

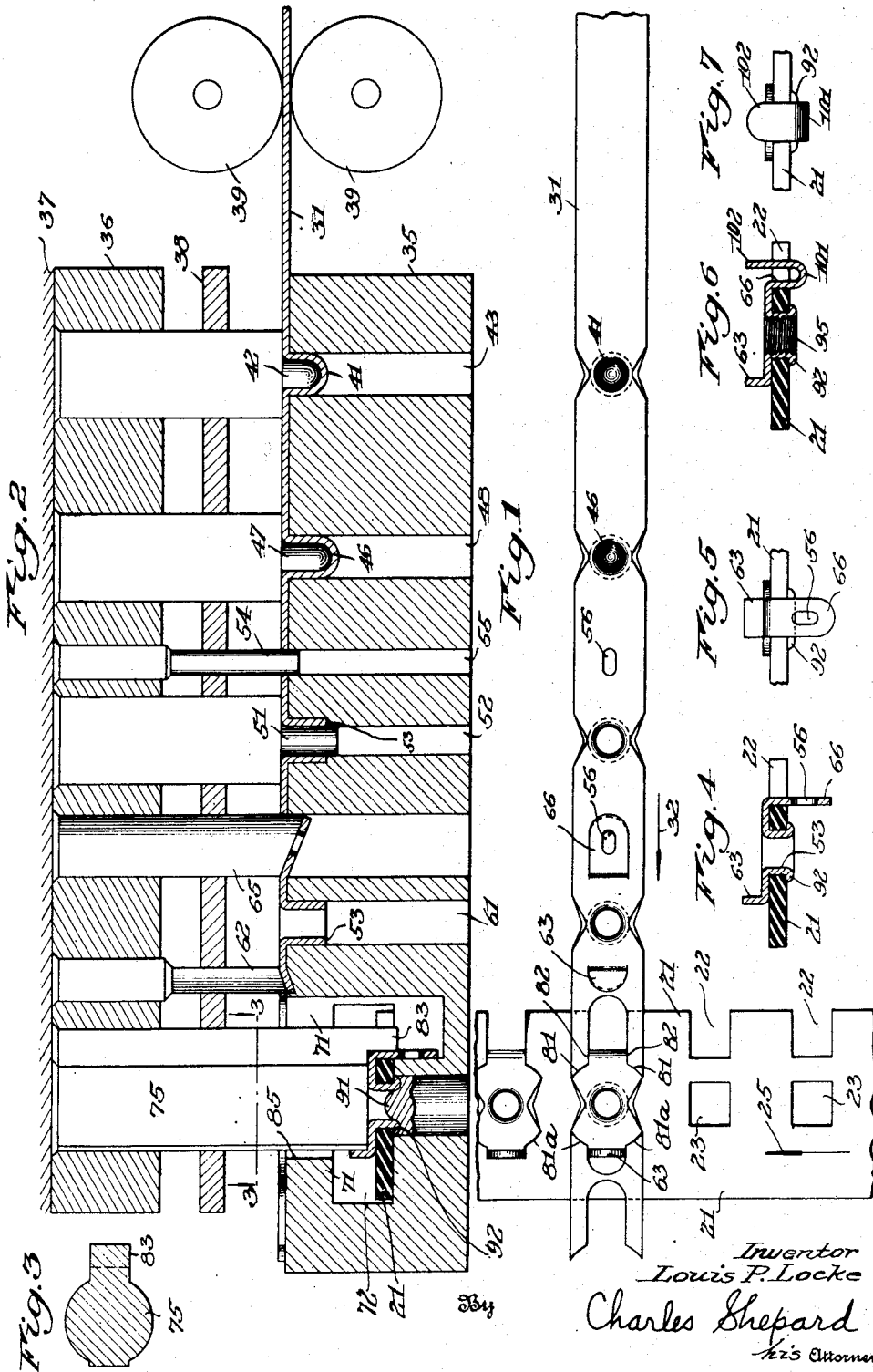
Nov. 17, 1953

L. P. LOCKE
APPARATUS FOR FORMING AND ASSEMBLING
ELECTRICAL TERMINALS

2,659,406

Original Filed June 10, 1947

2 Sheets-Sheet 1



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Fig. 8

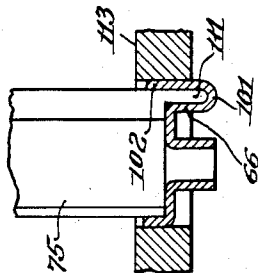
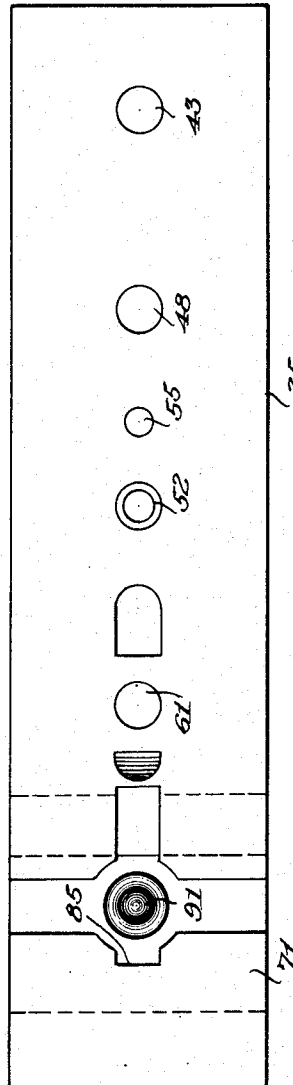


Fig. 9



INVENTOR.
Louis P. Locke
BY *Charles Shepard*
his Attorney

UNITED STATES PATENT OFFICE

2,659,406

APPARATUS FOR FORMING AND ASSEMBLING ELECTRICAL TERMINALS

Louis Peer Locke, Victor, N. Y.

Original application June 10, 1947, Serial No. 753,678, now Patent No. 2,610,390, dated September 16, 1952. Divided and this application July 30, 1949, Serial No. 107,791

4 Claims. (Cl. 153—1)

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The present invention relates to apparatus for forming and assembling electrical terminals or connectors such as are used in making connections of electric wires in various kinds of electrical apparatus.

Such electrical terminals or connectors commonly comprise a strip of insulating material, such as fibrous material or resinous or plastic material, and one or more metallic members mounted on the strip of insulating material. Usually at least two metallic members, and frequently a considerably larger number, are mounted on the same strip of insulating material. It has heretofore been common practice to form the metallic members in one operation or series of operations, such as on a punch press, and then later to place the formed metallic members by hand in the proper locations on the strip of insulating material and fasten them thereto.

An object of the present invention is the provision of generally improved and more satisfactory apparatus by which the metallic terminal members are automatically formed and concomitantly assembled or placed and fastened on the insulating strip, without requiring hand placement.

Another object is the provision of apparatus for use with a punch press or the like, so designed as to place the metallic member on the insulating strip and fasten it thereto in the same stroke of the press which performs the forming operation on the metallic member, or which performs the last of the series of forming operations if there is more than one such operation.

Still another object is the provision of apparatus of the character above mentioned, so designed and constructed that the forming part of the apparatus will not interfere with the proper longitudinal movements of the insulating strip, either before or after the metallic terminal members are fastened onto the insulating strip.

A further object is the provision of combined forming and assembling mechanism so designed and constructed as to form and concomitantly assemble on the insulating strip, an electrical terminal of a type which may have one cut edge overlying the insulating strip, or which have one cut edge or end projecting beyond an edge of the insulating strip, or which may have both of such features:

A still further object is the provision of combined forming and assembling mechanism so designed and constructed as to form and concomitantly assemble on a flat insulating strip, elec-

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trical terminals formed from successive portions of a long sheet metal strip, each such terminal having one end bent angularly in upstanding relation to the flat face of the insulating strip on which it is mounted.

These and other desirable objects are accomplished by the construction disclosed as an illustrative embodiment of the invention in the following description and in the accompanying drawings forming a part hereof, in which:

Fig. 1 is a diagrammatic plan of a metallic strip being fed in one direction, the metallic electrical terminal being formed from such strip, and an insulating strip being fed in another direction, the formed metallic terminal being mounted on such insulating strip;

Fig. 2 is a diagrammatic vertical section taken longitudinally along the metallic strip, showing also the punches and dies constituting an embodiment of the present invention;

Fig. 3 is a horizontal section taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a vertical section through one form of electrical terminal which may be formed and assembled according to the present invention;

Fig. 5 is a front elevation of the same with parts broken away;

Fig. 6 is a view similar to Fig. 4 showing a modified form of construction;

Fig. 7 is a front elevation of the construction shown in Fig. 6 with parts broken away;

Fig. 8 is a diagrammatic vertical section through a modified form of punch and die used in manufacturing the terminal construction shown in Figs. 6 and 7; and

Fig. 9 is a diagrammatic plan of the die shown in Fig. 2, and associated parts.

The same reference numerals throughout the several views indicate the same parts.

This application is a division of the patent application of Louis P. Locke, Serial No. 753,678, filed June 10, 1947, now Patent No. 2,610,390, issued September 16, 1952, for Electrical Terminal and Method and Apparatus for Making the Same.

In electrical terminals or connectors of the type here dealt with, comprising as above indicated a strip of insulating material and at least one and usually two or more metallic terminal members mounted on such strip of insulating material, the problem involved is to assemble the metallic members in the required number and at the required spacing on the insulating member or strip, with the greatest possible economy of separate steps in the manufacturing

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operation of forming the metallic members and placing them on the insulating material, while at the same time anchoring the metallic member firmly to the insulating material so that it will not later come loose and so that it will provide easy and convenient attachment for the wire or wires which are to be connected to the metallic member.

According to one form of the present invention, as illustrated particularly in Figs. 1 to 5 and 9, there is provided a strip 21 of insulating material such as fiber, resin, plastic, etc., which, in any suitable manner, is provided at proper intervals with a series of notches 22 and openings 23, one of the openings being opposite each notch 22, as seen in Fig. 1. The strip 21, thus notched and perforated, is fed intermittently or step by step into a punch press, the feeding being in the direction of the arrow 25.

A strip of suitable sheet metal, such as copper, is indicated at 31 and is fed into the press in the direction of the arrow 32, in overlying relation to the insulating strip 21 and substantially at a right angle thereto. The metal strip 31 is subjected, as it travels intermittently step by step, to the action of certain punches and dies mounted in the punch press. On the bed of the press is a compound die indicated in general by the numeral 35, and a series of punches are held in the punch holder 36 mounted on the platen 37 of the press. A stripper plate 38 may be employed to strip the metal from the punches after each punching operation. Any suitable feeding means is employed, indicated diagrammatically by the feeding rollers 39.

Taking up the successive operations performed on the metal strip in order, the first operation is the making of a shallow draw 41 in the metal strip by means of the draw punch 42 moving into the die opening 43. Then the strip of metal is fed forward one step, so that the shallow drawn part 41 is alined with the next punch, and a deeper draw 46 is formed by the punch 47 entering the opening 48 in the die. Next, the metal strip is advanced one more step so that the deeply drawn part 46 is alined with the punch 51 which comes down through the deep draw into the die space 52 and cuts out the bottom of the deep draw, to form a tubular boss or eyelet portion 53. Simultaneously therewith, the punch 54 enters the opening 55 in the die and punches out the small slot or hole 56 in the metal strip.

Then the strip 31 is fed forward one more step, whereupon the tubular boss 53 enters the opening 61 in the die, and the punch 62 cuts the curved end of the tab 63 to the left of the boss 53, while the punch 65 cuts the tab 66 around the hole 56 and turns this tab partly downwardly. The tabs 63 and 66 are not severed from the main body of the strip.

Then the metal strip is fed forwardly one more step to its final position in which it rests on what may be called an overhanging die or undercut die, having overhanging portions or ledges 71 which support the metal strip, and a lateral or crosswise opening 72 through the die below the level of the metal strip, in which opening 72 the insulating strip 21 lies crosswise of the metal strip. A punch 75, having the special shape best shown in Fig. 3, comes down into the overhanging die and severs the individual terminal from the main body of the metal strip 31 along the right hand set of arcuate lines 81 and the straight lines 82 shown in Fig. 1, at

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the same time severing a scrap piece from the terminal along the left hand set of arcuate lines 81a. A lateral and longitudinal extension 83 on the punch 75 first hits the tab portion 66 of the terminal just before the terminal is cut loose from the main body of the metal strip, and bends this tab portion downwardly at a right angle, as seen in Fig. 2. Then, just about the time that the downward bending of this tab 66 is completed, the main body of the punch 75 severs the terminal from the rest of the strip 31 along the cutting lines 81 and 82 and pushes it downwardly through the overhanging die, and during this downward pushing of the terminal, the tab 63 is forced by the overhanging part of the die to bend upwardly to a vertical position, and it slides down past the surface 85 of the die while maintaining its upstanding or vertical position. At the time that the punch 75 comes down, the insulating strip 21 is positioned in the opening 72 of the die in such position that one of the notches 22 and one of the holes 23 are directly below the punch. The punch carries the now severed terminal downwardly onto the insulating strip 21 in such position that the downturned tab 66 of the terminal enters the notch 22 and simultaneously therewith the boss or eyelet portion 53 enters the hole 23 of the insulating strip. As the punch continues its downward movement it forces the lower end of the boss 53 against the clinching anvil 91 which curls the bottom edge of the boss or eyelet 53 outwardly to clinch it over the lower surface of the insulating material 21, as seen at 92 in Figs. 2 and 4.

Those skilled in the art will readily understand from the foregoing description that although several stages or steps are necessary in the production of the electrical terminal, they are all performed in unison by one stroke of the press, upon successive portions of the metal strip 31, so that there is, in effect, only a single step or operation in manufacturing the terminal from the metal strip. After once the press has been set into operation and the advancing end of the metal strip 31 has been fed forwardly past the successive punches, each cycle of operation or stroke of the press thereafter completes the manufacture of one of the electrical terminals and the placing or anchoring thereof on the insulating strip. In other words, the punch 42 is performing the first operation on one part of the metal strip 31 at the same time that the punch 47 is performing the second operation on another part of the strip, and at the same time the punches 51 and 54 are performing the third operation on another part of the same strip, and at the same time the punches 62 and 65 are performing the fourth operation on another part of the same strip which has previously had the first, second, and third operations performed thereon, and all this occurs at the same time that the punch 75 is performing the fifth or final operation on still another part of the same strip, which other part has previously had the other four operations performed on it.

The notch 22 in the insulating strip 21 is just wide enough to receive snugly the downturned end of the tab 66. Hence the engagement of this tab or ear 66 in the notch 22 will prevent the terminal from turning on the insulating strip, notwithstanding the fact that the terminal is actually fastened to the strip only at one point rather than at two spaced points. Thus the

clinchng or riveting of the tubular part 53 of the terminal, as indicated at 92, is entirely adequate to anchor the terminal firmly on the insulating strip, in view of the engagement of the part 66 in the notch 22.

The fact that the tab 66 is turned down substantially simultaneously with the riveting or clinching of the terminal onto the insulating material, is one of the noteworthy features of this invention. In the comparable terminals of the prior art, it has usually been necessary to turn down any tab similar to the tab 66, as a separate and distinct operation after the metal member has been fastened to the insulating member. This separate operation is entirely avoided according to the present invention, due in large part to the special construction of the overhanging die and the special punch which turns the tab down simultaneously with the severing of the terminal from the metal strip of which it is made, and which, in a subsequent part of the same stroke of the press, rivets or clinches the terminal onto the insulating strip.

Production of these terminals is extremely rapid, for all that is necessary is to feed strip 31 of raw metal stock into the machine through the feeding mechanism 39, in one direction, and to feed the strip 21 of insulating material, previously punched and notched at proper intervals, into the machine in another direction at right angle to the feed of the metal strip, and it is even possible, if desired, to form the notches 22 and holes 23 on the same press, concomitantly with the formation of the metal parts. There issues from the machine a long strip of the insulating material with a series of electrical terminals fastened properly thereto, one at each hole 23 and notch 22. The completed strip of insulating material with terminals thereon may then be cut at appropriate intervals to provide insulating strips of the desired length with the desired number of terminals for any desired use. The special overhanging or undercut nature of the die used in the seating operation enables the insulating strip to be located at an elevation materially below the elevation of the unsevered part of the metal strip, and also enables the insulating strip with the metal terminals anchored thereon to feed smoothly through the press. The undercutting of the die is especially useful in facilitating feeding of the strip if the end of the metal terminal, instead of being bent down as in Figs. 2 and 4, is allowed to remain in a position projecting beyond the lateral edges of the insulating strip.

The terminal shown in Figs. 4 and 5, the manufacture of which has been described in detail above, is a terminal of great utility and satisfies most requirements. If three wires, for example, are to be connected together, one of them may have its end pushed through the hole 56, to hold the wire temporarily until it is soldered to the terminal; the second wire may have its end pushed through the eyelet 53, to hold it for soldering; and the third wire may have its end twisted one turn around the upstanding lug 63, to hold it for soldering. However, in some instances, it is preferred to have a terminal provided with screw threads for receiving a screw so that the end of a wire may be clamped under the head of a screw. If such a terminal is desired, it is a comparatively easy matter, after the terminal has been anchored onto the insulating strip, to thread the eyelet or boss 53 by a suitable threading die, such thread being indicated at 95 in Fig.

6. The desired screw may then be screwed into the thread 95.

In the modified form of construction shown in Figs. 6 and 7, the opening 55 in the tab 66 is omitted, and the tab 66, after extending downwardly through the notch 22, is then bent through 180° as indicated at 101 and extends upwardly again at 102 to an elevation above the top of the insulating strip 21. A wire may then be thrust endwise through the loop 101 and underneath the bottom of the insulating strip 21, as will be readily seen from Fig. 6. Another wire may be wrapped around the upstanding end 102 of the lug, if desired. Still another wire may be clamped under the head of a screw, screwed into the thread 95, while a fourth wire may be wrapped around the upstanding lug or ear 63, to hold it preparatory to soldering. Hence this form of terminal construction is particularly advantageous where several different wires are to be attached to the same terminal or connector.

This form shown in Figs. 6 and 7 can be made (except for the cutting of the threads 95) on the same apparatus illustrated in Fig. 2 and with the same steps, except for a slight variation in the shape of the punches and dies. If the hole 55 is omitted, then, of course, the punch 54, which makes this hole, is likewise omitted. The bending of the ear or lug 66 as at 101 can be accomplished simultaneously with the final operation, by altering the punch 75 and the overhanging die in the manner indicated diagrammatically in Fig. 8. The main portion of the punch 75 is the same as before, but the lateral extension which co-operates with the ear 66 is smaller, as indicated at 111, and has its bottom end curved, and the overhanging ledge 113 forming part of the die comes up fairly close to the punch portion 111, being separated from it only by the thickness of the metal of the strip 31. Hence, when the punch 75 comes down, the low end of the extension 111 will first bend the ear 66 downwardly and make the loop or curve 101, leaving the end 102 extending upwardly because the portion 113 of the die will not allow the portion 102 to bend downwardly. Then, as the punch continues its downward movement, the terminal portion with the ear 66 already bent into this form, will be severed from the rest of the metal strip 31 and will be carried down onto the insulating material and fastened thereto as before.

Certain specific forms of punches and dies have been disclosed in connection with the formation and assembly of certain specific forms of electrical terminals. But it should be understood that these specific forms are intended as illustrative examples only. Those skilled in the art will readily recognize that the same principles may be applied to the formation and assembly of various other shapes of electrical terminals. It is seen, for example, that the herein disclosed principle of using an overhanging or undercut die, enables the insulating strip to be fed through the apparatus even after the metallic terminals are seated or mounted thereon, without any parts of the die obstructing or interfering with the motion of the insulating strip and the mounted terminals. It is also seen that the overhanging or undercut die enables any desired cut to be made at any one or more of the end or side edges of the electric terminal, in a position directly over the insulating strip, as shown for example by the location of the cuts 81, 81a, and 82 in Fig. 1. Thus any desired cuts at the end or side edges, which are needed for the formation of the metal-

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lic terminal, may be made in the final forming stage, directly over the insulating strip, without resort to the cumbersome and often troublesome expedient of using horizontally retractable or movable die parts.

Likewise the use of an undercut or overhanging die permits one end of the terminal member to be bent up into upstanding relation to the insulating strip surface on which it is mounted, in the final severing and seating stage of operation, and in a location spaced inwardly from the lateral edges of the insulating strip, as at 63 and 102. If the upturned end or lug is to be located outwardly beyond the lateral edge of the insulating strip, this may be done without necessarily having an undercut or overhang of the die, by employing the same principle herein disclosed of having on the die a shoulder or abutment 85 or 113 which lies close to the punch at an elevation above the insulating strip, so that such shoulder or abutment contacts with the metal and bends the lug upwardly while the punch pushes the rest of the metal piece downwardly past the abutment and onto the insulating strip.

The overhanging or undercut nature of the die also permits one end of the metallic terminal to project beyond the side edge of the insulating strip, as would be the case, for example, if it were desired not to bend the portion 66 (Figs. 4 and 5) downwardly but to leave it projecting horizontally from the insulating strip, in a manner similar to the electrical terminals shown in Figs. 9 and 10 of the original drawings of the parent application of which the present application is a division. In short, the overhanging or undercut nature of the die results in great flexibility of the apparatus, enabling (by appropriate change in the cross sectional shape of the punch and corresponding cooperating cutting edges of the die) the formation and assembly of metallic terminals of many different desirable shapes, with or without upturned or downturned ends or lugs, with or without ends projecting laterally beyond the side edges of the insulating strip, and with or without cut edges or cut ends (cut in the final stage of the forming operation) directly overlying the face of the insulating strip on which the metallic terminal is seated. Yet with all this adaptability to various different shapes of terminals, it is apparent that the present apparatus may in each instance be used to assemble the metallic terminal in proper position on the insulating strip, concomitantly with the formation or shaping of the metallic terminal, and usually in the same stroke of the press which performs the final forming operation on the metallic terminal.

It is also apparent to those skilled in the art that the construction and operation of the forming and assembling apparatus is not necessarily dependent upon the formation of the notches or holes 22 and 23 in the insulating strip. The same principles of punches and dies for forming and assembling the metallic terminals, may be employed equally well when either the notches 22 or the holes 23, or both, are omitted from the insulating strip, and when the metallic terminal, as it is assembled onto the insulating strip, forms its own hole therein or therethrough, which is easily done when using relatively thin or soft insulating strips, although the pre-formed holes are preferred when the insulating strip is relatively thick or hard.

It will be noted that definite tracks or guide-

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ways are provided both for the insulating strip 21 and the metal strip 31, to insure proper lateral alignment of the respective strips as they are advanced toward crossing relation to each other.

In the case of the insulating strip 21, the track is provided by the upstanding vertical wall at the left edge of the strip 21 when viewed as in Fig. 2, which wall is substantially in contact with the left edge of the strip, and also is provided by the vertical wall which lies just to the left of the downturned end 66 of the electric terminal, so that as each terminal is attached or seated, it contacts with such vertical wall and helps to guide the insulating strip in its next advancing or feeding movement. Thus as the insulating strip is advanced, accurate alignment in a lateral direction is insured if the strip is gently urged laterally in a leftward direction when viewed as in Fig. 2, whereupon one or both of the vertical walls above mentioned will serve to guide the strip.

In the case of the metallic strip 31, the track or guideway is provided by the engagement of the various formed protuberances 41, 46, 53, etc., in their respective holes 43, 48, 61, etc., of the die. Once the first draw 41 has been made in accurate position on the strip, all of the subsequent forming operations must be accurately positioned because of the engagement of the drawn part in the subsequent holes 48, 52, and 61 of the die. Between successive strokes of the press, the metal strip springs upwardly out of these holes, of course, so that it may be advanced, but the metal strip parts drop downwardly into the proper holes again at the next stroke of the press. In addition to the lateral guiding of the metal strip in this manner, side guides such as upstanding ledges or pins (not shown) may be employed if desired.

It is seen from the foregoing disclosure that the above mentioned objects of the invention are admirably fulfilled. It is to be understood that the foregoing disclosure is given by way of illustrative example only, rather than by way of limitation, and that without departing from the invention, the details may be varied within the scope of the appended claims.

What is claimed is:

1. Apparatus for forming electrical terminals from a continuous metal strip and assembling them on an insulating strip, comprising, in combination, a support for holding an elongated insulating strip at one elevation in position so that it may be fed lengthwise, a die having a surface for supporting an elongated metal strip at an elevation above said insulating strip and in a direction in crossing relation to the length of said insulating strip in position to have successive portions of the metal strip fed step by step toward the insulating strip, a punch mounted for reciprocation upwardly and downwardly toward and away from said die, said punch and die having cooperating surfaces at one station for forming a securing boss on the under face of said metal strip in a location offset horizontally from said insulating strip, a clinching anvil mounted on said support for holding said insulating strip, said punch and die including a punch portion at a subsequent station directly over said clinching anvil and having shearing edges cooperating with shearing edges of said die for severing a portion of said metal strip containing a boss from the remainder of said metal strip while the boss of the severed portion is directly over said clinching anvil, said portion of said punch being so

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formed as to carry the severed portion of the metal strip downwardly and seat it upon the insulating strip with the securing boss on the severed portion extending through said insulating strip and alined with said clinching anvil to be clinched thereby upon exertion of downward pressure by said portion of said punch.

2. A construction as defined in claim 1, in which said shearing edges are directly over said insulating strip.

3. A construction as defined in claim 1, in which said punch and die have cooperating surfaces at said subsequent station for bending a portion of said metal strip upwardly at a substantial angle to said insulating strip, concomitantly with the severing and downward carrying of said severed portion of said metal strip.

4. A construction as defined in claim 1, in

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which said punch and die have cooperating surfaces at said subsequent station for bending a portion of said metal strip downwardly past an edge of said insulating strip concomitantly with the downward carrying and seating of said severed portion of said metal strip on said insulating strip.

LOUIS PEER LOCKE.

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