

Nov. 2, 1954

T. C. FREEDOM

2,693,218

CRIMPING TOOL

Filed Aug. 19, 1947

3 Sheets-Sheet 1

FIG. 6.

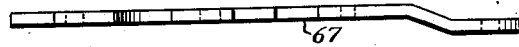


FIG. 1.

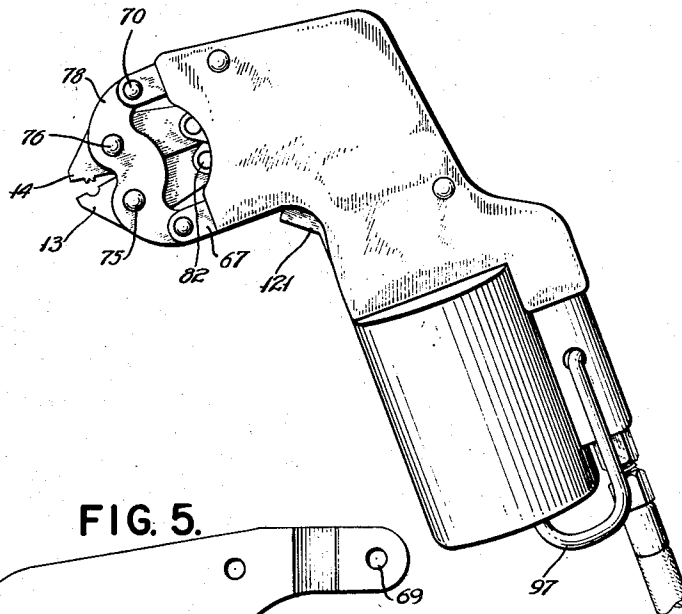
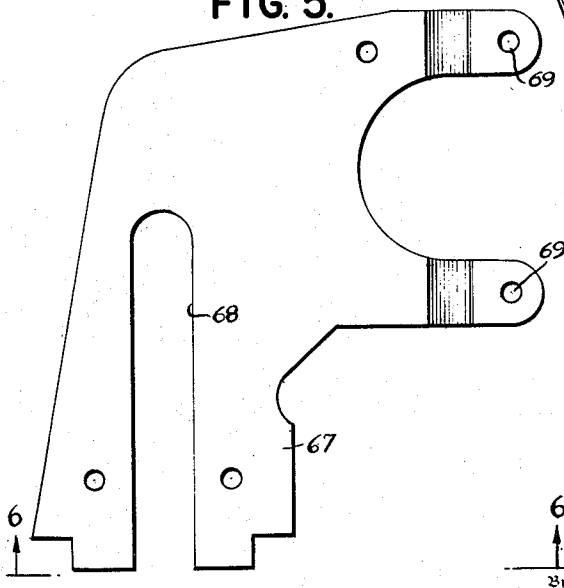


FIG. 5.



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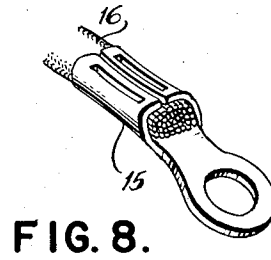
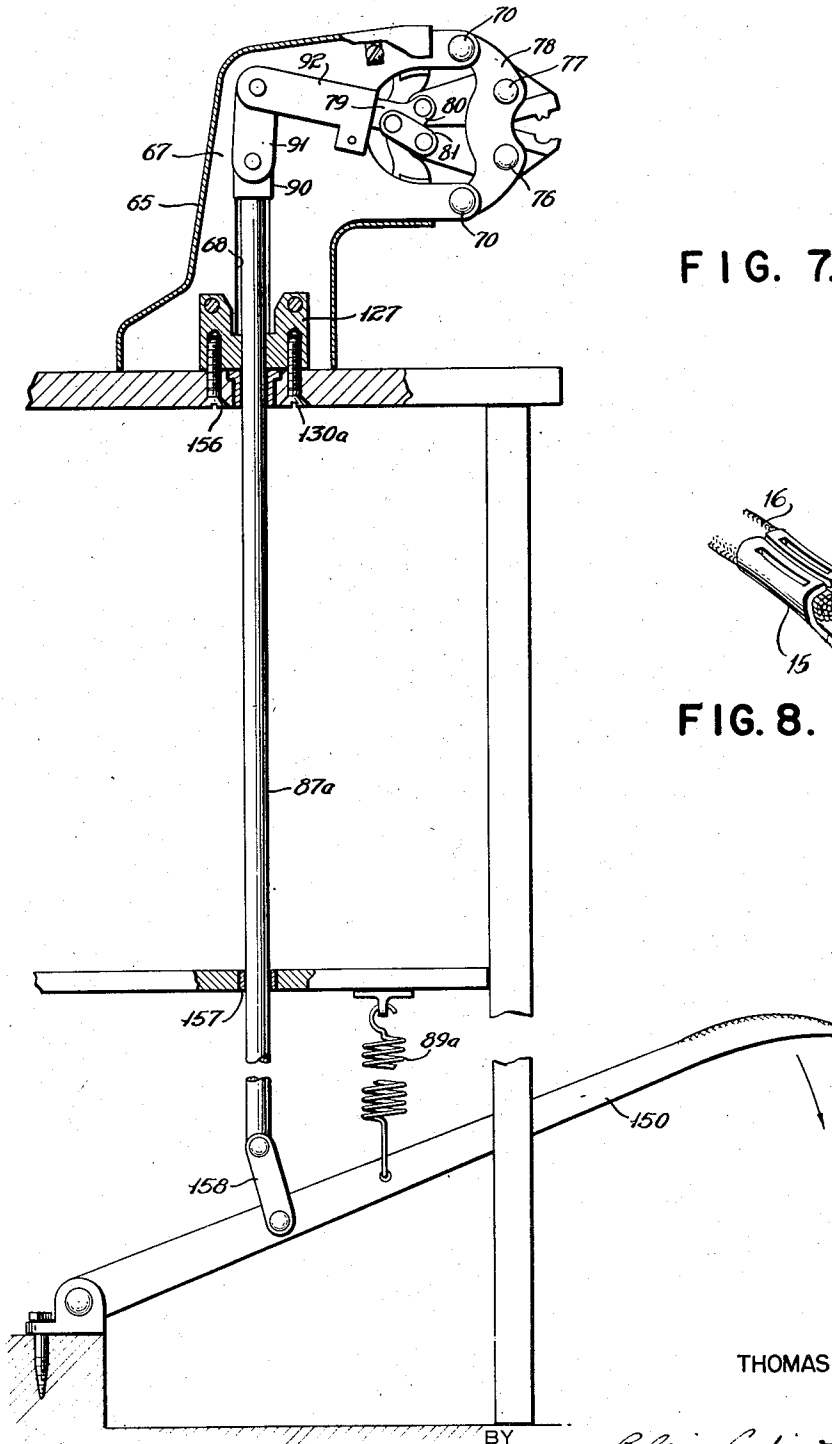
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## CRIMPING TOOL

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11 Claims. (Cl. 153—1)

The present invention relates to crimping tools, more particularly of the type employed in securing terminals to electrical conductors by pressing portions of the terminals on or around portions of the conductor.

Known devices for this purpose include portable hand tools provided with crimping dies which are moved by hand pressure against portions of the terminals to force the latter into firm engagement with portions of the conductors. There are also power operated crimping machines for large scale production of terminal equipped conductors.

An object of the present invention is to provide a crimping tool which will combine some of the advantages of a portable hand tool with accurately predetermined crimping pressure, and in general a precision which will assure uniformly excellent work.

A further object of the invention has been to provide a portable crimping tool having parts which can be easily and quickly interchanged, thereby enabling the user to apply varied sizes or types of terminals to varied sizes and types of conductors with various types of crimp connection. Thus it is feasible to provide for a single tool interchangeable die pieces adapted to secure suitable terminals on a wide range of conductors.

A further object of the invention has been to provide a portable crimping tool whereby the parts to be secured together by crimping are initially held in crimping position by a preliminary and relatively gentle gripping or clamping action and are then subjected to the final crimping pressure. An advantage in this feature is that it insures more accurately formed products, safer operation, and more rapid production.

Another object is to provide a standard tool which can be readily adapted for use with pneumatic, hydraulic, electric, mechanical or manual power, which is compact and light for use as a portable tool but can be readily mounted on a bench or in a standard press or on standard hydraulic, pneumatic and solenoid motors.

Another object is so to construct a crimping tool that the heavy duty parts are reduced to a few small parts and most of the parts can be made relatively light in weight and inexpensive.

Other objects and contemplated advantages and beneficial results in manufacture and use of said invention will more fully appear from the following specification and the appended drawings wherein a preferred embodiment and modifications thereof are described and illustrated. It is to be understood that these are not intended to be exhaustive or limiting but are intended for purposes of illustration in order that others skilled in the art may fully understand the invention, the principles thereof and the manner of applying it in practical use and so that they may modify and adapt it in various forms, each as may be best suited to the conditions of a particular use.

In said drawings, wherein like reference characters are employed to identify similar parts:

Figure 1 is a view in side elevation of a crimping tool of my invention shown in use;

Figure 2 is a side elevation with outer wall portions broken away of a further modification wherein power actuated devices are employed both in holding or gently gripping the parts to be secured together and also in applying the final crimping pressure thereto;

Figure 3 is a transverse section on enlarged scale on the line 3—3 of Figure 2;

Figure 4 is a view in perspective of a trigger lever for use in a device as shown in Figure 2;

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Figure 5 is a plan view of a side plate which when assembled in spaced relation with another like plate forms a piston guide and crimping jaw support, as shown in Figure 2;

Figure 6 is an edge view of said guide and support shown in Figure 5;

Figure 7 is a view partly in elevation and partly in section of a bench type root press; and

Figure 8 is a view in perspective of one form of terminal or connector applied to a conductor by crimping.

In using the portable fluid pressure operated crimping tool shown in Figures 1-6, the initial gripping or clamping of the terminal 15 on a conductor 16 is effected by applying less than full fluid pressure to close the crimping jaws lightly on the terminal. Crimping action of said jaws is then produced by applying full fluid pressure.

This tool, as best shown in Figure 2, comprises a frame, provided with hollow casing 65 having open ends, and cover plates at the sides to give a pistol grip portion shaped to fit comfortably in one's hand. At one of said open ends the die press assembly is mounted on the frame 65; and the crimping dies are carried on a pair of jaws in this assembly. Fluid pressure actuated jaw-operating means are secured to the frame at the other open end. The fluid pressure supply for the jaw-operating means is controlled by a valve responding to manual pressure on a trigger associated with the hand grip.

Within said casing 65 are spaced side plates 66 and 67, details of which are more clearly seen in Figures 5 and 6. Plate 66 is identical with plate 67 except that the outer end portions are bent upward instead of downward as seen in Figure 6. Each side plate 66, 67 is provided with a slot 68 which serves as a guide for reciprocating parts hereinafter to be described.

Outer end portions of said plates 66, 67 are also provided with holes 69 arranged to receive removable pins 70 (Figure 2), each of which has a head at one end and an annular groove at the other. A spring clip 71 with inwardly projecting portions which engage in said annular groove in a conventional manner retains each pin 70 in operative assembled position as shown, but allows for quick release and removal to interchange die press assemblies.

As seen in Figure 2, the crimping dies 13 and 14 are carried on a pair of cooperating pivotally mounted jaws 72, 73, which may be similar in construction and operation to like parts illustrated in U. S. Patent No. 2,359,083, with an interlocking roller 74 fitted in facing grooves to prevent endwise shifting between the jaws. Said jaws 72 and 73 are mounted between a pair of retaining plates 77 and 78 on pivots 75 and 76. Since the grooves for roller 74 swing about pivots 75 and 76 the roller moves back and forth with opening and closing of the jaws, and a slight change in the clearance for roller 74 in the facing slots occurs as the slots approach and recede from one another in their respective arcs of movement. In order to maintain precise relation of the crimping dies when they are under full pressure, the grooves are positioned so that, during the final closing of the dies under high pressure, these grooves swing in a narrow arc close to a line through the centers of the pivots 75 and 76. The roller 74 is made to fit exactly in the opposing grooves at a position well in advance of the final crimping position of the jaws 72, 73. As the jaws move to the end of a crimping operation their ends at 82 and 84 are pried apart against the work in the dies, considered as a fulcrum, and thus the plates 77 are subjected to increasing tension sufficient to accommodate the approaching arcs of the grooves and maintain the tight fit of the roller 74. At the end of the crimping operation the axis of roller 74 should be on or only slightly behind the common axial plane of pivots 75 and 76.

A jaw actuating toggle includes a shank 79, integral with the link arm 80, and a link 81. Arm 80 is pivoted to jaw 72 at 82, and link 81 is pivoted to arm 80 at 83 and to jaw 73 at 84. The arrangement is such that when shank 79 is swung downward (i. e., in a counter-clockwise direction on Figure 2), the jaws are moved to the open or full line position there shown. Movement of said shank in the opposite direction causes said jaws

to move first to terminal gripping position and finally to a closed or crimping position, indicated in dotted lines.

The toggle and jaw assembly above described is removably mounted between the projecting end portions of the side plates 66, 67 by means of pins 70 passing through aligned holes 85 in the retaining plates 77 and 78 and the holes 69 in side plate 66, 67. The pins 70 are secured in place by the quickly detachable snapping. Thus, assemblies forming heads provided with different types or sizes of dies may be readily interchanged for use with the jaw controlling and operating devices herein described.

Closing and opening movement of jaws 72, 73 is effected by fluid operated means including a piston secured to a plunger or piston rod 87 which reciprocates in a cylinder 88. A cylinder support or carrier block 127 is secured between plates 66, 67 by bolts 128; and a cylinder head 129 is secured to block 127 by screws 130. Said head 129 is retained in cylinder 88 by split rings 131 engaging interiorly open annular grooves 132. A spring 89 presses piston 86 toward its retracted position, as shown in Figure 2. Connection is made between the upper end of plunger 87 and the crimping head assembly through a clevis 90, a link 91, and a split clamping socket 92 having a recess open at one end to receive an end portion of shank 79 and provided with a clamping bolt 93, which releasably secures said shank in operative position.

Link 91 is connected to clevis 90 by a pivot pin 94. The outer end portions of said pin carry rollers 95 which ride in the guide slots 68 of side plates 66, 67, when plunger 87 is reciprocated to and from the dotted line position shown in Figure 2.

It will be understood that the initial portion of the outward stroke of plunger 87 is produced by application of relatively low pressure behind piston 86 in cylinder 88, as such movement is opposed only by the force of spring 89 and the friction of the pivots while jaws 72, 73 move toward a relatively light gripping position. After such initial gripping, application of increased pressure moves plunger 87 to its final crimping (dotted line) position.

In connection with the mode of operation hereinabove described, the outward or upward (Figure 2) thrust of plunger 87 transmits to shank 79 a force operating in a direction across the central longitudinal axis of said shank, which rocks said shank in a clockwise (Figure 2) direction from retracted to the extended position shown in dotted lines.

To actuate plunger 87 in the manner and for the purposes above described, fluid under pressure is admitted to cylinder 88 from a supply pipe 96 through a special valve and a connecting pipe 97. Said valve includes a low pressure valve chamber 98 and a high pressure valve chamber 99, said chambers being in open communication through a bleeder port 100. The low pressure chamber 98 connects with a slide valve chamber 116 and through it and port 101 to the inlet end of pipe 97. The inner end of chamber 116 is normally closed by a ball valve 102 yieldably seated therein by spring 111.

A conduit 103 between chambers 98 and 99 has its main opening into chamber 99 normally closed by a ball valve 104 yieldably seated by spring 105.

Under the ball valve 102 is a plunger having its lower end designed to engage ball 104. The stem 107 of this plunger is hollow to provide a central longitudinal passageway 108 open at one end through a port 109, and at the other end through slots 110. A spring 111 urges head 106 upward against valve 102. A wastage port 112 extending from port 101 to atmosphere has its effective extent of opening controlled by an adjustable screw 113 so as to limit the pressure built up in passage 116, 101 by the bleed passage 100.

An exhaust port 114 connects chamber 116 with atmosphere to discharge fluid pressure from cylinder 88 after the crimping operation has been completed. This port is controlled by the piston or slide valve 115. At the inner end of said plunger 115 is an extension or stem 117 of reduced diameter. An outward extension 118 of plunger 115 is threaded to receive adjusting nuts 119. A spring 120 bears against a nut 119 to hold plunger 115 normally in its upper position, as shown in Figure 2, in which the exhaust port 114 is clear and open; and the inner end of stem 117 is spaced from ball

valve 102. Under the same conditions the inner end of hollow stem 107 is spaced from ball valve 104.

Endwise movement is imparted to plunger 115 by rocking a trigger 121 pivoted at 122 and having an exposed finger piece 123 at one end and a transversely arranged connecting piece 124 at the other end. Said connecting piece is provided with a slot 125. The threaded extension 118 extends through said slot 125 and is engaged therewith by nuts 126. It will be apparent that spring 120 also biases trigger 121 toward its normal inoperative position, as shown in Figure 2.

In operation of a hand tool as above described, and assuming that the tool is held in one hand and a terminal is being held in position between dies 13, 14 with the operator's free hand, the trigger 121 is rocked by squeezing inwardly on the finger piece 123. This initial movement pushes plunger 115 inwardly, first to close the exhaust port 114 and then, by means of the extension 117, to unseat ball valve 102. Chamber 98 is thus opened to chamber 116; and the pressure fluid already in chamber 98, as well as that which leads through the bleed 100, is thereby conveyed to and through port 101. Piston 86 is moved by expansion of this pressure fluid and plunger 87 is thus advanced to close jaws 72, 73 until the terminal is lightly gripped between said dies 13, 14. In this position of the parts, the fluid pressure in chambers 98 and 116 and passage 101 is high enough to balance the gas discharges through the wastage port 112 with the in-flow through the bleed 100.

If at this point it appears that the terminal 15 is accurately positioned on the conductor 16 and that the terminal is in the correct operative relation to dies 13, 14, the operator applies additional inward pressure to finger piece 123 and further rocks trigger 121 to impart an additional increment of inward movement to plunger 115. In this movement stem 117, already bearing against ball valve 102, moves said ball farther inwardly, causing the inner end of hollow stem 107 to engage and unseat ball valve 104.

When the ball valve 104 is thus opened, an increased volume of fluid under pressure flows from chamber 99 through the slots 110, passageway 108, and port 109, into chamber 98 and thence through valve 102, chamber 116 and port 101 to pipe 97 and through it into cylinder 88. The minimum area of these passages, when the valves 102 and 104 are open, is so large that leakage through port 112 is insignificant.

This application of increased volume and hence of greater pressure to piston 86 produces further and final crimping movement of plunger 87 and of jaws 72, 73. It will be clear that with the parts arranged as described and shown, the toggle connection between plunger 87 and jaws 72, 73, supplies an increasing mechanical advantage, and therefore an increasing crimping force as the jaws close down on the terminal.

When crimping is complete, operator releases pressure on trigger 121. Spring 120 forces said trigger back to its initial inoperative position and at the same time retracts plunger 115 to clear the exhaust port 114; and to allow ball valves 102 and 104 to reseat aided by the line pressure and their respective springs. Back pressure from cylinder 88 thereupon discharges quickly through the exhaust port 114; and, as pressure recedes from cylinder 88, spring 89 forces plunger 87 back to its normal inoperative position. This movement opens jaws 72, 73, thereby releasing the crimped product and resetting the tool to receive the next terminal.

As will be readily understood by those skilled in the art, the fluid pressure motor shown in Figure 2 and described above is particularly designed for air pressure or other gas pressure. If the device is to be operated by liquid pressure, the bleed ports 100 and 112 and all the valve ports between 104 and 117 will usually be omitted, so that valve 104 is operated directly by the plunger 115 and the initial closing will be effected by merely "cracking" the valve 104 until the jaws are lightly closed. This simpler valve can be used also with air pressure but requires more accurate manipulation of the valve trigger.

Instead of the fluid pressure motor with its supply and exhaust valve controlled by a trigger, other types of reciprocating motors may be used with suitable controls operated by the trigger, and, as already mentioned above, the operating part of this apparatus may

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be connected to any type of fixed press or reciprocating mechanism to supply the power. As one example of this there is shown in Figure 7 a bench tool essentially the same as the operating head of the device of Figure 2 but using a foot lever 150 and pull rod 87a instead of the fluid pressure motor.

The block 127 in this case, instead of being attached to the cylinder head of the fluid pressure motor, is secured to the bench 154 by the screws 130a. Bushings 156 and 157 guide the pull rod 87a and the link 158 connects it to the foot pedal lever 150. Spring 89a serves to urge the device toward the open jaw position.

Since in this case it is convenient to operate with a pull on rod 87a, instead of a push, the toggle link arm 80 and shank 79 are inverted. Other parts may be substantially identical with those already described in connection with Figure 2 and are identified by the same reference characters.

It will be apparent from the foregoing description and the stated mode of operation of the several illustrated embodiments, that the present invention supplies a highly efficient crimping tool which combines the most advantageous features of hand and power operation. Other advantages in manufacture and use will be readily recognized by those skilled in the art.

What I claim is:

1. A tool for crimping metal terminal pieces in place on electrical conductors, comprising a casing, a connecting rod mounted for reciprocative movement therein, a socket member operatively connected to said connecting rod, a crimping head comprising spaced jaw retaining plates, crimping jaws pivotally mounted between said plates, a toggle lever pivotally connected to one of said jaws, a toggle link pivotally connected to the other of said jaws, and to said toggle lever, said toggle lever having a shank portion arranged and adapted to be releasably engaged with a portion of said socket member, crimping head supporting means mounted in said casing and having end portions extending therefrom, and means releasably engaging said end portions and said jaw holding plates of the crimping head and arranged and adapted to retain said crimping head in operative position on said support and with said shank portion of the toggle lever operatively engaged with said socket member.

2. A tool in which opposed jaws are interconnected for relative swinging movement into and out of work-engaging relation to each other at one side of their interconnection and having extensions on the other side thereof, said tool including in combination, a bell-crank located at said other side of the jaw interconnection and having one arm pivotally connected at its end with one jaw extension and a link connection from the juncture of its arms to the other jaw extension, means operating upon the other bell-crank arm for rocking said bell-crank about its pivotal connection with said one jaw extension to effect by toggle action jaw-closing and -opening movements of said bell-crank, a frame having a guideway arranged at an angle to the operating arm of the bell-crank, and a bell-crank operating slide mounted in said guideway and having a link connection to said bell-crank arm.

3. A tool according to claim 2 in which a fluid pressure cylinder has therein a piston connected to the bell-crank operating slide.

4. A tool according to claim 2 in which a fluid pressure cylinder has therein a piston connected to the bell-crank operating slide and in which there are a valve for controlling the introduction of fluid under low pressure into said cylinder, a second valve for controlling the introduction of fluid under high pressure into said cylinder, a trigger and operating connections between said trigger and said valves, including a lost motion connection to said high pressure controlling valve, whereby said valves are operated in low pressure-high pressure succession when said trigger is pressed.

5. A tool according to claim 2 in which a fluid pressure cylinder has therein a piston connected to the bell-crank operating slide and in which a conduit to the fluid pressure cylinder has a valve controlled port connecting it with a low pressure chamber and the low pressure chamber in turn has a valve controlled port connecting it with a high pressure chamber, said high pressure and low pressure chambers being connected by an open bleeder passage, and a trigger for controlling the operation of said valves has operating connections thereto, including

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a lost motion connection to the valve controlling the port to the high pressure chamber, whereby said valves are operated in low pressure-high pressure succession when said trigger is pressed.

6. A tool according to claim 2 in which a casing from which the jaws project has wall portions shaped to provide a hand grip extending in a direction at substantially right angles to the direction of projection of the jaws.

7. A tool in which opposed jaws are interconnected for relative swinging movement into and out of work-engaging relation to each other at one side of their interconnection and having extensions on the other side thereof, said tool including in combination, a bell-crank located at said other side of the jaw interconnection and having one arm pivotally connected at its end with one jaw extension and a link connection from the juncture of its arms to the other jaw extension, means operating upon the other bell-crank arm for rocking said bell-crank about its pivotal connection with said one jaw extension to effect by toggle action jaw-closing and -opening movements of said bell-crank, a slide-supporting frame having a guideway, a guide mounted in said guideway and having a link and socket connection to the toggle operating bell-crank arm, and means arranged and adapted for releasably retaining the socket and said arm in operative relation.

8. The invention of claim 1 wherein said tool is adapted to be supported by one hand and wherein said casing includes wall portions shaped to provide a hand grip.

9. The invention of claim 1 wherein said connecting rod is relatively long and extends from said casing to a point where reciprocative power may be applied to it.

10. The invention of claim 1 including a low power fluid pressure transmission system coupled with said connecting rod to move said jaws into terminal gripping relationship, and a high power fluid pressure transmission system including part of said low power system adapted to move said jaws from gripping relationship to crimping relationship.

11. A tool in which opposed jaws are interconnected for relative swinging movement into and out of work-engaging relation to each other and have extensions on the remote side of said interconnection, said tool having, in combination, a bell-crank located upon said remote side of the jaw interconnection, having one arm pivotally connected at its end with one jaw extension and having a link connection from the juncture of its arms to the other jaw extension, a frame supporting said jaw interconnection and having a guideway arranged at an angle to the operating arm of said bell-crank, a bell-crank actuating slide mounted in said guideway, a link connection from said slide to said bell-crank arm, a fluid pressure cylinder having therein a piston connected to said bell-crank actuating slide; a low pressure chamber and a high pressure chamber, a conduit between said fluid pressure cylinder and a first port connecting said conduit to said low pressure chamber, a first valve controlling said port, a second port connecting said low pressure chamber to said high pressure chamber, a second valve controlling said second port, said high pressure and low pressure chambers being connected by an open bleeder passage, a trigger for controlling the operation of said valves, said trigger being operably adapted to open said first valve, a plunger carried by said first valve and disposed to abut said second valve when said trigger is partly depressed and to open said second valve when said trigger is fully depressed.

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Oct. 28, 1941  
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