crimping operation occurs. The exact sequence of the crimping operation will depend upon the force necessary for the connector-crimping operation and the resistance of the parts of the tool head to elastic deformation. Thus, the tool may be arranged so that the two crimping operations are completed substantially simultaneously. The important thing is to prevent the insulation-crimping jaws from completely closing before the connector-crimping operation is completed, because the elastic deflection of the shorter insulation-crimping jaws may not be sufficient to insure satisfactory completion of the connector-crimping operation.

After the connector-crimping jaws 16 and 18 are completely closed or have met with a predetermined resistance to further movement, continued force applied to the toggle joint 72 causes elastic deflection or deformation of the jaws 16 and 18 and other parts of the tool head 2 and permits the bell-crank portions 106A and 106B to again exert a closing force on the insulation-crimping jaws 6A and 6B, which then crimp the ferrule portion of the connector around the in-

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sulation of the wire. That is, it is necessary to bend the jaws 16 and 18 and particularly the portion of these jaws adjacent the toggle mechanism in order to complete the application of the crimping force by the pairs of insulation crimping jaws. The positions of the jaws and the components of the toggle link 72 at the completion of the crimping operation are shown in Figure 12.

Thus, it is seen that I have provided for positive crimping of the connector to the wire and for the subsequent or simultaneous crimping of the thinner ferrule portion to the insulating covering. Differential movement of the jaws permits the connector to be easily positioned in the connector, the mechanism being such that the relative positions of the jaws in closed position can be easily adjusted.

From the foregoing, it is apparent that the crimping head described above is well suited to attain the ends and objects herein set forth, can be manufactured easily by conventional fabrication techniques, and that its various features and arrangements of parts can be modified readily to best suit it to a particular use. Certain features of the tool may be used to advantage in particular applications without a corresponding use of other features, and the elimination or modification of such features is to be considered within the scope of this invention unless specifically excluded by the following claims or required by the scope of the prior art.

I claim:

1. A connector-crimping tool for applying solderless connectors to wire, comprising a first, and at least a second laterally adjacent set of opposing and cooperating jaws each carrying a connector-crimping surface, unitary operating means for moving said jaws into and out of crimping relationship, and a force-multiplying mechanism connected to said operating means and including a first linkage engaging each of said first set of jaws and having a cam arm extension engaging at least one jaw of such second set of jaws, said cam arm extension having lost motion sufficient to delay crimping action of such second set of jaws until the relative motion between the first set of jaws has ceased and said force multiplying mechanism has significantly elastically deformed said first set of jaws, whereby a substantial crimping force is exerted by said first set of jaws, irrespective of their full closure, before the crimping action of such second set of jaws takes place.

2. In a connector-crimping tool for applying solderless connectors to insulated wire wherein a first crimping force is effective to crimp said connector directly to the conductive core of said wire and a second crimping force is effective to crimp said connector to the insulating covering of the wire, apparatus comprising first and second juxtaposed sets of opposing and cooperating jaws each carrying connector-crimping surfaces near one end, means pivotally supporting said jaws intermediate their ends, arcuately movable operating means for moving said jaws into and out of crimping relationship, a first linkage mechanism connected to said operating means and engaging the other ends of said first set of jaws from those carrying said connector-crimping surfaces and arranged to spread apart said other ends of said first set of jaws to bring their connector crimping surfaces into crimping relationship, an auxiliary bell crank linkage mechanism connected to said first linkage mechanism and having a free end engaging a wall of a cam

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surface in the edge of at least one jaw of said second set and responsive to the spreading of said other ends of said jaws of said first set beyond a predetermined amount, whereby substantial crimping force is applied to said second set of jaws only upon a predetermined spreading movement of the ends of said first set of jaws.

3. In a connector-crimping tool for applying solderless connectors to insulated wire wherein a first crimping force is effective to crimp said connector directly to the conductive core of said wire and a second crimping force is effective to crimp said connector to the insulating covering of the wire, apparatus comprising first and second juxtaposed sets of opposing and cooperating jaws each carrying connector-crimping surfaces near one end, a first pivot pin supporting intermediate portions of jaws of each of said sets, a second pivot pin supporting intermediate portions of the other jaws of said sets, first and second end plates supporting said pivot pins, movable operating means for moving said jaws into and out of crimping relationship, a toggle link connected to said operating means and engaging the opposite ends of said first set of jaws from the ends carrying said connector-crimping surfaces and arranged to spread apart said opposite ends of said first set of jaws to bring their connector-crimping surfaces into crimping relationship and to further spread said opposite ends within the limits of flexure of said first set of jaws, an auxiliary linkage connected to said toggle joint and engaging at least one jaw of said second set and responsive to the elastic deflection of said jaws of said first set beyond a predetermined amount, whereby substantial crimping force is applied to said second set of jaws only when a predetermined crimping force is exerted upon the jaws of said first set.

4. A connector-crimping tool for applying solderless connectors to wire, comprising first and second sets of pivotally-mounted opposing and cooperating jaws each carrying a connector-crimping surface associated with one end, one of said jaws of said second set having a cam surface, said jaws of said second set having overlapping surfaces adjacent said crimping surfaces, adjustable means locking one of the jaws of each set together for simultaneous movement, a flexible connection interconnecting said sets of jaws intermediate their ends, unitary operating means for moving said jaws into and out of crimping relationship, a toggle joint connected to said operating means and engaging said first set of jaws near the other ends from those carrying said connector-crimping surfaces, said toggle joint being arranged to spread apart said other ends of said jaws of said first set to bring the jaws into crimping relationship, and a jaw-

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actuating member extending from said toggle joint and engaging said cam surface of said jaw of said second set, said member being arranged for angular movement in response to actuation of said toggle to bring said second set of jaws into crimping relationship, and being arranged to provide greater angular movement of said second set of jaws than is imparted to said first set of jaws by said toggle joint.

5. A connector-crimping tool for applying solderless connectors to wire, comprising first and second sets of opposing and cooperating jaws carrying connector-crimping surfaces, operating means for moving said jaws into and out of crimping relationship, a toggle linkage mechanism connected to said operating means, said toggle linkage including an arm having a pivot and engaging one jaw of said first set, and a link connected to said arm and engaging the other jaw of said first set, said link including a lost motion cam engageable with at least one jaw of said second set whereby substantial crimping force is applied to said second set of jaws by said cam only upon the application of a predetermined crimping force by said first set of jaws.

6. Apparatus as claimed in claim 11 and wherein said cam surface is a U-shaped opening, the free end of said auxiliary bell crank linkage mechanism engaging one side wall of said U-shaped opening when said operating means and first linkage mechanism are actuated to move said first set of jaws into crimping relationship, the free end of said auxiliary bell crank linkage mechanism engaging the other side wall of said U-shaped opening when said operating means and first linkage mechanism are actuated to move said first set of jaws out of crimping relationship, whereby to move said second set of jaws into and out of crimping relationship when said first set of jaws are moved into and out of crimping relationship.

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