

Dec. 18, 1962

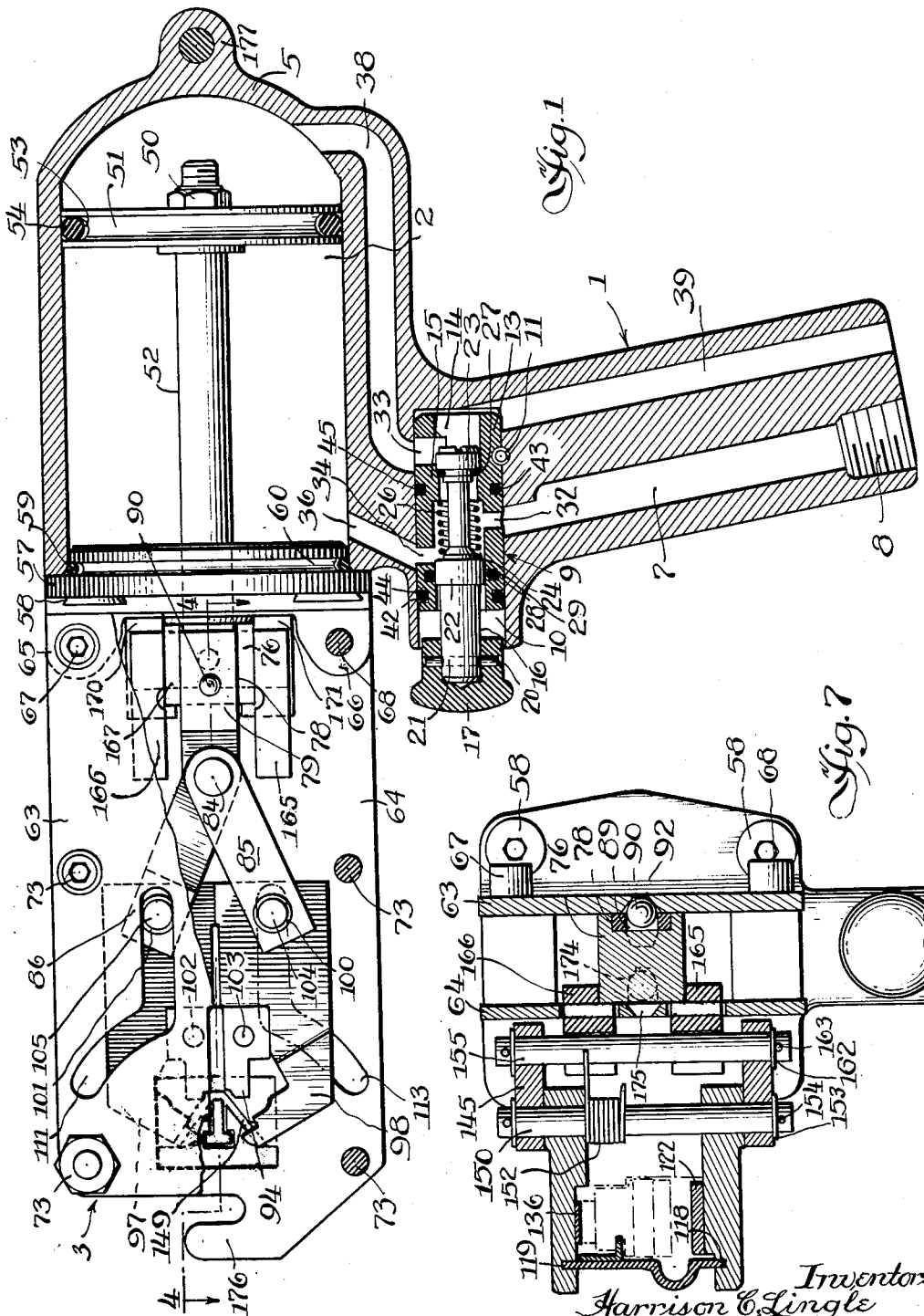
H. C. LINGLE ETAL

3,068,485

CRIMPING TOOL

Filed July 12, 1960

4 Sheets-Sheet 1



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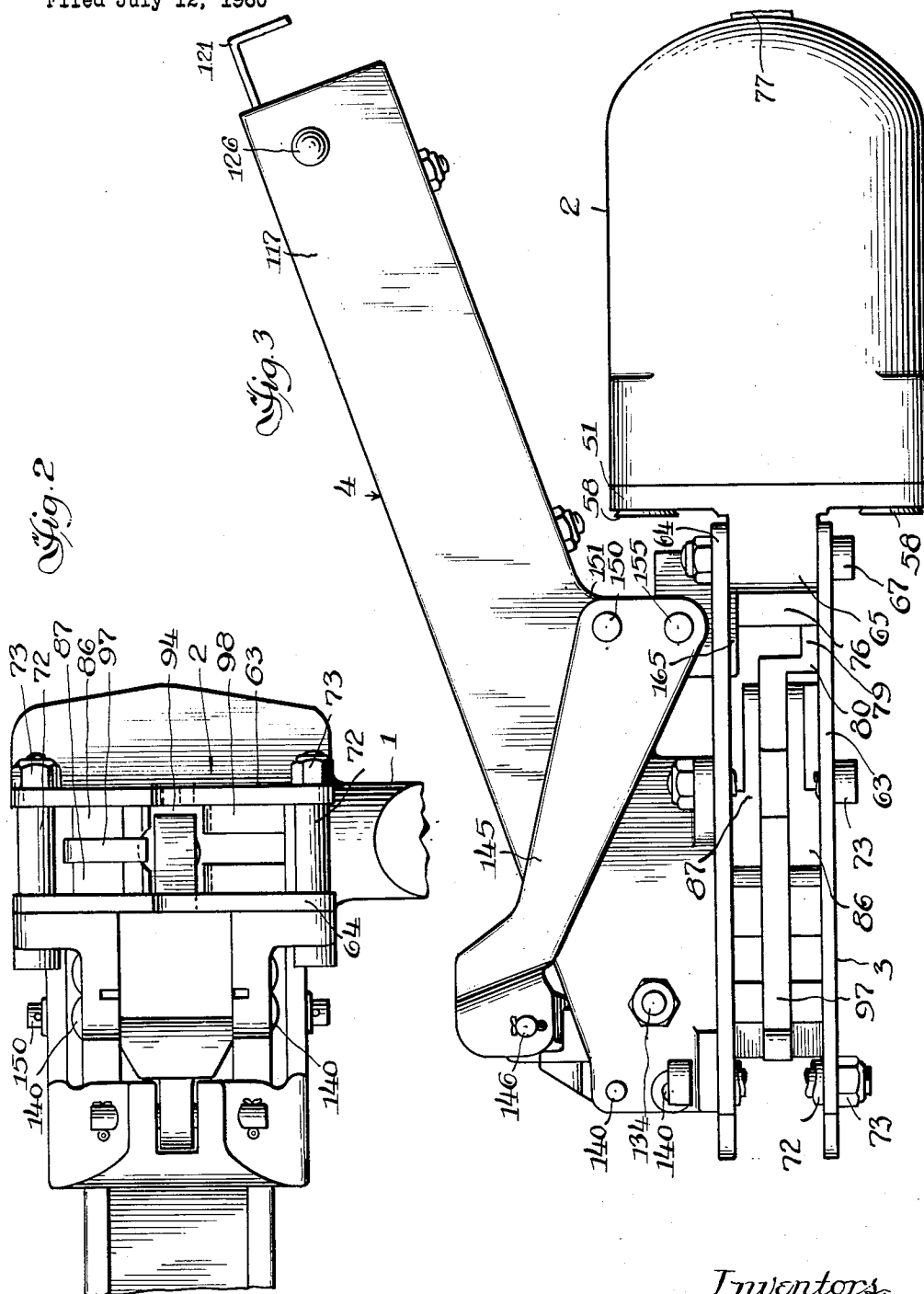
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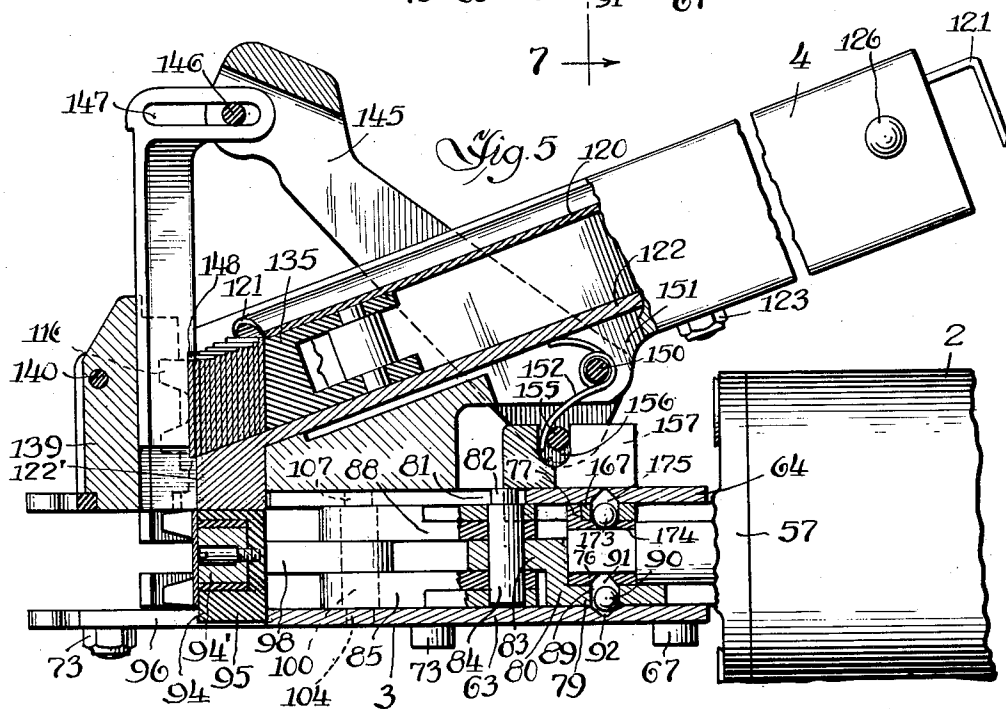
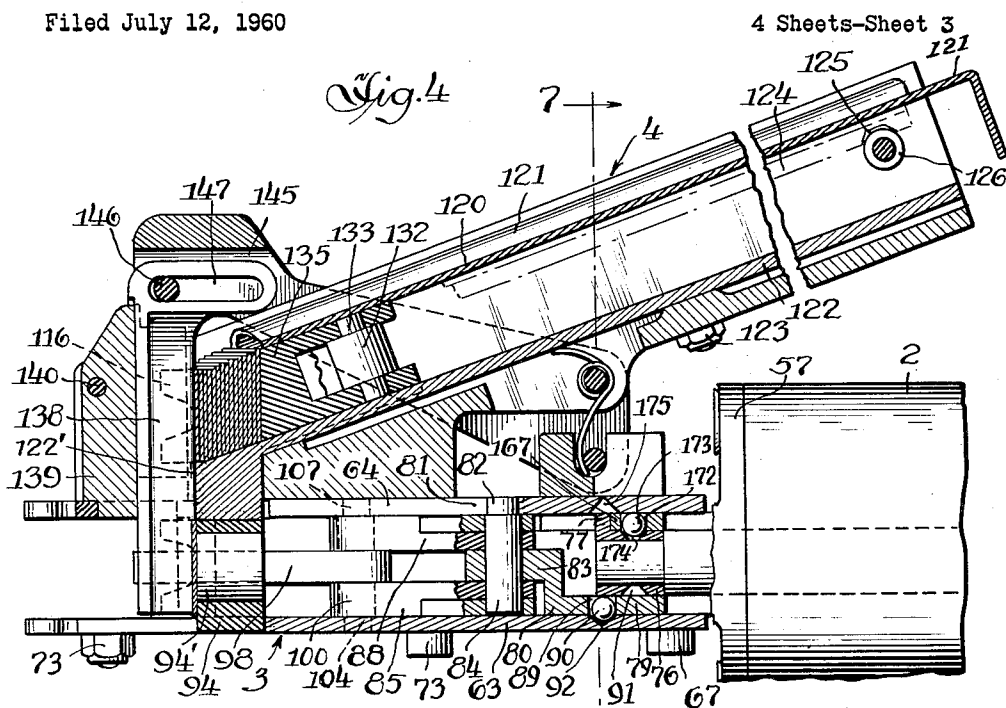
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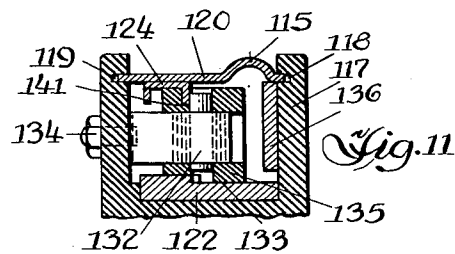
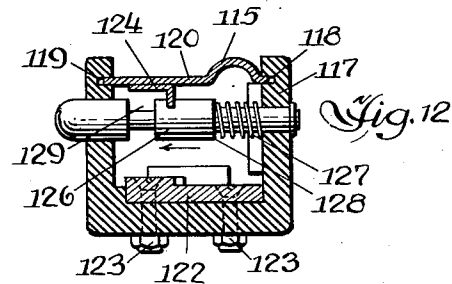
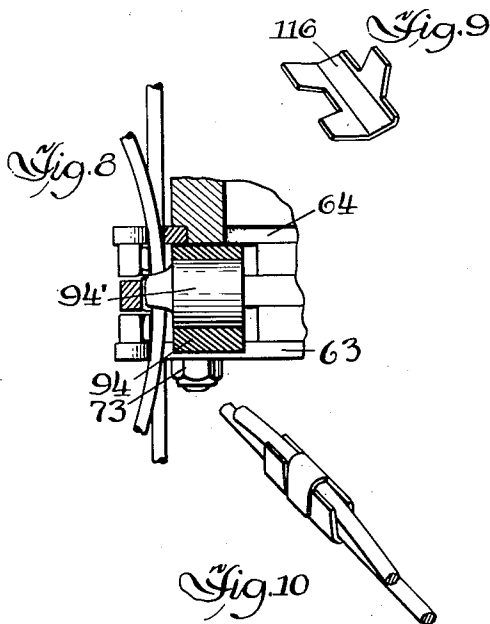
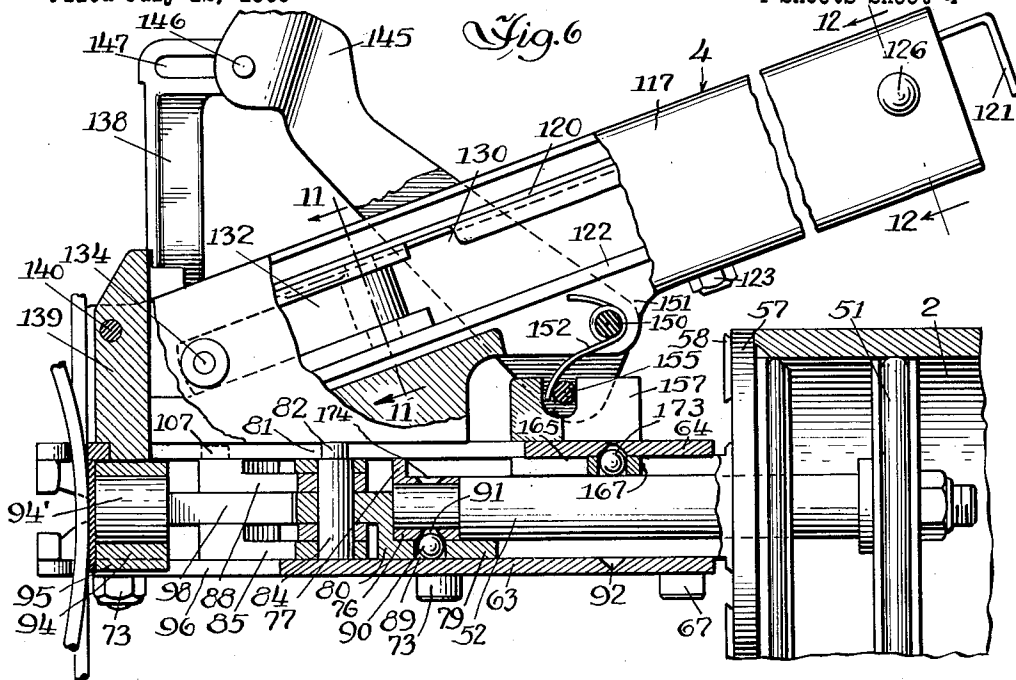
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3,068,485

CRIMPING TOOL

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Filed July 12, 1960, Ser. No. 42,268

10 Claims. (Cl. 1—187)

This invention relates to a crimping tool and more particularly to a tool which applies and crimps a clip or seal blank around overlapping or adjacent portions of a wire or other ligature, thereby sealing or securely fastening the same.

Devices embodying the present invention are of general utility and may be used in such environments as sealing overlapped ends of strapping or tying wire as well as for securely fixing together, by means of a crimped clip, adjacent wire members such as the individual coil springs and the frame therefor in a bed or other furniture spring assembly. Thus, while the principles of this invention have general applicability, the invention is described herein, for convenience and simplicity, with reference to a tool for crimping clips to tie adjacent wire members together, as an illustrative embodiment of the invention.

There are many unique and significant features incorporated in the present invention which represent a substantial advance in the art of crimping and sealing. Mechanisms embodying this invention are of higher efficiency and are more positive in operation. For example, the crimping jaw linkage is controlled by a unique and positive guiding cam and follower arrangement wherein a positive movement dependent upon the cam surfaces employed, is imparted to the linkage. Also, tools embodying the present invention and provided with a magazine for the clips or seals to be crimped have a unique, positively operating feed mechanism for moving a clip or seal from the magazine into a position nested in the crimping jaws of the tool. Further a new and improved drive coupling arrangement is effective, in one smooth and efficient movement, to coordinate and drive the clip or seal feeding and the crimping arrangements in timed succession.

As noted above, and as will be more fully evident hereinafter, many of the features of this invention are of general utility in various tools. They are particularly useful for crimping tools and may be employed with manual as well as with power operated tools. Although a power operated clip applying tool has been illustrated and described herein as an illustrative embodiment of this invention, it should be appreciated that the term "clip" as used hereinafter is intended to be and is used as a generic term for clips and seals etc., to be crimped.

The machine described and illustrated herein, is a pneumatically powered tool having a trigger operated control valve for a pneumatic piston which moves a ram head. The ram head is operatively connected to and forms a part of a coupling mechanism for transmitting power to a series of links connected to the crimping jaws. The coupling mechanism also transmits power to and operates the clip feeding mechanism which is cooperatively arranged with the clip magazine.

At the end of each ram stroke, an ejector, is actuated to eject a clip from the magazine and position the same between the crimping jaws. Then when the tool is positioned over the overlapping portions of the members to be secured together, the ram is moved so that the blank is bent and crimped by the crimping jaws.

Numerous other features and advantages of the present invention will become more readily apparent from the accompanying drawings which form a part of this specification, in which there is illustrated an embodiment of this invention, and in which:

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FIGURE 1 is a vertical cross-sectional view of an embodiment of this invention, with parts thereof broken away, to illustrate more clearly other parts thereof;

FIGURE 2 is a fragmental front view;

FIGURE 3 is a top plan view;

FIGURE 4 is a cross-sectional view taken substantially along the line 4—4 of FIGURE 1 and showing the mechanism with the ram in a fully retracted position;

FIGURE 5 is a view similar to FIGURE 4 but showing the mechanism with the ram in partly extended position;

FIGURE 6 is a view similar to FIGURE 4 but showing the mechanism with the ram in a fully extended position;

FIGURE 7 is a vertical sectional view taken substantially along the line 7—7 of FIGURE 4;

FIGURE 8 is a fragmental cross-sectional view of the crimping jaws, showing the same as they appear immediately after crimping a clip about two overlapping portions of adjacent wire members;

FIGURE 9 is a perspective view of an uncrimped clip blank;

FIGURE 10 is a perspective view of a crimped clip about two overlapping portions of adjacent wire members;

FIGURE 11 is a cross-sectional view of the clip blank magazine taken substantially along the line 11—11 of FIGURE 6; and

FIGURE 12 is a cross-sectional view of the magazine taken substantially along the line 12—12 of FIGURE 7.

The embodiment of this invention illustrated in the drawings has a pistol configuration. Broadly it consists of a handle 1, a pneumatic piston and cylinder 2, a crimper and drive coupling mechanism 3 and a magazine 4 for the clip blanks.

The Valve and Piston Mechanisms

The handle 1 has an air supply passage 7 with a threaded orifice 8, to receive an air supply hose. The air supply passage leads to a trigger valve mechanism 9 extending within a longitudinal bore 10 in the handle.

The trigger valve mechanism has a tubular valve housing body 13 fitted into the longitudinal bore 10. A transverse locking pin 11 extends across a chordal groove on the periphery of tubular body 13 to retain the same within the longitudinal bore 10.

The valve body 13 has an axial machined cavity 14 which has a step 15 therein that receives a plunger-type valve member 16. The valve plunger 16 reciprocates axially within the cavity 14 and extends past the forward end of the longitudinal bore 10. A cap-shaped finger piece or trigger 17 is affixed to the plunger by a transverse pin 20 for manual actuation of the valve.

The plunger 16 consists of two parts: a front cylindrical portion 21 having a first valve head 22 and a rear portion having a second valve head 23 which has a screw driver slot therein to facilitate assembly and disassembly of the two parts. The rearward face 24 of the first valve head 22 forms a shoulder against which one end of the valve spring 26 is seated. The other end of the spring bears against the shoulder formed by the ridge or step 15 in the tubular body 13 so that the spring normally biases the plunger 16 in a forward or outward direction.

The rearward or second valve head 23 carries a seal ring 27 which is disposed to cooperate with the valve seat formed at the rearwardly facing shoulder of annular ridge 15 and is biased thereagainst by the force of the valve spring 26 and the difference in force of air pressure acting on the two valve heads 22 and 23. Head 22 has a greater area than head 23 and, therefore, the plunger 16 is biased forwardly.

A front valve sealing ring 29 is disposed within an annular groove 28 on the inner surface of the tubular

valve body 13. This sealing ring cooperates with the first valve head 22 of the plunger-valve 16 to form a front air seal.

The tubular valve body 13 is formed with three radial openings 32, 33 and 34 which extend through the wall of the valve body and are so positioned that they communicate with the various air passages in the handle 1 and the piston-cylinder assembly 2. The valve opening 32 communicates with the air supply passage 7, opening 34 communicates with release or return stroke orifice 36 in the cylinder body 5, and opening 33 communicates with the drive or power stroke passage 38 in the cylinder body 5.

A clearance space behind tubular body 13 effects communication of power stroke passageway 38 with an air vent passage 39 contained in handle 1 for exhausting the head end of the cylinder. The rod end of the cylinder is exhausted by communication between the passage 36 and clearance about the trigger button 17. The valve body 13 is sealed in the handle by seal rings 42 and 43 which are sealed in peripheral grooves 44 and 45 in the outer surface of the body.

The trigger valve mechanism 9 described above permits controlled double stroke operation of the piston-cylinder assembly 2. This power mechanism includes a piston 51 secured to a piston rod 52 by a threaded nut 50. The piston body has a thick disk shape and in its periphery it has an annular groove 53 in which there is disposed a piston seal ring 54.

The piston is, of course, disposed to move axially of the cylinder cavity in the cylinder body 5 which is sealed at its rearward end by an integral dome shaped head, and at its rod end by a cover plate 57 which is secured to the cylinder body 5 by a number of bolts 58. A cover plate seal ring 59 is retained within a peripheral groove 60 on the inner projecting portion of the cover plate.

The position of piston 51 as shown in FIGURE 1 is its normal starting position because when the mechanism is connected to an air pressure supply, pneumatic pressure entering through passage 7 passes through valve openings 32 and 34 and through return stroke orifice 36 into the rod end of the cylinder to force the piston toward the head end of the cylinder (toward the right in FIGURE 1).

When the valve is operated by rearward finger pressure on the trigger 19, the front valve head 22 is moved rearwardly past the opening 34 to break communication between it and the air supply. Simultaneously the rear valve head 23, travels rearwardly to open orifice 33 to the air supply orifice 32 thereby permitting air to enter the head end of the cylinder. Thus, pressure is exerted on the piston 51 and it is forced forwardly or to the left in FIGURE 1. This forward movement expels air from the rod end of the piston 51 out through orifices 36 and 34 and through the clearance about the trigger button 19.

When the valve is released by the operator, the valve spring 26 and the greater force of the air pressure against valve head 22 as compared to valve head 23 forces the plunger forwardly to its normal position. This effects return of the piston to the head end of the cylinder by exhausting the air through the ports and passages 38, 33 and 39 and admitting air into the rod end of the cylinder through ports and passages 7, 32, 34 and 36.

Hence, by mere trigger depression the pneumatic force supplied to the mechanism causes reciprocation of piston 51 and piston rod of the power mechanism to drive the remainder of the mechanism. The forward end of the piston rod is tied to the coupling mechanism for driving the clip feeding and the crimping mechanism.

The Crimping and Coupling Mechanism

The crimping and coupling mechanism 3 of this invention include a pair of substantially rectangular, longitudinally extending parallel side plates 63 and 64.

These are fastened at their rear ends to lugs 65 and 66 on the cylinder cover plate 57 by bolts 67 and 68 respectively. The intermediate and front end portions of the side plates are held in parallel relationship by spacers 72 and bolts 73.

A block-shaped ram 76 is secured to the exposed end of the piston rod 52 for reciprocation therewith and a lug 77 extends from the front edge portion of one side of the ram 76 and acts as a sliding guide. On the opposite side of the ram 76 adjacent to the side plate 63, is a channel 78 (see FIGURE 1 and FIGURE 7) which slidably receives a leg 79 at the rearward end of a main link 80. The forward leg 83 of the main link 80 is affixed by a pivot pin 84 to two pairs of links 85, 86 and 87, 88 disposed on opposite sides, respectively, of leg 83. Pivot pin 84 has a side extension 82 which rides within slot 81 of side plate 64 to act as a guide for its reciprocal movement.

The leg 79 of the main link 80 has an aperture 89 therein which receives a steel ball 90 that acts as means to effect a unique lost motion, connect and disconnect coupling between the ram and the main link.

As best seen in FIGURES 4 and 5, ram 76 contains a detent hole 91. Another detent hole 92 is contained within side plate 63 at a point slightly forward of the position of detent hole 91 when ram 76 is in its rear-most position. The function of the detent holes 91 and 92 is to provide cam surfaces upon which the steel ball 90 can act and to provide for locking the link 80, selectively to the side plate and to the ram.

FIGURE 4 illustrates the starting position of the crimping mechanism. At this position, the steel ball 90 is located within the aperture or cavity 89 and detent hole 92 on the side plate. As the ram moves forwardly, upon initiation of the crimping stroke, the main link 80 remains stationary because the ball 90 locks the link to the side plate and there is only a slide connection between the link and the ram. When the front surface of the ram reaches the back surface of the main link, detent hole 91 is positioned over the steel ball 90, as best seen in FIGURE 5. The front surface of the ram 76 then bears against main link 80 and forces the main link forward. This causes the steel ball 90 to ride up over the front inclined surface and out of side plate detent hole 92 and partially into detent hole 91.

The ball 90 then provides a positive coupling between the ram and the main link and locks the same together as the ram moves to its forwardmost position seen in FIGURE 6. On the return stroke, the ram 76, acting through the steel ball, pulls the main link rearwardly. By the binding action on the steel ball, the ram and the main link travel rearwardly in unison until the rear surface of slide guide ear 95 of jaw pivot block 94 engages or contacts the rear boundary of slot 96 in side plate 63. Upon such contact, the cavity 89 and the detent hole 92 are so positioned that the steel ball 90 can move into detent hole 92. When this occurs, the main link is again locked to the side plate in a stationary position by the ball resting partially in the aperture 89 and partially in the detent hole 92, while the ram continues to travel rearwardly as the piston stroke is completed. A lost motion coupling and uncoupling connection between the piston drive and the main link is thus uniquely created. Such lost motion permits use of the initial and final stages of movement of the ram to control the seal feeding mechanism.

Reciprocation of the main link, as described above, drives the linkage and operates the jaws for crimping a clip or seal. The mechanism by which the crimping is effected includes the aforementioned connecting links 85, 86, 87 and 88 which are pivotally connected at their rearward ends to the main link 80. The forward ends of these links are connected, in pairs, to the rearward ends of a pair of crimping jaw links 97 and 98 by pivot pins 100

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and 101 respectively. The forward ends of the jaw links are formed as crimping jaws.

A jaw pivot block 94 with a centrally located magnetic insert 94' bolted axially therein and a slide guide ear 95 extending laterally therefrom into a slot 96 in the side plate 63 reciprocates within the forward end portion of the side plates. The jaw links 97 and 98 are pivoted to block 94 by jaw pivot pins 102 and 103.

When looking at a side view of the device as shown in FIGURE 1, jaw 97 is disposed over jaw 98. At a point removed and outward from the pivot point of each jaw with the pivot block, the links 86, 87 and 85, 88, are pivotally connected with jaws 97 and 98 respectively. The ends of the pivot pins 100 and 101 extend into angular cam slots formed in the side plates 63 and 64 and act as cam followers for controlled operation of the crimping jaws. Extension 104 of pin 100 extends into a cam slot in side plate 63 identical to cam slot 113 in plate 64. Extension 105 of pin 101 extends into cam slot 111 of side plate 63. The end of pin 101 opposite extension 105 extends into a cam slot in side plate 64 identical to cam slot 111 in plate 63 and extension 107 of pin 100 extends into cam slot 113 of side plate 64.

These pivot pin cam followers and side plate cam slots provide an unusually effective control for the crimping jaws. When ram 76 is advanced forwardly by pneumatic force, the pivot pins initially ride in the straight portion of their respective cam slots. During this movement, the jaws remain open but move forwardly. As the pins reach the elbow portions of the slots they are cammed outwardly. Such outward movement of the pins causes jaws 97 and 98 to pivot about the pivot pins 102 and 103 respectively and to close thereby sealing and crimping the seal blank held within the crimping jaw. During the crimping operation the pivot block remains in a fixed position.

It should be noted that the cam slots may be provided with other configurations to effect variation in movement over that shown. For example, the radius or the shape of the slot could be varied to provide for faster closure, or greater crimping force, or different linear movement of the crimping jaws. Obviously, many variations are possible.

On the return stroke of the piston the cycle of movement of the jaws and links is reversed so that the jaws first open to a cam controlled position free from the member on which the clip was crimped, and then move rearwardly to their normal rest position. When the jaws reach their rest position, a new clip is moved from the magazine 4 into position between the jaws by the clip feed mechanism.

The seal or clip blank 116 used in conjunction with the crimping mechanism forming the herein described illustrative embodiment of this invention is shown in FIGURE 9. In FIGURE 10 it is shown after it has been crimped around juxtaposed portions of adjacent wires.

The Magazine

The magazine 4 which holds a stack of clip blanks to be fed to the crimping mechanism is affixed to the outer side of side plate 64 by the extension of bolts 73. The magazine consists of an open chute 117, which may be made of a single casting having machined clip-blank guides or rails 122 and 136 (FIGURES 11 and 12) affixed to the inner surfaces thereof by bolts 123 for guidance of the blanks. The front edge of rail 122 is formed as a shear edge 122' shaped in accord with the back portion of the clip blank in the magazine. In cooperation with ejector 138, described below, it acts to slidably shear the front seal blank from the seal blank clip 116 contained in the magazine.

On the inner surface of the chute 117, near the edges thereof are two cover grooves 118 and 119 (see FIGURES 6, 11 and 12). A slide cover 120, having a handle 121 at its upper end and a longitudinal humped portion

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115 for clearance over the stacked clip blanks in the magazine is slidably disposed within the grooves.

Affixed to the undersurface of the cover is a locking flange 124 having recesses 125 and 130 therein, which permit locking the cover in either an open or a closed position. As shown in FIGURES 4 and 12, a notch 125 in the flange 124 is engaged by the locking pin 126 when the cover is in a closed position. The notch 130 of flange 124 seen in FIGURE 6 is engaged by the locking pin when the cover is in an open position.

The locking pin 126 itself extends transversely of the chute and is normally spring biased by spring 127 acting upon shoulder 128 in the direction of the arrow shown in FIGURE 12. An annular groove 129 on the locking pin 126 permits release of the locking pin from the notches 125 and 130, when the locking pin is depressed against the force of the spring by finger pressure on the exposed free end of the pin.

As seen in FIGURES 4, 5, 6 and 11, the magazine refilably carries a stack of clips or seals 116 which are biased toward the front of the tool by a coiled or reel spring 132 which is wound on a pin 133, affixed across the arms of a U-shaped seal blank follower 135. The free end of the spring 132 is affixed, by bolt 134, to the mount portion of the magazine.

The follower 135 is operatively coupled to the magazine cover by an inwardly extending tab finger 141. And, since the follower is biased forwardly by spring 132, the cover is also biased forwardly. However, both the cover and the follower can be locked by locking slot 130 in an open position to permit insertion of a stack of clips.

Transversely disposed across the mouth end of the magazine is a locating block 139, which acts to guide the ejector 138 of the clip feed mechanism in its transverse clip blank pickup and positioning movement. The block 139 is affixed within the mouth of the magazine by bolts 140. The inner surface of the locating block corresponds to the inner shape of the clip blank and acts as a saddle therefor. Thus, coupled with the shear surface of shear edge 122', it forms a properly shaped opening 149 adjacent the delivery zone of the magazine to permit delivery of the severed blank into the open crimping jaws.

The ejector is reciprocated across the mouth of the magazine by the action of a bifurcated or yoke-shaped lever 145. Lever 145 contains a pivot pin 146 which engages an elongated slot 147 in the outer end of the ejector 138. To effect travel of the lever 145 from a clip blank engaging or pickup position, such as shown in FIGURE 5, to a position where the clip blank is disposed between the jaws of the tool, such as shown in FIGURE 4, the lever 145 is pivoted about a mounting pivot pin 150 so that the pivot pin 146 is free to move forwardly and inwardly. A shoulder 148 on the ejector engages and severs the first clip blank by a lateral movement against edge 122' of rail 122 from the stacked blanks 116 within the magazine. It then pushes the severed blank through opening 149 formed between the shear edge 122' and the locating block 139 as described above, in the same plane as side plate 64 and places it in front of magnet 94' of jaw pivot block 94. The magnet holds the blank in the jaws until the blank is crimped about the juxtaposed wires to be sealed.

The lever 145 has two flat arms at its rearward inner end (shown vertically disposed in FIGURES 3-6), the upper end of each being mounted on the pivot pin 150 which is journaled within lugs 151 integral with the under-surface of magazine chute 117.

A spring 152, encircling pivot pin 150, biases the lever 145 in a counter-clockwise direction. Such bias force acts to move the seal blank once it has been severed from the clip as described in greater detail below. Washers 153 and transverse pins 154 retain pivot pin 150.

A drive pin 155, disposed across the open yoke portion of the arms of the lever 145 and held by washers 162

and pins 163, is engaged in an oversize slot 156 cut across the outer portion of a lever block 157 (see FIGURES 4, 5 and 6). This drive pin transmits the power of the pneumatic piston to the lever to raise the ejector to its full high position (FIGURE 5) against the force of spring 152, and, in combination with the force of spring 152, on the downward or seal engaging and positioning stroke, provide the added power to sever the front seal blank of the magazine contained clip. The force of the spring then positions the severed seal blank. The oversize slot 156 as shown by the various positions in FIGURES 4-6, acts to provide the proper sequence of force.

The lever block 157, as seen in FIGURES 1 and 3-6, extends through slots 170 and 171 in the side plate 64 for sliding movement longitudinally thereof and has two integral flat slide fingers 165 and 166 which are joined by a web 167. The fingers extend forwardly along the inner surface of the side plate. Forward movement of the block is limited by the length of slots 170 and 171 and the thickness of web 167.

The web 167 contains a steel ball cavity 172, for receiving a steel coupling ball 173. Detent holes 174 and 175 are located on ram 76 and side plate 64 respectively to co-act with the steel ball in similar fashion to the steel ball-detent holes of the main link-ram lost motion connection.

Specifically, when the ram is in complete rearward or release-stroke position (see FIGURE 4), detent hole 174 in the ram is positioned under the steel ball 173.

On initiation of the crimping stroke, the ram is moved forwardly from the position seen therefor in FIGURE 4. During such movement, the forward facing inclined surface of detent hole 174 locks against the steel ball 173 and moves the lever block forwardly to the position of FIGURE 5. Such forward movement causes the lever 145 to pivot in a clockwise direction and the ejector is drawn outwardly to a seal blank engaging position. When web 167 of the lever block 157 reaches the forward end of slots 170 and 171 in side plate 64 and when ram 76 reaches the back surface of main link 80, the detent hole 175 in side plate 64 is positioned exactly over the steel ball 173. The ball is then forced outwardly (upwardly in FIGURE 5) into locking hole 175 by the back angular surface of detent hole 174. The lever block and, hence, the ejector therefore, stop moving and are locked even though the ram continues to travel forwardly to the position of FIGURE 6, by force of the pneumatic piston.

On the return stroke, when the ram reaches the position of FIGURE 5, slide guide ear 95 of jaw pivot block 94 contacts the rear boundary of slot 96 in side plate 63. This positions detent hole 174 under the ball 173. The guide lug 77 of the ram 76 simultaneously engages the front surface of web 167. The ball 173 is forced down into the detent hole 174 to lock the block and the ram together. With continued rearward travel of the ram, the block is moved rearwardly by the aforesaid locking action as well as the action of guide lug 77 against the front surface of web 167. This movement causes the drive pin 155 to move the lever 145 counterclockwise. The ejector thereby severs the front blank from the seal blank clip and positions it against jaw pivot block 94. In this position, it is within the open crimping jaws where it can, upon crimping action of the mechanism, be sealed about the juxtaposed portions of the ligature.

It should be noted that the lost motion connection between the ram and the lever block permits unique actuation of the ejector at the initiation, and at the termination of the crimping stroke.

The front end of the side plates contains a wire engaging hook 176 which is positioned by the operator under the juxtaposed portions of the wire prior to the initiation of the clip applying and crimping stroke. In operation, the crimping jaws move to the front of the

side plates and around the hook-held wires to crimp a clip blank around the juxtaposed portions.

An eye piece 177 in the dome of the housing of the pneumatic power means is used to secure the machine to a balancing weight thereby relieving some of the load required to transport the machine.

Operation of the Mechanism

To use the machine, the operator initially loads the magazine with seal blanks. This is accomplished by opening the magazine by depressing locking pin 126 and sliding the cover 120 outwardly to an open position. A stack of seal blanks 116 such as shown in FIGURES 4 and 5, is then placed into the open magazine. The locking pin 126 is again depressed and cover 120 is moved back into a magazine closing position and locked when the locking pin 126 engages slot 125. The male end of a pneumatic supply conduit is then threadably secured to threaded air passage orifice 8.

The juxtaposed portions of the ligature or wires to be clipped or sealed together are then engaged by the hook 176 of the machine. When the operator presses trigger 19, air travels to the head end of the cylinder to force piston 51 forwardly of the machine.

In the initial stages of the forward motion of the piston, piston rod and ram, the lever block 157, the lever 145 and the ejector 138 are actuated. Such actuation occurs through the camming and locking action of the front facing inclined surface of detent hole 174 acting upon steel ball 173 contained within web 167 of lever block 147. Lever block 147 is thus moved forwardly. When the lever 145 assumes an outer or withdrawn position (FIGURE 5), by the forward motion of lever block 147, web 167 of the lever block has reached the depth of slots 170 and 171 within the side plate 64 and detent hole 175 on side plate 64 is positioned directly over the steel ball of web 167. As discussed above, the steel ball is cammed upwardly into this cavity and the lever block is locked against further forward movement.

With the positioning of detent hole 175 over steel ball 173 of the web, the steel ball 90 of the main link, the detent hole 91 on the ram and the detent hole on side plate 63 also assume an aligned position. Furthermore, at this point, the front surface of the ram engages the back surface of the main link 80 and forces the latter forwardly. Steel ball 90 is cammed upwardly into cavity 89 and detent hole 91 and the ball locks the main link to the ram. The ram continues to move forwardly by force of piston 51. Such continued forward movement of the ram causes the pivot pin 84 connecting the main link and the crimping jaw to also travel forwardly. Simultaneously, the pivot pins 100 and 101 between the links and the crimping jaws move forwardly and then outwardly because of the camming action of the cam slots 110, 111, 112 and 113 upon the extended ends of pivot pins 100 and 101. Outward movement of the pivot pins 100 and 101 causes the crimping jaws 97 and 98 to close and crimp a clip blank, contained within the crimping jaws, around the juxtaposed portion of ligature.

On the return stroke of the piston, caused by release of the trigger, the links are pulled rearwardly by the camming or locking action of the rearward facing sloping surface of detent hole 91 upon steel ball 90.

At the same time the co-action of the pivot pin cam followers and the cam slots in the side plates pivot the links inwardly and open the crimping jaws.

When slide guide lug 77 of ram 76 engages web 167 of lever block 157, slide guide ear 95 of jaw pivot block 94 engages the rear boundary of slot 96 as a stop therefor. This positive stop aligns the mechanisms so that the steel ball 90 can be, and in operation is then forced into detent hole 92 on side plate 63 to lock the crimping mechanism against further rearward travel. The lever block 157 is then pulled rearwardly by the action of slide guide lug

Engagement of the lug 77 with the block 157 causes the ball 173 to be forced out of the recess 175 and into recess 174 thereby locking the block 157 and the ram 76 together.

Rearward movement of the block 157 causes a counter-clockwise pivoting action of the lever which causes the ejector 138 to pick up and deliver the front clip blank from the stack through opening 149 into the open mouth of the crimping jaws. Upon complete rearward movement of the piston, no further action occurs until the trigger is again depressed.

It will be appreciated that numerous modifications may be made without departing from the scope of the invention. For example, the angular shape of the cam slots may be modified to provide a different movement of the link-crimping jaw pins. For example, an outward arcuate sloping surface, or a stepped surface for initial sealing and tight crimping action might be utilized, and the link pin extensions might be modified with rollers to ease the action or force required. Also, the crimping jaws and the ligature engaging hook might be redesigned to permit the sealing and crimping of flat strapping.

Although an illustrative embodiment of the invention has been described in considerable detail, it should be understood that the description and the modifications indicated were intended to be illustrative only, rather than restrictive.

We claim:

1. A crimping tool comprising power means, crimping means connected to said power means, and control means for actuating said power means, said crimping means comprising a pair of parallel side plates having cam slots therein, a block reciprocally mounted between said side plates, and a pair of crimping jaws pivotally mounted on said block, link pins affixed to said crimping jaws, links pivoted to said link pins and connecting said crimping jaws to said power means, said link pins extending into the cam slots in said parallel side plates, said slots being so formed that a pivotal movement is imparted to said crimping jaws when said power means is actuated.

2. A crimping tool comprising a power drive means, clip blank feeding means and crimping means, a first lost motion means operatively connecting said feeding means to said power means, a second lost motion means operatively connecting said power means to said crimping means, and control means for actuating said power drive means, said clip blank feeding means comprising a clip blank magazine, and clip blank ejector means therefor, said ejector means being operatively connected to said power means through said first lost motion means so as to cause delivery of a clip blank into said crimping means at the completion of each crimping stroke.

3. A crimping tool comprising power drive means, clip blank feeding means and crimping means both operatively connected to said power means, and control means for actuating said power drive means, said clip blank feeding means comprising a clip blank magazine with its mouth adjacent to the crimping means, a reciprocating seal blank ejector disposed adjacent the mouth of said magazine, and an actuator for said ejector pivotally mounted to said magazine, a transverse pivot pin-elongated slot connection between said actuator and said ejector, and a lost motion connection between said actuator and said power means so that upon initiation of the sealing stroke and the termination of the release stroke of said crimping means, said actuator will move said ejector to a clip blank engaging position and then to a clip blank delivery position.

4. A crimping tool comprising power drive means, clip blank feeding means and crimping means both operatively connected to said power means, and control means for actuating said power drive means, said clip blank feeding means comprising a channel shaped clip blank magazine having a mouth adjacent to the crimping means, a cover on said magazine, a reciprocating seal blank

ejector secured to the magazine at the mouth thereof, a magazine straddling actuator yoke member with two flat arms each pivotally secured to a cam pin extending therebetween and pivotally secured to the undersurface of said magazine, a transverse pivot pin-elongated slot connection between said actuator yoke member and said ejector, and a reciprocating slide block operatively connected to said cam pin and actuated through a lost motion connection to said power drive means.

5. A crimping tool comprising power drive means, clip blank feeding means and crimping means both operatively connected to said power means by lost motion coupling means, and control means for actuating said power drive means, said clip blank feeding means comprising a side plate on said tool, a channel shaped clip blank magazine secured to said side plate and having a mouth adjacent to the crimping means, a cover for said magazine, a reciprocating clip blank ejector secured to the mouth of said magazine, a magazine straddling actuator yoke member with two flat arms each pivotally secured to a first pin extending across said two arm members and pivotally secured to the undersurface of said magazine, a transverse pivot pin-elongated slot connection between said actuator yoke member and said ejector, and a reciprocating slide member operatively connected to said first pin and actuated through a lost motion connection to said power drive means, said lost motion connection comprising a ball projecting from a ball cavity in said reciprocating slide member, a ram on said power drive means, a ball detent hole in said ram into which said ball projects whereby a locking action is imparted by said ram on said ball and said reciprocating slide member, and a detent hole in the side plate for release of said ball from said locking action.

6. A crimping tool comprising power drive means, clip blank feeding means and crimping means both operatively connected to said power means by lost motion coupling means, and control means for actuating said power drive means, said clip blank feeding means comprising a side plate on said tool, a channel shaped clip blank magazine mounted on said side plate and having a mouth adjacent to the crimping means, a reciprocating clip blank ejector secured to the mouth of said magazine, a magazine straddling actuator yoke member with two flat arms each pivotally secured to a pin extending across said two arm members and pivotally secured to the undersurface of said magazine, a transverse pivot pin-elongated slot connection between said actuator yoke member and said ejector, and a reciprocating slide member operatively connected to said yoke member and actuated through a lost motion connection to said power drive means, said lost motion connection comprising a ram slidably engaging said reciprocating slide member and connected to said power drive means, a ball projecting from a ball cavity in said reciprocating slide member into a detent hole in said ram whereby a locking action is imparted in one direction by said ram on said ball and said reciprocating slide member, and a detent hole in the side plate so positioned as to permit release of said ball from said locking action when said yoke member has lifted said ejector to a clip blank engaging position, said ram having another surface to engage said slide member to effect positive movement of said reciprocating slide member in a direction opposite to said direction caused by the locking action of said steel ball and ram.

7. A crimping tool comprising power drive means in a housing, clip blank feeding means and crimping means both operatively connected to said power drive means, and control means for actuating said power drive means, said power drive means comprising a pneumatically operated piston within a cylinder housing, a piston rod projecting from said cylinder housing and a ram affixed to the projecting end thereof, said clip blank feeding means comprising a first side plate affixed to said cylinder housing, a channel shaped clip blank magazine secured to said

side plate and having a mouth adjacent to the crimping means, a cover for said magazine, a reciprocating clip blank ejector secured to the mouth of said magazine, a magazine straddling actuator yoke member with two flat arms each pivotally secured to a pin extending across said two members and pivotally secured to the undersurface of said magazine, a transverse pivot pin-elongated slot connection between said actuator yoke member and said ejector, and a reciprocating slide member operatively connected to said cam pin and actuated through a lost motion connection to said power drive means, said lost motion connection comprising a ball projecting from a ball cavity in said reciprocating slide member, and a ball detent hole in said ram of said piston rod into which said ball projects, whereby a locking action is imparted by said ram on said ball and said reciprocating slide member, and a detent hole in said first side plate for release of said ball from said locking action, said crimping means comprising a second side plate parallel to said first side plate and both secured to said cylinder housing, and each having cam slots therein, a pivot block slidably mounted between said side plates, a pair of crimping jaws pivotally mounted on said block, link pins affixed to an outer portion of each of said crimping jaws, a main reciprocating link, links pivoted to said link pins and connecting said crimping jaws to said main reciprocating link, said link pins extending, at their ends, into the cam slots in said parallel side plates, said slots being formed in an outwardly flaring direction so as to impart a crimping and a release movement to said crimping jaws as said main link reciprocates between said side plates, said main link being operatively connected by a lost motion connection to said ram on said piston rod extension, said lost motion connection comprising a slidable engagement of said main link with said ram, a ball projecting from a ball cavity in said main link into a ball detent hole in said ram whereby a camming and locking action is imparted in one direction by said ram on said ball and said link, and a detent hole in one said second side plate so positioned as to release said ball from said locking action, said ram having another surface to effect positive movement of said main link in a direction opposite to said one direction.

8. In a crimping tool having a pair of crimping jaws as the crimping means pivotally mounted on a reciprocating block, link pins affixed to an outer portion of said crimping jaws, links pivoted to said link pins and connecting said crimping jaws to a main reciprocating link, said link pins extending, at their ends, into cam slots, said slots being so formed that a pivotal movement is imparted to said crimping jaws as said main link reciprocates.

9. A crimping tool comprising a power means, clip blank feeding means and crimping means, a first lost motion means operatively connecting said feeding means to said power means, a second lost motion means operatively connecting said power means to said crimping means, and control means for controlling the operation of said power means, said clip blank feeding means comprising a clip blank magazine and clip blank ejector means operatively connected to said power means through said first lost motion means whereby the clip ejector means and crimping means will be sequentially operated to feed and crimp the clip blank to seal overlapped ends of wires or other members together.

10. A crimping tool including power drive means; clip blank feeding means and crimping means operatively connected to said power means; said clip blank feeding means comprising a clip blank magazine, a clip blank ejector, and means for actuating said ejector; and a lost motion connection between the actuating means and power means whereby after the actuating means has moved the ejector to place a clip blank in said crimping means the power means may continue to operate said crimping means independently of the clip blank feeding means.

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