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APPARATUS FOR MAKING ELECTRICAL CONNECTIONS

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Fig. 3

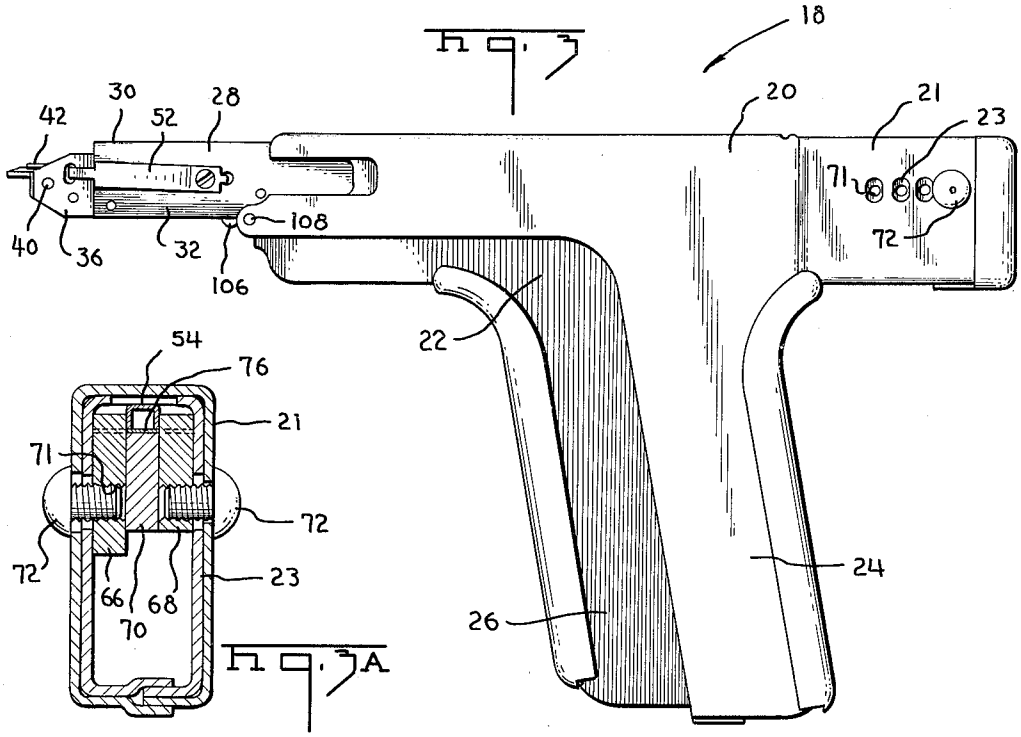


Fig. 3A

Fig. 1

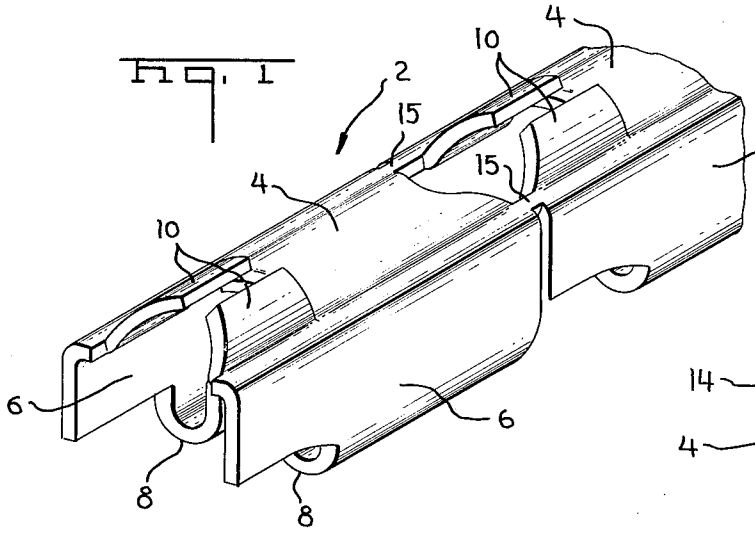
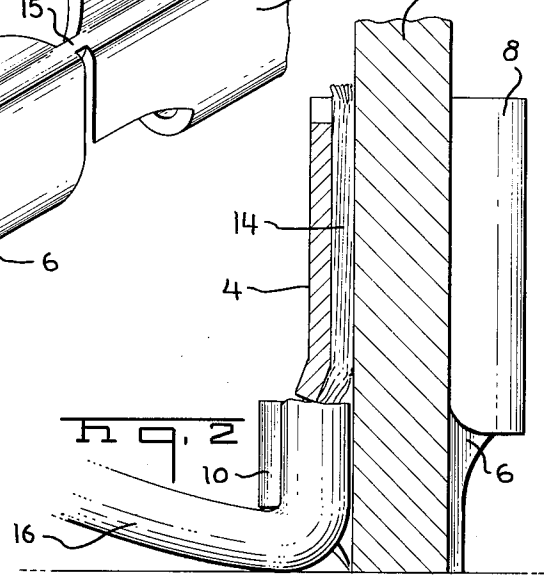


Fig. 2



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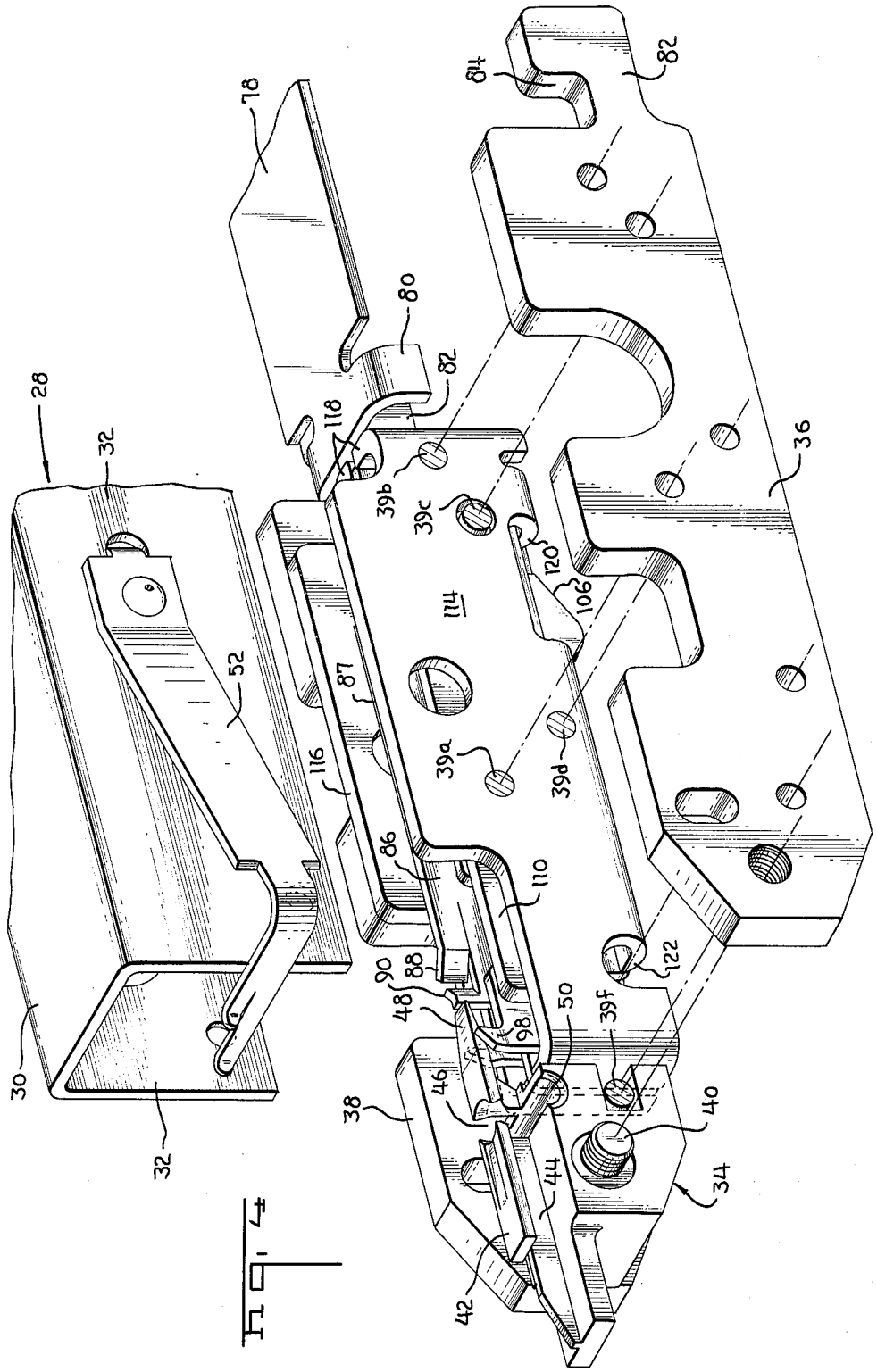

FIG. 4

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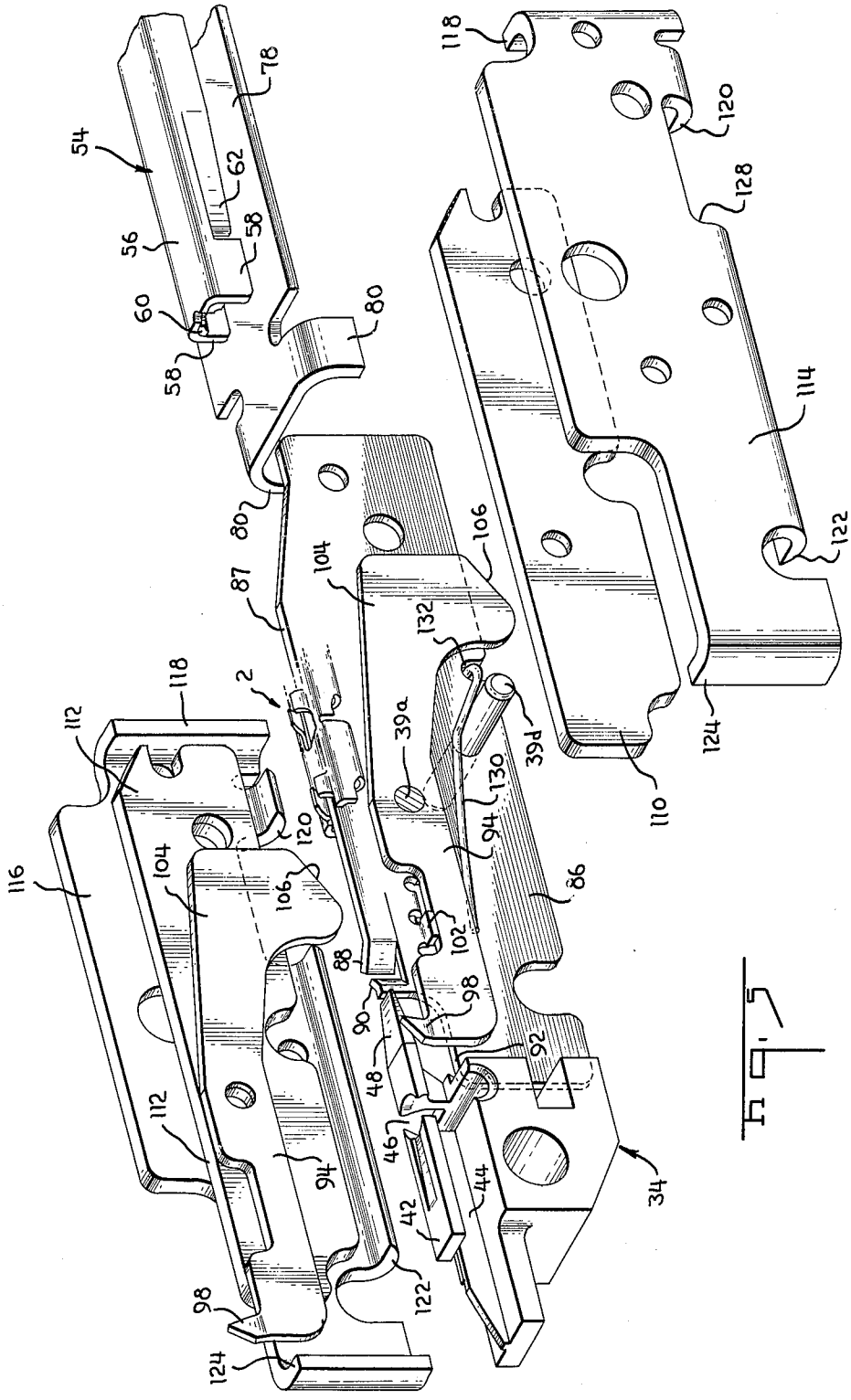

FIG. 5

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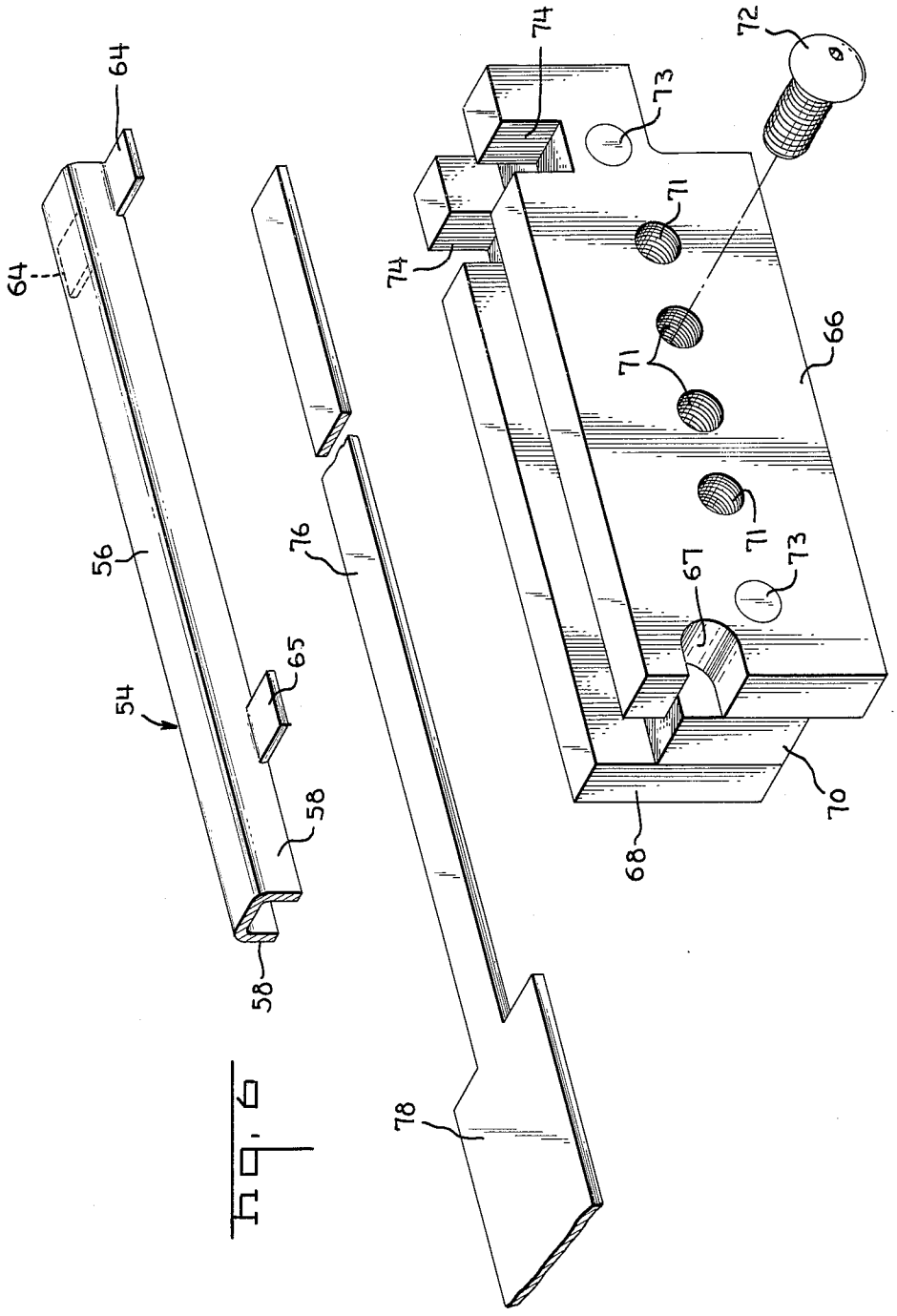

Fig. 6

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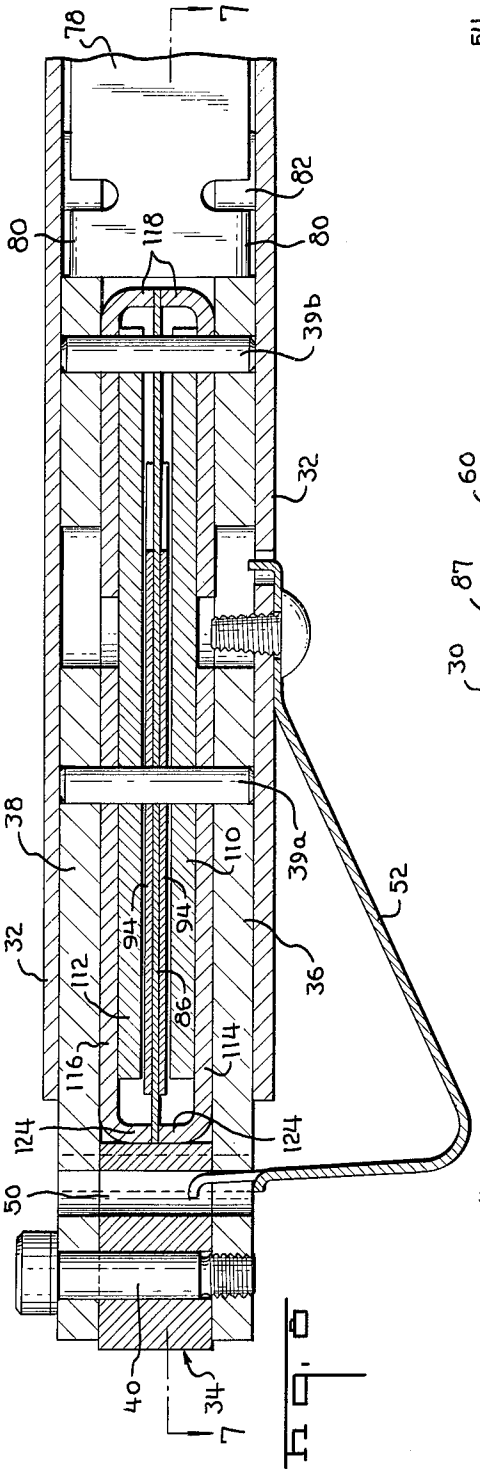

FIG. 8

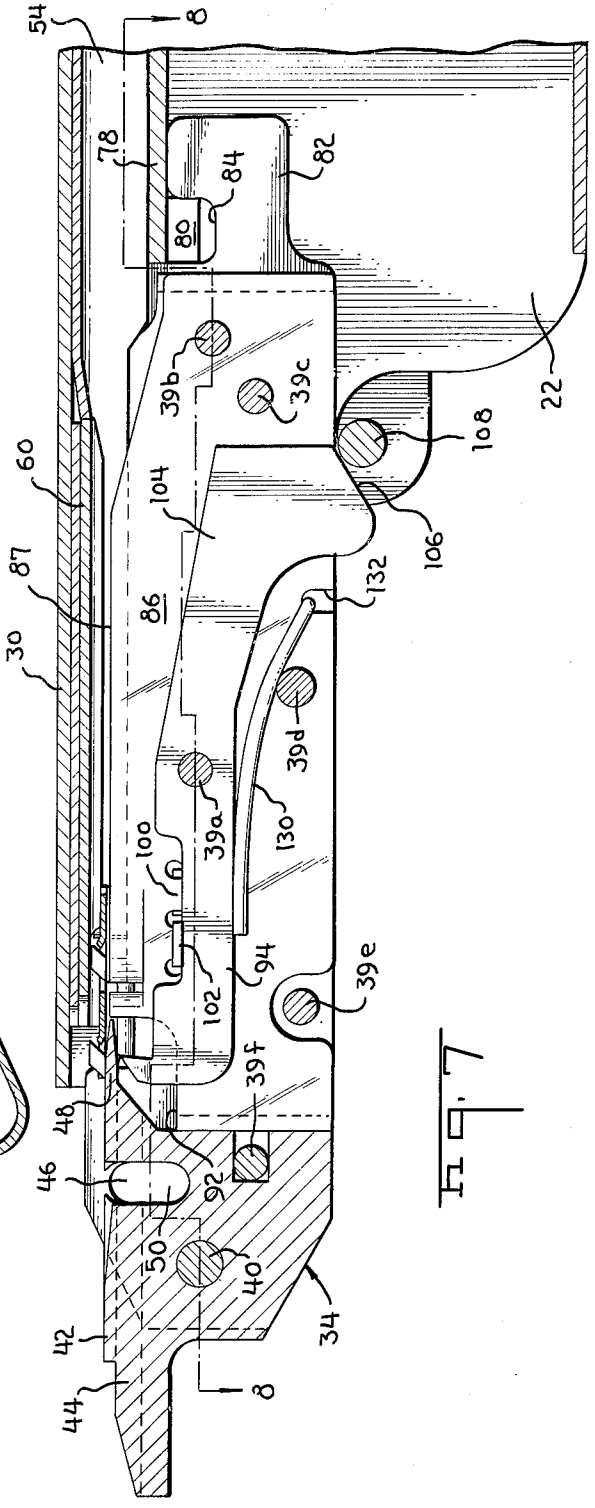

FIG. 7

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FIG. 11

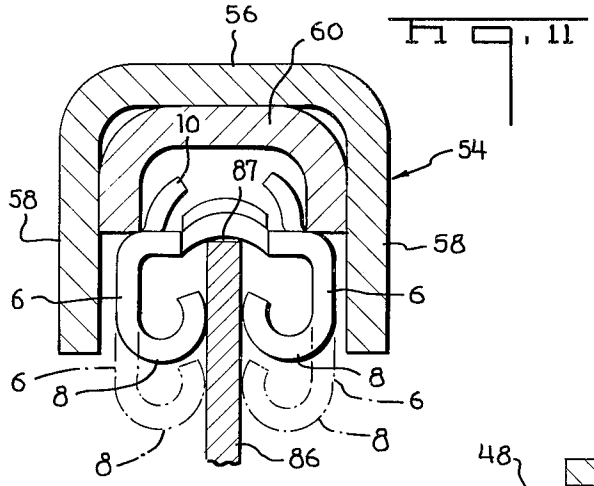


FIG. 10

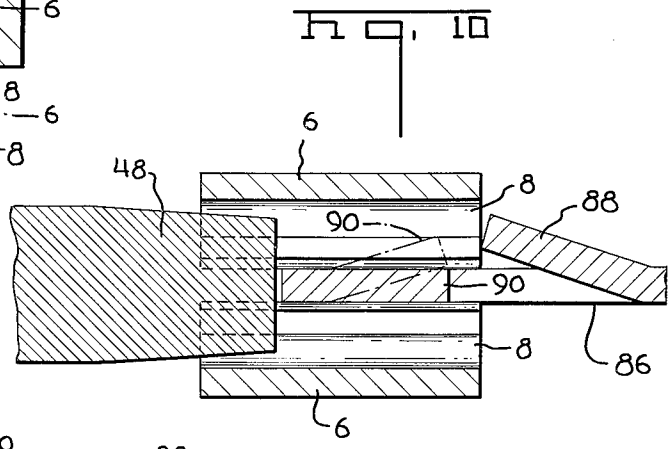
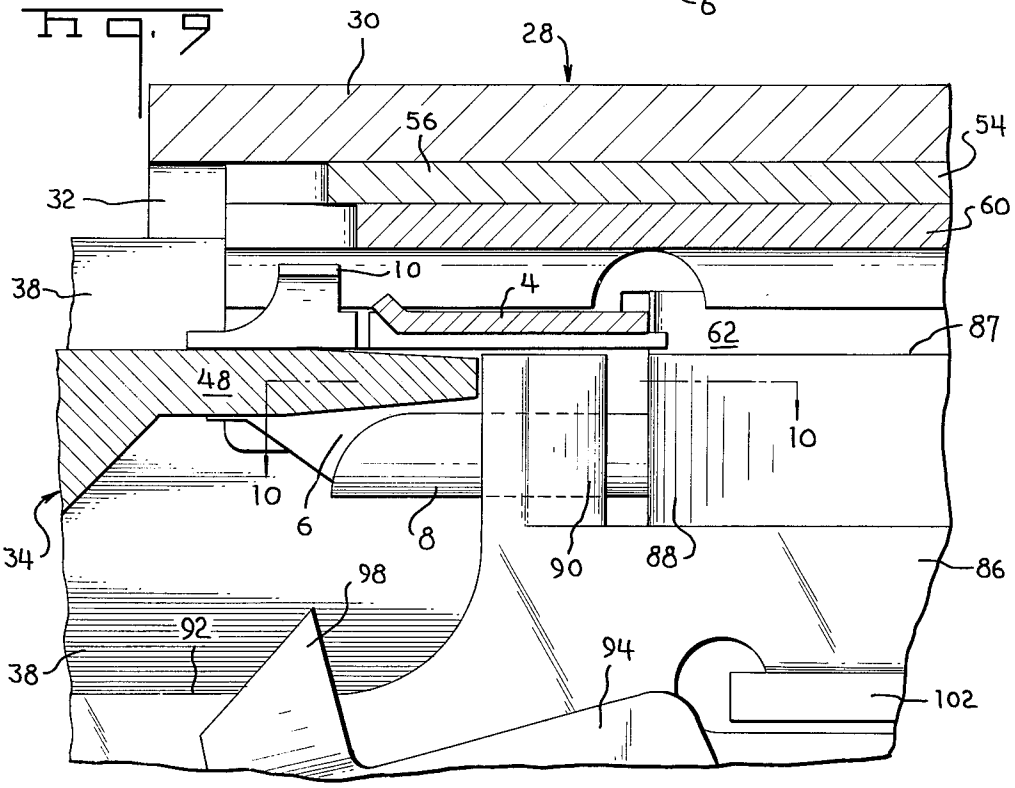


FIG. 9



United States Patent Office 3,220,099 Patented Nov. 30, 1965

3,220,099

APPARATUS FOR MAKING ELECTRICAL CONNECTIONS

Robert Alvin Long, Harrisburg, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

Filed Dec. 17, 1964, Ser. No. 419,175
8 Claims. (Cl. 29—203)

This invention relates to apparatus for electrically connecting conductors to terminal posts by means of terminal clips which are adapted to be telescopically moved onto the post and to hold the conductors thereagainst.

In my co-pending application, Serial No. 299,377, filed August 1, 1963, of which the present application is a continuation-in-part, there is disclosed a device for electrically connecting a conductor to a terminal post by means of a generally channel-shaped open-sided terminal clip which is adapted to be moved telescopically onto the post and to drag the conductor over the surface of the post in the manner such that after the terminal clip comes to rest, it holds the conductor against the surface of the post. The apparatus disclosed in co-pending application 299,377 comprises a reciprocable clip pusher which pushes a strip of end-to-end connected clips along a predetermined path and a mandrel over which the leading clip of the strip is pushed when an electrical connection is being made. The leading clip of the strip is severed from the strip of clips by means of a detent device which engages the clip that is next adjacent to the leading clip and prevents movement of the trailing portion of the strip while the clip pusher is pushing the leading clip over the mandrel and onto the post. The leading clip of the strip is thereby broken away from the strip so that it can be pushed independently over the mandrel and onto the post to make a single electrical connection. It should be added that the apparatus disclosed and claimed in application, Serial No. 299,377, is a device in accordance with the general teachings of the copending application of Robert F. Cobaugh, Serial No. 171,074, filed February 2, 1962.

The present invention relates to an improved device in accordance with the general teachings of the above-identified Cobaugh application and, more specifically, an improved device of the general type disclosed and claimed by co-pending application, Serial No. 299,377.

An object of the invention is, therefore, the provision of an improved apparatus for making clip-type electrical connections between conductors and terminal posts. A further object is to provide a device which can be manufactured and assembled at a relatively low cost. A still further object is to provide a device for making clip-type electrical connections having an improved detent mechanism for controlling the movement of the strip of end-to-end connected terminal clips when an electrical connection is being made. A still further object is to provide a device which can be used with terminal clips of varying sizes.

These and other objects of the invention are achieved in one embodiment thereof comprising a hand tool constructed in accordance with the general teachings of my co-pending application, Serial No. 299,377 and comprising a mandrel and a reciprocable clip pusher which is movable along a rectilinear path extending over and beyond the end of the mandrel. The arrangement is such that clip pusher engages the leading clip of a strip of end-to-end connected clips and straddles the entire strip during its movement so that the strip is pushed along the rectilinear path during movement of the push rod. In order to separate the leading clip of the strip, which is to be applied to an individual terminal post, from the trailing portion of the strip, I provide a pair of detent levers pivotally mounted on each side of the relatively thin guide rib over which the clip pusher moves. These

levers are normally biased into engagement with the underside of the strip so that they engage the clip which is next adjacent to the leading clip and thereby prevent further movement of the trailing portion of the strip beyond the detent levers. The leading clip is thus broken away from the trailing portion of the strip and pushed onto the terminal post. The guide rib is relatively thin and is straddled by the strip of clips with the sidewalls of the individual clips extending parallel to the sides of the rib and with the edge of the rib being received between the clip sidewalls. This arrangement for guiding the strip of clips permits the accommodation of clips of varying heights in a single tool so that one tool can be used to make electrical connections with terminal posts of different sizes. A further advantage of the invention is that the guide rib, and many of the associated parts can, if desired, be manufactured by conventional stamping and forming operations with the attendant advantage of low unit cost.

In the drawing:

FIGURE 1 is a perspective view of a short section of strip of end-to-end connected terminal clips;

FIGURE 2 is a perspective view of a clip-type electrical connection between a terminal post and a conductor;

FIGURE 3 is a side view of a hand tool in accordance with the invention;

FIGURE 3A is a view taken along the lines 3—3 of FIGURE 3;

FIGURE 4 is a partially exploded perspective view of the nose portion of the tool of FIGURE 3;

FIGURE 5 is a view similar to FIGURE 4 but showing the parts fully exploded;

FIGURE 6 is an exploded fragmentary perspective view showing some parts contained in the rearward end of the tool;

FIGURE 7 is a sectional side view of the nose portion of the tool;

FIGURE 8 is a view taken along the lines 8—8 of FIGURE 7;

FIGURE 9 is a sectional side view, on an enlarged scale, showing the detent mechanism by means of which the strip of clips being fed through the tool is prevented from moving rearwardly in the tool;

FIGURE 10 is a view taken along the lines 10—10 of FIGURE 9; and

FIGURE 11 is a sectional view showing the guide rib and clip pusher and illustrates the manner in which varying sizes of clips can be used in the tool.

Referring first to FIGURES 1 and 2, in a clip-type connection between a terminal post 12 and a conductor 16, the stripped end 14 of the conductor is held against the surface of the post by means of a terminal clip which embraces the post. The clips are ordinarily manufactured in end-to-end strip form 2 with each clip comprising a web portion 4 having sidewalls 6 extending from its opposite sides. These sidewalls are reversely curled inwardly towards the underside of the web as shown at 8 and are advantageously dimensioned to grip the post and wire 14 relatively tightly thereby to establish a stable, low-resistance electrical connection. The sidewalls thus define an open seam extending axially along the clip on the side opposite to the web. An outwardly cupped insulation support 10 is provided at one end of the web 4 of each clip through which the insulated portion 16 of the wire emerges in the finished connection. The individual clips of the strip are connected together as shown at 15, the strength of the connecting section being such that the clips can be broken apart by imposing a tensile force on the strip as will be explained more fully below.

The present invention is described below in an embodiment comprising a hand tool 18 constructed in accordance with the general principles of my previously iden-

tified application, Serial No. 299,377. Accordingly, the general principles of operation and construction of the tool 18 will be described only to the extent necessary for an understanding of the principles of the present invention.

The tool 18, FIGURE 3, comprises an outer housing member 20 and an inner housing 22, the outer housing having a depending handle portion 24 and the inner housing having a corresponding handle portion 26. The outer housing member has a rearward extension 21 and the inner housing has an extension 23 contained within the extension 21. The two housing portions are relatively telescopically slidable into each other upon squeezing of the handles 24, 26 to move the clip pusher, described more fully below, relatively over the tool mandrel. A rectangular frame (not shown) is contained within the housing members 20, 22 and has a channel-shaped projection 28 extending forwardly from the end of the outer housing 20, this projection 28 comprising a web or top-plate section 30 from which sidewalls 32 depend. A pair of support plates 36, 38, FIGURE 4, are retained between the inner surfaces of the sidewalls 32, by pins 39*c*, 39*e*, and project beyond the end of the projection 28. A mandrel block generally indicated at 34 is secured between the plates 36, 38 by means of a fastener 40.

A mandrel comprising an elongated head 42 and a rib 44 is provided on the upper surface of the mandrel block, the head portion 42 conforming generally to the internal dimensions of a terminal clip so that an individual clip can be moved over the mandrel and onto a terminal post. An opening 46 extends transversely of the mandrel head and downwardly through the rib portion 44 for reception of an end portion of a wire which is to be connected to a terminal post. An extension 48 projects rearwardly from the opening 46 and also conforms to the internal dimensions of a terminal clip. During usage, as explained in my copending application, Serial No. 299,377, the end portion of the insulation of a wire is stripped therefrom when the terminal clip drags the wire from the opening 46 and over the upper surface of the mandrel head 42. The stripped section of the insulation remains in the opening 46 and is removed by means of a transverse opening 50 which extends through the mandrel block and intersects the opening 46. Advantageously, a spring member 52 is provided on the sidewall 32 which has a leg in alignment with the opening 50 so that the remaining section of insulation can be removed by merely pressing on this spring to drive the end portion thereof through the transverse opening 50.

The clip pusher 54 (see FIGURES 5–7 and FIGURE 9), by means of which the leading clip of the strip contained in the tool is fed over the mandrel, is of generally channel-shaped cross section having a top wall 56 and depending sidewalls 58. A channel-shaped liner or insert 60 is mounted in the forward end of the clip pusher and serves to adjust the internal dimensions of the clip pusher to the external dimensions of an individual one of the clips so that the clip being pushed over the mandrel will be closely and accurately controlled during its movement. A pair of fingers 62 are struck inwardly from the sidewalls 58 at the forward end of the clip pusher and have inwardly turned end portions which are adapted to lodge between the leading clip of the strip and the next adjacent clip during operation. The rearward end of the clip pusher 54 is provided with laterally extending ears 64 which extend into notches 74 in a pair of spaced-apart support plates 66, 68. An additional ear 65 is provided on one of the sidewalls of the clip pusher adjacent to the rearward end of this member and extends into a notch 67 in the forward edge of the plate 66. The plates 66, 68 are secured to a block 70 by means of pins 73 and to the outer housing member by screws, one of which is shown at 72. The clip pusher 54 is thereby secured to the outer housing member and moves relatively over the mandrel when the two housing members are moved into telescoping relationship with each other.

A strip 2 of terminal clips is fed over the upper surface of a guide plate 76, the rearward end of which rests slidably on the upper surface of the block 70 and the forward end of which is enlarged as shown at 78. Flanges 80 are provided on the opposite sides of the enlarged forward ends 78 of the strip support plate, these flanges being received in notches or pockets 84 in the rearward ends 82 of the support plates 36, 38. The clip pusher straddles the strip of clips resting on the support plate and engages the strip in the gap between the leading clip and the next adjacent clip by means of the inwardly directed fingers 62. Upon relative leftward movement of the clip pusher 54, the leading end portion of the strip is thus moved leftwardly over the upper edge 87 of a guide rib 86 in a manner such that the depending sidewalls of the clips extend over the opposite sides of the rib. An obliquely directed lance 88 is struck from the upper edge portion of the guide rib 86 to define a forwardly facing shoulder which functions as a detent for preventing retrograde movement of the strip during relative rearward movement of the clip pusher. The edge portion 90 of the plate adjacent to the outwardly struck lance 88 is advantageously also bent laterally but to a lesser degree than the lance 88 in order to guide the strip onto the extension 48 of the mandrel (see FIGURE 10). The forward end portion of the rib 86 is cut away as shown at 92 and the previously identified extension of the mandrel head extends into this notch in the rib so that its rearward end is disposed adjacent to the upper edge 87 of the guide rib.

A pair of levers 94 are pivotally mounted on the pin 39*a* on each side of the plate 86 and have upwardly directed hooks 98 on their forward ends. These hooks are dimensioned to conform to the gap which remains between adjacent clips of the strip on the underside thereof and function as detents for preventing forward motion of the strip after the hooks have been engaged with the terminal clip which is next adjacent to the leading clip.

Ears 102 are struck out from the rib 86 immediately below the lance 88 and function as stops to prevent upward movement of the levers beyond the position shown. The rearward ends 104 of the levers 94 slope generally downwardly and are provided with rearwardly facing camming surfaces 106 which are engaged by a pin 108 extending between the sidewalls of the forward portion of the housing 108 as will be explained below. It should be pointed out at this juncture that the upwardly directed hooks 98 of the levers 94 will normally be in engagement with the frontal portion of the leading terminal of the strip. When the handle portions 24, 26 are squeezed, the outer housing member 20 and the clip pusher move relatively leftwardly in the drawing and the strip of clips is pushed leftwardly towards the mandrel. During this initial portion of the operating cycle, the pin 108 moves against the camming surfaces 106 of the levers 94 and momentarily swings the levers in a counterclockwise direction about their pivotal axis to disengage the hooks from the leading end portion of the strip. Upon further relative leftward movement of the pin 108, the levers are permitted to return to their normal positions under the influence of a spring 130 so that they are biased against the underside of the strip. When the gap between the leading terminal of the strip and the next adjacent terminal moves into alignment with these hooks, the hooks lodge in the gap and prevent further leftward movement of the strip. As a result, the leading terminal is broken away from the strip and pushed onto the terminal post as explained more fully in my above-identified copending application.

A pair of support plates 110, 112 are mounted on each side of the levers 94 and the entire sub-assembly compris-

ing the guide rib, the levers, and the support plate is contained in a two-part housing **114**, **116**. Each part of this housing comprises a plate having inwardly directed flanges **118**, **120**, **122** and **124** on its sides which abut when the parts are in their assembled relationship to form a housing member surrounding the sub-assembly of the parts mentioned above. A notch **128** is provided on the lower side of each of the housing parts **114**, **116** through which the trailing ends **104** of the levers **94** project. This sub-assembly contained in the nose portion of the tool is secured in position by the pins **39***a*–**39***f*. Pins **39***c* and **39***e* extend through the depending sidewalls **32** and through the parts contained between these sidewalls. The remaining pins extend through the plates **36**, **38**, through the housing members **114**, **116**, and through the rib **86**.

The forward ends of the levers **94** are normally biased upwardly, as viewed in the drawing, by means of a hair-pin-type spring **130**, the bight of which extends through a notch **132** on the lower edge of the rib **86** and the legs of which are lodged between the opposed surfaces of the rib **86** and the surfaces of the plates **110**, **112**. The legs of this spring thus extend over the pin **39***d* and are normally stressed resiliently in a manner which urges the forward ends of the levers upwardly.

The structural features of the tool shown, which are not described above, are substantially the same as those of the tool described in detail in my co-pending application, Serial No. 299,377. Inasmuch as the present invention concerns primarily the detent mechanism shown in FIGURES 4 and 5 and this mechanism has been described in detail above, it is not deemed necessary to further describe the structural features of the tool.

In operation, the operator first inserts a wire into the opening **46** of the mandrel and squeezes the handle extensions **24**, **26**. During this portion of the operating cycle, the clip pusher moves relatively leftwardly with respect to the mandrel until the leading end of the clip pusher is disposed in overhanging relationship to the end of the mandrel. It is during this portion of the cycle that the strip **2** is advanced a short distance and the levers are depressed, as shown in FIGURE 9, to permit movement of the strip past the forward ends of the hooks. After such initial movement of the strip, the hooks engage the strip between the leading clip and the next adjacent clip so that the leading clip, upon further movement of the clip pusher, is broken away from the strip and pushed onto the mandrel.

After such initial movement of the clip pusher with respect to the mandrel, the operator positions the tool in alignment with the terminal post to which a connection is to be made and presses downwardly whereby the clip pusher moves relatively further beyond the end of the mandrel and pushes the terminal clip onto the post.

It should be noted that the disclosed form of tool differs from the tool disclosed in application, Serial No. 299,377 in that the outer housing member **20** may be secured to the plates **66**, **68** by means of any one of the four tapped holes **71**. The screw **72** extends through one of four holes in the outer housing extension **21**, through an elongated slot in the inner housing extension **23** (as described fully in co-pending application 299,377) and is threaded into one of the four tapped holes **71** in the plate **76**. This arrangement permits the stroke of the clip pusher to be controlled in order to adapt the tool to posts of varying heights and/or to usage under circumstances where one or more terminal clips have previously been applied to a post. If it is desired to shorten the stroke of the clip pusher, it is thus merely necessary to move the screw from the remote opening and tapped hole to one of the three remaining openings and tapped holes. The shortest stroke for the clip pusher is achieved by threading the screw through the tapped hole and opening on the left in FIGURE 6.

A salient advantage of the present invention is that the detent sub-assembly comprising the rib, the levers, the support plates, and the guide plates can be manufactured by conventional stamping and forming methods at an extremely low cost and without the necessity of a high degree of precision. These parts can further be assembled with relative ease and disassembled, if necessary, for modification or repair. A further advantageous feature is that since the individual terminal clips are supported by the guide rib only, which extends between the curled sidewalls of the clips, a tool in accordance with the invention is adapted to accept terminal clips of different sizes, as illustrated in FIGURE 11. In this view, a terminal clip having relatively wide sidewalls is shown in phantom lines while a clip having comparatively narrow sidewalls is shown in full lines. Either size of clip, as well as clips of intermediate size, can be accommodated in the tool shown.

I claim:

1. Apparatus of the type intended for applying open-sided terminal clips in end-to-end strip form to terminal posts thereby to electrically connect conductors to said posts, said apparatus comprising, a mandrel for supporting said clips during movement onto said post, a relatively thin guide rib in alignment with said mandrel, clip pushing means engageable with the leading clip of said strip for pushing a strip of said clips along a predetermined path extending over said guide rib and over said mandrel, and detent means engageable with the next adjacent clip of said strip, said detent means comprising lever means pivotally mounted beside said guide rib on an axis extending transversely of said predetermined path, hook means on said lever means, said hook means being engageable with said next adjacent clip during movement of said strip, and means, responsive to said clip pusher means for moving said hook means into engagement with said strip after said leading clip has been pushed by said clip pushing means beyond said hook means whereby, said leading clip is broken away from said strip and pushed over said mandrel and onto said terminal post.

2. Apparatus of the type intended for applying open-sided terminal clips to terminal posts thereby to electrically connect conductors to said posts, said apparatus comprising, a mandrel for supporting said clips during movement onto said post, a relatively thin guide rib in alignment with said mandrel, clip pushing means engageable with the leading clip of said strip for pushing a strip of said clips along a predetermined path extending over said guide rib and over said mandrel, detent means engageable with the next adjacent clip of said strip, said detent means comprising a pair of levers, one of said levers being disposed on each side of said rib, said levers being pivotally mounted intermediate their ends on a pin extending through said rib, one end of each of said levers being disposed adjacent to said mandrel, said one end of each lever having means thereon for engagement with said terminal strip, spring means normally biasing said levers into engagement with said strip of clips, and means responsive to said clip pushing means engageable with the other ends of said levers for swinging said levers about said pivotal axis during initial movement of said clip pusher means thereby to permit movement of said leading clip past said one end of each of said levers whereby, said leading clip is pushed over said mandrel, said one end of each lever being engageable with the next adjacent terminal of said clip whereby said leading clip is broken away from said leading terminal.

3. Apparatus of the type intended for applying terminal clips in end-to-end strip form to terminal posts thereby to electrically connect conductors to said posts, said terminal clips having an open seam extending axially along one side thereof, said apparatus comprising, a relatively thin guide rib, reciprocable clip pushing means for pushing a strip of said clips axially over said guide rib with said rib extending into said seam, a first detent means disposed beside said rib and engage-

able with the leading clip of said strip thereby to prevent movement of said strip in the direction of clip feed, detent disengaging means, responsive to the movement of said clip pushing means, for disengaging said first detent means from said leading clip during initial movement of said clip pushing means whereby, said leading clip is permitted to move past said first detent means, said detent disengaging means permitting engagement of said detent means with the next adjacent clip of said strip whereby, said leading clip is broken away from said next adjacent clip and pushed onto said terminal post.

4. Apparatus as set forth in claim 3 wherein said first detent means comprises a lever pivotally mounted beside said guide rib and having hook means thereon for engagement with said leading terminal clip.

5. Apparatus as set forth in claim 3 wherein said first detent means comprises a lever pivotally mounted intermediate its ends beside said rib, said lever having hook means at one end thereof for engagement with said leading clip, said detent disengaging means being engageable with the other end of said lever to swing said lever about its pivotal axis thereby to disengage said hook means from said leading terminal clip.

6. Apparatus as set forth in claim 3 including guide platform means for said clips disposed in axial alignment with said rib and extending upstream, relative to the direction of clip feed, therefrom, said clip pushing means comprising a channel member movable relatively over said guide platform means and in straddling relationship to a strip of said clips, said channel member having means engageable with said leading clip to push said leading clip over said rib and beyond said detent means.

7. Apparatus as set forth in claim 3 including a lance struck from said rib and disposed upstream, relative to the direction of clip movement, from said first detent means,

said lance functioning as a second detent means for preventing retrograde movement of said strip of clips.

8. Apparatus of the type intended for applying terminal clips in end-to-end strip form to terminal posts thereby to electrically connect conductors to said posts, said terminal clips having an open seam extending axially along one side thereof, said apparatus comprising, a relatively thin guide rib, reciprocable clip pushing means for pushing a strip of said clips axially over said guide rib with said rib extending into said open seam, lance means struck out from said rib and extending obliquely therefrom and in the direction of movement of said strip whereby, said lance functions as a detent means for preventing retrograde movement of said strip of clips, a lever disposed beside said rib having a hook extending therefrom and intersecting the path of movement of said strip, said hook being disposed in advance of said lance means by a distance substantially equal to the length of a single clip, said hook being engageable with the leading clip of said strip, and means for disengaging said hook from said leading clip during initial movement of said clip pushing means whereby, said leading clip is pushed past said hook and said hook engages said next adjacent clip, and upon further movement of said clip pusher said leading clip is broken away from said next adjacent clip and pushed onto said terminal post.

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THOMAS H. EAGER, *Examiner.*