

Dec. 26, 1961

J. LONG
MACHINE

3,015,020

Original Filed March 31, 1955

18 Sheets-Sheet 1

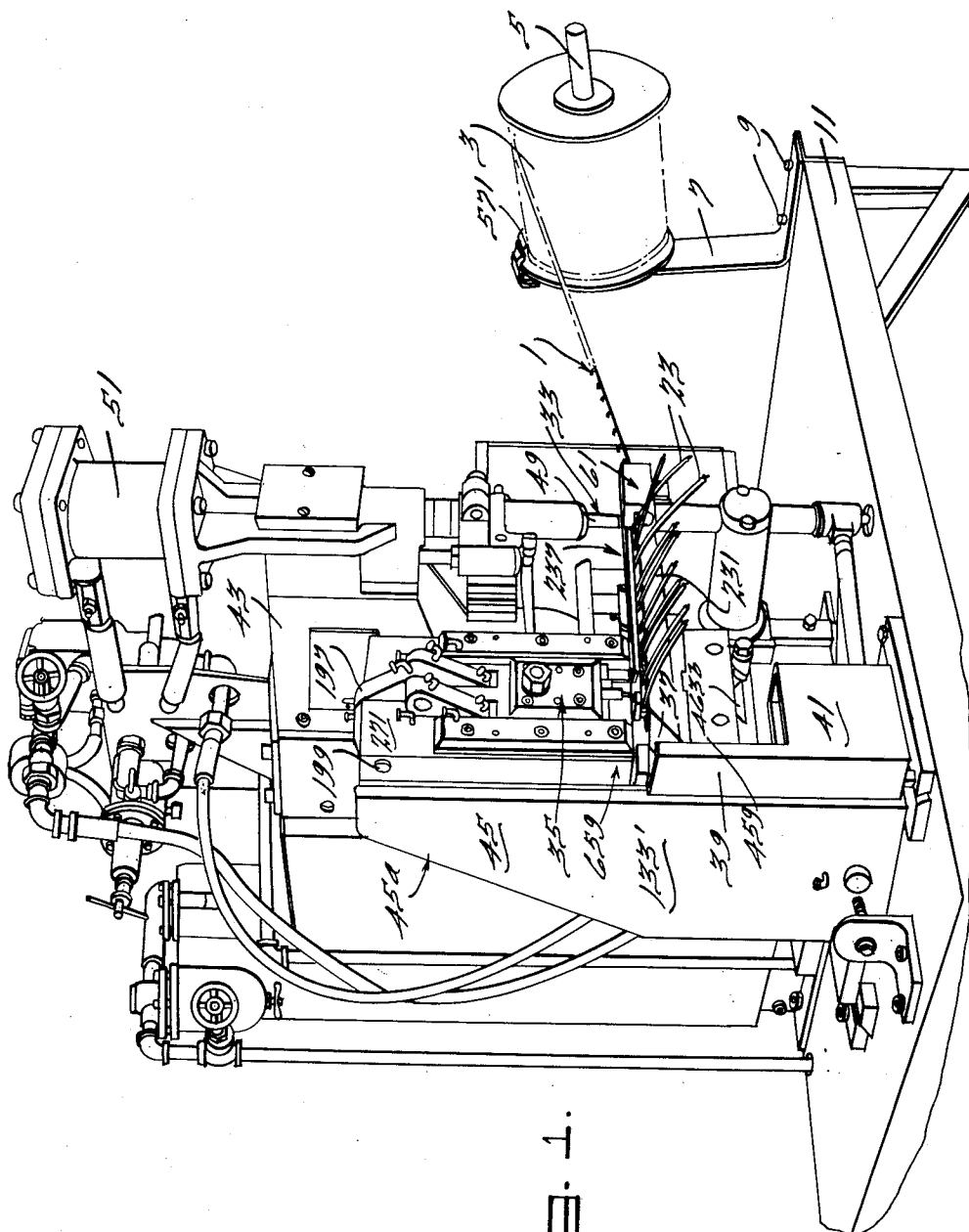


FIG. 1.

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18 Sheets-Sheet 2

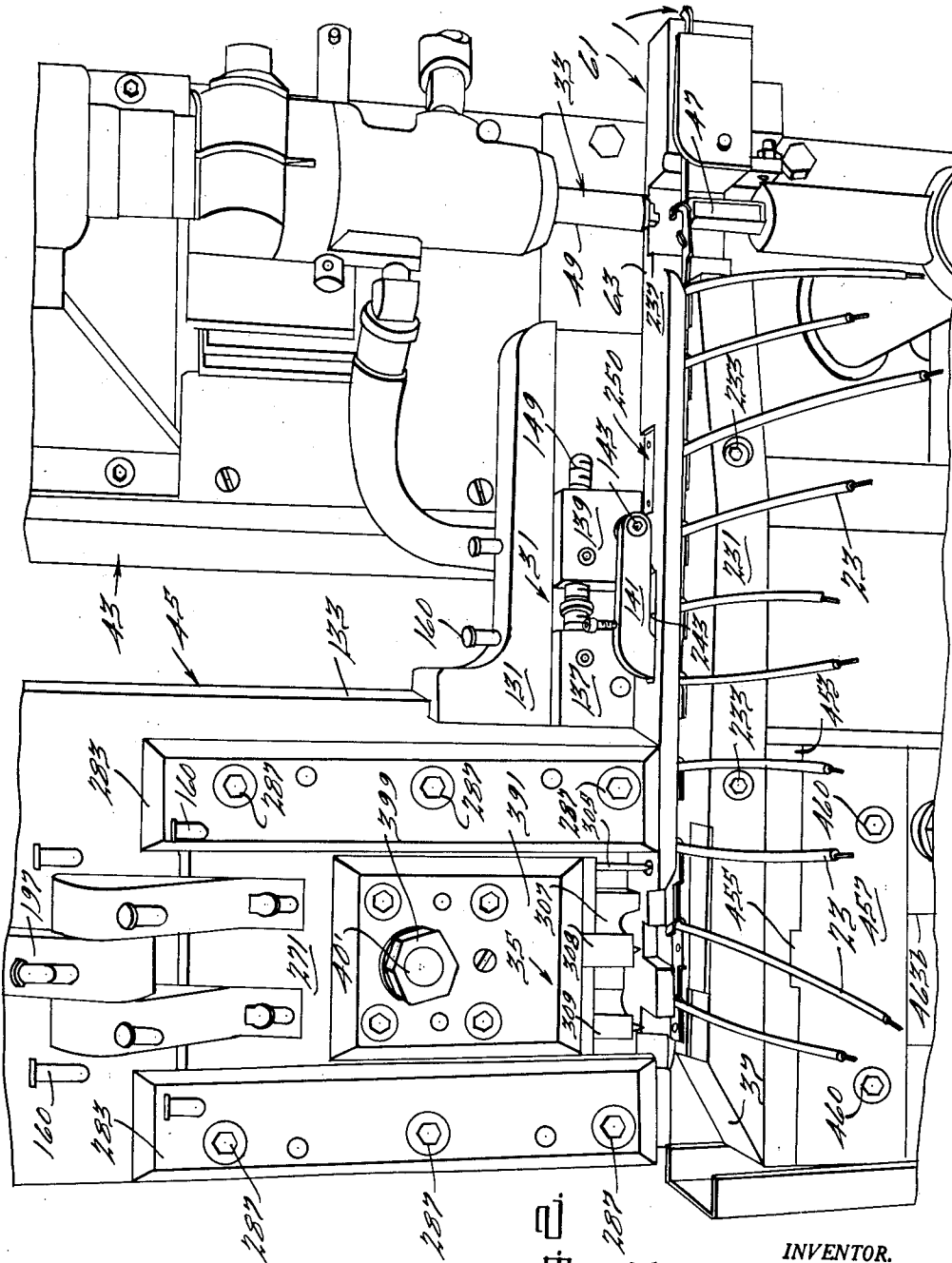


FIG. 2.

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MACHINE

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18 Sheets-Sheet 3

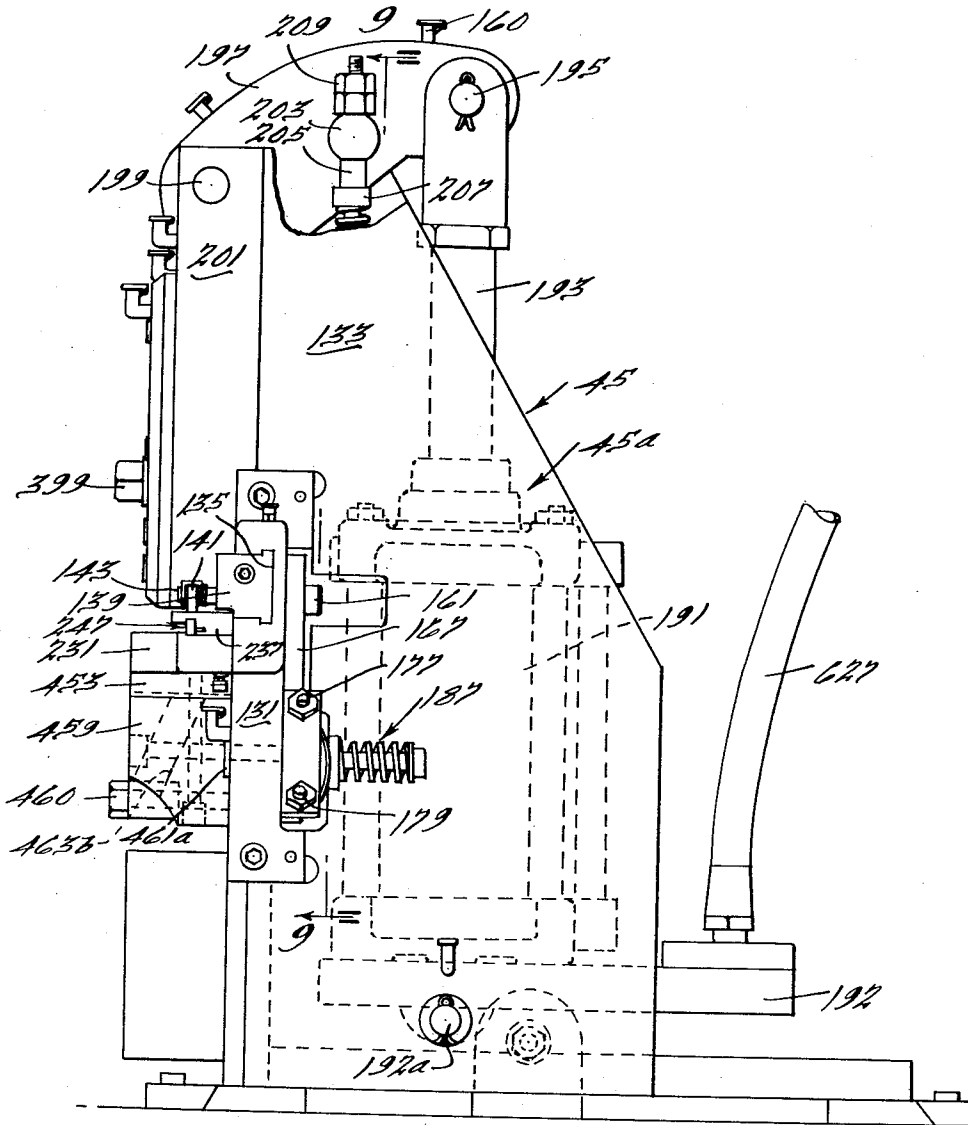


FIG. 3.

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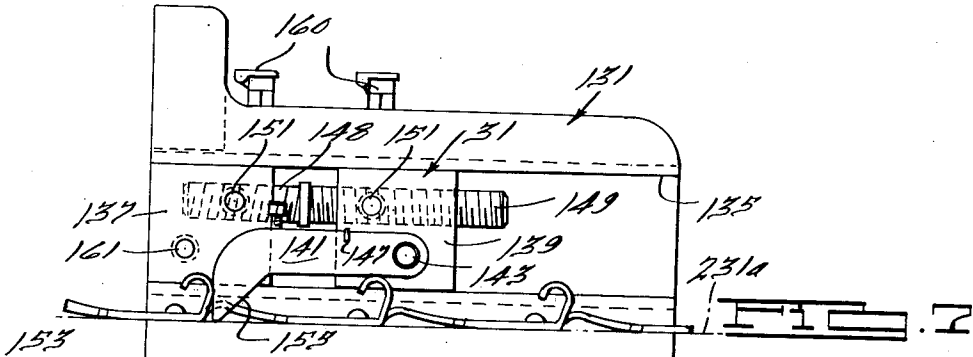
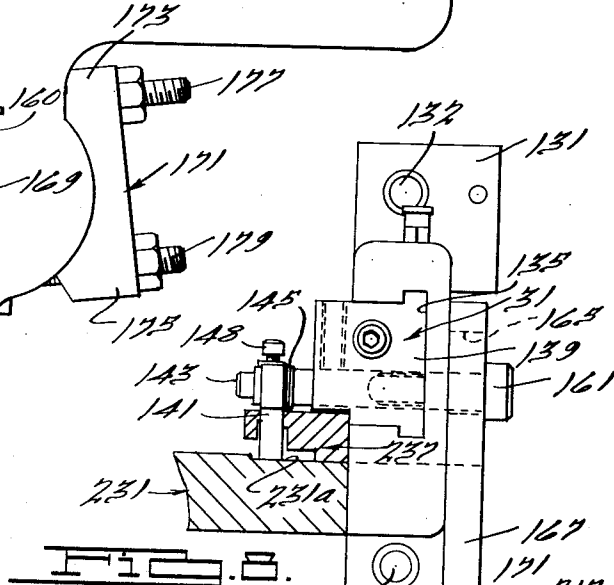
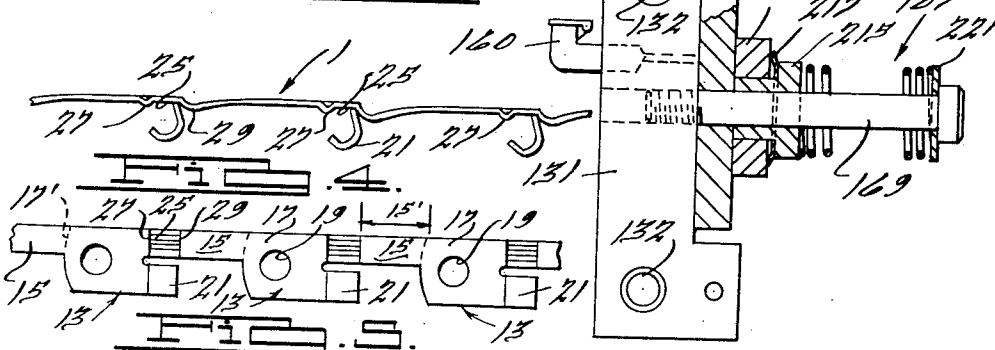
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MACHINE

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INVENTOR.
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Dec. 26, 1961

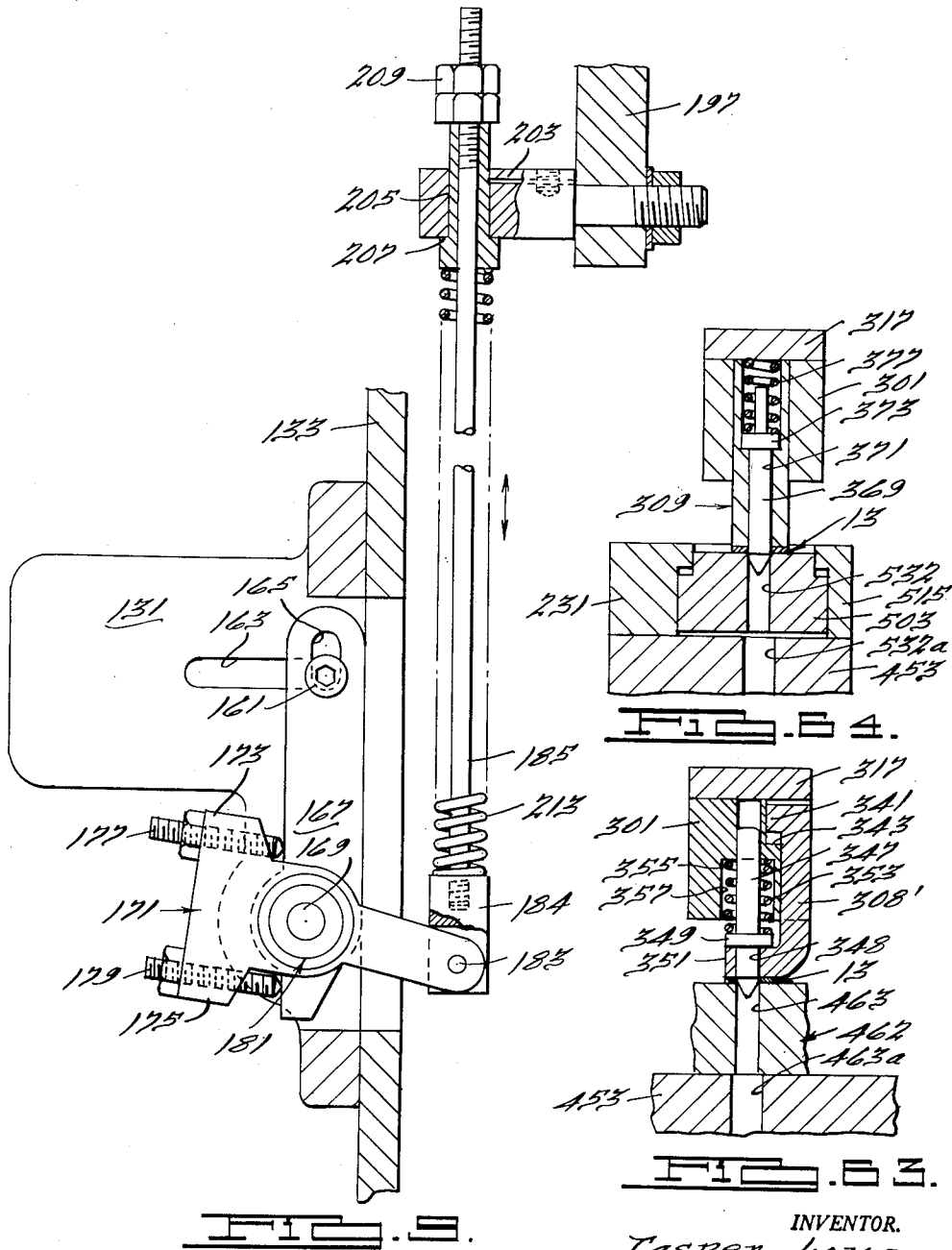
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3,015,020

MACHINE

Original Filed March 31, 1955

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INVENTOR.

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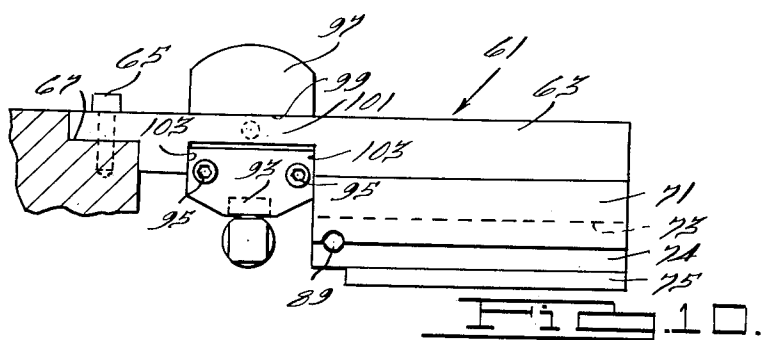
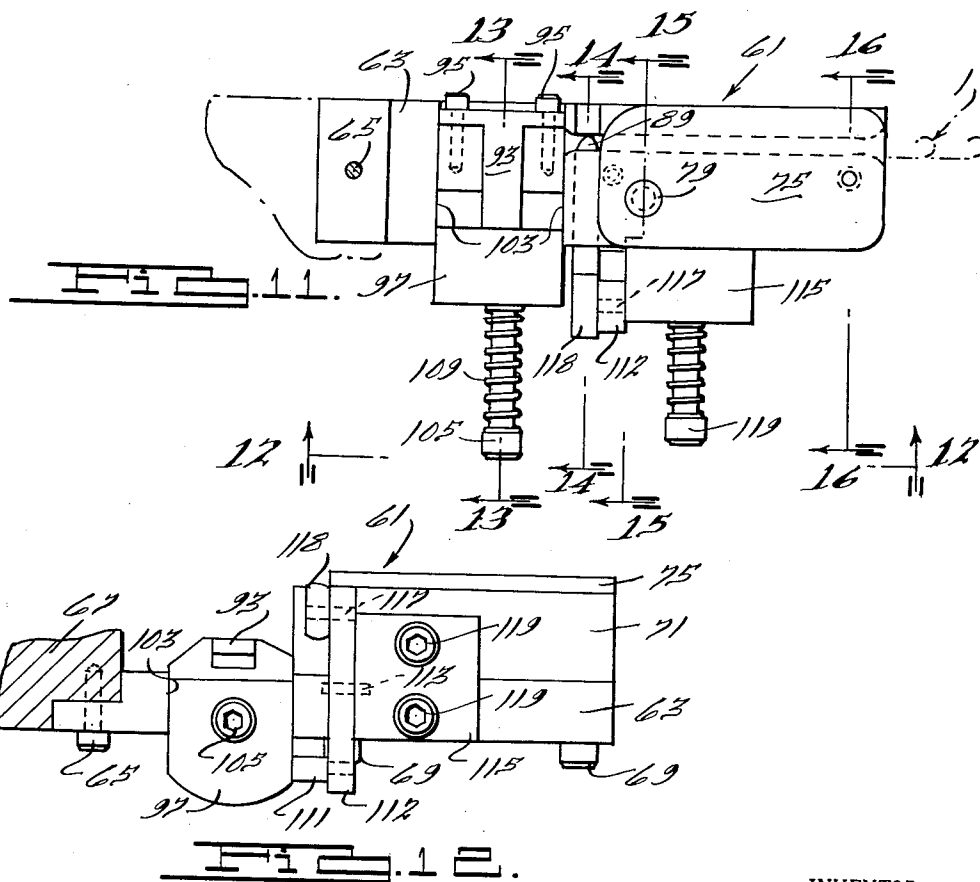
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J. LONG
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18 Sheets-Sheet 6



INVENTOR.
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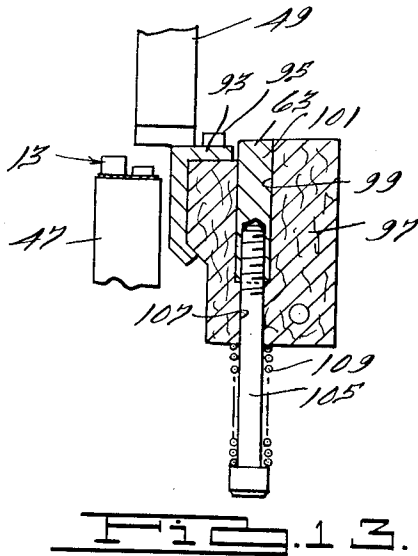
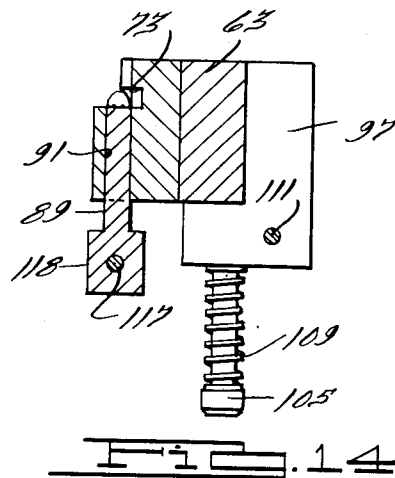
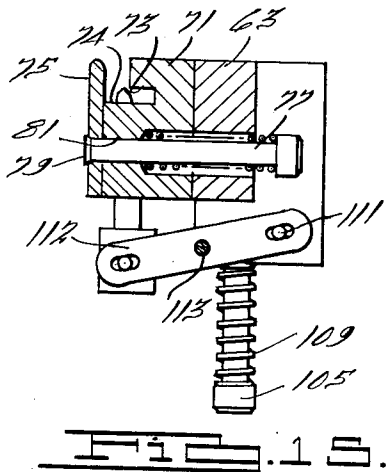
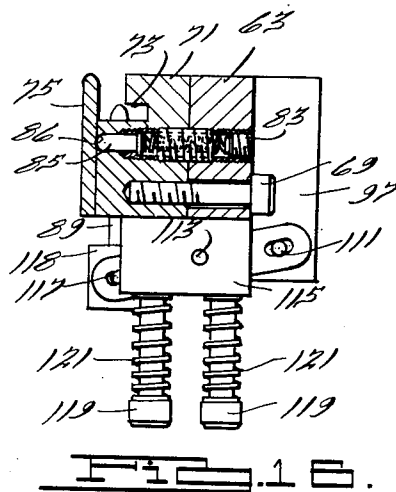
Dec. 26, 1961

J. LONG
MACHINE

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Original Filed March 31, 1955

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INVENTOR.
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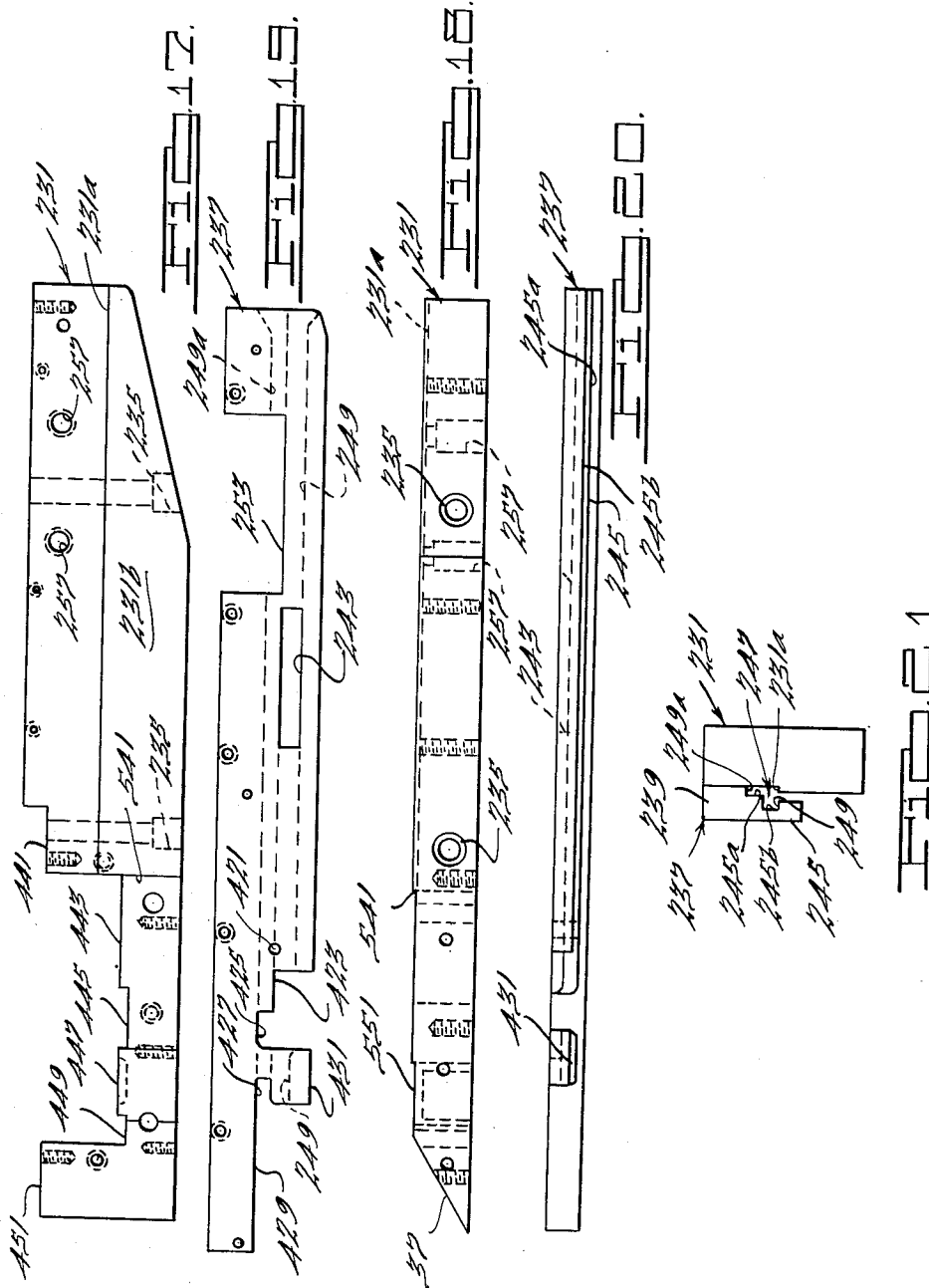
Dec. 26, 1961

J. LONG
MACHINE

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Original Filed March 31, 1955

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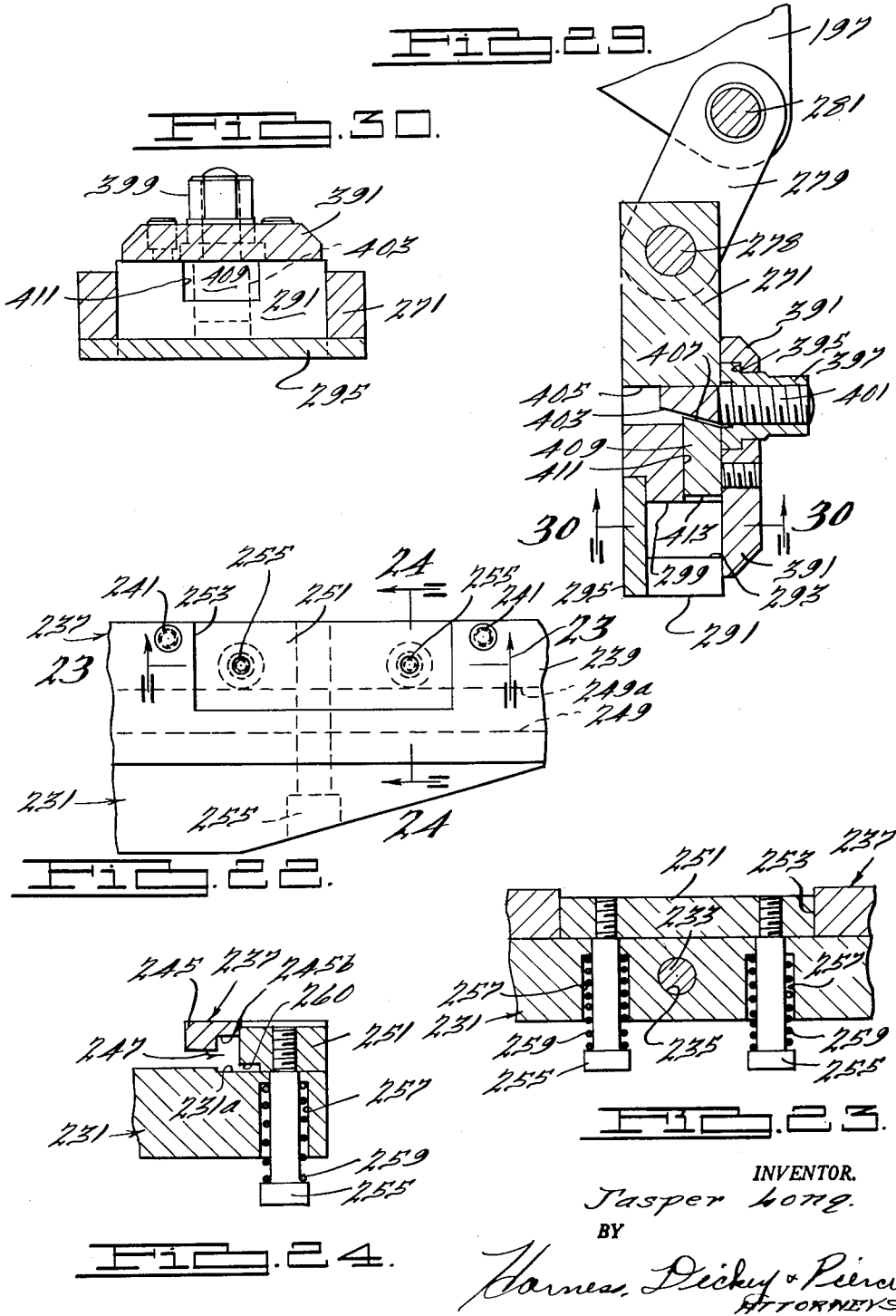
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J. LONG
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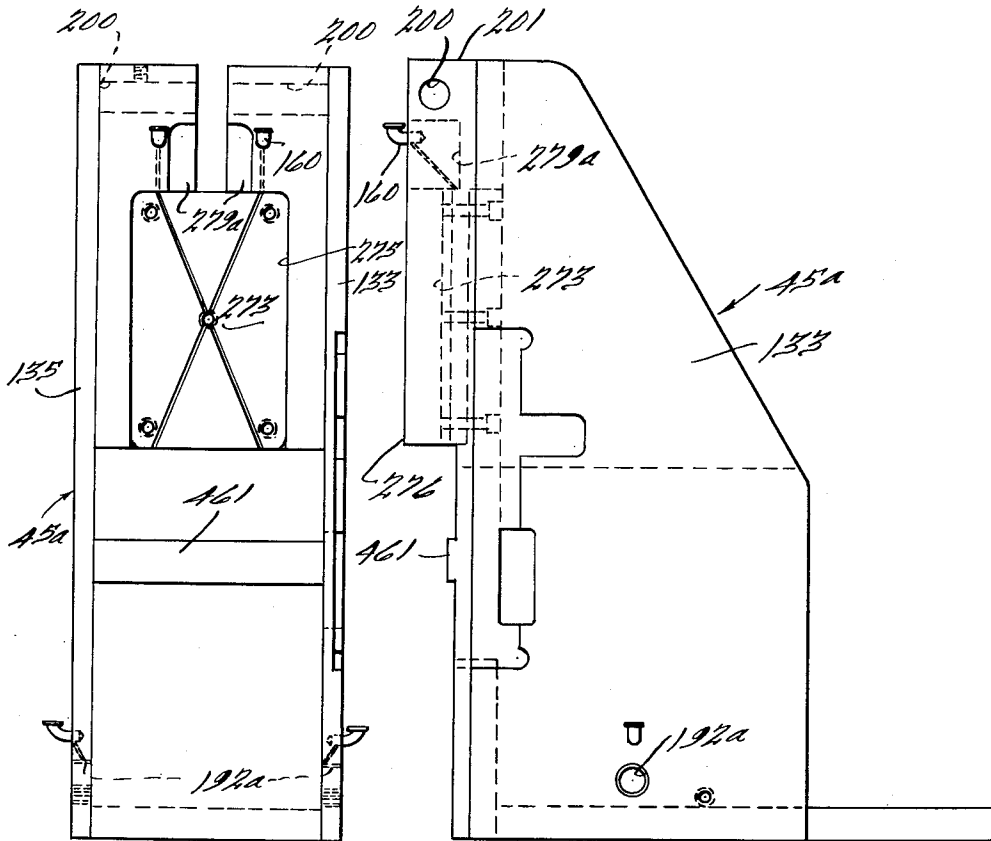
Original Filed March 31, 1955

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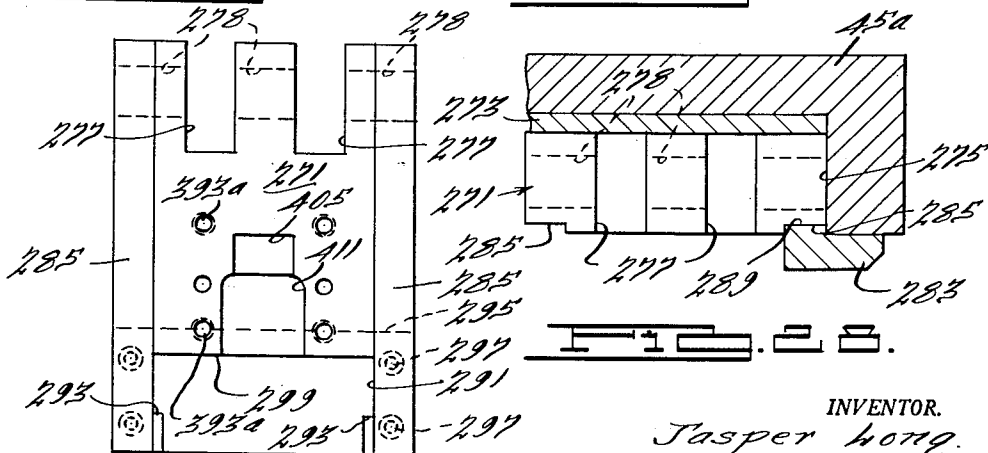


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18 Sheets-Sheet 10



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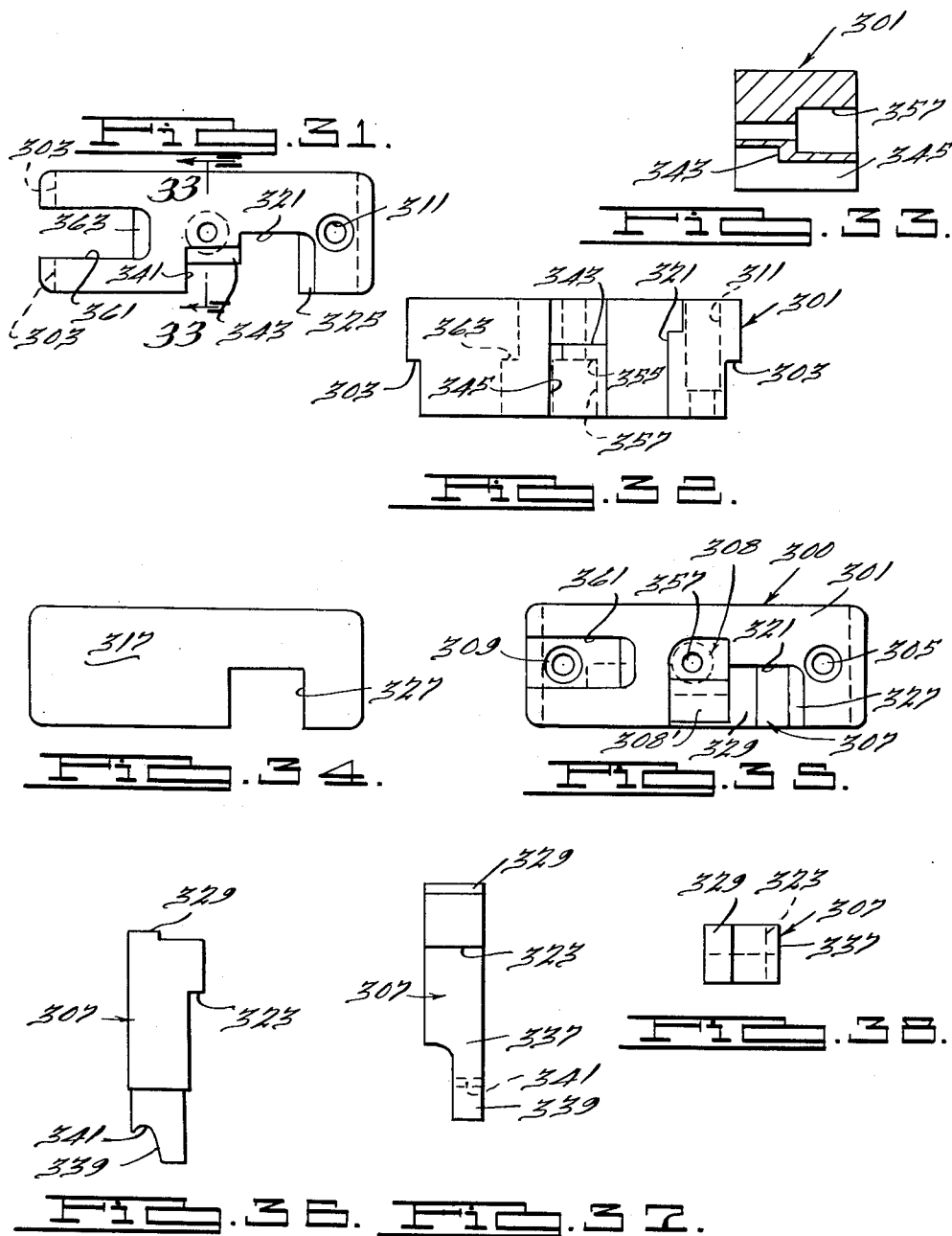
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18 Sheets-Sheet 11



INVENTOR.

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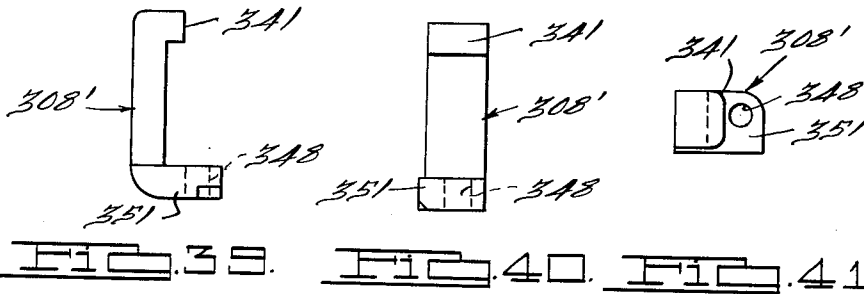
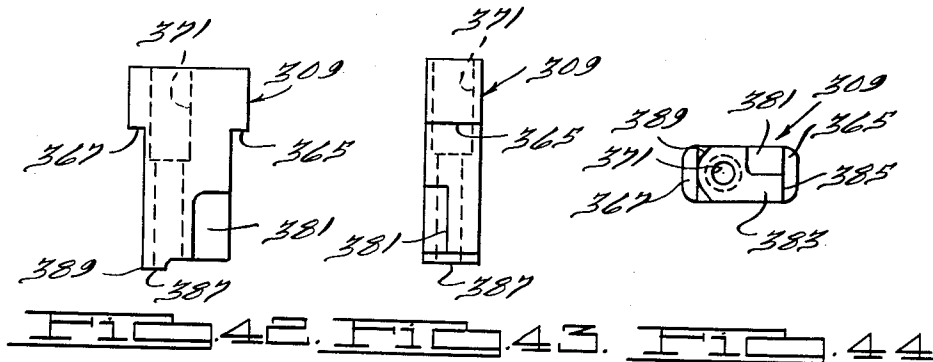
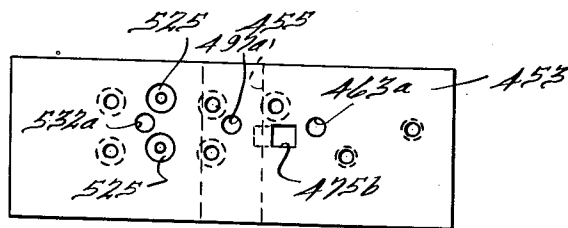
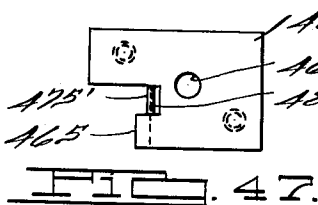
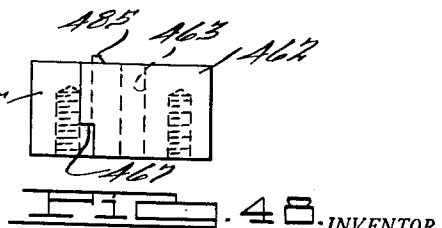
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18 Sheets-Sheet 12



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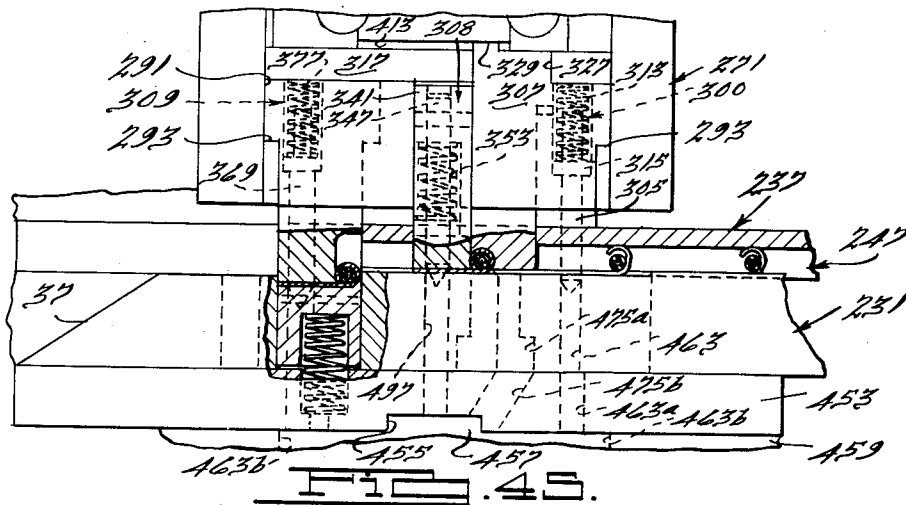


FIG. 45.

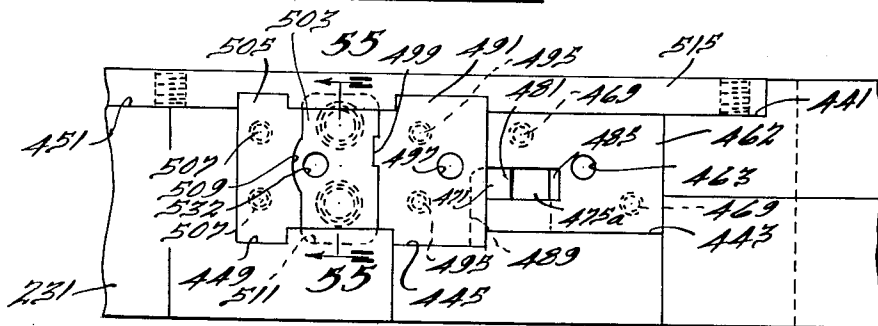


FIG. 46.

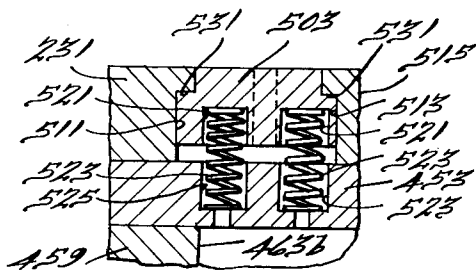


FIG. 47.

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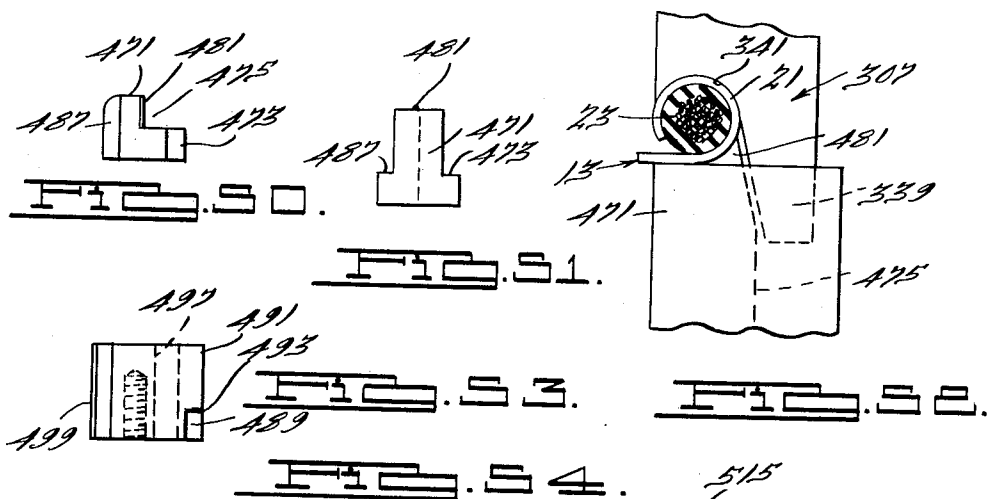
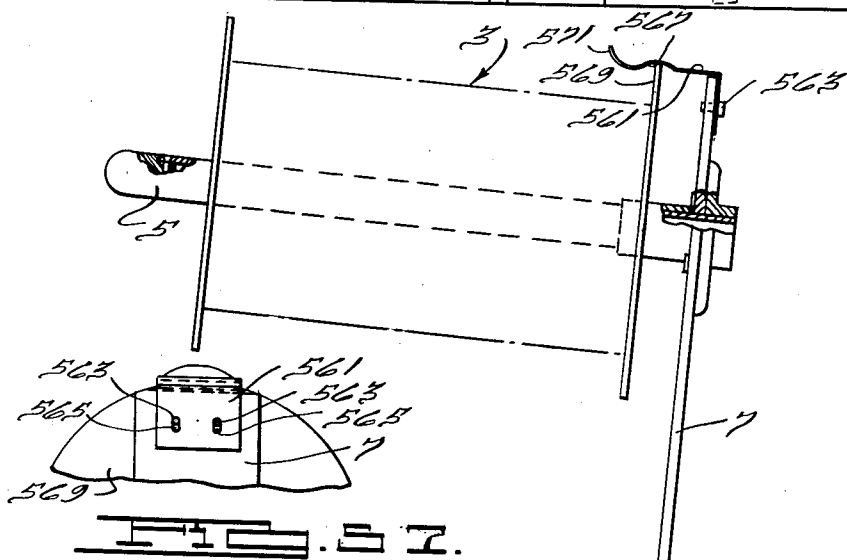
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Original Filed March 31, 1955

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FIG. 56. *Harness, Dickey & Piers.*
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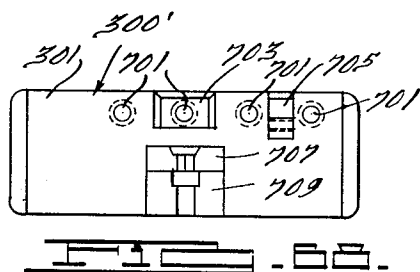
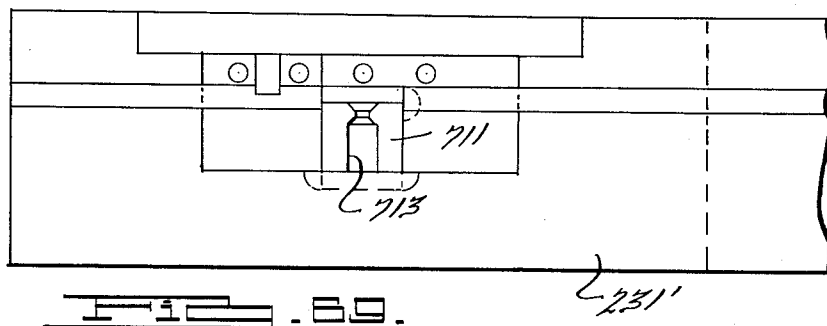
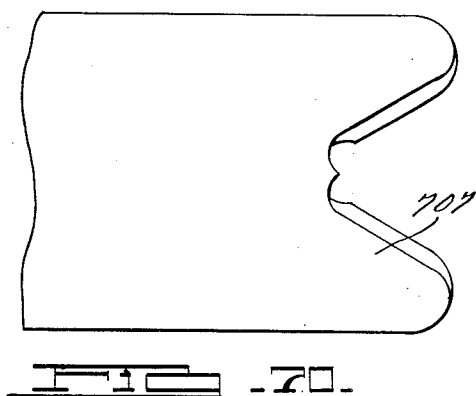
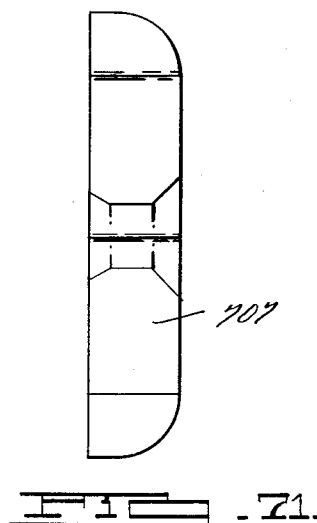
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Original Filed March 31, 1955

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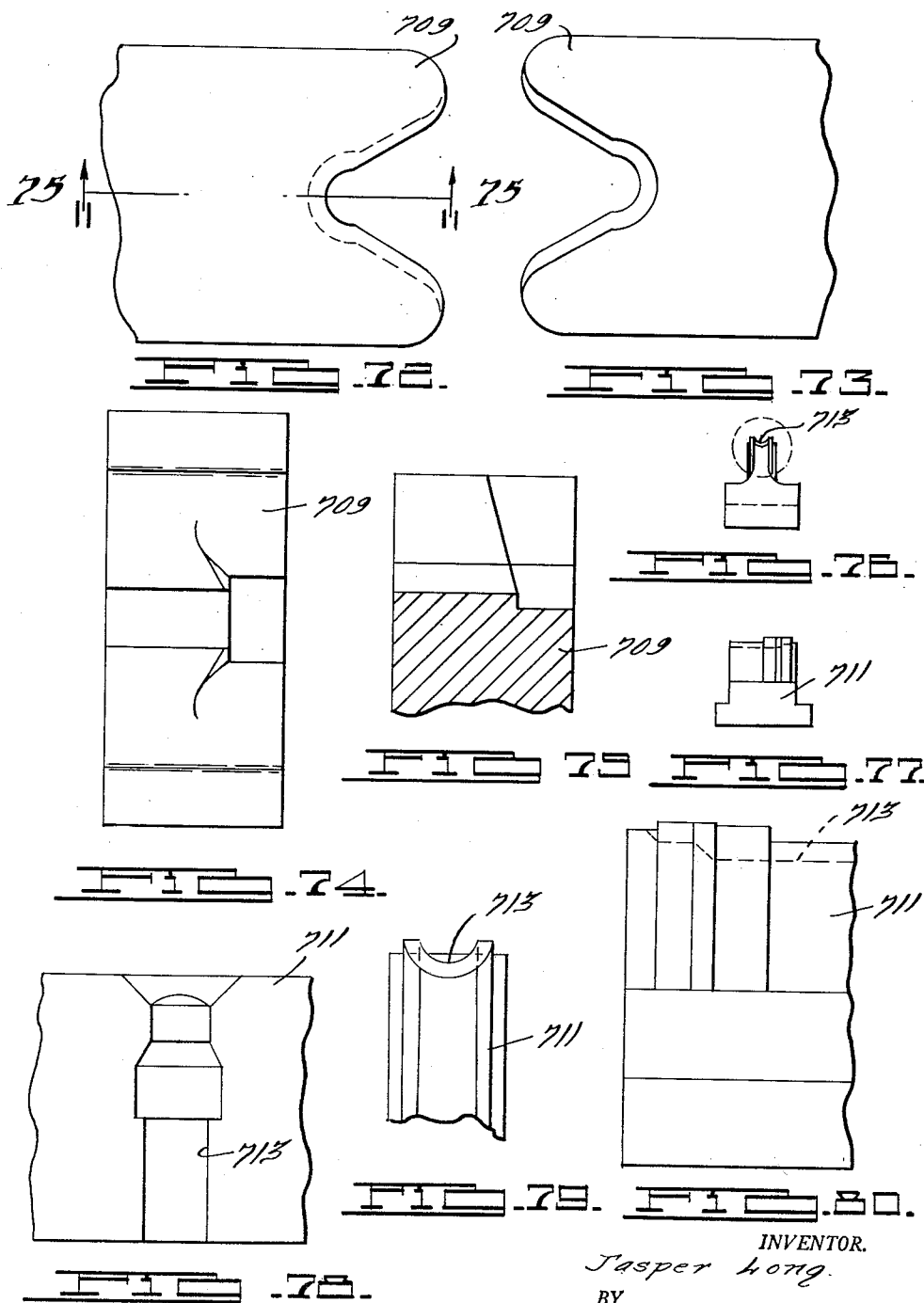
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18 Sheets-Sheet 18



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1

**3,015,020
MACHINE**

Jasper Long, Sturgis, Mich., assignor to Wade Electric Products Co., Sturgis, Mich., a corporation of Michigan
Continuation of application Ser. No. 498,211, Mar. 31, 1955. This application Nov. 18, 1957, Ser. No. 697,267
8 Claims. (Cl. 219-79)

My invention relates to a method and apparatus for combining lead wires with electric terminal elements and this application is a continuation of my copending application, Serial No. 498,211, filed March 31, 1955, which in turn is a continuation-in-part of my copending application, Serial No. 69,806, filed January 7, 1949, and both now abandoned.

In my copending applications I have disclosed a method and apparatus for assembling wire conductors and metal contact elements. The afore-disclosed apparatus and the apparatus of the present invention are designed for use in the mass production of electric terminal and wire assemblies. In my prior apparatus of said application I have taken coiled metal strip and progressively formed in it the metal contact elements in such a way that they remain a part of the strip and are oriented so that they receive wires which extend transversely to the length of the strip. After a contact element is formed in the strip, a wire is inserted in the wire receiving portion of it and then as the strip is moved through subsequent stages the wire is mechanically secured by crimping or staking to the contact element and also spot welded to it. As a final operation, the contact element with the affixed wire is cut off from the strip. The wires are carried through these various operations by the strip which acts as a conveyor for them, this being possible because of the transverse disposition of the wires with respect to the strip. Suitable means are provided to index the strip exactly the right amount so that the various portions thereof are in proper alignment with the mechanism that operates upon them and suitable means are provided to support the weight of the strip with the wires attached thereto.

For the most part the assembly of wires and contacts is carried out at the plant of the user of such assembly, for example, at an automobile plant. Recently, however, it has been found that the needs of such manufacturers are better satisfied if they are provided with the terminals already formed in strips which are coiled up into reels or spools. The manufacturer then can omit the first stage of the apparatus and method described in my copending applications, the forming stage, and use only the remaining stages wherein the wires are attached to the contact elements in the strip and then the assembly of wire and contact element is severed from the strip.

The present invention concerns modifications in the previously disclosed apparatus which adapt it especially to assemble wires with contact elements when the contact elements are supplied to the machine in strip form. The apparatus disclosed herein, though in its broad aspects not so limited, contemplates that the wires be welded to the contact elements and is adapted to be used in conjunction with spot welding apparatus that is available on the open market, the specific form illustrated herein being sold by the Taylor-Winfield Company of Warren, Ohio. The apparatus of the present invention includes features whereby the strips of terminals are properly fed to the spot welding and to the staking apparatus and oriented with respect to them so that they are in the proper location for automatic operation. Various safety features are incorporated to prevent jamming in the event of the malformation of a contact element received in the strip or in the event of other operating contingencies that may arise. An important feature is that certain parts

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are readily interchangeable so that different terminal designs can be handled on the same apparatus.

The invention is disclosed in preferred form in the accompanying drawings in which:

FIGURE 1 is a perspective view taken from a position at the front-left of apparatus embodying the invention;

FIG. 2 is an enlarged front perspective of the apparatus shown in FIG. 1;

FIG. 3 is a side elevation of the apparatus of this invention with the weld equipment removed and with attachment 61 removed;

FIG. 4 is an elevation from the weld pocket side of a typical strip of terminals that may be attached to wires by means of this invention, the elevation being taken from the top of FIG. 5;

FIG. 5 is a plan view of the strip of terminals of FIG. 4;

FIG. 6 is a side elevation of the strip taken from the bottom of FIG. 5;

FIG. 7 is a front view of the feed mechanism 31 with parts removed and parts broken away;

FIG. 8 is a side elevation taken from the right of FIG. 7, with parts removed and parts broken away;

FIG. 9 is a view, partly in section, partly broken away, and with parts removed and added, taken from the back of FIG. 7;

FIG. 10 is a plan view with parts removed and broken away of the assembly 61;

FIG. 11 is a front view of the structure of FIG. 10;

FIG. 12 is a bottom view of the structure of FIGS. 10 and 11;

FIGS. 13-16 are sections taken on lines 13-13 to 16-16, respectively, of FIG. 11;

FIG. 17 is a plan detail view of the die retainer plate;

FIG. 18 is a front elevation of the die retainer plate taken from the bottom of FIG. 17;

FIG. 19 is a plan detail view of the stripper which is mounted on top of the die retainer plate;

FIG. 20 is a front elevation of the stripper of FIG. 19;

FIG. 21 is a cross section through the combined stripper and die retainer plate;

FIG. 22 is a plan view of a feed check device in the stripper;

FIG. 23 is a section on line 23-23 of FIG. 22;

FIG. 24 is a section on line 24-24 of FIG. 22;

FIG. 25 is a front detail elevation of the frame for the stake and cutoff apparatus;

FIG. 26 is a side elevation of the frame shown in FIG. 25;

FIG. 27 is a detail front elevation of the slide for carrying the punch and pilot parts;

FIG. 28 is a top view of the slide of FIG. 27 with parts added to show how the slide is held in place on the frame;

FIG. 29 is a vertical section through the slide assembly, the punch and pilot assembly being omitted;

FIG. 30 is a reduced size section along line 30-30 of FIG. 29;

FIG. 31 is a top view of the punch holder carried by the slide of FIG. 27;

FIG. 32 is an elevation taken from the front of the punch holder;

FIG. 33 is a section on line 33-33 of FIG. 31;

FIG. 34 is a plan view of the punch backup plate;

FIG. 35 is a top plan view of the punch holder with the backup plate in position;

FIG. 36 is a front elevation of the staking punch;

FIG. 37 is a side elevation of the staking punch of FIG. 36;

FIG. 38 is a top view of the punch of FIG. 36;

FIG. 39 is a side elevation of the punch pressure pad;

FIG. 40 is a front view of the punch pressure pad;
 FIG. 41 is a top view of the punch pressure pad;
 FIG. 42 is a front elevation of the cutoff punch;
 FIG. 43 is a side elevation of the punch of FIG. 42;
 FIG. 44 is a bottom elevation of the cutoff punch of FIG. 42;

FIG. 45 is a front view with parts removed, broken away, and sectioned, of the slide carrying the punch and pilot assembly and of the die sections;

FIG. 46 is a plan view of the die section mounting or backup plate;

FIG. 47 is a plan detail view of die section 462;

FIG. 48 is a front elevation of the die section of FIG. 47;

FIG. 49 is a plan view of the die retainer plate and die section assembly;

FIG. 50 is a plan view of an insert in die section 462;

FIG. 51 is a front elevation of the insert in FIG. 50;

FIG. 52 is a front elevation, enlarged, of a portion of the insert and staking punch as they cooperate to attach ears 21 to a wire;

FIG. 53 is a front elevation of die section 491;

FIG. 54 is a front elevation of die section retainer 515;

FIG. 55 is a section on line 55—55 of FIG. 49;

FIG. 56 is a side view partly in section of the coil stand;

FIG. 57 is a side view of FIG. 56 showing the coil brake;

FIG. 58 is a diagrammatic view of the operating circuit;

FIG. 59 is a front elevation of a wire feeding and holding mechanism;

FIG. 60 is a cross section on line 60—60 of FIG. 59;

FIG. 61 is a plan view of the die retainer with spring plate added;

FIG. 62 is a front elevation of FIG. 61;

FIG. 63 is a section through the pressure pad and die assembly;

FIG. 64 is a section through the cutoff punch and die assembly;

FIG. 65 is a plan view of a portion of a strip containing a different type of terminal;

FIG. 66 is a cross section through the modified form of terminal;

FIG. 67 is a front elevation of the modified punch and pilot set for handling the terminal of FIG. 65;

FIG. 68 is a bottom view of the punch and pilot set of FIG. 67;

FIG. 69 is a plan view of a portion of the die section or bed used in connection with the modified form of terminal;

FIG. 70 is a side elevation of the bottom portion of the staking punch for attaching the stripped, stranded wire ends to the terminal of FIG. 65;

FIG. 71 is a bottom view of the punch of FIG. 70;

FIGS. 72 and 73 are side elevations taken from opposite sides of the staking punch for bending arms on the terminal of FIG. 65 around the wire insulation;

FIG. 74 is a bottom view of the punch of FIG. 72;

FIG. 75 is a cross section through the center of the punch of FIG. 72;

FIG. 76 is a front elevation in detail of a die section cooperating with the punches of FIGS. 70-75;

FIG. 77 is a side elevation of the die section of FIG. 76;

FIG. 78 is an enlarged plan view of the die section of FIG. 76;

FIG. 79 is an enlarged front view of the die section; and

FIG. 80 is an enlarged side elevation of the die section.

Referring first to FIGS. 1 and 2 and 4-6 for a general view of the invention, the machine is intended to perform the operations of welding, staking, and cutoff on metal electrical contacts or terminals of various shapes, FIGS. 4-6 showing the shape that is illustrated in particular in

the several figures that will be first described hereinafter. The terminals come in strip form, as indicated by the reference numeral 1, and are preferably wound up into a coil 3 which, as again mentioned herein, is mounted on a suitable spindle 5 projecting from a bracket 7 that is affixed at 9 to the top of a table 11.

The strip 1 consists of a series of identically formed metal terminal or contact elements 13 which are interconnected one with the other by rather thin carrier strip portions 15 which are eventually removed and discarded as scrap material. The terminal element 13 consists of a flat contact portion 17 having a pilot and detent hole 19. Spaced sideways of the flat portion 17 is a rebent arm 21 of a shape best seen in FIGS. 4 and 6 which is adapted to embrace a wire, such as the wires 23 illustrated in FIGS. 1 and 2. The arm 21 may be of a size to embrace the bared end or stranded ends of the wire 23 or may be, and preferably is for the particular contact shown, large enough to embrace the insulation of the wire. Eventually, in the operation of the apparatus of this invention, the arm 21 is staked or firmly crimped about the wire 23 so as to mechanically hold it tightly to the terminal element 13. In alignment with the opening provided by the rebent arm 21 is a weld pocket 25. The pocket 25 is adapted to receive the stripped or bared end of the wire 23 which can then be welded to the bottom of the pocket. The pocket is defined by side barriers or portions 27 and 29. The barrier 27 is formed by a crimp struck in the metal of the carrier section 15 and the barrier 29 is similarly formed by an upstruck portion of the carrier portion of the strip 1. The transverse serrations shown in the bottom of the weld pocket may be used to improve the spot weld that is obtained, this being disclosed and claimed in a copending application Serial No. 489,920, filed February 23, 1955, of the present inventor, assigned to the assignee hereof, and now abandoned.

The strip 1 of terminals in the coil 3 is automatically pulled from the coil, causing the coil to unwind, by a feed mechanism 31 which engages the cut out portions in the strip behind arms 21 to index the strip toward the left, that is, through the various stages of the apparatus. As the strip 1 is fed through the apparatus supported on suitable surfaces which will be mentioned hereinafter, it passes first through a spot welding stage at 33 where the wires 23 are inserted in and spot welded to the pocket 25 of each of the contact elements 13 in the strip 1. At a later point, the arm 21 is bent down tightly in the contact with the wire, this constituting a staking or crimping operation resulting in a mechanical connection of the wire and the contact element 13. After the staking operation each contact 13 is severed from the strip 1, this being done by removing the section 15 of carrier strip as indicated by the line 15' in FIG. 5. The staking and the cutoff operation are, in the apparatus shown, carried out at the point 35. After the cutoff operation, the combined wire and contact 13 are ejected from the machine, sliding down the inclined surface 37 into a chute 39 and thence into a tote box or other suitable container properly placed beneath the machine to receive them.

The apparatus that is illustrated herein consists of two separate units which can, however, within the purview of the invention, be combined into one unit. These two units are the spot welding apparatus 43, the illustrated apparatus being of a type available on the open market and furnished by the Taylor Winfield Company of Warren, Ohio, as model No. EB2-8-20, and the other unit is the apparatus 45 for performing all the other operations on the terminals in strip form, including the apparatus for feeding and for guiding the strip 1. Both the units 43 and 45 are mounted on the table 11 so as to be at a convenient working height for the operator who is required to feed the wires 23 into the terminal arms 21 at the spot welding point 33 and to step on a suitable switch to actuate each cycle of spot weld, stake, cutoff, retract, and feed.

As already indicated, the spot welding apparatus 43 is

of a conventional type that may be purchased on the open market, and it includes a lower fixed electrode 47 which acts as an anvil to support the bottom of the weld pocket 25. The feed apparatus 31 is adjusted so that it indexes the strip 1 just the right amount on each stroke to position successive weld pockets 25 exactly over the anvil 47. Spaced above the lower electrode 47 is a movable upper electrode 49, the axis of the upper electrode being offset from that of the bottom so that wear can be compensated for by angularly moving it about its axis. This is moved by an air cylinder 51 forming a part of the weld apparatus 43 and, of course, the movement of the electrode 49 is synchronized with indexing of the strip 1 by the feed mechanism 31 so that when the electrode is in contact with the wire in the weld pocket 25, there is no tendency on the part of the feed mechanism 31 to move the strip 1.

There is a good possibility that the weld pocket will become substantially heated during the weld operation occurring at station 33. This would have the effect of expanding or increasing the length of the adjacent portions 15 in alignment with it and increasing the spacing between the adjacent pilot holes 19, thus throwing off the spacing of the contacts 13 in the strip 1. In order to overcome this possibility and to insure that each successive weld pocket 25 is positioned exactly under the electrode 49 and in proper position on the lower electrode 47, there is provided a positioning and guide attachment 61 (FIGS. 10-16). The assembly 61 includes a mounting member 63 which is a copper plate (to minimize induction heating effects) that is secured by bolt 65 to the back of a plate that forms a part of the apparatus 45 as shown at 67. Secured to the mounting strip 63 by bolts 69 is a steel plate 71 that is cut out, as shown at 73, to receive and guide the strip 1. One side of the opening 73 is partly open so far as concerns the plate 71. However, this is closed by a pivotal strip 75 that is pivoted on a non-threaded pin 77 which is peened over an opening in the plate 75, as shown at 79, the stud 77 sliding in an aperture 81 in the block 71 and being spring loaded, as illustrated, to hold it tightly in place and also to allow a certain amount of lateral give of the plate 75. A detent assembly 83 that can be purchased on the open market, including a spring loaded detent nib 85, is threaded through the blocks 63 and 71 and seats in a suitable detent recess 86 in the plate 75 so as to hold it in the strip-retaining position shown in the drawings. The strip 75 may be pivoted down below strip supporting surface 74 to permit the strip 1 to be moved transversely out of recess 73 and the assembly 61.

The assembly 61 also includes a pilot member 89 that slides in a suitable vertical aperture 91 formed in the member 71. The pilot member 89 is located so as to engage in the hole 19 of a contact 13 on the outboard side of the one which is being welded and is connected by mechanism now to be described which is actuated by the movable top electrode 49 so that when the electrode moves down to perform the spot welding operation the pilot pin 89 is moved up through the opening 19 in the adjacent contact 13 to properly position it and thus properly position the weld pocket 25 beneath the welding electrode and further to compensate for any expansion due to heating of the section 15 during the spot welding operation. When the upper electrode 49 comes down, it contacts a metal insert 93 which is attached by cap screws 95 to a slotted fiber block 97, the slot 99 in the fiber block receiving the thin section 101 of the mounting plate 63. When the fiber block 97 slides on the section 101, it is guided against lateral movement by its side edges which are engaged with a cutout in the block 63, as shown at 103. A screw or bolt 105 extends slidably through an opening 107 in the fiber block and threads into the plate section 101, a spring 109 acting to resist downward movement of the block 97 when contacted on insert 93 by the welding electrode 49. When urged to the elevated position by the spring 109, the block 97 is approximately a quarter of an inch or so (FIG. 13) above the top of the lower elec-

trode 47. The upper electrode 49 is offset in the direction of the block 97 from the lower electrode and, as a consequence, when it comes down to contact the weld pocket, it strikes the point 93 forcing the block 97 down against the resistance of the spring 109. An incidental advantage of the offset of the upper electrode is that when the contact portion wears the electrode can simply be rotated about its axis to bring a fresh section thereof in alignment with the weld pocket and with the lower electrode 47.

Adjacent a bottom portion, the block 97 carries a transverse pin 111 received in a slot near one end of a lever 112 which is pivoted at a central portion 113 to a steel block 115. The other end of the lever 112 is connected by a pin 117 to a bottom portion 118 of the pilot pin 89. The pins 111 and 117 work in elongated slots in the lever 112. It will be seen that if the block 115 maintains a fixed position, and if the fiber block 97 goes down, the pivot 113 will remain stationary and the pin 117 at the other end of the lever 112 must go up. Since this is connected to the pilot pin 89, the pilot pin will rise in its opening 91 to center itself in the opening 19 of the next adjacent contact 13. However, it may happen that there is no hole 19 available to receive the pilot pin 89. In this case the pin will not be able to rise sufficiently to permit the block 97 to drop under the influence of the weld electrode 49. In order to prevent jamming of the apparatus under these circumstances, the block 115 is yieldably secured to mounting plate 63 and the plate 71, this being done by a pair of bolts 119 which thread into these plates after slidably extending through apertures in the block 115. The springs 121 surrounding the bolts 119 act to tightly hold the block 115 in place in the bottom of the plates 63 and 71 but would be overcome to permit downward movement of the block 115 in the event that the pilot pin cannot enter the hole 19. Because of the pilot 89, the next contact to be welded is properly spaced from the electrodes 47 and 49 and the pilot will also function to properly position the contact under the electrodes.

Turning now to the mechanism 31 (FIGS. 2, 3, 7-9) for feeding the strip 1 into the apparatus 43 and 45, the apparatus 31 is mounted upon a bracket or block 131 that is bolted to upright side member 133 of the frame 45a for apparatus 45. The mounting bracket 131 includes a reentrant, or substantially T-shaped, slot 135 in which are slidably mounted a pair of similarly shaped blocks 137 and 139. The block 137 is the driving block while the block 139 is the driven block and pivotally carries the pawl 141 which is mounted on the pin 143 and urged to a downward position by a coil spring 145 having a bent end over the top of the pawl 141 as seen at 147 (FIG. 7), a screw 148 providing manual means for lifting the pawl. The driven block 139 is adjustably connected to the driving block 137 by the stud 149 which, as can be seen best in FIG. 7, threads on opposite hands through both of them so that by rotating the stud in one direction the blocks will be moved toward each other and by rotating it in the other direction the blocks will be moved away from each other to vary the terminal positions of the pawl 141. Lock dog pins may be used as shown at 151 to engage upon the thread of the stud 149 to prevent inadvertent rotation thereof, the pins 151 including soft plugs engaging the threads so as not to damage the threads of the stud 149, the plugs being held in place by set screws.

The feed mechanism 31 is positioned so that when it is driven to the left the blunt nose 153 of the pawl 141 will engage behind the arms 21 of the strip 1 to force the strip to move to the left. The back side 155 of the pawl nose is tapered and when the blocks 137 and 139 are forced to move to the right the taper will tend to ride up over the next adjacent arm 21 and then drop down behind it in position for the next indexing movement back toward the left, this downward movement

being, of course, facilitated by the spring 145. Movement of the pawl 141 to the right does not cause movement of the strip 1 to the right because it is synchronized with the pilot 87 in apparatus 61 and with the pilots and other apparatus in the punch and die section 35 which at the moment the pawl 141 is being retracted to the right will be inserted in or bear upon the strip so as to hold it firmly in position against any tendency to move backward toward the right.

It may be noted here that the members 160 seen throughout the various figures are lubrication cups of a standard type arranged to furnish lubricant to bearing surfaces.

In order to drive the blocks 137 and 139 the block 137 has a fixed pin 161 secured to it which extends out the back side thereof through a slot 163 in the mounting member 131. The pin 161 is received in an elongated slot 165 at the top of a lever 167 which is pivoted at 169 on the mounting bracket 131. Also pivoted on the pin 169 is a transverse lever 171 which has upper and lower flange portions 173 and 175 through which are threaded adjusting screws 177 and 179 which bear upon a back face of the lever 167 as seen best in FIG. 9. Projecting out from the other side of the lever 171 is an angled arm 181 that is pinned at 183 to the bottom block 184 on a vertical rod 185. The levers 171 and 167 are pressed together by the spring pressed yieldable assembly 187 shown in FIG. 8 and mentioned again presently.

It will be seen that as the rod 185 moves up (punch 35 down) and down (punch 35 up) the lever 167 will move to the right or to the left, respectively, to retract or advance the blocks 137 and 139 and the pawl 141. The rod 185 is driven by an air cylinder 191 (FIG. 3) that is available on the open market and which also drives the punch and stake mechanism 35 and which is tied into the circuit for welder cylinder 51 to synchronize the two so that rod 193 and electrode 49 move simultaneously in opposite directions. The air cylinder 191 is mounted on an air distributor and rocker plate 192 which is journaled at 192a on the sides 133 and 133' of the frame 45a. Cylinder 191 has a piston rod 193 that is pivoted at 195 to the rear end of a rocker member 197 which in turn is pivoted at an intermediate point by means of a pin 199 in holes 200 to side portions 201 forming a part of the frame 45a for the apparatus 45 (the stake and cutoff mechanism 35 being pinned to the front of arm 197 so that it moves down when rod 193 moves up). A cross piece 203 is secured in a pivotal manner to the lever 197. Slidably extending transversely through the transverse cross pin 203 is a collar 205 having a bottom shoulder 207. Slidably extending through the collar 205 is the rod 185. The top end of the rod is threaded to receive the nuts 209 which bear upon the top end of the collar 205. Between the bottom of the collar and the top of block 184 at the bottom of the rod 185 is a coil spring 213, which, however, may be replaced by a fixed length sleeve if a safety feature to be hereinafter mentioned is not desired.

The mechanism just described will enable the air cylinder 191 to be used to reciprocate the blocks 137 and 139 even though the actual stroke of the piston rod 193 is not designed especially for the stroke of the pawl 141. This is accomplished because of the studs 177 and 179 which may be adjusted to control movement of the lever 167 (driving blocks 137 and 139) and which may also incorporate a dwell of the lever if that is necessary. It will be seen that there is a lost motion corresponding to the spacing of collar shoulder 207 from 203 as governed by nuts 209. On downward movement the force by the member 203 is applied to the shoulder of the collar 207 and the force is transmitted through the spring 213 to the pin 183 and moves the lever 171 in a direction to advance the strip 1 through the machine. When the transverse piece 203 moves upward there is a certain amount of lost motion until the top of it contacts the

nuts 209 whereupon it lifts the rod 185 to pivot the lever 171 in a counterclockwise direction, thus retracting the pawl 141. In the event an obstruction of some sort is encountered during the advance movement of the pawl, the spring 213 will yield to prevent damage to the equipment. However, if desired the spring 213 may be replaced by a solid sleeve to provide a positive drive between the member 203 and the lever 171.

It will be appreciated that while the feed mechanism 31 has been shown between the welding unit 43 and the mechanical forming unit 45, that it could very well be in other locations. For example, the weld unit 43 and the unit 45 could be next to each other and the feed unit 31 could be on the inlet side of the spot weld unit (between coil 3 and spot weld 33) or conceivably could even be arranged on the outlet side of certain parts of the staking apparatus 35.

The mechanism 187 (FIG. 8) for holding the levers 167 and 171 firmly against the mounting bracket 131 includes a T-shaped annular collar 215 that bears at its bottom portion upon the outer face of the lever 167 to hold it firmly against the back face of the member 131. Between the shoulder of the collar 215 and the face of the lever 171 is a cup shaped spring member 217 which is yieldably held against the member 171 by the collar 215 which in turn is held in position by the spring 219 shouldering against the washer 221 on the stud 169 which is threaded into the block 131. This spring arrangement serves to resist undesired movement of the levers and to insure that they are in proper alignment at all times.

As best seen in FIGS. 1-3, 8, and 17-21, the movements which have been described so far for the strip 1 occur as it slides upon a bed or die retainer plate 231 which is securely fastened by bolts 233 in holes 235 to the frame 45a and to the member 131. Mounted on the top of the back portion of the die retainer plate 231 is a stripper plate 237. In cross section (FIG. 8) the stripper 237 has a base or leg portion 239 which is secured by bolts 241 (FIG. 22) to the top of the stripper plate 231. The stripper has a suitable slot 243 cut out in it to accommodate the back and forth movement of the nose of the pawl 141 and the stripper is of a height such that it lies beneath the major portion of the body of the pawl 141 as can be clearly seen in FIG. 2. The stripper 237 has an overhang portion 245 with cutouts 245a and 245b which together with the leg 239 define a track or recess 247 for the strip 1 which is of a width substantially equal to the overall length of the contact element 13 and a height which is substantially the same as the height of the rebent arms 21. The overhanging edge 249 along with back edge 249a will hold the arms 21 within the recess 247 to prevent any accidental misalignment of the strip 1 tending to cause it to move out of the channel or recess 247. This is further facilitated by a slight cutout or groove 231a formed in the surface of the die retainer 231.

The stripper 237 may also be provided with a relatively short spring loaded feed check 250 (FIGS. 22-24) which exerts downward pressure upon the weld pockets 25 and in particular upon the ridges 27 and 29. The feed check includes a plate 251 which is received within a cutout 253 in the stripper 237. Threaded into it are a pair of studs 255 which slidably extend through holes 257 in the die retainer plate 231, these holes being enlarged so as to provide a seat for the springs 259 which act to resiliently hold the top of cutout 260 on feed check plate 251 against the tops of the ridges 27 and 29, it being noted that the outer edge of plate 251 terminates at about the outer edge of cutout 245a so that it does not project over arms 21.

After the spot welding operation at location 33, the strip of terminals is fed to the stake and cutoff position 35, being pushed along by the pawl 141 on the surface 231a of the die retainer plate 231 and being guided by the

stripper 237. The apparatus 35 includes a punch and pilot carrying slide 271 (FIGS. 25-30) which rides on a backup plate 273, both the slide and the backup plate being disposed in a recess 275 formed in the front face 276 of the main frame 45a. The slide 271 has a pair of cutouts 277 opening out of the top end thereof and pinned in these cutouts at 278 are a pair of links 279 (working in frame face cutouts 279a) which at their upper ends are pinned on opposite sides of the rocker arm 197 as shown at 281. It will therefore be seen that as the rocker arm 197 moves up and down it will operate through the links 279 to move the slide 271 down and up, respectively. The slide is held in position in its recess by rails 283 on opposite sides thereof which engage the recessed edges 285 of the slide and are bolted at 287 to the front face 276 of the frame to hold it in place, it being recognized that the rails may be readily removed to permit removal of the slide by lifting it from the front of frame 45a. In holding the slide in place the rails 283 have a projection 289 along one edge which fits into the cutout corners or edges 285 on the sides of the slide 271.

The bottom end of the slide 271 has a T-shaped opening 291 providing upwardly facing shoulders 293 on opposite sides thereof. The back of this opening is closed by a plate 295 which is screwed to the back of the slide by countersunk screws 297 so that the surface of the plate 295 is flush with the back surface of the slide. The opening 291 serves to receive the punch and pilot set 300, and provides a means whereby such sets can be readily changed to accommodate different types of contact elements 13. It will be seen that a punch and pilot set supported in the opening 291 will be pushed down through the contact strip by the shoulder 299 and will be lifted out of the contact strip 1 by the shoulders 293.

The punch and pilot assembly 300 (FIGS. 31-45) includes a punch holder 301 and this has downwardly presenting shoulders 303 adapted to rest on the upwardly presenting shoulders 293 of the slide. In the order of contact by a contact element 13 entering the apparatus 35, the punch and pilot assembly 300 carries a pilot 305, a staking punch 307, a pilot and pressure pad subassembly 308, and a cutoff punch and pilot assembly 309. It can be seen in the drawings that the three pilot elements provided in the assembly 300 engage the pilot holes 19 in three adjacent contact elements as they are passing through the unit 35.

The pilot 305 fits in a counterbored hole 311 in the punch holder 301 and has a spring 313 engaging a shoulder 315 on the pilot to yieldably press it downwardly so that it extends out the bottom of the punch holder 301. The spring is confined in place by a punch retainer backup plate 317 which simply lies on top of the punch holder 301 when the latter is inserted in the opening 291 in the slide. The bottom of the pilot pin 305 is tapered so as to permit it to easily enter the holes 19 in the contact elements and the over-all length of the pilot element is such that it can be entirely received above the strip 1 against the compression of the spring 313 in the event that there is no hole for it to enter.

The forming or staking punch 307 has a substantially L-shaped upper portion so that it can be received in an opening 321 in the punch holder 301 and its shoulder 323 seat itself on a shoulder 325 in the punch holder. The top portion of the forming punch 307 is longer than the top of the opening 321 so that the forming punch extends above the top of the punch holder 301 and through a suitably shaped opening 327 provided for it in the backup plate 317. The top of the punch 307 has a projection 329 on its inside edge which projects up above the backup plate 317 and therefore above the top 299 of the hole 291 in the slide. The purpose of the projection 329 will be described presently. The lower end of the punch 307 is relieved as shown at 335 and then it is provided with a reduced section 337 which is shaped as shown at 339 to receive the leg 21 of the contacts 13 and then bend it

over by means of the radius portion 341 tightly around the wire. The lower end 339 of the punch is received in an opening in the die plate, as will be described hereinafter, and the taper on it, in effect, provides a lead on the bottom of the punch which acts to properly and slowly bend the rebent portions 21 on the contact elements.

The pressure pad member 308' (FIGS. 39-41, 45, and 63) has a flange portion 341 at the top thereof which fits on a shoulder 343 in the punch holder 301. The punch holder 301 is cut out along one edge as shown at 345 to receive the length of the pressure pad member 308'. The height of the flange 341 is slightly less than the depth of the shoulder 343 (by about the thickness of contact 13) from the top of the punch holder 301 so as to permit a certain amount of vertical movement of the pressure pad. The pressure pad 308' is spring urged in a downward direction by a pilot member 347 in hole 348 having the usual tapered bottom and being provided with a flange 349 (FIG. 63) that bears upon the foot 351 of the pressure pad member. The flange provides a seat for a coil spring 353 which at its top end seats in the shoulder 355 provided in a counterbored hole 357 in the punch holder 301. The pilot pin 347 is also short enough so that it can move upwardly in the event that there is no hole 19 for it to enter in a contact element 13. The function of the stripper or pressure pad 308 is to hold the contact elements flat during the staking operation performed by the punch 307 and to properly locate and align them. It might be noted that each of the pilot pins that is contained in the punch and pilot assembly 300 is aligned with and fits into suitable holes in the lower die retainer plate 231, as will be mentioned again hereinafter.

The cutoff punch 309 (FIGS. 42-45 and 64) is of a T shape and one side of the T fits into side slot 361 in the punch holder 301 so that a shoulder 365 rests upon a shoulder 363 in the punch holder. The opposite punch shoulder 367 is in alignment with and an extension of the shoulder 303 on the punch holder 301 and thus will seat itself on the shoulder 293 in the slide. The cutoff punch 309 carries a pilot pin 369 which is in all respects similar to the pilot pin 305 that has already been described. This pilot pin 369 fits in a counterbored hole 371 in the member 309. The pin 369 has an enlarged shoulder or flange 373 resting on the shoulder 375 in the counterbore and pressed against it by a coil spring 377 which is confined in place by the backup plate 317. The bottom end of the pilot pin projects through the small diameter portion of the counterbore and out through the bottom of the punch 309 to fit into the opening 19 in the contact element 13 below the cutoff punch 309.

It will be appreciated that it is the function of the cutoff punch and the cooperating die member, which will be hereinafter described, to sever the contact along the ridge 29 and also to complete the formation of the flat contact portion 17 of the contact element by severing it along the line 17' (FIG. 5) from the adjacent carrying strip 15. The bottom of the cutoff punch is relieved at 381 to clear rebent ends 21 and to provide a reduced section and cutoff portion 383, the edge 385 of which is in alignment with the edge of the ridge 29 to cooperate with the lower die section in severing the carrying strip 15 along the line 29. Spaced below the edge 385 by a distance which corresponds to the height of the ridge 29 above the flat contact surface 17 of the element 13 is a flat surface 387 which includes the curved cutoff edge 389 which, as will be seen, conforms to the curvature of the end of the contact portion 17 and will sever the contact along the line 17'.

As can be seen in the drawings, the pilot 305, the stake punch 307, the pressure pad 308, and the cutoff punch 309 all project a substantial distance down from the bottom of the punch holder 301. The pilot 305 is yieldable so that it can be retracted up into the punch holder a sufficient distance to avoid jamming. The pressure pad

308 is also yieldable and can be retracted a slight amount up into the punch holder. The cutoff punch 309 on the other hand is rigid and fixed in position. The staking punch 307 is rigidly fixed but it is also adjustable in the position, by means to be presently described, so as to make it possible to vary the tightness of the crimp obtained by folding the rebent leg 21 over on the wire 23. All of the punches are held in place in the punch holder 301 and the punch holder held in place in the opening 291 in the slide 271 by means of a cover plate 391 (FIGS. 2, 29, and 30) which is suitably secured as by the screws 393 in holes 393a to the front face of the slide 271. The plate 391 is provided with a counterbored hole 395 to receive a threaded collar 397 which is provided with hex outer surface 399 so that it may be readily turned by a wrench or the like. Threaded through the member 397 so that it will move axially when the member 397 is rotated is a cam member 401 having an inclined surface 403, the portion 403 being received in an opening 405 (FIGS. 27 and 29) in the slide member 271. The inclined surface 403 bears upon an inclined surface of similar shape 407 on the cam member or gib 409 which rides in a slot 411 provided for it in the slide 271. The bottom 413 of the gib or cam member 409 bears upon the projection 329 on the top of the forming punch 307. It will be seen that by adjusting the gib 409 up or down the amount of projection of the forming punch 307 below the bottom of the punch holder will be controlled and thus the tightness with which the punch 307 crimps the wire to the contact will also be controlled. It will be noticed that the gib 409 is a good deal wider than the projection 329 on the punch 307. This makes it possible for the structure of FIGS. 29-30 to be used with a variety of different punch and pilot sets of the type represented by set 300. In some of the other sets the staking punch may be located in a different position but the rather wide width of the element 409 enables it to contact them nevertheless.

As can be seen in FIG. 19, the stripper plate 237 has openings formed therein to permit passage of the projecting portions of the punch and pilot assembly 300. Thus, it has the opening 421 for the pilot pin 305. It has a side cutout opening 423 for the forming and staking punch 307. It has a cutout and side opening 425 for the pressure pad 308. It has the cutout opening 427 for the portion 385 of the cutoff punch 309, the remainder of the stripper being in line with the inside edges of 427. The portion 431 is provided with an opening similar to the opening 247 already described for receiving the strip 1 and serves as a guide for the strip as it is moving into position for the cutoff operation.

Turning now to the parts which lie below the contact strip 1, that is the die section parts, the bed or die retainer 231 (FIGS. 17-18), as has already been pointed out, is bolted to the front of the frame 45a of the machine. This member is cut out on the inside edge to provide a surface 441, an opening 443, another opening 445, a surface 447 projecting outwardly of the plane of the opening 445, and another recess 449. Parallel with the surface 441 is another surface 451. Various die sections presently to be described fit or are, in effect, keyed in the openings that have just been enumerated and supporting them from underneath is a die backup plate 453 (FIGS. 45-46) which is located immediately below and in contact with the bottom of the die retainer 231. The plate 453 has a key slot 455 which receives a projection or integral key 457 on the mounting foot 459 which is bolted by bolts 460 to the front of the frame of the machine, being located thereon by frame key 461 fitting in a slot 461a at the rear of the foot 459.

The die section 463 (FIGS. 47-49) fits into the opening in the die retainer defined by the surface 443. This die section contains the opening 463 to receive the pilot pin 305 and is provided on one corner with a cutout 465

The cutout 465 is enlarged at the bottom to provide a downwardly presenting shoulder 467. Screws 469 shouldering in suitable openings in the backup plate 453 are threaded into the die section 461 to hold it in place and suitable holes 463a and 463b are provided in plate 453 and foot 459 to connect hole 463 to atmosphere to prevent vacuum binding of the pilot pin.

Disposed within a part of the opening 465 in the die section 462 is an insert 471 (FIGS. 49-51). This is substantially T-shaped in section and one shoulder 473 engages with the shoulder 467 to hold the insert 471 in place on top of the plate 453 and in the retainer 231. One corner of the insert 471 is cut out as shown at 475 and this acts in conjunction with the cutout portion 475' in the die section 462 to provide an opening 475a which lies just below the staking punch nose 339 and extends clear down through the die retainer 231, the die backup 453 (hole 475b) and the mounting foot 459 and empties into a scrap bucket 41 at the front of the machine. Thus, any trimmings or pieces of metal which are severed from the strip during the staking operation will fall down through the opening 475a and be removed from the die parts and from the path of the contact strip 1 so as to prevent jamming up of the apparatus. The insert 471 is provided with a nib or rib 481 which is shaped as shown in an enlarged view in FIG. 52. The nib 481 is curved on its contact engaging face so that it helps to prescribe the curvature that is followed by the rebent arm 21 on the contact element as it is being curled around over the wire 23. The nib 481 is of a transverse width such that it is approximately as wide as the arm 21. In order to lift up the contact portion 17 of the next contact element so that it will not abut the outer face of the nib 481, a second and somewhat higher nib 485 is provided on the die section 462. The bottom of the contact portion 17 of each contact 13 rides up over the top of the nib 485 and lifting it above the surface 231a on the top of the die retainer 231. Contact elements do not drop in place on surface 231a under punch 307 until the rebent arm 21 slides in place behind the curved side of nib 481.

The insert 471 has another shoulder 487 and this fits in a suitable slot 489 provided in another die section member 491 (FIGS. 49 and 53), the slot 489 having a downwardly presenting shoulder 493 that engages the shoulder 487. Die section 491 fits in the opening 445 in the die retainer 231 and is secured in place by screws 495 which shoulder in the backup plate 453. The die section 491 has a hole 497 (hole 497a in plate 453) for the pilot pin 347 in the pressure pad 308. The die section 491 has a key section or projection 499 which actually defines a cutting edge at its top that cooperates with the edge 385 of the cutoff punch 309 to sever the carrying strip 15 from the strip 1 along the strip edges 29.

Spaced from the die section 491 but cooperating with it to help guide and hold a die section pressure pad 503 is another die section member 505 that fits in the opening 449 in the die retainer 231 being secured in place by bolts 507 that shoulder in the backup plate 453 and thread into it. The die section 505 is curved as shown at 509 to receive a similarly curved section on the pressure pad 503, it being observed that the curvature at 509 is the same as the curvature at 389 on the punch 309 and that the corner of the curvature 509 cooperates with the corner 389 to sever the contact along the line 17'. The pressure pad member 503 is yieldably mounted and will depress under the pressure of the cutoff punch 309. It exposes the edges 499 and 509 to cooperate with the edges 385 and 389 in cutting off the terminal from the rest of the strip 1.

The pressure pad 503 fits in an undercut slot 511 which is formed in the die retainer 231 and the other side of it fits in a similarly shaped slot 513 cut into a die retainer plate 515 which is screwed along the inside face of the retainer 231 against surfaces 441 and 451 to hold and key the various die section parts in place and in their respective openings in the die retainer 231. The pressure

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pad 503 has suitable openings 521 in the bottom to receive a pair of coil springs 523 that fit in holes 525 in the backup plate 453 and constantly urge the pressure pad 503 to seat itself against the shoulders 531 formed at the top of the slots. Pad 503 also has opening 532 for pilot 369 and plate 453 has opening 532a communicating with hold 463b to prevent vacuum locking of the pilot or punch.

After the terminals have been cut off they slide down an inclined die retainer section 37 and into a bin or other suitable collecting receptacle. The carrying strips 15 also slide down the inclined surface 37 and constitute scrap that is obtained in the course of the operation on the strip 1.

The die retainer 231 is relieved as indicated at 541 so that it does not have the shoulder cutout as shown at 231a. Thus, there is at this point no side guide for the bottom of the strip, that is for the outside edge of the contact portion 17. This may be provided by a flat thin spring piece 543 (FIGS. 61-62) which has bent over flanges 545 that are screwed at 547 to the sides of the die retainer 231. The inside edge of the spring plate 545 may be recessed as shown at 549 to line up with the hole 475a. This spring plate accommodates the movement of the terminal as it clears the nib 485 and also serves to accommodate different size wires being used in connection with the terminals 13. The angle between the attachment flanges and the top surface of the spring plate is slightly greater than 90° so that the plate is not exactly parallel with the top surface of 231. This provides spring action and will also serve to catch against the portions 21 of the contact 13 and prevent them from moving sideways under weight of the wires that have been attached to them. It will be seen that plate 543 and the outer or front part 231b of the top of bed 231 will support the wires 23 to some extent and tend to prevent outward movement or twisting of the contact strip 1 under the weight of the wires.

It will be noted that the retainer 231 is relieved at 551 by a depth that is at least as thick as the terminal, preferably somewhat thicker. This cooperates with the die pressure pad so as to permit the cutoff operation.

Turning now in particular to FIGS. 1, 56, and 57 the stand for the reel or coil 3 of terminals is arranged so that the spindle 5 makes an angle of approximately 5° with the surface of the table 11. This improves the feed of the strip 1 and tends to hold the coil 3 in place against the vertical bracket 7. In order to restrain motion of the strip 1 under the influence of the feed mechanism 31, and the pawl 141, the bracket 7 is provided with a right angle spring plate 561 which is attached to the bracket 7 by screws 563 extending through slots 565 in a side of the spring plate so as to permit a certain amount of vertical adjustment thereof. The plate 561 has an S-shaped curvature at its free end and the downwardly presenting portion 567 engages the rim 569 of the coil 3 with spring pressure providing a frictional resistance to its angular movement on the spindle 5. The outermost portion of the free end of the plate 571 serves as a finger tab whereby the plate can be lifted from the rim 569 when it is desired to remove the coil 3.

The control circuit for the combined spot welder 43 and mechanism apparatus 45 will be by now more or less evident to those skilled in the art. It is shown schematically in FIG. 58 wherein the air cylinder 51 on the spot welding apparatus 43 is used to reciprocate the movable electrode 49. The cylinder 51 receives air through conduits 601 and 603 which have in them flow control valves 605. The conduits 601 and 603 receive air under the control of a solenoid operated four-way valve 607 which in the illustrated embodiment is of a type sold by the Taylor-Winfield Company as model No. U-10038-B, a description of which is found in their catalog 11-213 and their description sheets 11-112 of January 1, 1954, the valve being sold under the trademark "Seal-Off." Air

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is furnished to the valve 607 by the conduits 609 and 611, the conduit 609 including a regulator 613 and the conduit 611 including a needle valve 615. The valve 607 is also of a pilot type and line 617 furnishes pilot air to it. Air from the pressure source flows into lines 609 and 611 through an air lubricator 619 and air strainer 621 in the line 623. Line 625 is an exhaust line from the valve 607. The conduits 627 and 629 are taken off the T connections where lines 601 and 603 enter the valve 607 and run respectively to the bottom and to the top of air cylinder 191 which is shown diagrammatically in FIG. 8. Suitable rate of movement controls (not shown) may be used in connection with lines 627 and 629 and cylinder 191 if desired. It will be seen that with this arrangement the ram 193 will move simultaneously with the electrode 49 but in the opposite direction. The air circuit just described is under the control of a foot switch 631 which will be operated by the worker who inserts wires into the weld pockets 25 at position 33. When the switch 631 is closed it activates the timer and control mechanism for the spot weld apparatus 633, receiving power from leads 635. The timer 633 is a part of the control circuit that is furnished with the spot weld apparatus and is therefore available on the open market. It controls the weld cycle, the hold time, the squeeze time, and the leads 637 from it control operation of the solenoid 639 for the valve 607. Once the switch 631 is closed the timer will run the entire apparatus through a complete cycle.

The lengths of the wires 23 which are attached to the contacts 13 may vary considerably, depending upon the precise application to which the completed assembly will be put. As a consequence, when the lengths are relatively long there is a possibility that the wires may become entangled as they move from point 33 through the cutoff operation at point 35. This may be avoided by use of the mechanism 650 shown in FIGS. 59 and 60. This mechanism includes an upper movable rack assembly 651 which is attached at 653 to the pivot pin 143 for the pawl 141. The other end of the assembly 651 may be guided in a hole 655 formed in a bracket 657 that can be bolted to the side of the frame 45a at about the point 659 (FIG. 1). Thus, the assembly 651 will reciprocate back and forth with the feed pawl 141 and will be disposed along side the outside edge, that is the front edge, of the stripper 237. The assembly 651 has a pair of spaced plates 661 which are fixedly joined together at the top by an intermediate plate 663 of substantially less depth than the plates 661. Pivoted between the plates 661 are a series of pawls 665, connected to the plates by the pins 667. The tops of the pawls 665 are rounded off as shown at 669 so that the top portions cooperate with the bottom of the intermediate plate 663 to permit pivoting in only one direction as indicated by the arrow 671, that is in a clockwise direction when viewed from the front of the machine. Thus, as the assembly 651 moves to the left on said motion the pawls 665 will engage behind the wires 23 and shift them leftwardly with the strip 1, or at least will prevent them from dragging behind as the strip 1 is moved to the left. When the pin 143 is retracted, that is moved to the right, the inclined back surfaces of the pawls 665 will pivot upwardly to ride over the tops of the wires and fall in place behind them.

Cooperating with the upper assembly 651 is a lower fixed assembly 673 which is bolted at 675 to the front face of the bed or die retainer 231, the end surface 37' being lined up with incline 37. The lower assembly 673 is similar to the upper in that it has a pair of plates 677 between which pawls 681 are pinned at 683 and because of stop pins 685, are permitted to pivot only in a counterclockwise direction as shown by the arrow 687. Thus, the pawls 681 will permit the wires to be moved to the left but will not permit them to be moved backward to the right. It can be seen that the assemblies 651 and 673 will cooperate to keep the wires 23 separated yet

permit proper feeding of the strip 1 and it will be noted that the pawls 665 and 681 are pivoted in such a way that they always tend to return by gravity to vertical positions.

The terminals themselves are described in more detail in my copending applications, Serial Nos. 374,615 and 489,920, filed August 17, 1953, and February 23, 1955, respectively, the latter now abandoned, and turning now to the use of the machine for one modified form of terminal such as shown in FIGS. 65 and 66, the terminal 13' is found in a strip 1' and has pilot holes 19' and a flat contact portion 17'. The connecting portions 15' are spaced away from the weld pockets 25' so that they will not be heated (expanded) during the spot welding operation. There is a weld pocket 25' and there are parallel arms 20' which are to be folded in double-C fashion onto the stripped or bared ends of a lead wire, the ends thereof digging into the center of the wire. The arms 21' are the converse of each other in shape and are to be bent in side-by-side overlapping relationship around the insulation on the lead wire. As seen in FIG. 66 the pocket 25' is on a different level than the surface 20a for receiving the bared end of the wire which is engaged by arms 20' and this is on a different level than the surface 21a for receiving the insulation of the wire, the bottom of pocket 25' being at approximately the axis of wire 23, and the bottom 20a being located below by approximately the radius of the bared wire end, and the bottom 21a below it by approximately the radius of the outer insulation. It will therefore be understood that the die retainer 231' for this form of strip will be cut out in a similar stepped fashion to engage the bottom of each of these sections as well as the bottom of the contact 13'. Also, it will be provided with guide edges in combination with a stripper to engage the top and opposite ends of the terminal, that is opposite side edges of the strip 1', to confine it within a track or recess against upward or lateral movement just as in the case of contacts 13. The feed mechanism and other apparatus apart from the punch and pilot set 300' (FIGS. 67 and 68) are the same as in the previous embodiment, though, of course, the guide mechanism 61 will have to be modified somewhat to accommodate the different form of the terminal strip 1'.

The punch and pilot set 300' has a punch holder 301' and a top backup plate 317' which are of the same outward shape as their counterparts 301 and 317 so that the unit 300' can be inserted in the opening 291 in the slide 271 to rest on shoulders 293. The set 300' carries four pilot pins 701, one of which is mounted in a planishing punch or pressure pad 703 which acts to hold the contact flat during staking and to help strip the contacts from the punches and pilots. The punch 703 and the cutoff punch 705 are mounted within the carrier 301' by means following the principles of construction already described in connection with set 300.

The ears 20' are staked in place by a punch 707 and the arms 21' are staked by a punch 709. These cooperate with a die section 711 which is mounted in the die retainer 231' in accordance with the principles set forth hereinabove. The detail shape of the bottom ends of the punches 707 and 709 and the cavity 713 in die section 711 are shown rather completely in FIGS. 70-80 and it will be seen that the die section cavity 713 is shaped to conform to variations in the width and in the bottom surface of the contacts 13' and that the bottoms of the punches will bend over the ears 20' and 21' in the manner indicated.

I claim:

1. The method of attaching lead wires to metal contacts which comprises feeding a long strip containing a multiplicity of interconnected metal contacts disposed so that the lead wire receiving portions thereof are transverse to the length of the strip and to the direction of feed movement, interrupting the feed movement of said strip at periods during which a spot weld apparatus re-

ceiving said strip is operative, inserting a lead wire into a contact that is disposed in said spot weld apparatus in position for spot welding, after spot welding the wire to the contact resuming feed of said strip and discontinuing operation of said spot weld apparatus and feeding said spot welded wire and contact into a staking apparatus, interrupting feed of said strip while operating said staking apparatus to bend a portion of the contact onto the lead wire, resuming feed of said strip until said spot welded and staked lead wire and contact are disposed in a cutoff apparatus, interrupting feed of said strip and operating said cutoff apparatus to sever said staked and spot welded lead wire and contact from the strip.

2. In a machine for securing lead wires to electric terminals, a guide and support member having a horizontal recess extending therethrough and provided with a slot coextensive with the length thereof communicating said recess with a horizontal surface spaced transversely from said recess, said recess being adapted to receive a strip of said electric terminals and said slot being adapted to receive lead wires connected to said terminals and extending transversely of the strip, said horizontal surface being located to support such transversely extending lead wires, a feed pawl disposed to operatively engage terminals in said strip and move the strip lengthwise in said recess, carrier block means carrying said feed pawl and disposed in a track extending parallel to said recess for reciprocating movement, a stake punch and cutoff punch mechanism arranged to receive a strip of terminals from said recess and disposed for reciprocating movement at right angles to said recess, a pressure cylinder operatively connected to said mechanism to reciprocate it, and means also connected to said pressure cylinder and to said carrier block for reciprocating said feed pawl.

3. The invention set forth in claim 2 including spot weld apparatus in alignment with said recess and including a movable electrode, said spot weld apparatus including a pressure cylinder for reciprocating said movable electrode, and conduit means interconnecting said pressure cylinders so that they operate simultaneously.

4. In a machine for spot welding and staking a lead wire to a metal contact, a spot weld apparatus including a fixed electrode and a movable electrode each disposed on a vertical axis, horizontal guide tracks separated from each other and located on opposite sides of said electrodes but in alignment with each other, means associated with one of said tracks and engageable with a strip of terminals therein for intermittently indexing said strip to bring successive contacts in alignment with said electrodes, pilot means engageable with openings in a strip to properly locate the contact elements with respect to said electrodes, and means synchronizing operation of the movable electrode, the feed means, and the pilot means.

5. The invention set forth in claim 4 wherein said pilot means is operated by said movable electrode.

6. The invention set forth in claim 4 including a spring pressed feed check engageable with a strip to resist movement thereof.

7. In an apparatus for connecting lead wires to metal terminals in strip form, feed mechanism for indexing a strip of terminals, mechanism for attaching lead wires to the terminals, and ratchet mechanism engageable with wires after they have been attached to the terminals to keep them separated one from the other.

8. In an apparatus for assembling conductor wires to contact elements which have been formed in a strip so that they have wire receiving portions extending transversely to the length of the strip, means for spot welding a wire to a contact element, means for severing a contact element with assembled wire from said strip, index means for moving the strip with assembled wire from the spot weld means to the cutoff means, and a horizontally disposed table means providing surface means extending

between said spot weld means and said cutoff means on which said strip may slide and of sufficient width in a direction transverse to the strip to support wires which have been spot welded to the contact elements.

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