July 20, 1954

R. P. HIPPLE
APPARATUS FOR FORMING TERMINALS
AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 1

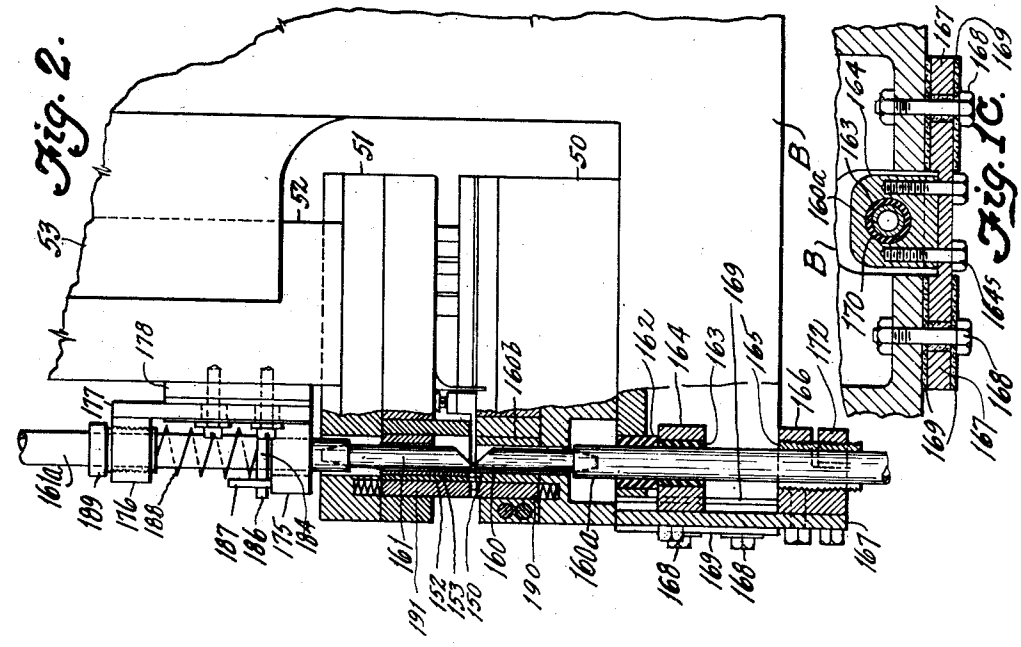

Fig. 2.

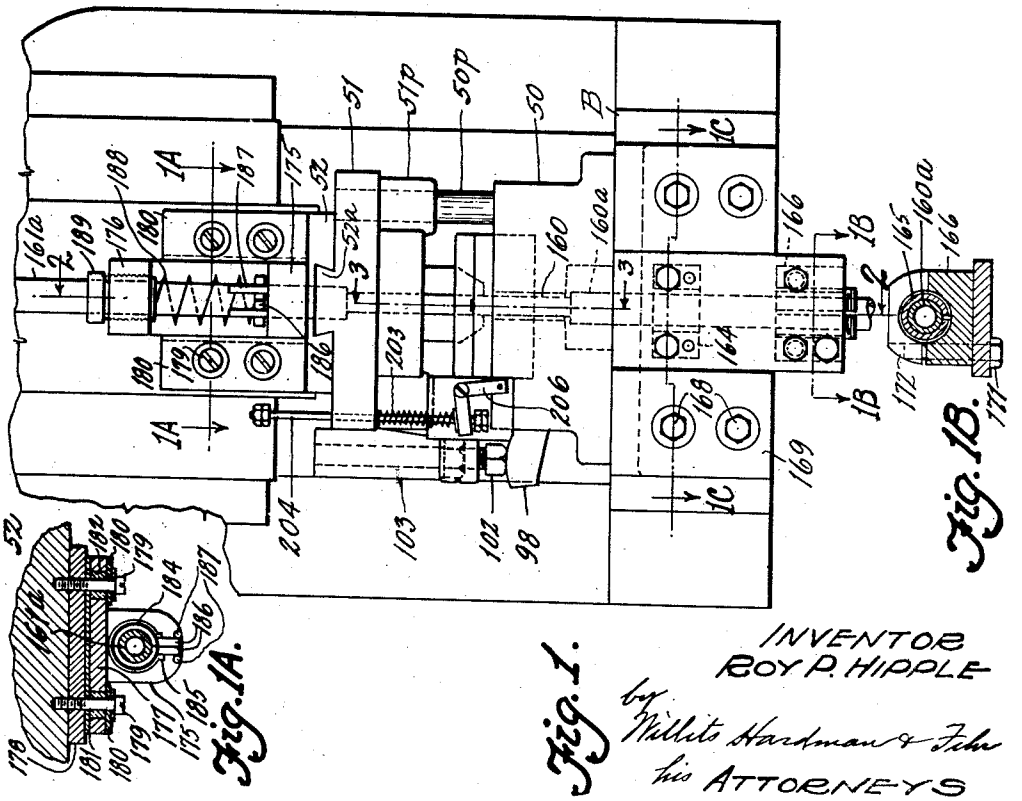

Fig. 1.

Fig. 1A.

Fig. 1B.

Fig. 1C.

INVENTOR
ROY P. HIPPLE
by Willits Hardman & Fehr
his ATTORNEYS

July 20, 1954

R. P. HIPPLE

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 2

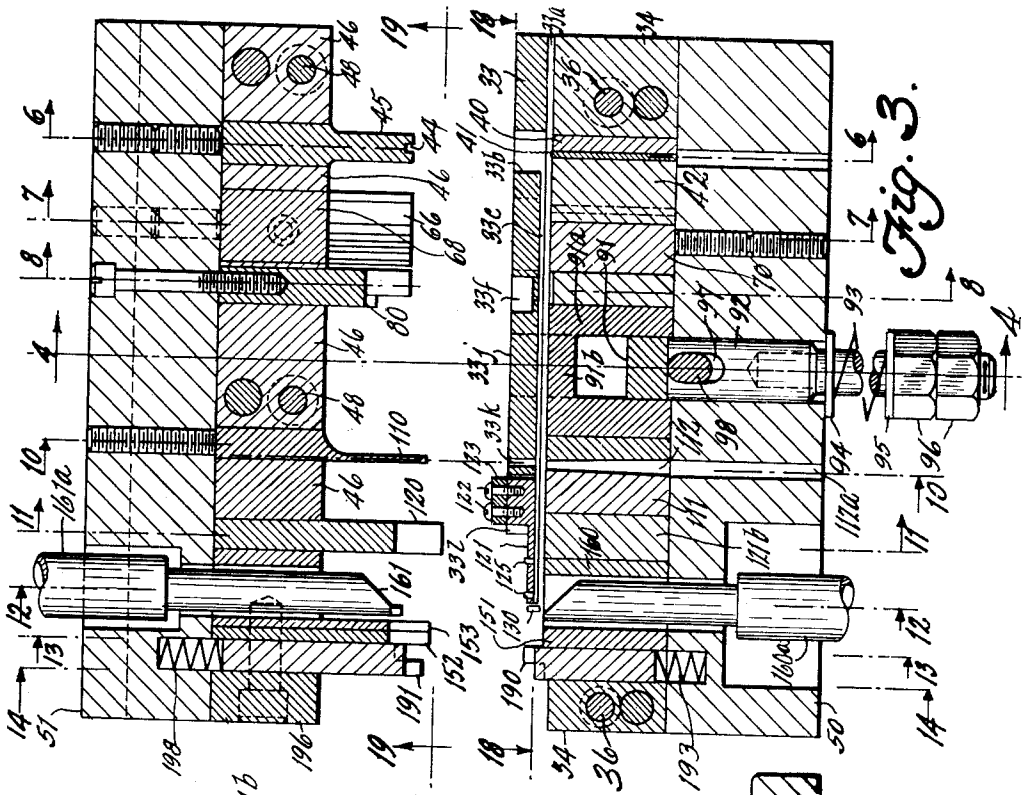

Fig. 3.

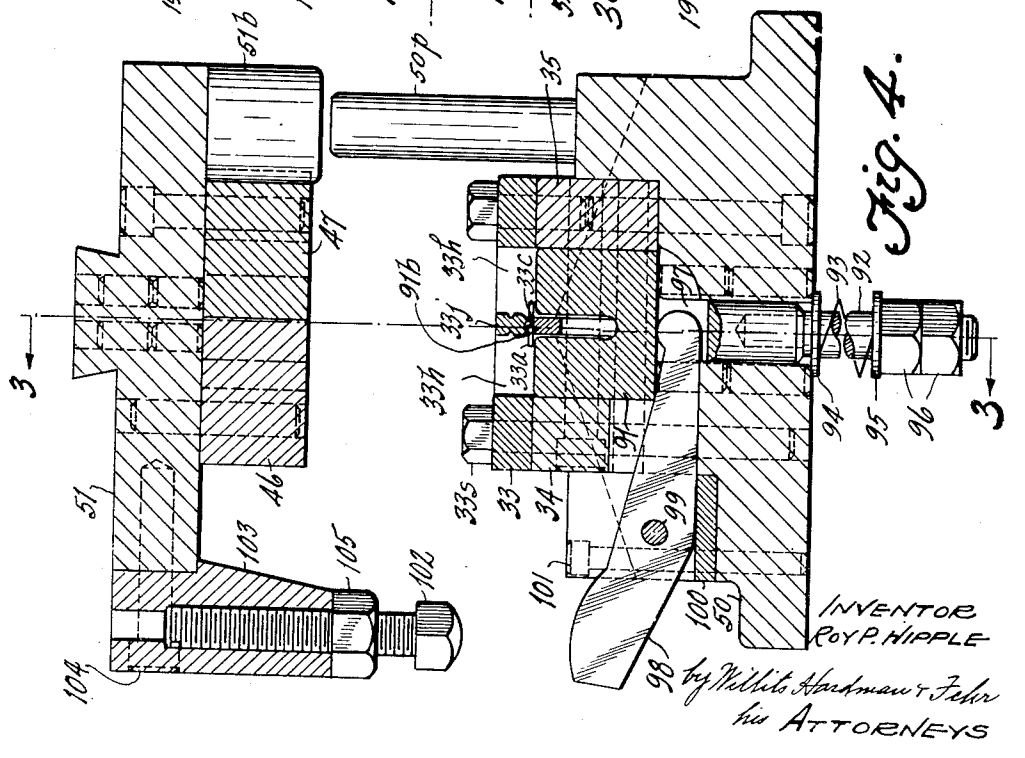

Fig. 4.

INVENTOR
ROY P. HIPPLE

by Willits Hardman & Fisher
his ATTORNEYS

July 20, 1954

R. P. HIPPLE

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 3

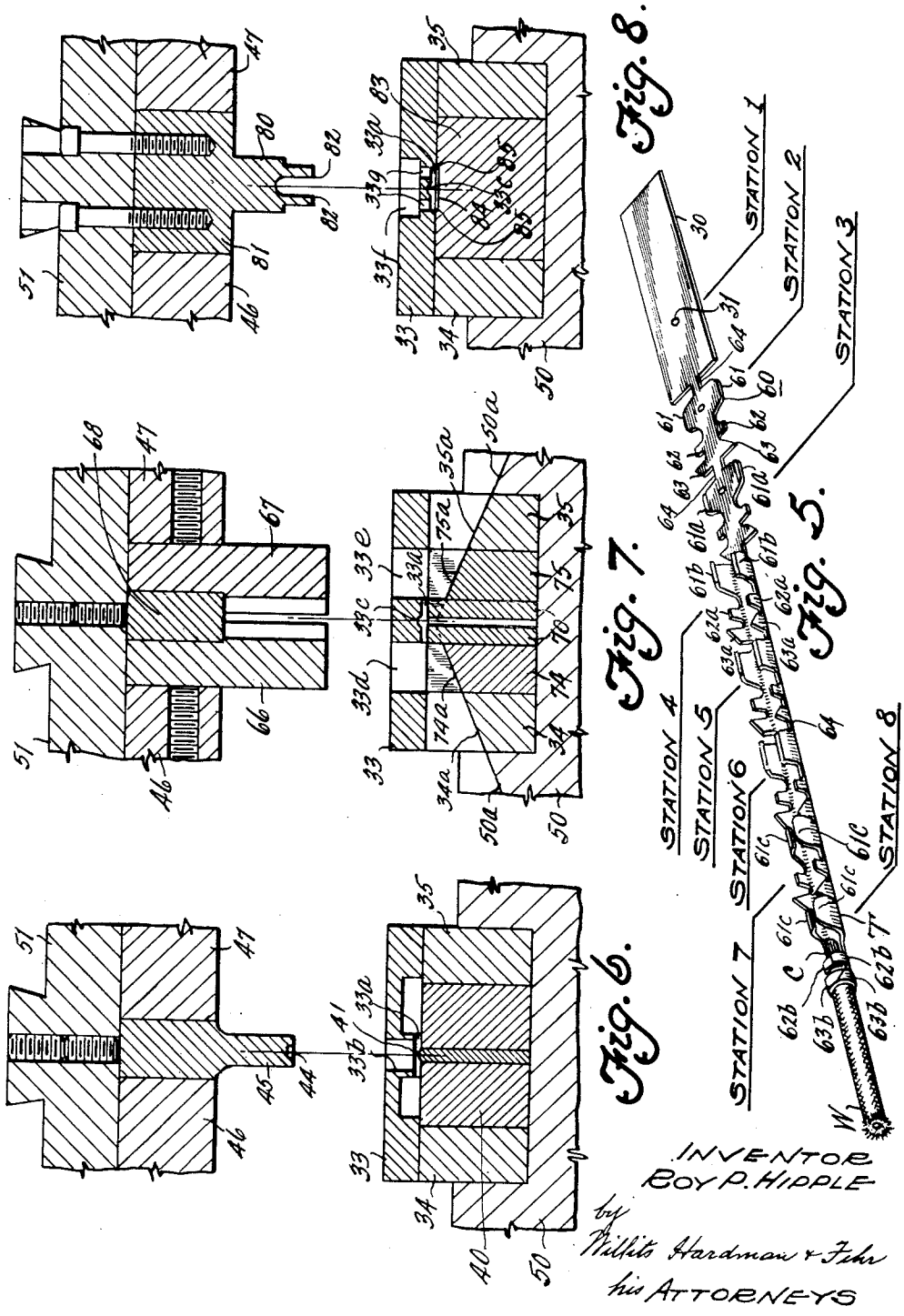

Fig. 8.

Fig. 7.

Fig. 5.

Fig. 6.

INVENTOR
ROY P. HIPPLE
by
Willits Hardman & Fehr
his ATTORNEYS

July 20, 1954

R. P. HIPPLE

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 4

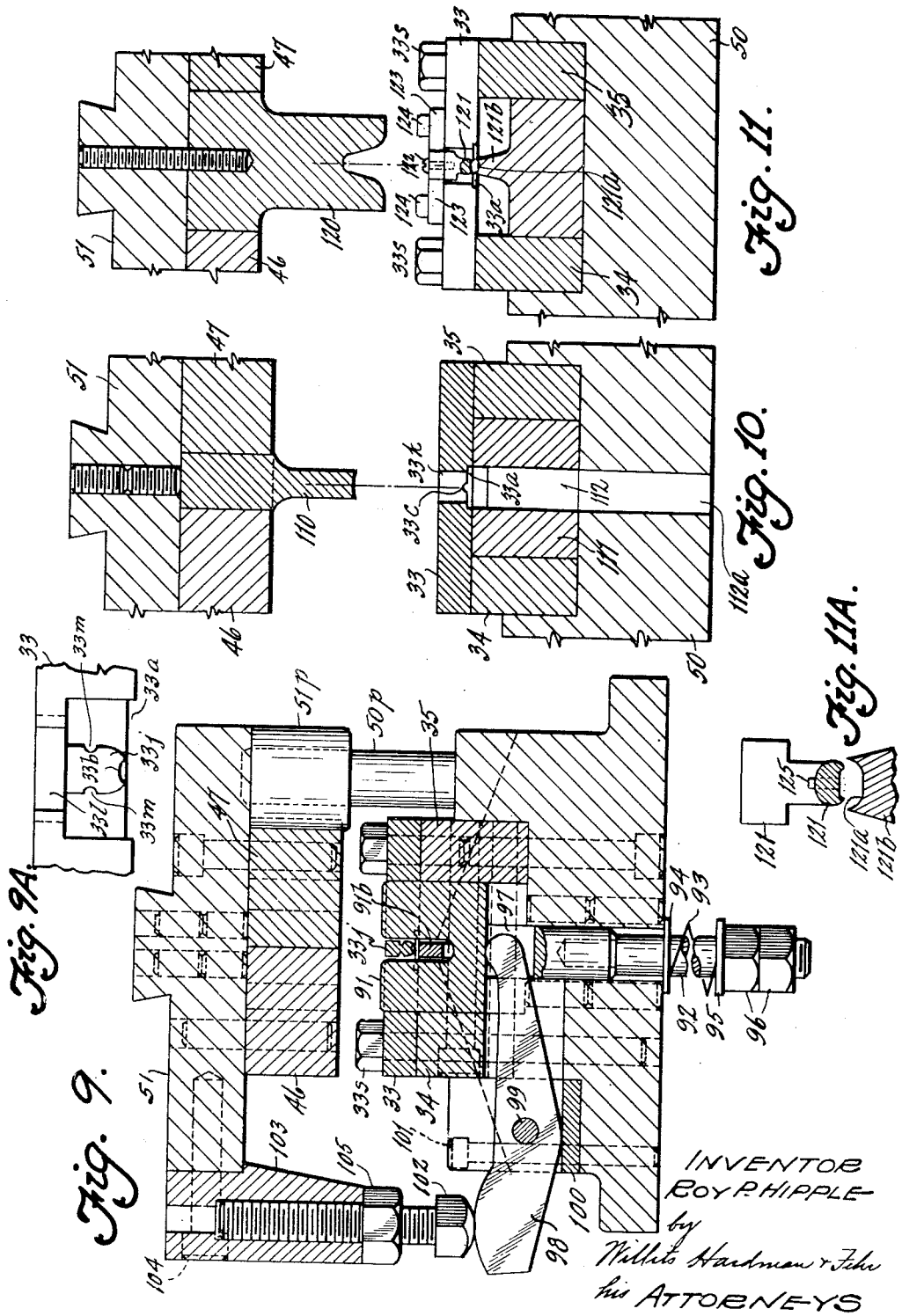

Fig. 11.

Fig. 10.

Fig. 11A.

Fig. 9A.

Fig. 9.

INVENTOR
ROY P. HIPPLE
by
Willits Hardman & Fish
his ATTORNEYS

July 20, 1954

R. P. HIPPLE
APPARATUS FOR FORMING TERMINALS
AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 5

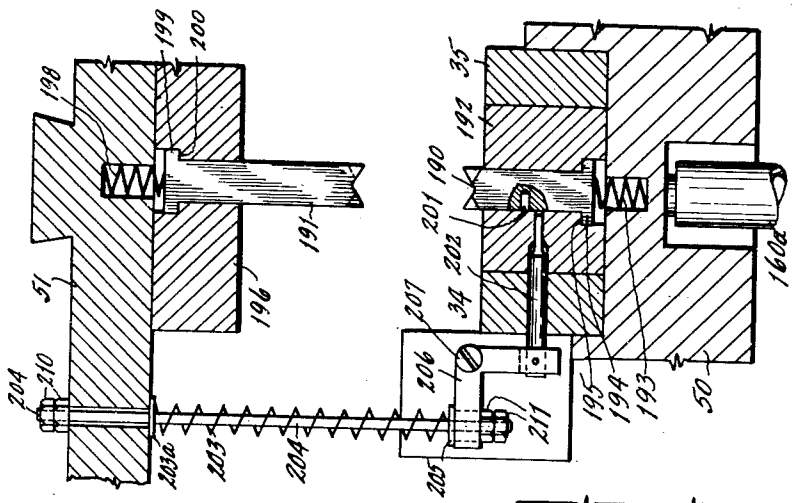

Fig. 14.

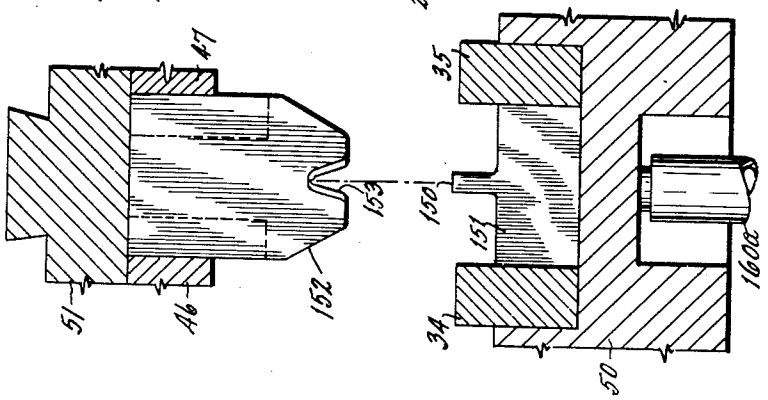

Fig. 13.

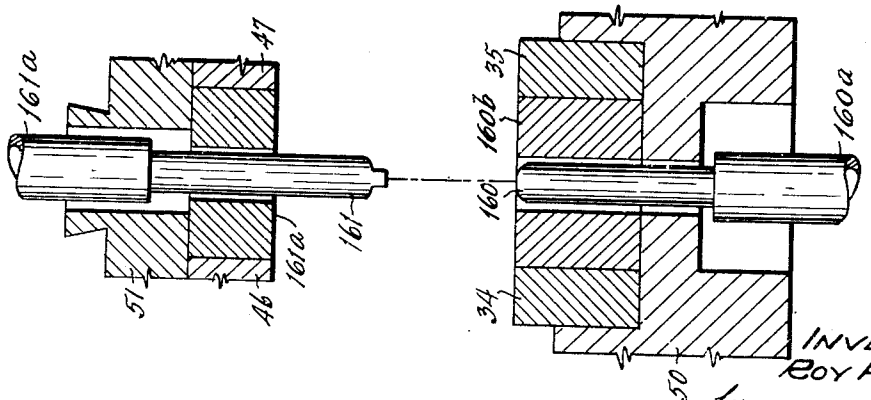

Fig. 12.

INVENTOR
ROY P. HIPPLE
by
Willits Hardman & Fehr
his ATTORNEYS

July 20, 1954

R. P. HIPPLE

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 6

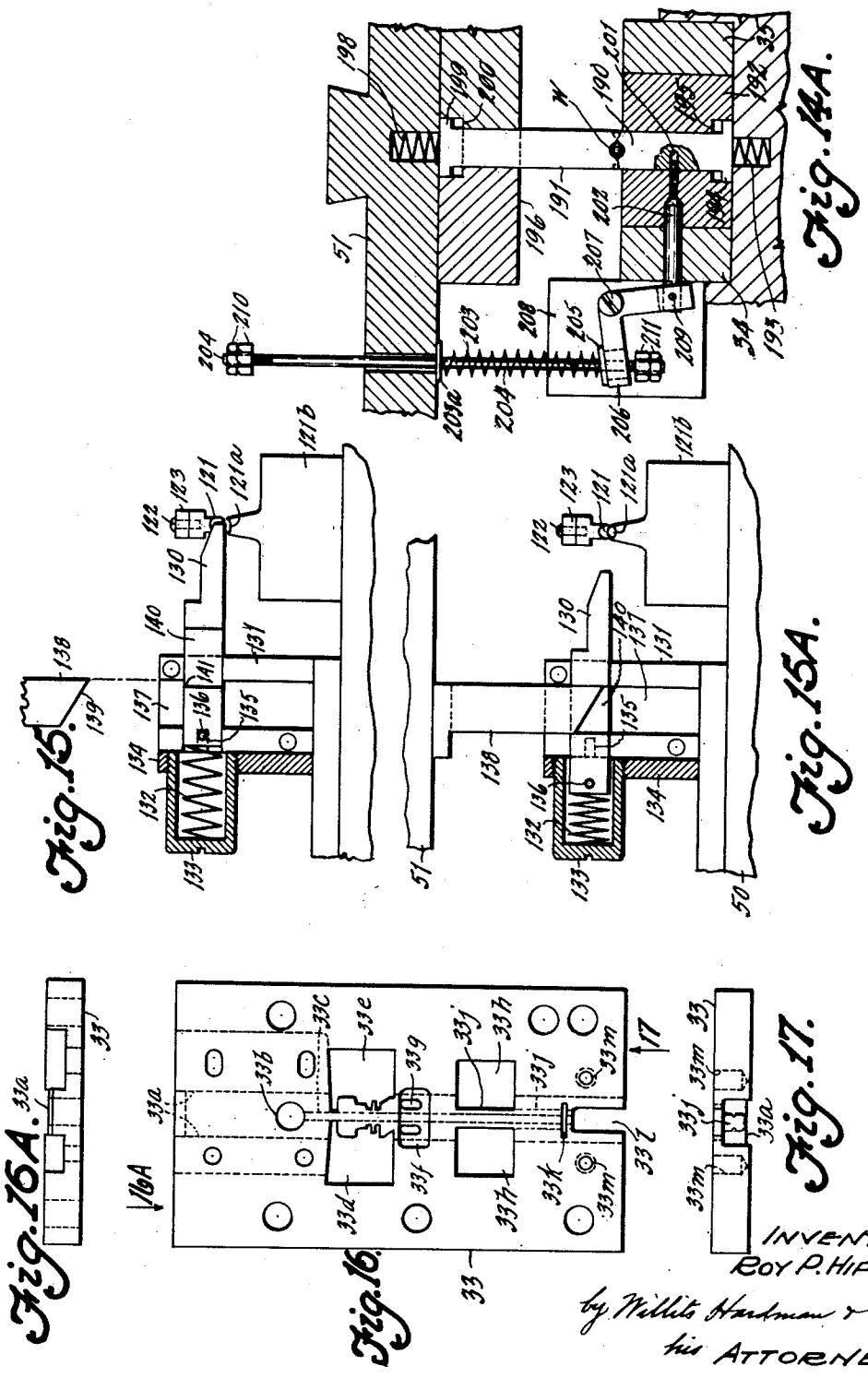

Fig. 14A.

Fig. 15A.

Fig. 15.

Fig. 16A.

Fig. 16.

Fig. 17.

INVENTOR
ROY P. HIPPLE
by Willis Hardman & Fehr
his ATTORNEYS

July 20, 1954

R. P. HIPPLE

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

2,684,421

Filed July 21, 1950

7 Sheets-Sheet 7

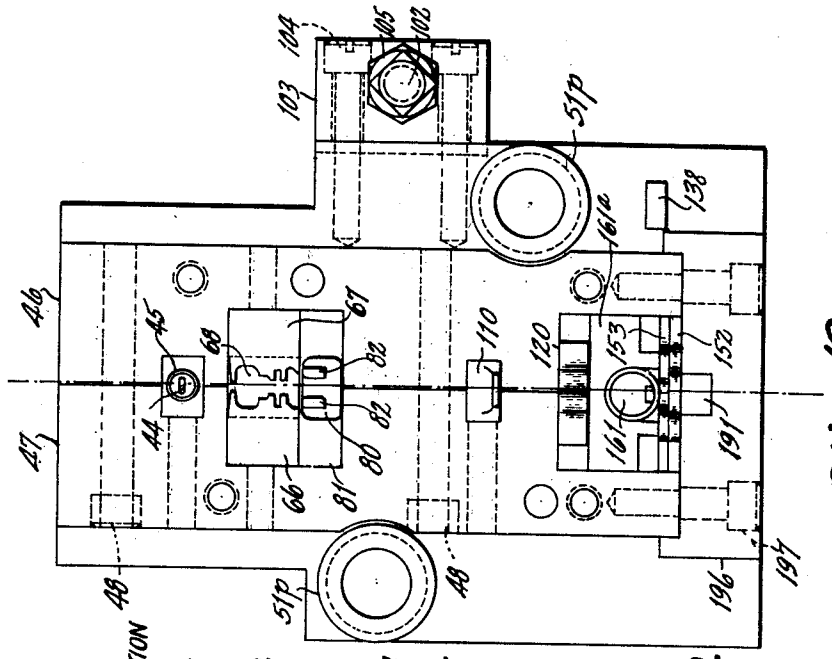

Fig. 19.

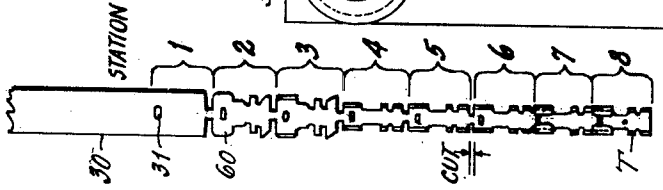

Fig. 20.

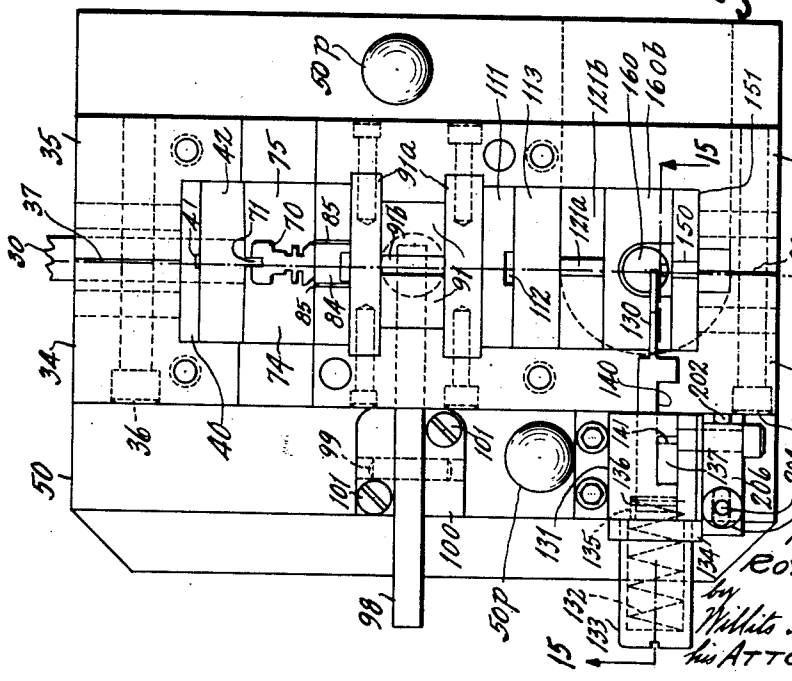

Fig. 18.

INVENTOR
ROY P. HIPPLE
by
Willits Hardman & Fehr
his ATTORNEYS

Patented July 20, 1954

2,684,421

UNITED STATES PATENT OFFICE

2,684,421

APPARATUS FOR FORMING TERMINALS AND ATTACHING SAME TO WIRES

Roy P. Hipple, Warren, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application July 21, 1950, Serial No. 175,093

4 Claims. (Cl. 219—4)

1

This invention relates to the art of manufacturing terminals from strip sheet metal and for mechanically and electrically connecting them with a wire.

It is an object of the present invention to provide apparatus adapted to be operated by a punch press and which forms terminals from a strip of sheet metal fed lengthwise which severs them successively from the strip and feeds them to a station where an operator applies a wire to the terminal and where devices crimp portions of the terminal around the wire and where welding electrodes connected with a welding current source are applied to weld the bared core to the terminal. The apparatus comprises a base assembly adapted for mounting on the press bed and a head assembly adapted for support by the press ram, said assemblies having cooperating punches and dies which respectively operate at stations to shape the strip to progressively form a terminal having ears for attaching the terminal to a wire having a bared core portion extending from the insulated portion of the wire and having, at the last operating station, means for crimping the ears around the wire and electrodes for welding the core to the terminal, said assemblies providing at a station in advance of the welding station, means for severing the terminal from the strip fed by the press, and the base assembly providing means for guiding severed terminals in the welding station and for maintaining location thereof at the welding station.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a front view of a machine embodying the invention.

Figs. 1A, 1B and 1C are fragmentary sectional views taken, respectively, on lines 1A—1A, 1B—1B and 1C—1C of Fig. 1.

Fig. 2 is a side view of the machine, partly in section, the section being taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view on line 3—3 of Fig. 1.

Fig. 4 is a sectional view on line 4—4 of Fig. 3.

Fig. 5 is a perspective view showing the steps of forming a terminal clip, the left end terminal clip being attached to a wire.

Figs. 6, 7 and 8 are sectional views, taken respectively, on lines 6—6, 7—7 and 8—8 of Fig. 3.

Fig. 9 is a view similar to Fig. 4 showing parts

2

thereof in different positions. Fig. 9A is part of Fig. 17 enlarged.

Figs. 10 and 11 are sectional views on the lines 10—10 and 11—11 of Fig. 3.

Fig. 11A is an enlargement of a portion of Fig. 11.

Figs. 12, 13 and 14 are sectional views on lines 12—12, 13—13 and 14—14 of Fig. 3.

Fig. 14A is a view similar to Fig. 14, showing the parts thereof in different positions.

Fig. 15 is a sectional view on line 15—15 of Fig. 18.

Fig. 15A is a view similar to Fig. 15, showing parts thereof in different positions.

Fig. 16 is a plan view of a lower die cover plate.

Figs. 16A and 17 are views, respectively, in the direction of arrows 16A and 17 of Fig. 16.

Fig. 18 is a plan view of the lower die assembly on line 18—18 of Fig. 3.

Fig. 19 is a bottom view of the upper punch assembly on line 19—19 of Fig. 3.

Fig. 20 is a plan view of the strip as it is formed by the punches and dies shown in Figs. 18 and 19.

Referring to Fig. 5, a strip of material 30 is operated upon by punches and dies capable of being mounted in a conventional punch press having means for feeding the strip in a direction which is toward the left in Figs. 5 and 3 and down in Fig. 20. At various stations, numbered 1 to 8 in Figs. 5 and 20, certain operations are performed. At station 1, the strip is deformed to provide a small boss 31 (Fig. 5). As the strip is fed toward the left in Fig. 3, it passes through a groove 33*a* (Fig. 16) provided by a cover plate 33 attached by screws 33*s* (Figs. 3 and 4) to two die holders 34 and 35 which, as shown in Fig. 18, are fastened together by screws 36 so that they meet on the lines 37 and 38. These plates 34 and 35 secure between them a plate 40 which, as shown in Figs. 3, 6 and 18, locates a punch 41 which is confined in a groove of plate 40 by a block 42. Punch 41 is in alignment with a socket 44 of a die 45 clamped between plates 46 and 47 (Fig. 19) and held together by screws 48. Plates 34 and 35 are attached to a base 50 (Fig. 18) mounted on the bed B (Fig. 2) of the punch press. Plates 46 and 47 are attached to a head 51 having a dovetail flange 52*a* (Fig. 1) received by a similar groove in the ram or plunger 52 guided by the frame 53 (Fig. 2) of the punch press. As the ram 52 descends, the strip 30 is squeezed between the die 45 and the punch 41 (Figs. 3 and 6) to form the boss 31 (Fig. 5). The die 45 (Fig. 6)

passes through a hole 33b (Fig. 17) in cover 33 which provides a groove 33c which receives the boss 31.

At station 2 (Figs. 5 and 20), the strip 30 is shaped to form the blank 60 having ears 61, 62 and 63 which are joined to the strip 30 by a neck 64. The operation of forming the blank 60 is performed by punches and dies at station 2 as shown in Fig. 7. Punches 66 and 67 are confined between bars 46 and 47 (Fig. 19) with a spacing block 68 between them. Dies 66 and 67 cooperate with a fixed punch 70 (Fig. 18) which is received between them, said punch having a central groove receiving a tang 71 of the block 42 and said punch 70 being located between blocks 74 and 75 confined between bars 34 and 35 (Fig. 18). The blocks 74 and 75 and the bars 34 and 35 are provided with inclined surfaces 74a, 75a, 34a, 35a and the base 50 is provided with surfaces 50a (Fig. 7), which provide inclined chutes down which the metal sheared from the strip to form the blank 60 (Fig. 5) may descend.

The operation performed at station 3 (Fig. 5) is to bend the ears 61 as shown at 61a. This operation is performed by a punch 80 (Fig. 8) integral with a block 81 confined between bars 46 and 47 (Fig. 19) and having prongs 82 which cooperate with a die 83 (Figs. 8 and 18) having a slightly depressed surface 84 and having inclined surfaces 83a shaped to produce the bending of the ears 61 and 61a. Recess 33f in cover 33 receives punch 80 and holes 33g receive the prongs 82 (Figs. 16 and 8).

The next operation is to cause the ears of the blank 60 to be bent, as shown at station 4 (Fig. 5), into the positions 61b, 62a and 63a, respectively. For this purpose, the cover plate 33 (Fig. 16) provides a rib 33j about which the ears are bent by upward movement of a head 91 (Fig. 4) of a rod 92, said head 91 moving from the position shown in Fig. 4 to that shown in Fig. 9. During this movement, the prongs of the head 91 are received by holes 33h (Fig. 16) of plate 33. Head 91 moves between bars 34 and 35. Normally the head is down as shown in Fig. 4. To hold it down there is a spring 93 confined between a washer 94 bearing against the base 50 and a washer 95 bearing against a nut 96 attached to the threaded end of rod 92. Rod 92 has a notch 97 for receiving an end of a lever 98 pivotally supported by a pin 99 fixed to a bracket 100 which screws 101 attach to base 50. Movement of the head 91 from the position shown in Fig. 4 to that shown in Fig. 9, is effected during downward movement of the head 51 by virtue of engagement with the lever 98 by a screw 102 threaded through a bracket 103 which screws 104 attach to head 51. Screw 102 is adjustable and is retained in the desired position of adjustment by lock nut 105. During the operation at station 4, the central part of the blank 60 is confined between rib 33j (Fig. 9) and a rib 91b of a block 91a (Fig. 3) which appears H-shaped in Fig. 18 and is confined between bars 34 and 35. At station 5 (Fig. 5), no change is made in the formation of the terminal. At station 6, the neck 64 is severed by the cooperation of a punch 110 (Fig. 10) confined between bars 46 and 47 (Figs. 10 and 19) and cooperating with a die 111 (Fig. 18) having a groove 112 for receiving the punch, and groove being closed by a block 113 (Fig. 18). Base 50 has a hole 112a through which the severed neck 64 gravitates. Plate 33 has a hole 33k (Fig. 16) which receives the punch 110.

At station 7 (Fig. 5), the ears 61 are formed as shown at 61c. This is effected by the cooperation of a die 120 (Fig. 11) retained between bars 46 and 47 and cooperating with an anvil 121 which screws 122 (Fig. 3) attach to a bar 123 which screws 124 attach to plate 33 (Fig. 11). During the operation at station 7, the central point of the terminal T is supported by a surface 121a (Fig. 11) of a block 121b. The anvil 121 carries pins 125 (Fig. 3) which are received in the space between the bent-over edges of ears 61c (Fig. 5), thus locating the terminal clip T rotatively relative to the anvil 121. As the strip 30 moves to the left in Figs. 5 and 3, it will push the severed terminal T from station 6 to station 7 and from station 7 to station 8. As the terminal T moves from station 7 to station 8 (Fig. 5), the bent ears 61c receive between them the left hand pin 125 on the anvil 121 so that the terminal will not turn while at station 8.

As shown in Figs. 3, 9A and 16, plate 33 has a notch 331 which receives anvil 121 and the rib 33j has the groove 33b at its bottom and two side grooves 33m which receive ears 61 bent to 61b at station 4 (Fig. 5).

At station 8, the terminal is attached to the wire W and is welded thereto. The operator places the wire W with its bared core C upon the terminal T. To locate the wire properly with respect to the terminal, the operator pushes the core C against a stop bar 130 which is guided for horizontal movement by a plate 131 and which is urged to the right in the position shown by a spring 132 within a hollow plug 133 secured into a plate 134 fastened to plate 131. Right movement of the bar 130 by spring 132 is limited by the engagement with the end of a notch 135 of plate 131 by pin 136 attached to bar 130. Plate 131 has a groove 137 for receiving a bar 138 attached to head 51 (Fig. 15A) and having an oblique camming surface 139. Bar 138 is received by a groove 140 in bar 130; and the corner 141 of groove 140 is engaged by the surface 139 as the bar 138 moves to the position shown in Fig. 15A to effect retraction of the strip 130 to permit engagement of the work by a welding electrode. While the terminal is supported by a projection 150 of a block 151 confined between plates 34 and 35 (Fig. 13), dies 151 and 153 (Figs. 13 and 3) confined between bars 46 and 47 (Fig. 19), descend to cause, respectively, the operations of bending the ears 63 around the insulation of the wire W as indicated at 63b (Fig. 5) and the operation of bending the ears 62 around the bared core C of the wire as indicated at 62b.

The core C is welded to the terminal T while the terminal T is supported by a fixed electrode 160 (Fig. 3) and a movable electrode 161 is caused to descend upon the core and exert pressure thereon while welding current passes. Electrode 160 (Figs. 1 and 2) extends through a block 160b confined between bars 34 and 35 (Fig. 18) and the tubular, water cooled holder 160a which supports electrode 160 extends through a non-conducting bushing 162 supported by a bed B, a non-conducting bushing 163 in a bracket 164 and a split threaded bushing 165 threaded into a clamping bracket 166. Brackets 164 and 166 are secured to a plate 167 which screws 168 attach to bed B, said plate 167 being insulated by the provision of non-conducting plates 169 and non-conducting bushings 170 (Fig. 1C). The electrode holder 160a can be adjusted vertically and

then clamped in adjusted position by the turning of a screw 171 (Fig. 1B) which causes a clamping portion 172 of bracket 166 to be drawn tightly against the split bushing 165 and the latter thereby retracted around the electrode holder 160a.

The upper electrode 161 is mounted in a tubular, water cooled holder 161a which is supported by the press ram 52 and guided for vertical movement relative thereto by brackets 175 and 176 attached to a plate 177 which (as shown in Fig. 1A) together with a plate 178 is attached to the ram 52 by screws 179 which pass through non-conducting plates 180 and 181 and non-conducting bushings 182. Holder 161a is embraced by a clamp ring 184 (Fig. 1A) which can be adjusted along the electrode and then clamped thereto by tightening of a screw 185 (Fig. 1A). Holder 161a is prevented from turning due to the location of arms 186 which are part of the clamp ring 184 between pins 187 attached to bracket 175. A spring 188 is confined between the clamp 184 and the lower end of a bushing 189 threaded through the bracket 176 and tends to urge the latter against the bracket 175. When the electrode 161 is caused by ram 52 to descend upon the wire core C, the ram 52 travels slightly further so that the spring 188 urges the electrode 161 against the core C with pressure which can be adjusted by turning the bushing 189. When the ram 52 is raised, the bracket 175 engages the clamp ring 184 to lift the holder 161a and the supported electrode 161.

The electrode holders 160a and 161a are connected with a welding current source by connecting straps, not shown, and by hoses (not shown) with a source of cooling water.

During the operations performed at station 8, the wire W is clamped between plungers 190 and 191 (Figs. 14 and 14A). Plunger 190 is guided by a block 192 received between bars 34 and 35 and is urged upwardly by a spring 193 until lugs 194 of the plunger 190 engage shoulders 195 of the block 192. Plunger 191 is guided by a block 196 which, as shown in Fig. 19, is attached to plates 46 and 47 by screws 197. A spring 198 (Fig. 14) urges plunger 191 downwardly until lugs 199 thereof engage shoulders 200 of block 196. As the head 51 moves down from the position shown in Fig. 14 to that shown in Fig. 14A to cause the wire W to be clamped between the plungers 191 and 190, the plunger 190 is moved to the position shown in Fig. 14A wherein a hole 201 of the plunger receives a pin 202 which moves horizontally to the right due to the action of a spring 203 surrounding a rod 204 bearing upwardly against a washer 203a urged by the spring 203 against the head 51 and bearing downwardly against a washer 205 which bears against a lever 206 pivoted at 207 on a plate 208 and connected by pin 209 with the pin 202. The plunger 190 is held down after the wire is attached to the terminal while the operator removes the wire with terminal attached. It is desirable to hold the plunger 190 down during withdrawal of the wire because the lower spring 193, if allowed to expand, and lift the plunger 190 to normal position as the head 51 (Fig. 3) begins upward movement, might cause bending of the wire where it joins the terminal. When the head 51 returns to its upper position shown in Fig. 14, the pin 202 is retracted from the hole 201 of plunger 190 to allow the plunger to return to the position shown in Fig. 14. The retraction of the pin 202 is effected by upward movement of rod 204 at the time when nuts 210 on the upper end of rod 204 are being moved upwardly by head 51 and the nuts 211 on the lower end of rod 204 are engaging lever 206 to move it clockwise.

During the vertical movements of head 51 (Fig. 4) relative to base 50, the pilot bushings 51b thereof receive pilot pins 50p attached to the base 50. Actually the separation of head 51 from base 50 is not so great as shown in Figs. 3 and 4 and other figures. Separation is shown greater than normal for clarity of illustration.

The ears 61 which are formed as shown at 61C in Fig. 5 provide a socket for reeciving a plug connector. If the terminal to be formed and attached to a wire were one having a flat plate instead of a socket, the blank 60 would be one which provides, between ears 62 at station 2 (Fig. 5), and neck 64 a flat plate sometimes known as a spade terminal-receiving connector socket. If the terminal is one having a flat end, the operation at stations 3 and 7 would be omitted. Since the anvil 121 would not be required, the cover plate 33 would be long enough to provide a groove 33a which would extend to stop bar 130 (Fig. 3) so that the terminal, after having been severed, would be located edgewise at the last station where the operations are performed as described for station 8 of the illustrated apparatus.

The welding and terminal shaping operations performed at station 8 require close spacing of electrode 161 and dies 153 and 152 and close spacing of electrode 169 and block 151 (Fig. 3). It is advantageous to sever the terminal T in advance of its arrival at station 8 and to cause movement of the severed terminals by movement of the unsevered strip. For the guidance of the severed terminals, the anvil 121 at station 7 is used.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Apparatus for forming a terminal clip from a metal strip and attaching the clip to an electrical conductor, comprising fixed forming dies, a member for supporting said dies in a generally aligned relationship, a ram movable relatively to the dies, a plurality of punches supported by the ram in normally spaced alignment with said dies and adapted to cooperate therewith, means operable to move the ram so as to bring all of said punches into cooperative engagement with the dies as said metal strip is moved past the dies in order to progressively form a terminal having a plurality of ears by means of which the terminal is attached to an insulated wire having a bared core portion, means for moving said strip lengthwise past said dies intermittently so that a part of the strip from which a clip is formed is progressively moved to different positions with respect to said dies, said punches and said dies coacting at said different positions to form said clip, said ram including a punch adapted to coact with an oppositely disposed die to crimp a first set of ears of said clip around the bared core and a second set of ears about the insulated part of the wire at the last position occupied by said clip before it is moved beyond the dies, a fixed electrode mounted on said die supporting member, another electrode mounted upon said ram and movable with respect thereto, said electrodes adapted to coact to weld said first set of ears to said bared core concurrently with said crimping operation, means for severing

the terminal clip from said strip before the crimping and welding operations, and guiding means in alignment with a path of movement of said strip for guiding the severed clip whereby movement of the strip effects movement of the clip to the crimping position.

2. Apparatus for forming a terminal clip from a metal strip and attaching the clip to an electrical conductor, comprising fixed forming dies, a member for supporting said dies in a generally aligned relationship, a ram movable relatively to the dies, a plurality of punches supported by the ram in normally spaced alignment with said dies and adapted to cooperate therewith, means operable to move the ram so as to bring all of said punches into cooperative engagement with the dies as said metal strip is moved past the dies in order to form a terminal having a plurality of ears by means of which the terminal is attached to an insulated wire having a bared core portion, means for moving said strip lengthwise past said dies intermittently so that a part of the strip from which the clip is formed is progressively moved to different positions with respect to said dies, said punches and dies coacting at said different positions to form said clip, said ram including a punch adapted to coact with an oppositely disposed die to crimp a first set of ears of said clip around the bared core and a second set of ears around the insulated part of the wire at the last position occupied by said clip before it is moved beyond the dies, a fixed electrode mounted on said die supporting member, another electrode mounted upon said ram and movable with respect thereto, said electrodes adapted to coact to weld said first set of ears to said bared core concurrently with said crimping operation, a stop located in the path of movement of said movable electrode for normally limiting its movement toward the core, and means operated by movement of said ram toward the dies for retracting the stop so as to permit movement of the electrode to welding position.

3. Apparatus for forming a terminal clip from a metal strip and attaching the clip to an electrical conductor, comprising fixed forming dies, a member for supporting said dies in generally aligned relationship, a ram movable relatively to the dies, a plurality of punches supported by the ram in normally spaced alignment with said dies and adapted to cooperate therewith, means operable to move the ram so as to bring all of said punches into cooperative engagement with the dies as said metal strip is moved past the dies in order to progressively form a terminal having a plurality of ears by means of which the terminal is attached to an insulated wire having a bared core portion, means for moving said strip lengthwise past said dies intermittently so that a part of the strip from which a clip is formed is progressively moved to different positions with respect to said dies, said punches and dies coacting at said different positions to form said clip, said ram including a punch adapted to coact with an oppositely disposed die to crimp a first set of ears of said clip around the bared core and a second set of ears about the insulated part of the wire at the last position occupied by said clip before it is moved beyond the die, a fixed electrode mounted on said die supporting member, another electrode mounted upon said ram and movable with respect thereto, said electrodes adapted to coact to weld said first set of ears to said bared core concurrently with said crimping operation, and spring operated members supported by the ram and fixed dies respectively proximate the welding position and movable into welding engagement with the conductor when the ram is moved toward the die.

4. Apparatus for forming a terminal clip from a metal strip and attaching the clip to an electrical conductor, comprising fixed forming dies, a member for supporting said dies in a generally aligned relationship, a ram movable relatively to the dies, a plurality of punches supported by the ram in normally spaced alignment with said dies and adapted to cooperate therewith, means operable to move the ram to bring said punches into cooperative engagement with the dies to progressively form a terminal having a plurality of ears by means of which the terminal is attached to an insulated wire having a bared core portion as said metal strip is moved past the dies, means for moving said strip lengthwise past said dies intermittently so that a part of the strip from which a clip is formed is progressively moved to different positions with respect to said dies, said punches and dies coacting at said different positions to form said clip, said ram including a punch adapted to coact with an oppositely disposed die to crimp the first set of ears of said clip around the bared core and a second set of ears about the insulated part of the wire at the last position occupied by said clip before it is beyond the dies, a fixed electrode mounted on said die supporting member, another electrode mounted on said ram and movable with respect thereto, said electrodes adapted to coact to weld said first set of ears to said bared core, two wire engaging clamps supported respectively by the dies and ram and disposed adjacent said electrodes, the first clamp having a wire engaging surface normally located above the terminal engaging surface of said electrode, a spring for urging said first clamp upwardly, means responsive to the movement of the ram toward the dies for causing the second clamp to engage the wire and to force the first clamp to a position lower than normal, a latch adapted to be operatively connected to the first clamp to maintain said first clamp in its lower position against the action of said spring, and means operated by the ram as it substantially completes its movement away from the dies for retracting said latch in order to permit the operator to remove the wire from the terminal attached before the first clamp can return to normal position.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,613,715	Matson	Jan. 11, 1927
1,873,125	Holmes et al.	Aug. 23, 1932
1,959,150	Basch et al.	May 15, 1934
2,169,862	Keller	Aug. 15, 1939
2,288,918	Parker	July 7, 1942
2,409,147	Neuhaus et al.	Oct. 8, 1946
2,477,859	Burge et al.	Aug. 2, 1949
2,494,137	Martines	Jan. 10, 1950

OTHER REFERENCES

Page 3 of the section entitled "Terminal Assembly Methods That Reduce Costs" in the A-MP Bulletin No. 494. (Copy in Div. 14.)