United States Patent

[11] **3,585,346**

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[54] **TERMINAL SOLDERING MACHINE WITH MEANS FOR SEGREGATING SUCCESSIVE TERMINALS FROM A STRIP**
11 Claims, 19 Drawing Figs.

[52] **U.S. Cl.** **219/85,** 219/79, 228/47
[51] **Int. Cl.** **B23k 1/04**
[50] **Field of Search** 219/85, 78, 79, 80, 103; 29/203; 228/47

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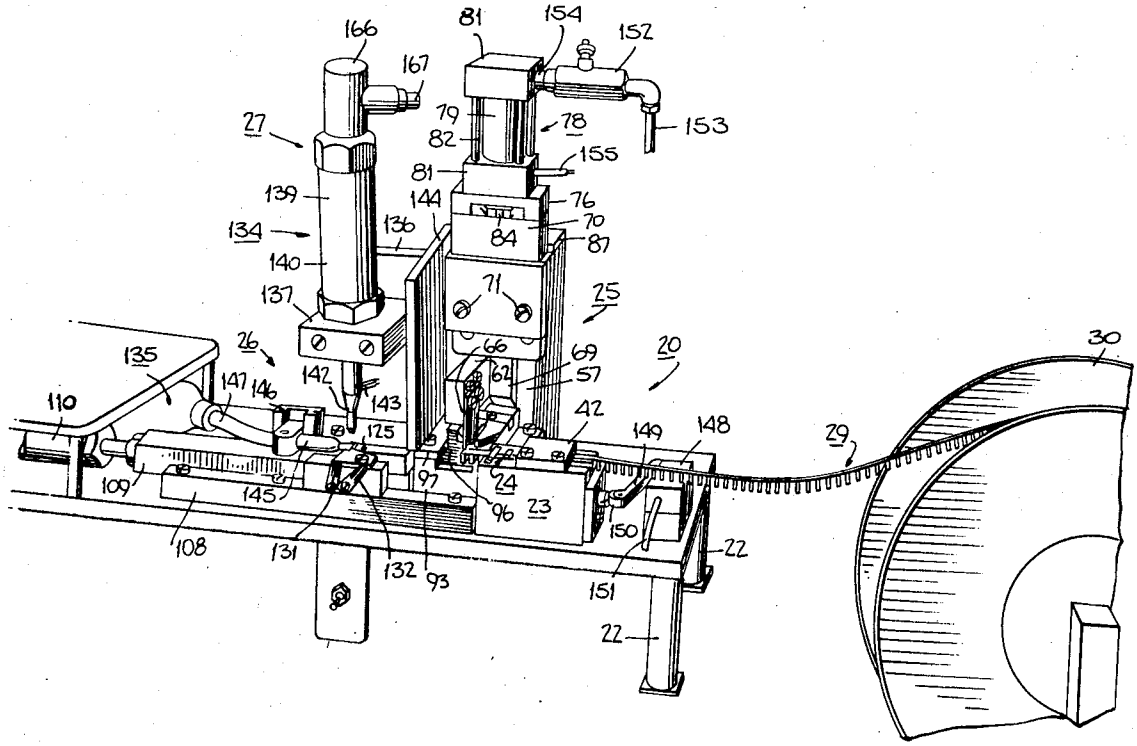
Primary Examiner—J. V. Truhe
Assistant Examiner—C. A. Schutzman
Attorney—Thomas M. Marshall, Esq.

ABSTRACT: The machine automatically forms a soldered connection between a conductor wire and a terminal severed and conveyed from the supply strip. The machine operation is cyclic beginning with the formation of a connection and ending with the fixed positioning of another terminal at the soldering station. The electrical circuit which is used in forming the soldered connection initiates the pneumatic circuit which is used to sever and position the terminals of the supply strip.



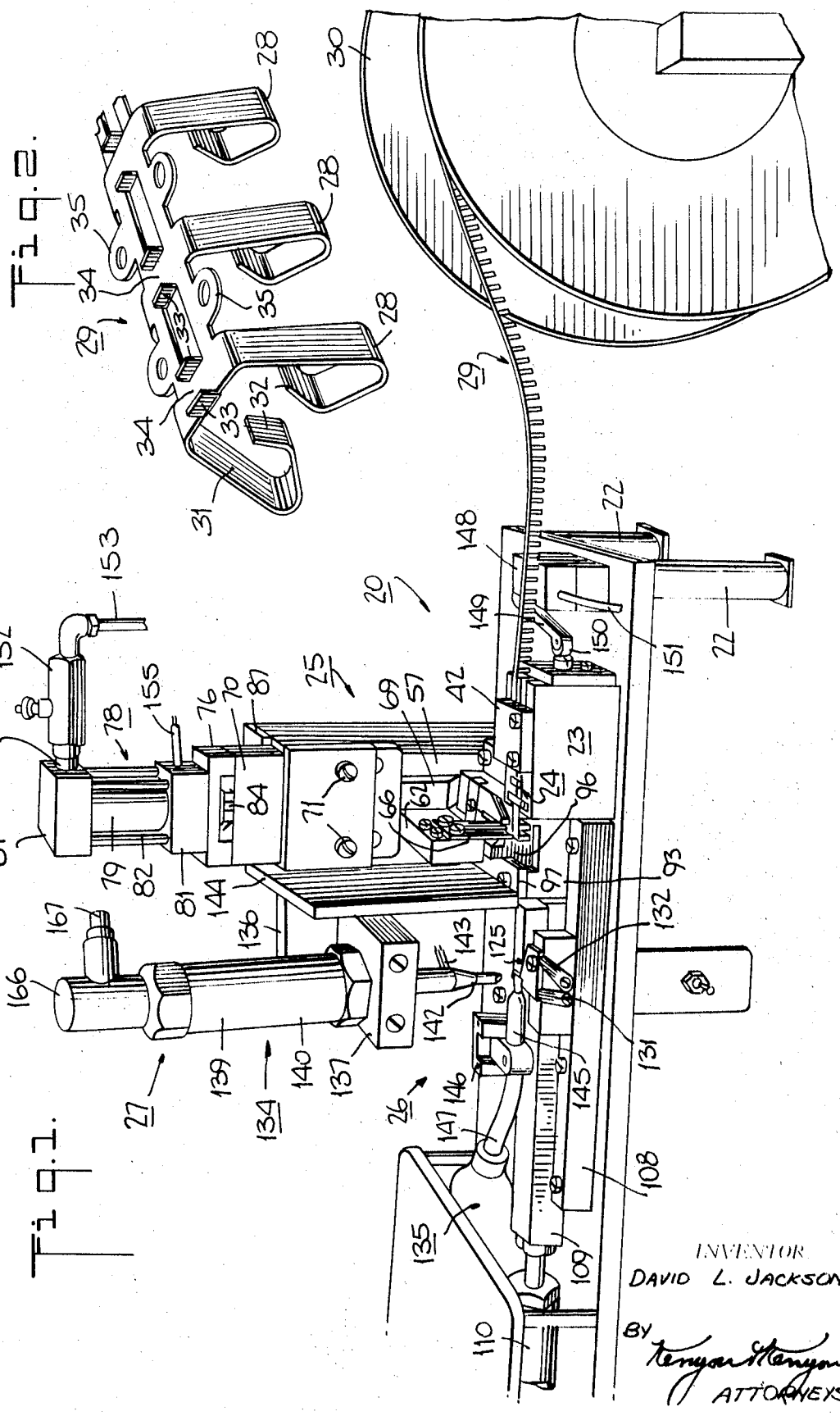

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Fig. 1.
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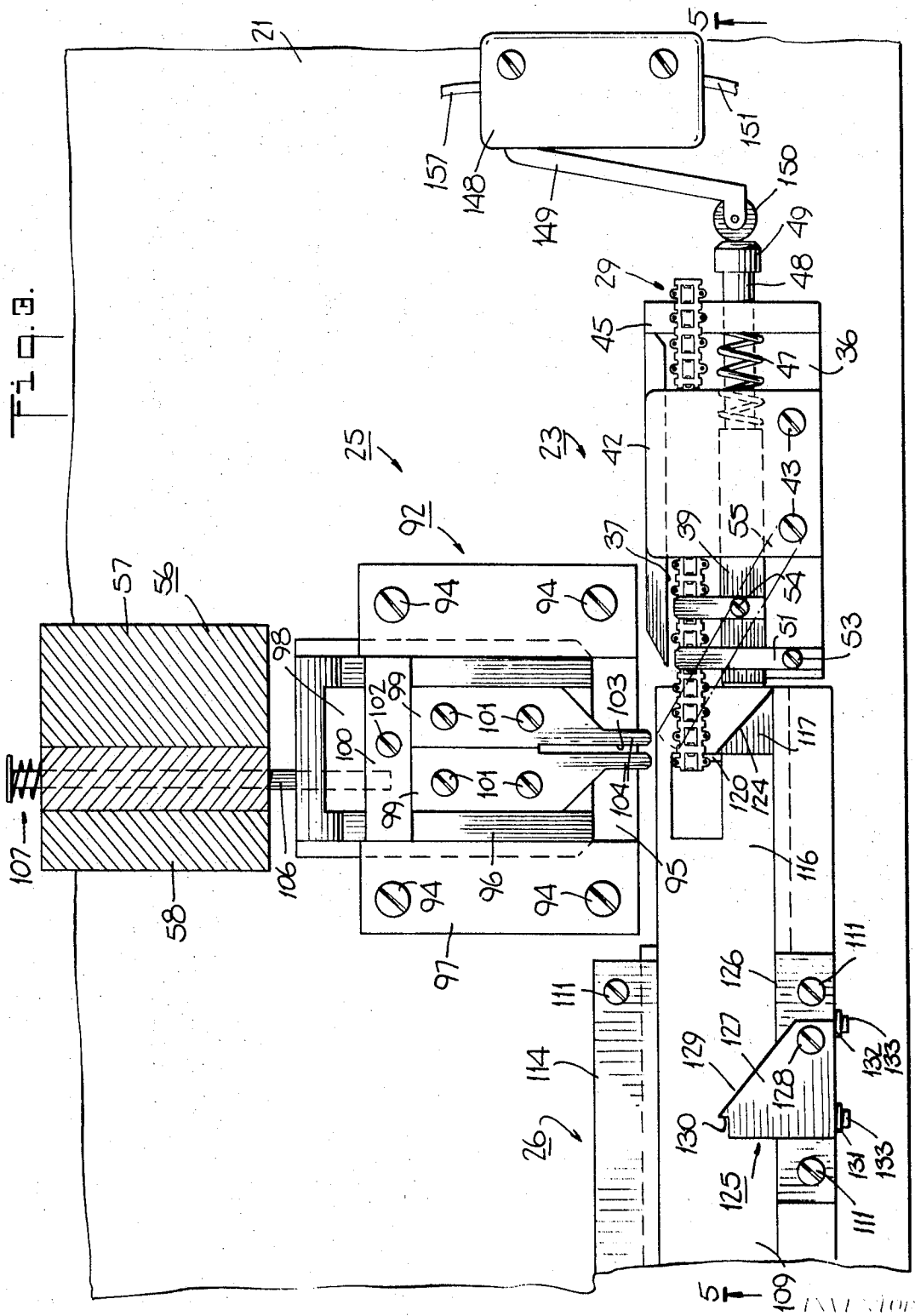
Fig. 3.



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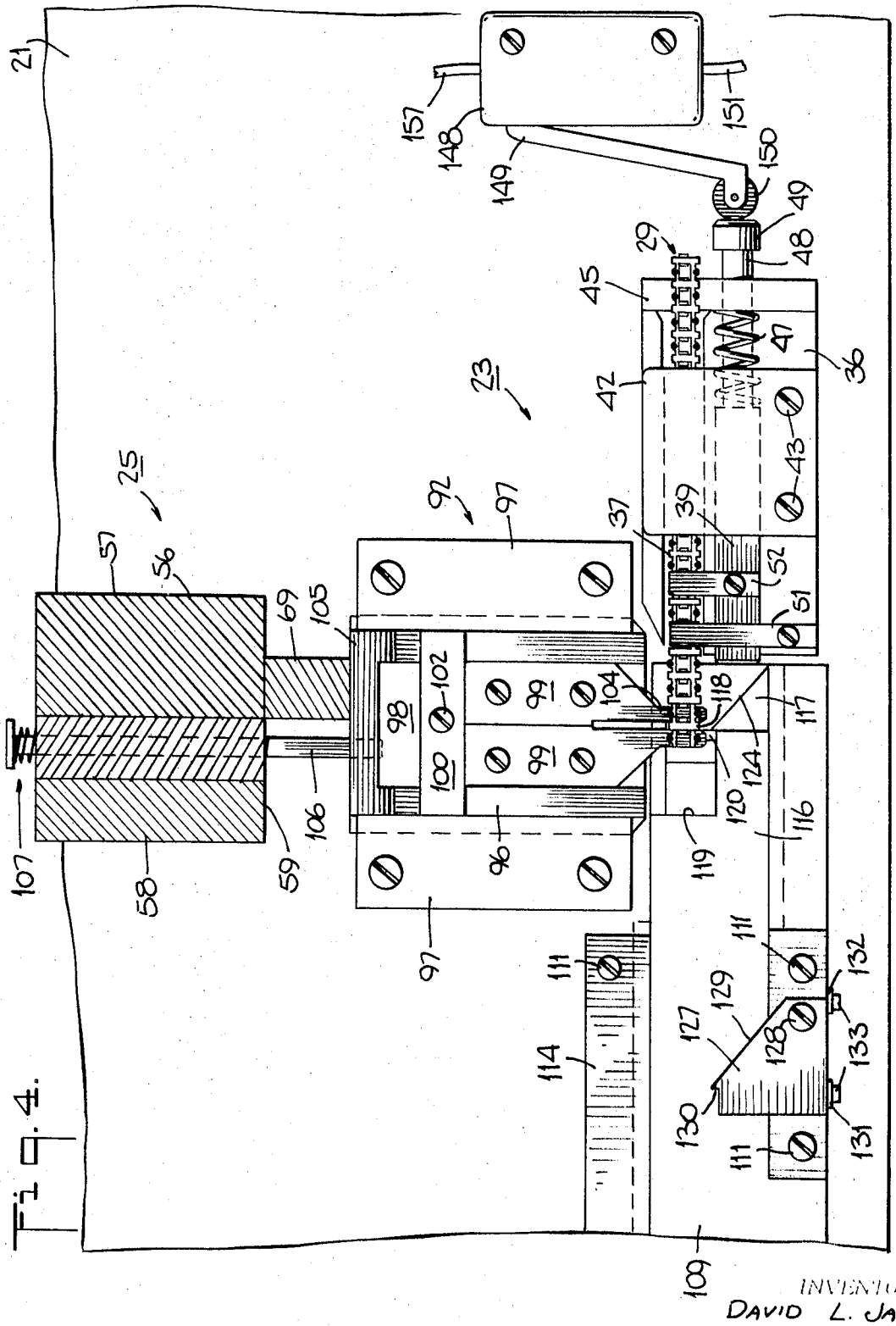

Fig. 4.

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Fig. 5.

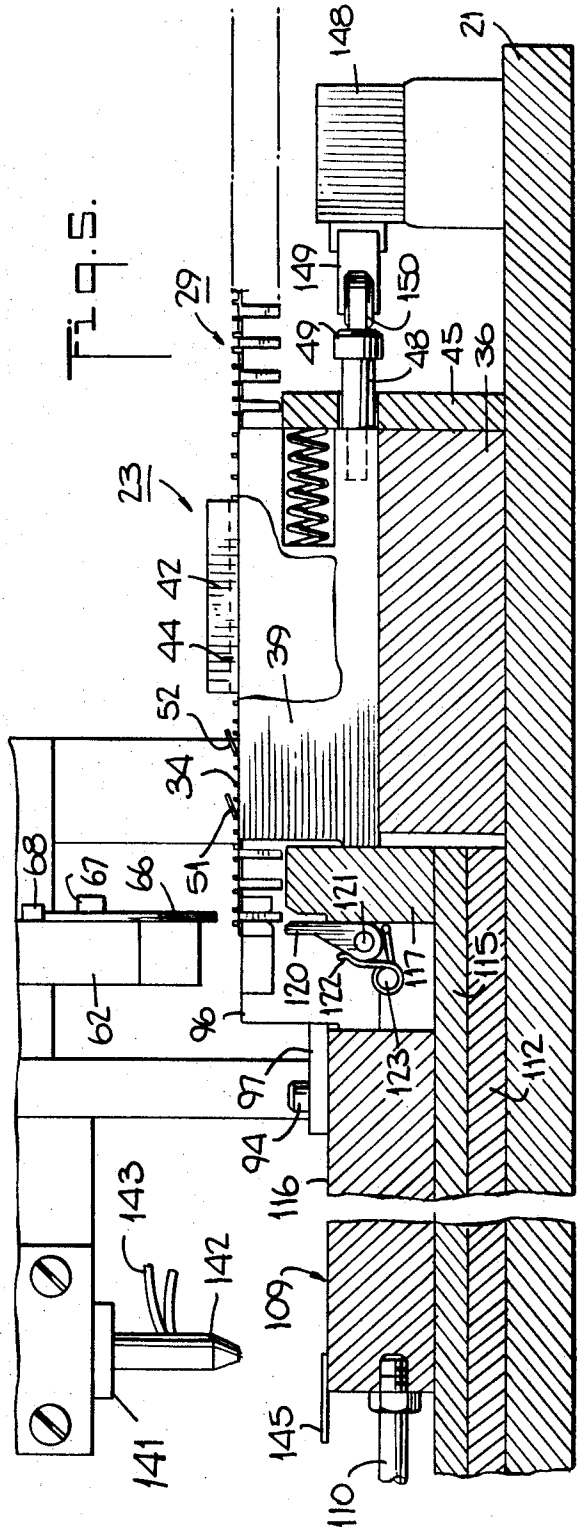

Fig. 11.

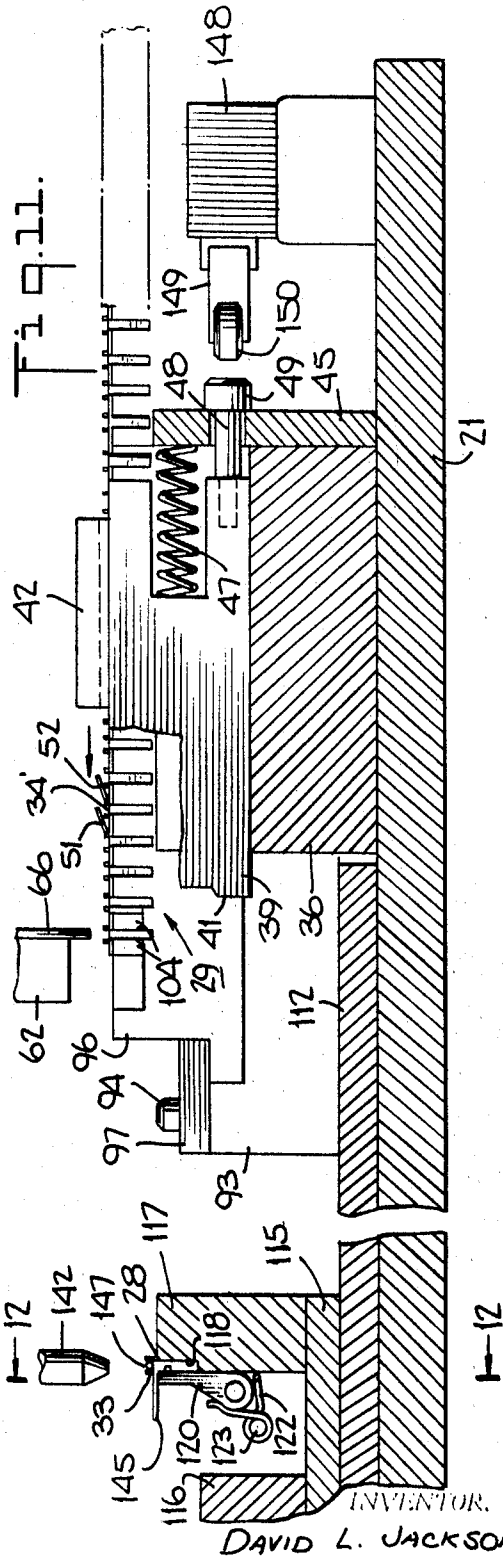

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Fig. 12.

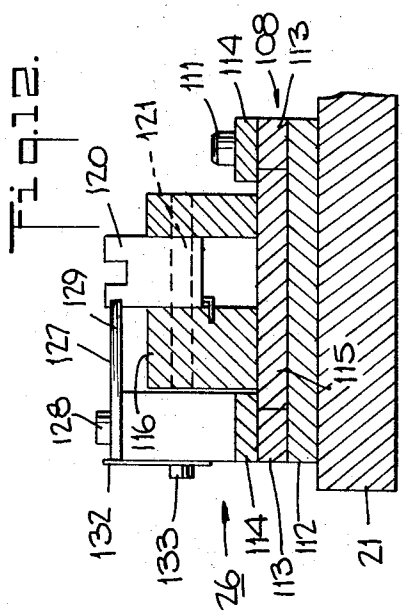

Fig. 6.

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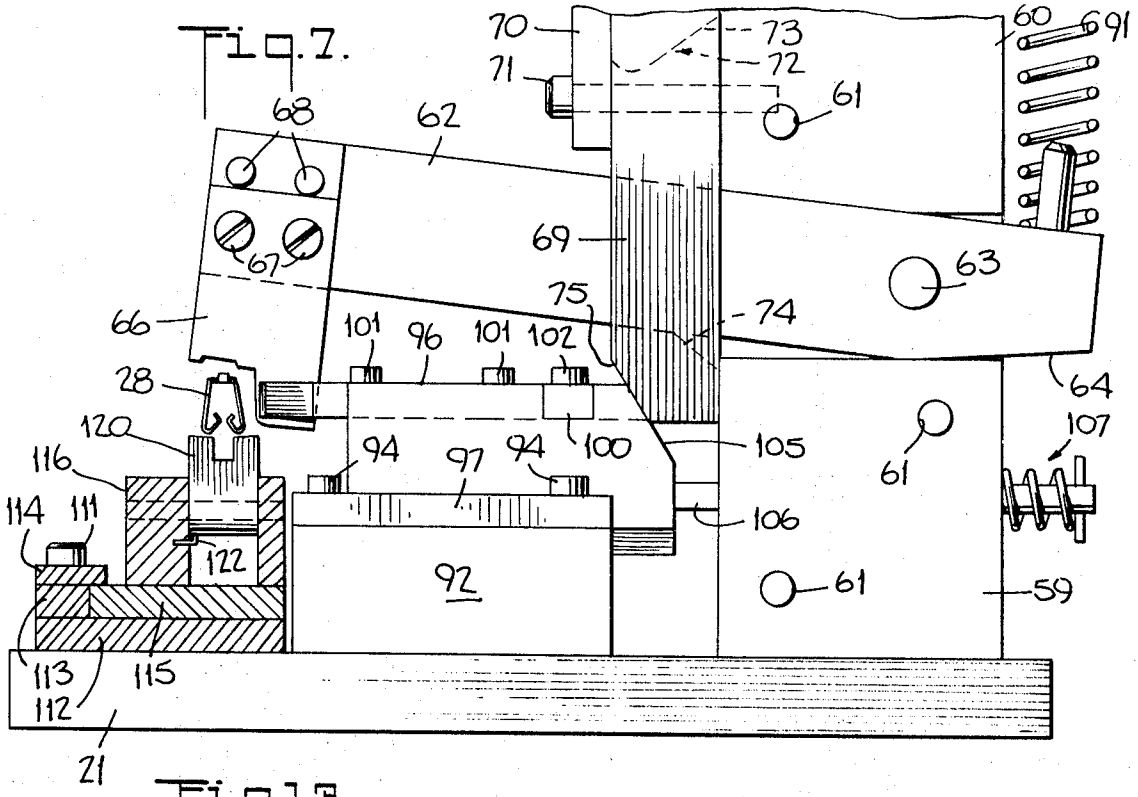
Fig. 7.



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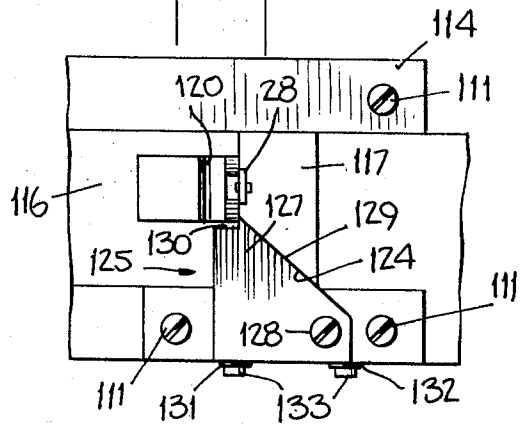

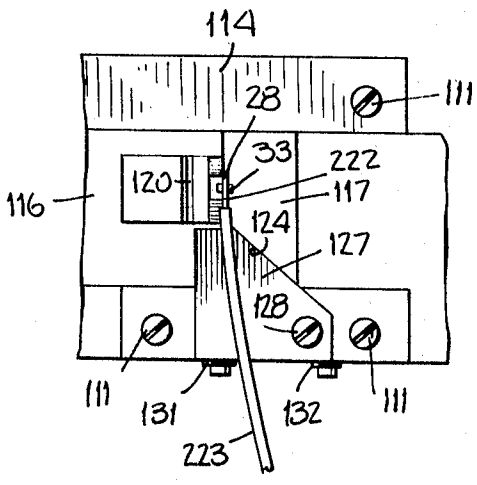

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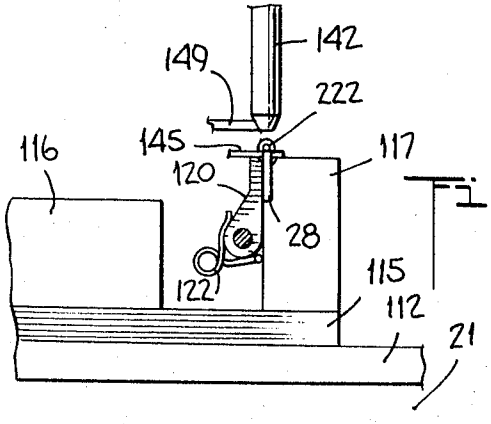

Fig. 15.

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Fig. 16.

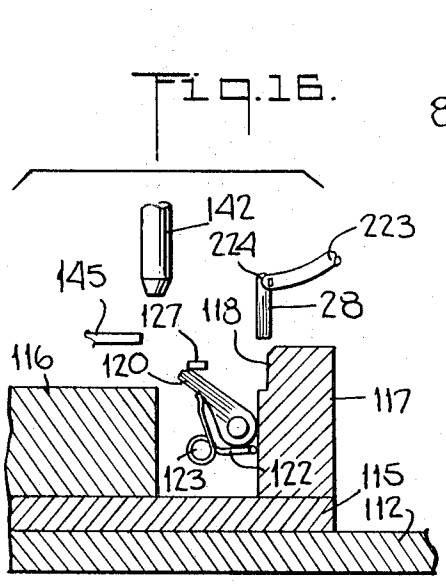

Fig. 8.

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Fig. 10.

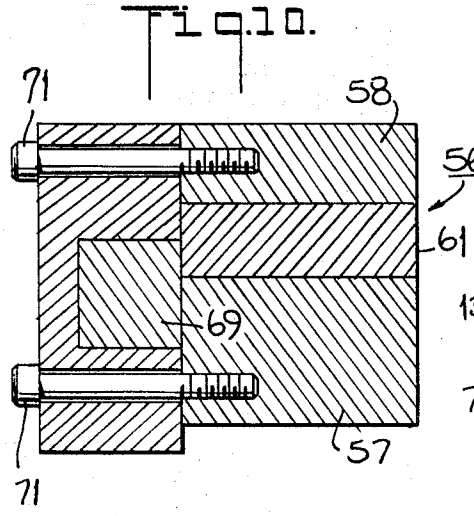

Fig. 9.

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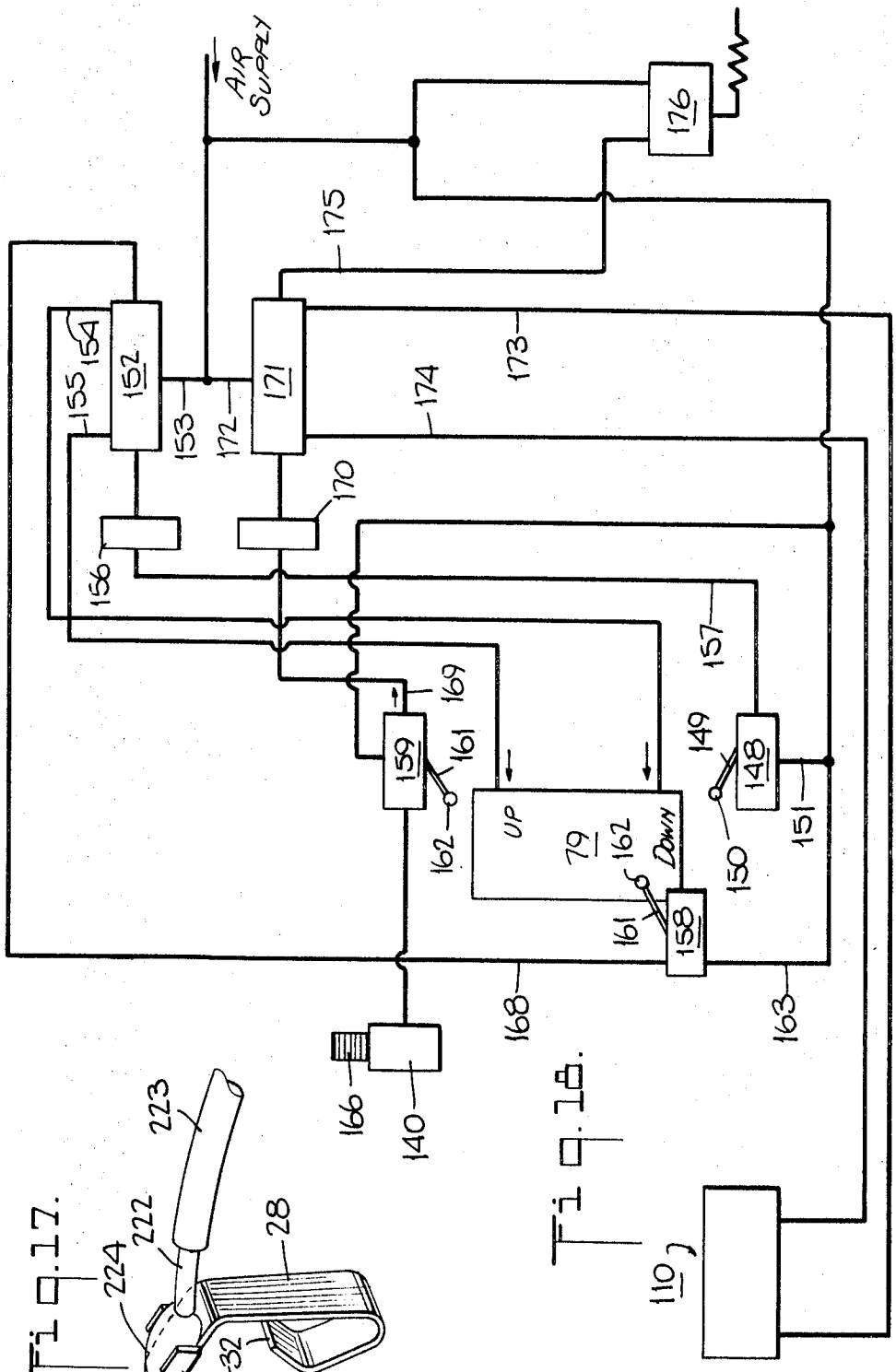

Fig. 1a.

Fig. 17.

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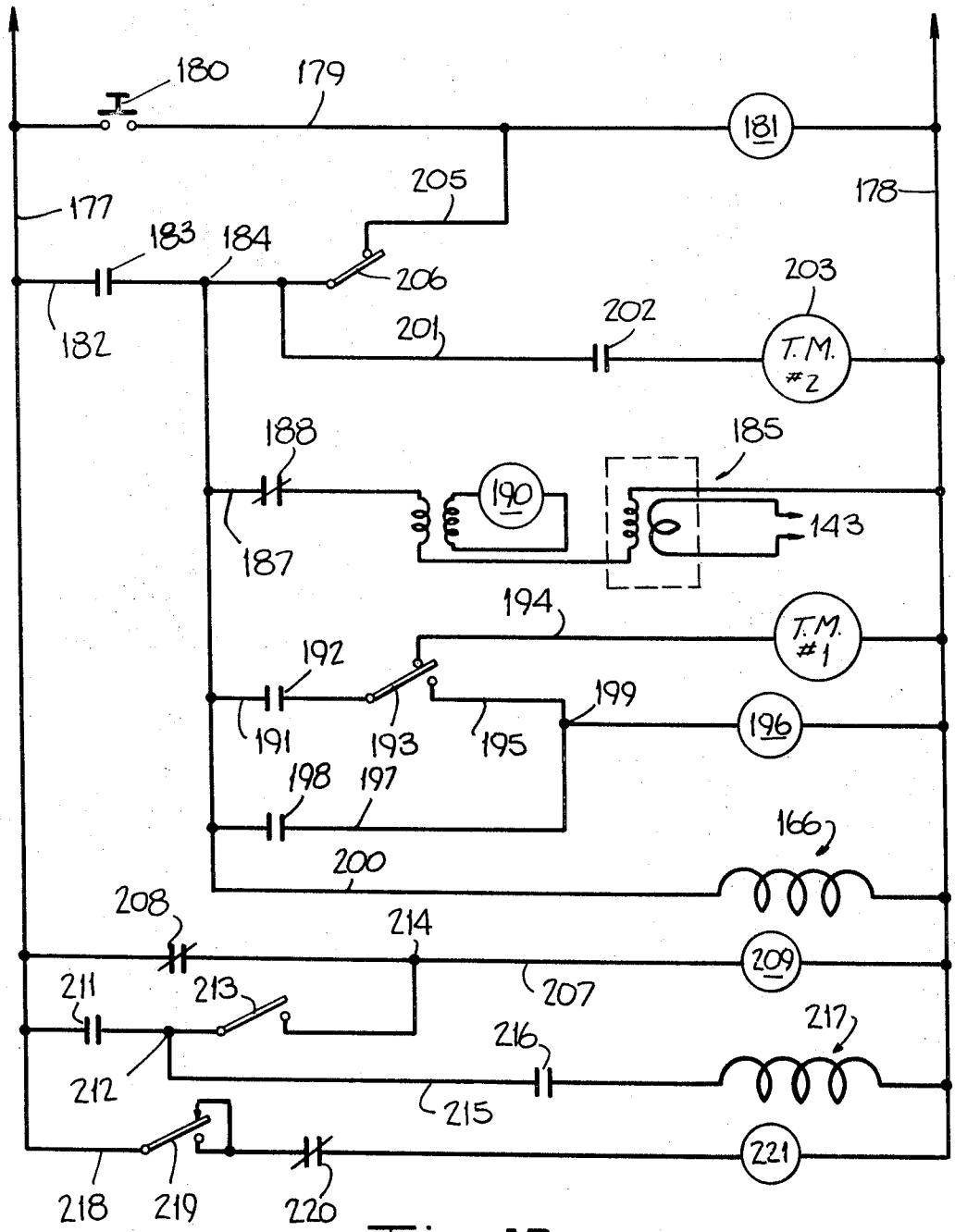

Fig. 19.

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TERMINAL SOLDERING MACHINE WITH MEANS FOR SEGREGATING SUCCESSIVE TERMINALS FROM A STRIP

This invention relates to a soldering machine. More particularly, this invention relates to a soldering machine for soldering lengths of conductor wire to electrical terminals. Still more particularly, this invention relates to a soldering machine for automatically segregating individual electrical terminals from an interconnected series of electrical terminals for soldered securement to individual lengths of conductor wire.

Generally, the soldering machine of the invention is adapted to provide a soldered connection between individual short lengths of conductor wire and electrical terminals which are supplied to the machine in an interconnected series. The machine is adapted to receive the interconnected series of electrical terminals at one end, segregate the foremost electrical terminal from the remainder of the series, position the segregated electrical terminal with a length of conductor wire at another end of the machine and solder the terminal and conductor wire together while maintaining the paths of travel of the interconnected series of terminals and the segregated terminals in substantially the same direction.

The soldering machine includes a means at one end for receiving the foremost terminals of a series of interconnected electrical terminals each of which is provided with a pair of spaced flanges on the upper surface to define a saddle, as well as a means for advancing the received series of terminals in a path into the machine in increments equal to the spacing between adjacent terminals. The machine also includes a means for severing the foremost terminal from the series of terminals while moving the severed terminal into a position below the plane of the advanced terminals. In addition, a carriage means is provided to carry the severed terminal towards the other end of the machine, while maintaining the path of travel in the same direction as the path of the advanced series of terminals, in order to position the severed conductor at a predetermined soldering station between a pair of soldering electrodes. Preferably, the upper soldering electrode is mounted on the machine over the soldering station to be brought into position over the terminal when an end of a length of conductor wire and a solder compound are positioned within the saddle of the contact. After a terminal and conductor wire have been soldered together the connection is removed.

The soldering machine is adapted to operate automatically so that a connection can be made between a terminal and a conductor wire for each cycle of the machine. To this end, the machine is automatically controlled by an operator in dependence upon the actuation of the soldering operation.

Accordingly, it is an object of the invention to provide a soldering machine for soldering of individual electrical terminals of individual conductor wires.

It is another object of the invention to provide a soldering machine for rapidly and efficiently soldering electrical terminals to conductor wires.

It is another object of the invention to provide a soldering machine for segregating individual terminals from a series of electrical terminals and for soldering the segregated terminals to individual conductor wires in sequential manner.

It is another object of the invention to provide a soldering machine for soldering electrical terminals to electrical conductors which is cycled in dependence on actuation of the soldering operation.

It is another object of the invention to provide a soldering machine for directing and maintaining a series of electrical terminals in one direction of movement of soldering to electrical conductors in sequential order.

It is another object of the invention to move a series of interconnected electrical terminals in incremental manner through a soldering machine for subsequent securement to electrical conductor wires.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a perspective front view of a soldering machine of the invention;

FIG. 2 illustrates a portion of a series of interconnected electrical terminals supplied to the machine of FIG. 1;

FIG. 3 illustrates a cross-sectional plan view of the machine of FIG. 1 at a position prior to severing of the foremost terminal from the series of interconnected terminals;

FIG. 4 illustrates a cross-sectional plan view of the machine similar to FIG. 3 at a position at severance of the foremost terminal;

FIG. 5 illustrates a view taken on line 5–5 of FIG. 3 with the means for carrying a severed terminal to the soldering station positioned below the means for severing the foremost terminal from the series of terminals;

FIG. 6 illustrates a partial cross-sectional view of the machine at severance of the foremost terminal;

FIG. 7 illustrates a side view of the severance means of the machine positioned over a terminal;

FIG. 8 illustrates a view similar to FIG. 7 during actuation of the severing means;

FIG. 9 illustrates a view similar to FIG. 7 at severance of a terminal;

FIG. 10 illustrates a view taken on line 10–10 of FIG. 9;

FIG. 11 illustrates a view similar to FIG. 5 with the severed terminal at the soldering station;

FIG. 12 illustrates a view taken on line 12–12 of FIG. 11;

FIG. 13 illustrates a plan view of a terminal at the soldering station positioned in the carrying means;

FIG. 14 illustrates a view similar to FIG. 13 with a conductor wire positioned in the saddle of the terminal;

FIG. 15 illustrates a view of the carrying means, terminal, conductor wire and soldering electrodes during soldering;

FIG. 16 illustrates a view of the carrying means upon movement from the soldering station;

FIG. 17 illustrates a perspective view of a connection made by the machine between a terminal and conductor wire;

FIG. 18 illustrates a schematic of a pneumatic system of the apparatus of the invention; and

FIG. 19 illustrates a schematic of an electrical circuit of the apparatus of the invention.

Referring to FIG. 1, a soldering machine 20 of the invention has a base 21 which is supported on a plurality of legs 22 and includes a terminal feed assembly 23 mounted near one end of the base 21 to receive and advance a series of interconnected terminals in increments equal to the spacing of the terminals to a severing station 24 outside of the feed assembly 23, a severing assembly 25 mounted on the base 21 adjacent to the feed assembly 23 at the severing station 24 for severing the foremost terminal from the series of terminals while moving the severed contact below the plane of the remainder of the series of terminals, a reciprocal carriage assembly 26 positioned on the base 21 below the severing assembly 25 in alignment with the feed assembly 23 to receive and carry the severed foremost terminal in an upright state to a soldering station, and a soldering assembly 27 positioned at the soldering station to solder the terminal to a conductor wire to form a connection. The machine 20 is operated so that a terminal is moved through the various operations of the machine in a series of sequential steps in dependence on the actuation of the soldering assembly. That is, after the soldering assembly has formed a soldered connection, the machine advances, severs and carries a subsequent terminal into the soldering position, the prior terminal having been removed.

The soldering machine 20 is supplied with a series of terminals 28 which are interconnected in a strip 29 from a supply roll 30 mounted in spaced relation to the feed assembly 23. The supply roll 30 is freely rotatable about a fixed axis so that the strip 29 of terminals 28 can be readily fed into the soldering machine 20 by a slight pulling force on the free end of the strip 29.

Referring to FIG. 2, the terminals 28 are formed of a substantially uniform width with a pair of depending legs 31 having an inturned foot 32 for providing a pair of opposed gripping contact surfaces and a pair of upstanding flanges 33 along the top surface to form a saddle 34. The terminals 28 are interconnected tc each other at the top surface to either side of the saddle 34 in consecutive manner by pairs of integral shaped tabs 85 with or without holes.

Referring to FIGS. 1, 3 and 5, the terminal feed assembly 23 of the soldering machine 20 has a guide block 36 secured on the base 21 which has a pair of longitudinally extending grooves 37, 38 in the upper surface disposed parallel to the axis of the machine 20. The groove 37 is dimensioned to receive the strip 29 of terminals 28 which is in alignment with the groove 37 in order to guide the terminals 28 through the feed assembly 23 with the saddle forming flanges 33 projecting slightly out of the guide block. The other groove 38 is dimensioned to receive a slide block 39 in slideable relationship. The slide block 39 is formed with a recess 40 in the rear end directed outwardly of the machine 20 towards the supply roll 30 and a protuberance 41 on the lower portion of the forward end. A guide plate 42 is secured, as by bolts 43, to the top surface of the guide block 36 to overlie the grooves 37, 38 and maintain the terminal strip 29 and slide block 39 in the respective grooves 37, 38. The guide plate 42 has a groove 44 in the underside which overlies the groove 38, in order to provide clear passage for the flanges 33 of the terminal 28. Also, an end plate 45 is secured, as by bolts 46 (FIG. 1), to the end of the guide block 36 facing the end of the machine 20 in order to confine the slide block 39 in the guide block 36.

In addition, the feed assembly 23 has a spring 46 (FIGS. 3 and 5) positioned in the recess 40 of the slide block 39 against the end plate 45 which urges the slide block 39 away from the end plate 45. In order to limit the extent to which the slide block 39 is urged out of the guide block 36 by the spring 47, a stop screw 48 having a shoulder 49 in passed through a bore 50 in the end plate 45 and threaded into engagement with the end of the slide block 39 with the shoulder 49 dimensioned to abut the exposed face of the end plate 45 at the limit of the slide block movement out of the guide block 36.

Also, a pair of spaced spring fingers 51, 52 (FIG. 3) are secured to the top surfaces of the guide and slide blocks 36, 39 to project over the groove 37 into the path of the saddle forming flanges 33 of the terminals 28. The forwardmost spring finger 51 is secured, as by a screw 53, to the guide block 36 whereas the rearmost spring finger 52 is secured, as by a screw 54, to the slide block 39. Each spring finger is inclined to the path of the terminal strip 29 in a direction towards the forward part of the feed assembly in order to permit the several terminals 28 to pass under the spring fingers without interference when the terminals 28 are moved forward relative to the spring fingers in the guide block 36. The spacing of the spring fingers 51, 52 is sufficient to allow the terminal strip 29 to be moved forward a distance equal to the terminal centerline spacing in the strip 29 without the spring fingers 51, 52 interfering with each other.

The feed assembly 23 also has a leaf spring 55 secured to the top of the guide plate 42 by one of the bolts 43 which extends angularly past the forward end of the guide block 36 to restrain the foremost terminals in the spring 29 projecting out of the feed assembly 23 from upward movement from the severing station 24.

Referring to FIGS. 1, 3, 9 and 10, the severing assembly 25 has a frame 56 secured to the base 21 as by bolts (not shown) which is composed of a pair of upstanding horizontally spaced plates 57, 58 and a pair of vertically spaced pads 59, 60 sandwiched between the plates 58, 58; the plates and pads being secured in fixed relation by suitable bolts (not shown) passing transversely through respective bores 61 (FIG. 9) thereon. The pads 59, 60 are spaced apart in order to define a confined passage between the plates 57, 58. The top surface of the lower pad 59 is horizontal, that is, parallel to the base 21, whereas, the bottom surface of the upper pad 60 is horizontal for a short length at one end and inclined, for example, on an angle of 8°, at the end closer to the severing station 24 in an upward direction.

In addition, an elongated cutter arm 62 (FIG. 9) is mounted in the frame 56 by a pivot pin 63 secured in the plates 57, 58 to extend over the severing station 24 and to pivot between the limits defined by the top surface the lower pad 59 and the inclined surface of the upper pad 60. The cutter arm 62 is formed with an inclined lower surface 64 at the end within the passage defined by the plates and pads to facilitate pivoting movement and with a side notch 65 at the other end to receive a cutter blade 66. The cutter blade 66 is secured, as by bolts 67, to the cutter arm 62 in abutment with a pair of pins 68 secured in the notch 65. The pins 68 serve to back up the cutter blade 66 in order to absorb some of the impact loads imposed on the cutter blade 66 upon severance of a terminal 28. The cutter blade 66 is shaped at the severing end to the shape of the terminal 28 being severed and is of a thickness to pass between the flanges 33 of the terminal, for example, a thickness of 0.065 inch.

Referring to FIGS. 9 and 10, in order to pivot the cutter arm 62 about the pivot pin 63, a plunger 69 is slideably mounted within a channel-shaped guide block 70 secured to the face of the plates 57, 58 of the frame 56 by bolts 71. The plunger 69 projects into the plane of the cutter arm 62 and is formed with a notch 72 having inclined sidewalls 73, 74 in one side to receive an intermediate portion of the cutter arm 62 so that upon downward movement of the plunger 69, the upper wall 73 of the notch 72 abuts and directs the cutter arm 62 downwardly. The plunger 69 is also formed with a chamfered surface 75 at the lower end. A channel-shaped bracket 76 is secured across the top of the guide block 70 as by bolts (not shown) and includes an aperture 77 in alignment over the plunger 69. The bracket 76 mounts an air valve assembly 78 thereon which includes an air cylinder 79 and a piston 80 reciprocally mounted in the air cylinder 79. The air cylinder 79 is mounted between a pair of blocks 81 which are spaced by rods 82 and has a reduced neck 83 which passes through the aperture 77 of the bracket 76. A suitable threaded nut 84 is threaded on the neck 83 against the underside of the bracket 76 to fix the air cylinder in place. The piston 80 passes through the neck 83 and is threaded at the end into the plunger 69 and secured as by a nut 85. Thus, upon downward movement of the piston 80, the plunger 69 moves downward to abut and pivot the cutter arm 62 and pin 63.

In order to return the cutter arm 62 to its initial position, the frame 56 is provided with a return spring assembly 86 (FIG. 9) which is mounted to act on the end of the cutter arm 62 remote from the cutter blade 66. The return spring assembly 86 includes a plate 87 secured to the upper pad 60 as by bolts 88, a pair of guide pins 89, 90 mounted on the plate 87 and cutter arm respectively, and a compression spring 91 positioned around the guide pins 89, 90 between the plate and cutter arm for urging the cutter arm end away from the plate 87.

Referring to FIGS. 3 and 9, the severing assembly 25 also includes a die assembly 92 positioned in front of the frame 56 under the cutter arm 62 for accurately positioning the foremost terminal of the terminal strip 29 beneath the cutter blade 66 and for severing the foremost terminal from the strip. The die assembly 92 includes a slide base 93 which is fastened to the base 21 as by bolts 94 and which is provided with a channel 95 transverse to the path of travel of the terminal strip 29 and parallel to the cutter arm 62. In addition, the die assembly 92 includes a blade holder 96 of a generally inverted T-shaped cross section which is slideably mounted in the channel 95 of the slide base 93 and retained therein by a pair of slide caps 97. The slide caps 97 are removably secured to the slide base 93 by the bolts 94 to project over the sides of the blade holder 96 after the blade holder is in place so as to prevent vertical movement of the blade holder.

The blade holder 96 is provided with a cruciform-shaped recess 98 in which a pair of die blades 99 and key 100 are removably secured as by screws 101, 102. The die blades 99

are disposed parallel to each other and to the cutter arm **62** and are in abutment with the key **100** which is disposed transversely to the die blades **99**. Each die blade **99** projects from the blade holder **96** in a direction towards the terminal strip **29** and is provided with a recess **102** in a side in opposition to the other die blade so as to form a passage with the other die blade which is substantially equal to the thickness of a terminal **28**. In addition, each die blade **99** is shaped at the projecting end with a nose **104** which is sized to correspond to the spacing between adjacent terminals in the terminal strip **29** so as to segregate the foremost terminal from the strip. The wall of the recess **103** is also relieved to present a sharp cutting edge along the top of the die blade.

The blade holder **96** is also formed with a sloped surface **105** on the rear end which is normally positioned under the plunger and which is complemental to the chamfered surface **75** of the plunger **69**. Also, the rear end of the blade holder **96** is secured to a return rod **106** which passes through the lower pad **59** of the frame **56**. The end of the return rod **106** is provided with a suitable spring assembly **107** which constantly urges the return rod **106** and, consequently, the blade holder **96** away from the path of travel of the terminal strip **29**.

Referring to FIGS. **1**, **3**, **5**, **11** and **12**, the reciprocal carriage assembly **26** includes a slideway **108**, a slide **109** slideably mounted in the slideway **108** and an air cylinder and piston assembly **110** secured to one end of the slide **109** for reciprocating the slide in the slideway. The slideway **108** (FIGS. **3** and **12**) is secured to the base **21** by bolts **111** and is constructed with a slide base **112** having a cutout at the end adjacent the die assembly **92** for clearance purposes, a pair of spacer bars **113** disposed in spaced relation along the sides of the slide base **111** to guide the slide **109** along the slide base **111** and a pair of retainer bars **114** disposed on top of the spacer bars **113** which are dimensioned to project over the spacer bars **113** to retain the slide **109** in the slideway **108**. The slide and retainer bars on the cutout side of the slide bars are shortened to provide clearance with respect to the die assembly **92**. The slide **109** includes a slide plate **115** which is retained in the slideway by the retainer bars **114**, a slide block **116** which is secured to the slide plate **115** as by screws, and a nest end block **117** (FIGS. **3** and **6**) which has a clearance slot **118** positioned in the plane of the cutter blade **66** to receive a severed terminal is secured to the slide plate **115** and the end of the slide block **116** as by screws. The end of the slide block **116** to which the next end block **117** is secured is bifurcated with a cutout **119** (FIG. **3**) facing the slot **113**. A clamp **120** having a bifurcated end in alignment with the slot **118** is pivotally mounted in the cutout **119** on a pin **121** secured in the slide block **116**. In addition, a spring **122** (FIG. **6**) is mounted on another pin **123** to bias the clamp **120** against the nest end block **117** to confine a severed terminal **28** between the clamp **120** and nest end block **117** (FIG. **6**).

The nest end block **117** is sized to project above the slide block **116** to a plane immediately below the terminal strip **29**. In addition, the nest end block **117** if formed with a sloped face **124** in the plane of the clearance slot **118**.

Referring to FIGS. **1**, **3** and **16**, the reciprocal carriage assembly **26** also includes a spring back unit **125** which is secured to one side of the slideway **108** at the soldering station. The spring back unit **125** has a mounting block **126** which is secured on the top of a retainer bar **114** by the bolts **111** and a plate **127** which is pivotally secured to the mounting block **126** by a single screw **128** and which projects over the top surface of the slide block **116** into the path of the clamp **120**. The plate **127** is formed with a sloped forward face **129** which is complemental to the sloped face **124** of the nest end block **117** and a notch **130** behind the sloped face **124**. In addition, the mounting block **126** has a pair of spring fingers **131**, **132** secured to the outer side as by bolts **133** which project into the plane of the plate **127** on either side of the screw **128** to resiliently bias the plate **127** against rotation. Thus, as the clamp **120** is moved into abutment with the plate **127** by the cylinder and piston assembly **110**, the sloped face **124** facilitates pivoting of the plate **27** to permit passage of the clamp **120** past the sloped face **124** and the spring finger **131** facilitates the return of the plate **127** to position the clamp **120** in the notch of the plate **127**. Further, as the clamp **120** is moved in the opposite direction, the plate **127** pivots the clamp **120** away from the nest end block **117** to release the terminal from between the clamp and nest end block.

Referring to FIGS. **1** and **6**, the soldering assembly **27** has an upper electrode unit **134** and a lower electrode unit **135** positioned across the soldering station. The upper electrode unit is mounted on a mounting plate **136** secured to the guide block **70** of the severing assembly **25** by the bolts **71** in a cantilevered manner. The upper electrode unit **134** includes a base plate **137** which is secured as by bolts **138** to the mounting plate **136**, an air cylinder and piston assembly **139** mounted on the base plate **137** having a spring return air cylinder **140** and a piston **141** (FIG. **6**) reciprocally mounted in the air cylinder **140**, and an electrode **142** secured to the lower end of the piston **141**. The electrode **142** is positioned over the soldering station to be moved downwardly directly over a severed terminal held thereat by the plate **127** of the reciprocal carriage assembly **26**. In addition, the electrode **142** is provided with a suitable current supplying means **143** (FIG. **6**) to induce a flow of current in the electrode.

In addition, a heat shield **144** of any suitable material is secured on the mounting plate **136** between the soldering assembly **27** and the severing assembly **25** to reduce the amount of heat radiated by the soldering assembly **27** towards the severing assembly **26**. Likewise, in order to reduce the heat transmitted through the base plate **137**, the base plate **137** can be made of a suitable heat resistant material. For example, the air cylinder **140** can be mounted on a plate of heat shield material which is secured to a second plate of good heat insulating properties and the second plate can be secured to the mounting plate **136**.

The lower electrode unit **135** includes an electrode **145** mounted in a horizontal position at the soldering station for positioning under the saddle of a terminal. The electrode **145** is mounted by a suitable frame **146** secured to the slideway **108** of the carriage assembly **26** and is connected by an electrical line **147** into an electrical circuit (not shown) for the conduction of a current flow. The electrode **145** cooperates with the electrode **142** to induce a flow of current therebetween through the terminal and thus induce sufficient heat to form a soldered connection between a terminal and a conductor wire.

Alternatively, the soldering assembly can be constructed with a pair of spaced electrodes mounted on a common reciprocable piston of an air cylinder such as spring return air cylinder **140**. In this alternate assembly, the pair of electrodes are brought down over a terminal, conductor wire and solder in the soldering station to touch the wire. Upon touching the wire with the electrode circuit energized an electrical contact is made to cause a flow of current to pass between the electrodes through the wire, terminal and solder. The flow of current thus induces a sufficient degree of heat to develop to form a soldered connection between the terminal and conductor wire.

The soldering machine **20** includes a pneumatic system and an electrical system for operating the machine.

Referring to FIGS. **1** and **13**, the pnuematic system includes an air microswitch **148** mounted on the base **21** which has a resiliently biased arm **149** on which a roller **150** is mounted at one end to contact and follow the movements of the shoulder **49** of the stop screw **48** secured to the slide block **36** of the terminal feed assembly **23**. The microswitch **148** is interposed in a pneumatic line **151** connecting the air valve assembly **78** to a suitable air source (not shown) for controlling the passage of air to the air valve assembly **78**. The air valve assembly **78** includes a double pressure piloted four-way valve **152** which is connected to the air source through a line **153** for directing the reciprocal movement of the piston **80**. The valve **152** communicates with air cylinder **79** through a pair of lines **154**, **155**

connected to opposite ends of the air cylinder. An impulse relay valve **156** is placed in a line **157** between the microswitch **148** and valve **152** to direct an impulse of air through the valve **152** into one of the lines **154, 155** to the air cylinder **79**.

Referring to FIG. **8**, the pneumatic system also includes a pair of three-way apertured microline pilot valves **158, 159** which are mounted on the frame **56** in communication with the air source. A plate **160** secured to the plate **87** of the return spring assembly **86** mounts the pilot valves **158, 159** in spaced vertical relation to each other. Each pilot valve has a spring biased lever **161** mounting a roller **162** at the free end which serves to actuate the pilot valve to pass air from a line **163, 164** connected to the air source through the pilot valve. In order to actuate the pilot valves, a cam lever **165** is secured to the piston **80** to follow the vertical movements of the piston and to project into the plate of the rollers **162** on the levers **161** of each pilot valve.

Referring to FIG. **1**, the spring return air cylinder **140** of the soldering assembly is connected through a solenoid valve **166** and line **167** to the air source of the machine.

Referring to FIG. **18**, the lower pilot valve **158** communicates with valve **152** through a line **168** to direct a flow of air into the valve **152** upon actuation. The upper pilot valve **159** communicates with the air cylinder and piston assembly **110** through a line **169**, an impulse relay valve **170** and a double pressure piloted valve four-way valve **171**. The valve **171** is connected by a line **172** to the air source and by a pair of lines **173, 174** to opposite ends of the air cylinder and piston assembly **110**. In addition, valve **171** communicates through a line **175** with a valve **176**, such as a three-way foot valve, which is interposed between the air source and valve **171** for controlling the passage of air into line **173** to actuate the air cylinder and piston assembly **110**.

Referring to FIG. **19**, the electrical system of the machine **20** is connected to the solenoid valve **166** of the soldering assembly as well as the foot valve **176** of the pneumatic system in order to actuate each in sequence.

The electrical system has power lines **177, 178** across which a line **179** is connected having a manually operated switch **180** and a relay **181**. In addition, a line **182** having a normally open relay contact **183** connects through a terminal **184** to a heater **185**, a timing motor **186** and the solenoid valve **166** of the upper electrode **142** in parallel. Line **187** has a normally closed relay contact **188**, a transformer **189** and a relay **190**. Line **191** has a normally open relay contact **192** and a time control switch **193** which contacts either to the line **194** of the timing motor **186** or the line **195** of a relay **196**. In addition, line **197** which has a normally open relay contact **198** connects through terminal **199** and line **195**. Line **200** connects to the solenoid valve **166**.

Line **201** having a normally open contact **202** connects a second timing motor **203** to terminal **204** in line **182** and line **205** connects relay **181** to terminal **204** through a second time control switch **206**.

Line **209** is connected between the power lines and carries a normally closed contact relay **208** and a relay **209**. Line **210** which carries a normally open relay contact **211** has a terminal **212** which connects through a nonactivated solenoid microswitch **213** to a terminal **214** in line **207** and which connects through line **215** having a normally open relay contact **216** to the solenoid **217** of valve **176** of the pneumatic system of the machine. Line **218** has a normally closed switch **219**, a normally closed relay contact **220** and a relay **221**.

In operation, the terminal strip **29** is initially fed from the supply roll **30** into the longitudinal groove **37** of the feed assembly **23** and under the guide plate **42** and leaf spring **55** so that the saddle **34** of the terminals in the strip project through the planes of the spring fingers **51, 52**. The spring fingers **51, 52** are spaced apart relative to the saddles of the terminals so that initially the spring fingers, which are inclined, abut the rear flanges **33** of two terminals which are spaced apart. At this time, (FIGS. **1** and **7**), the plunger **69** of the severing assembly **25** is in an uppermost position, the blade holder **96** is in a retracted position from the severing station, the slide **109** is in a retracted position with the nest end block **117** at the soldering station, the slide block **39** of the feed assembly **23** is projecting out of the guide block **36** towards the severing station, the roller **150** on the microswitch arm **149** is in contact with the stop screw **48** which is in a position abutting the end plate **45** of the feed assembly **23**, and the upper electrode **142** is in an uppermost position above the soldering station.

Referring to FIGS. **1, 3, 5, 8, 18** and **19**, a master switch **221** is thrown to activate the electrical circuit of the machine **20**. This energizes the electrical circuitry of the machine and activates relay **209** to close the relay contact **211** (FIG. **19**). Thereafter, the switch **180** is actuated by an operator **23** through a foot pedal to activate relay **181**. This closes relay contact **183** and opens relay contact **220**.

Upon closing of relay contact **183**, the solenoid valve **166** is actuated to admit air from line **167** (FIG. **18**) into the air cylinder **140** to move the upper electrode **142** downwardly over a terminal **28** in the soldering station. Also, the heater **185** is activated to induce a flow of current to heat the electrode **142** and the relay **190** is activated.

Upon activation of relay **190**, relay contact **192** is closed to actuate the timing motor **186**. The time control switch **193** then begins a heating time interval at the end of which switch **193** shuts off motor **186** to begin cooling of electrode **142** and activates relay **196**.

Upon activation of relay **196**, relay contact **188** opens to shut off current supply to heater **185** and relay **190**; relay contact **198** closes to maintain relay **196** energized; and relay contact **202** closes to energize timing motor **203**. As relay **190** is deactivated, relay contact **192** opens to deenergize line **191**. The time control switch **206** then begins a cooling time interval at the end of which switch **206** deactivates relay **181**.

Upon deactivation of relay **181**, relay contact **183** opens to deenergize the timing motor **203** and the solenoid **166** so that the upper electrode returns under the spring biasing force to its uppermost position. In addition, relay contact **220** closes to activate relay **221**.

Upon activation of relay **221**, relay contact **208** opens while relay contact **211** remains closed; and relay contact **216** closes to energize solenoid **217**.

Actuation of solenoid **217** causes valve **176** to send an impulse of air through line **175** (FIG. **18**) into four-way valve **171**. Air is then conducted from valve **171** through line **173** to actuate the piston assembly **110** to move the slide **109** (FIG. **1**) to the severing position (FIG. **5**) so that the nest end block **117** abuts the protuberance **41** of the slide block **39** of the feed assembly **23** and pushes the slide block **39** against the end plate **45**. At the same time, the shoulder **49** of the stop screw **48** moves out of the guide block **36** and urges the roller **150** and microswitch arm **149** away from the feed assembly **23**. The microswitch **148** is thus actuated and the pneumatic system of the machine takes over the following sequence of operations. As the slide block **39** moves toward the end plate **45** (FIG. **3**), the spring finger **52** carried thereon moves across the saddle **34'** of the next rearmost terminal in the strip **29** while the strip is maintained in position by the other spring finger **51** to abut the rearmost flange of the terminal. This movement is facilitated by the inclination of the spring finger **52**. At the same time the clamp **120** which is in an upright position and the next end block **117** are moved into the severing station with the clearance slot **118** in vertical alignment with the cutter blade **66**.

Next, referring to FIGS. **4, 8** and **18**, the air microswitch **148** transmits a pulse of air through line **157** to relay valve **156** to actuate four-way valve **152** to direct a pulse of air through line **154** into air cylinder **79** to move the piston **80** and, consequently, the plunger **69** downwardly (FIG. **8**). As the plunger **69** begins to move downwardly, the lower sidewall **74** in the notch **72** of the plunger **69** moves away from the cutter arm **62** and the chamfered surface **75** engages the sloped surface **105** of the blade holder **96** to force the blade holder **96**

and die blades 99 towards the terminal strip 29 against the force of the spring assembly 107 on the return rod 106. Since the foremost terminal 28 in the strip 29 is positioned at the severing station, as the die blades 99 moves into the strip 29, the recesses 103 of the die blades 99 segregate the terminal 28 from the remainder of the strip (FIG. 4) with the noses 104 of the die blades passing immediately under the tabs 35 connected to either side of the terminal 28 to support the terminal 28. At the same time that the die blades 99 segregate the terminal 28, the die blades also pass around the lower portion of the cutter blade 66 to subsequently act as a guide.

Referring to FIG. 8, as the plunger 69 continues to move downwardly under the force of the piston 80, the upper sidewall 73 of the notch 72 of the plunger 69 abuts the cutter arm 62 and starts to pivot the cutter arm 62 about the pivot pin 63 in the frame 56 against the force of the spring 91 in the direction indicated by the arrow. As the cutter arm 62 is pivoted, the plunger 69 moves the blade holder 96 to the severing position and ceases further movement of the blade holder 96.

Referring to FIGS. 6 and 9, as the plunger 69 is moved into a lowermost position (FIG. 9), the severing end of the cutter blade 66 on the cutter arm 62 abuts the surface of the terminal 28 between the flanges 33 and forces the terminal 28 against the edges of the recesses 103 of the die blades 99 to sever the terminal 28 from the tabs 35 on either side. The severed tabs 35 are subsequently removed in the following operation cycles of the machine 20. The cutter blade 66 also pushes the severed terminal 28 from between the noses 104 of the die blades downwardly into the clearance slot 118 of the nest end block 117. Since the clamp 120 is in an upright position at this time, the severed terminal 28 is clamped in place in an upright position (FIG. 6).

Upon reaching the lowermost position, cam lever 165 actuates lever 161 of the pilot valve 158 to cause a pulse of air to travel through line 168 (FIG. 18) into valve 152 for directing a pulse of air through line 155 into air cylinder 79 to move the piston 80 and plunger 69 upwardly. The severed terminal is then in clamped engagement in the nest end block 117. As the plunger 69 moves upwardly, the cutter arm 62 is pivoted under the force of the spring 91 about the pivot pin 63 in a clockwise manner as viewed in FIG. 8. Upon reaching the uppermost position, cam lever 165 actuates lever 161 of the pilot valve 159 to cause a pulse of air to travel through line 169 to actuate relay valve 170 (FIG. 18). Relay valve 170 in turn activates valve 171 to direct air through line 174 into piston assembly 110 to return slide 109 to the soldering station (FIG. 11) under the electrode 142. As the slide 109 moves away from the soldering station (FIG. 11), the slide block 39 of the feed assembly 23 also moves in the same direction under the force of the spring 47. At the same time, the shoulder 49 of the stop screw 48 moves away from the roller 145 of the microswitch arm 144 with the inertia of the arm 144 allowing a gap to exist momentarily under the roller 145 springs against the shoulder 49. Since the slide block 39 moves toward the soldering station and likewise the severing station, the spring finger 52 pushes the terminal strip 29 past the other spring finger 51 to bring the foremost terminal of the spring into substantially accurate alignment over the severing station.

Referring to FIGS. 11, 12 and 13, as the severed and clamped terminal 28 approaches the soldering position, the clamp 120 abuts the sloped face 129 of the plate 127 and pivots the plate about the screw 128 against the force of the spring finger 131. As the clamp 120 passes by the end of the sloped face 129, the plate 127 is pivoted in the opposite direction so that the clamp 120 becomes positioned in the notch 130. At the same time, the sloped face 124 of the nest end block 117 abuts the sloped face 129 of the plate (FIG. 13). The slide 109 also ceases further movement as the terminal is then at the soldering position. The operation cycle of the machine 20 is thus completed. As the slide 109 returns to the soldering position, it causes switch 213 (FIG. 19) to close in order to set up the electrical system for the start of another cycle.

When the operation cycle is repeated, the terminal in the soldering position is soldered to a conductor wire and removed before the slide 109 is moved to the severing station. For example, referring to FIGS. 14 and 15, with the terminal 28 of a prior operation between the soldering electrodes 142, 154 the exposed end 222 of an insulated conductor wire 223 is positioned in the saddle 34 between the flanges 33 (FIG. 14) and a suitable strand of solder material 224 is placed over the wire end 222. Thereafter, when a cycle is started to move the electrode 142 downwardly over the solder material, conductor wire and terminal (FIG. 15), the heat generated between the electrodes by the heating means melts and solders the solder material to the terminal 28 to bond the conductor wire 223 to the terminal 28 to form a mechanical and electrical connection (FIG. 17). The remainder of the operation cycle is then repeated as above described.

Referring finally to FIGS. 12, 14 and 16, after a connection is formed between the conductor wire and terminal and the slide 109 begins to move toward the severing station, the clamp 120 is forced against the wall of the notch 130 in the plate 127 with a force less than the force of the spring finger 132 so that the plate 127 is not pivoted about the screw 128. As the slide 109 continues to move the clamp 120 is pivoted about the pin 121 (FIG. 16) against the force of spring 122 into the cutout 118 to release the clamping force on the terminal 28. The terminal and conductor connection is then removed by the operator. Thereafter, as the slide 109 moves still further and the clamp 120 passes under the plate 127, the clamp 120 is returned to an upright position against the nest end block 117 under the force of the spring 122. The remainder of the cycle continues as above until another severed terminal is brought into the soldering station.

It is noted that the operation of the soldering machine is such that the various steps performed by the machine are sequentially carried out automatically in a timed manner once the operation cycle is initiated by an operator. It is also noted that the operation cycle starts with a soldering step.

The invention provides a soldering machine which operates at a high rate of output of connections between terminals and conductor wires for example, at a rate of 5,000 connection per 8 hour working day. In addition, the invention allows the terminal strips and terminals to be conveyed through the various operations of the soldering machine in an accurate simple manner. Further, because the various operations of the machine on the terminals are exposed to view, the soldering machine can be readily inspected and repair should the occasion arise.

Since the operation cycle of the soldering machine starts with the soldering of a terminal to a conductor while the terminal is in a fixed position, the alignment of a conductor on the terminal can be easily and quickly performed. Also, since the operation cycle ends with the positioning of a subsequent terminal at the soldering station, there is no loss in time in forming a subsequent connection which would otherwise occur if the terminals had to be brought into the soldering position.

It is finally noted that once a cycle of the soldering machine is started, the remainder of the cycle is completely automatic.

Having thus described the invention, it is not intended that it be so limited as changes may be readily made therein without departing from the scope of the invention. Accordingly, it is intended that the foregoing Abstract of the Disclosure, and the subject matter described above and shown in the drawings be interpreted as illustrative and not in a limiting sense.

What I claim is:

1. A soldering machine comprising:

means for receiving an interconnected series of electrical terminals at one end of the machine, said means including means for advancing the series in increments equal to the spacing between adjacent terminals;

means for segregating the foremost terminals of the series from the remainder of the series, said segregating means including means for severing the foremost terminal;

means for positioning the severed terminal at another end of the machine, said positioning means including a carriage means to carry the severed terminal to said other end; and

soldering means at said other end for forming an electrical and mechanical connection between the positioned terminal thereat and a conductor wire;

wherein said means for advancing the series of interconnected terminals includes a slide block for abutting said carriage means slidably mounted in said means for receiving the series of interconnected terminals, a first spring finger secured to said slide block projecting into the path of the interconnected terminals, a second spring finger secured to said means for receiving the interconnected terminals projecting into said path, said first and second spring fingers being spaced apart a distance at least equal to the spacing between the terminals in the interconnected series, and spring means urging said slide block toward said carriage means whereby said carriage means moves said slide block against said spring means to move said spring finger apart upon movement toward said spring means and said spring means moves said slide block toward said carriage means to move said spring fingers toward each other upon movement of said carriage means away from said spring means.

2. A soldering machine as set forth in claim 1 wherein said carriage means includes a nest end block on one end thereof having a clearance slot for receiving a terminal in an upright position from said segregating means, a pivotally mounted clamp facing said slot in said nest end block, and a spring biasing said clamp against said nest end block.

3. A soldering machine as set forth in claim 2 further comprising a slideway guiding said carriage therein and means on said slideway for pivoting said clamp away from said nest end block upon movement of said carriage to said segregating means.

4. A soldering machine as set forth in claim 2 further comprising a slideway guiding said carriage between said segregating means and said soldering means, a plate pivotally secured to said slideway projecting into the path of said clamp, said plate having a sloped forward face for slidably abutting said clamp and a notch to the rear of said face for receiving said clamp therein, and resilient means secured to said slideway biasing said plate against rotation away from said path of said clamp.

5. A soldering machine as set forth in claim 1 wherein said means for severing the foremost terminal includes a cutter arm pivotally mounted over a severing station, a cutter blade on one end of said arm for movement into the path of the foremost terminal to sever the foremost terminal from the series of interconnected terminals and means for pivoting said arm.

6. A soldering machine as set forth in claim 5 wherein said means for pivoting said arm includes a spring assembly at the other end of said arm urging said one end of said arm away from the path of the foremost terminal and a plunger for abutting said arm between said ends to direct said one end of said arm downwardly into the path of the foremost terminal.

7. A soldering machine as set forth in claim 5 wherein said means for pivoting said arm is operatively connected to said means for advancing the series of interconnected terminals for actuation in response thereto.

8. A soldering machine as set forth in claim 1 wherein said means for segregating the foremost terminal includes a pair of die blades, each of said die blades having a nose spaced from the nose of said other die blade to form a passage substantially equal to the thickness of the foremost terminal, and means for reciprocally moving said noses into the path of the series of interconnected terminals to segregate the foremost terminal therefrom.

9. A soldering machine as set forth in claim 8 wherein said means for reciprocally moving said noses is responsive to said means for severing the foremost terminal.

10. A soldering machine as set forth in claim 8 wherein said means for reciprocally moving said noses includes a blade holder mounting said die blades thereon, a plunger for abutting an end of said blade holder opposite said noses to force said blade holder towards the path of the foremost terminal, a first spring assembly urging said blade holder away from the path of the foremost terminal and means for reciprocally moving said plunger relative to said blade holder end.

11. A soldering machine as set forth in claim 10 wherein said means for severing the foremost terminal includes a cutter arm pivotally mounted over said blade holder, a cutter blade on one end of said arm for movement into the passage between said noses, and a second spring assembly at the other end of said arm urging said arm away from said blade holder; said cutter blade abutting said plunger intermediately of said ends for direction downwardly towards said blade holder whereby said plunger moves said blade holder and cutter arm simultaneously.