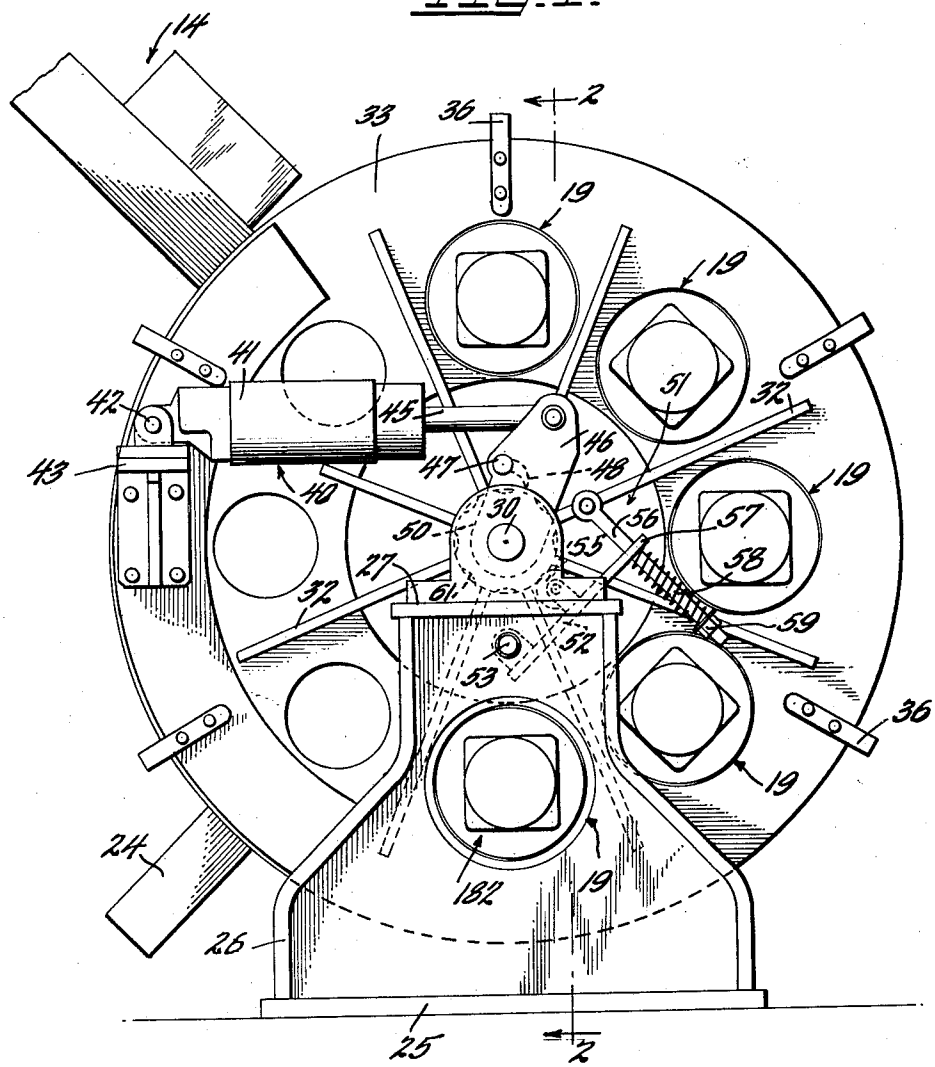
Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 1

FIG. 1.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

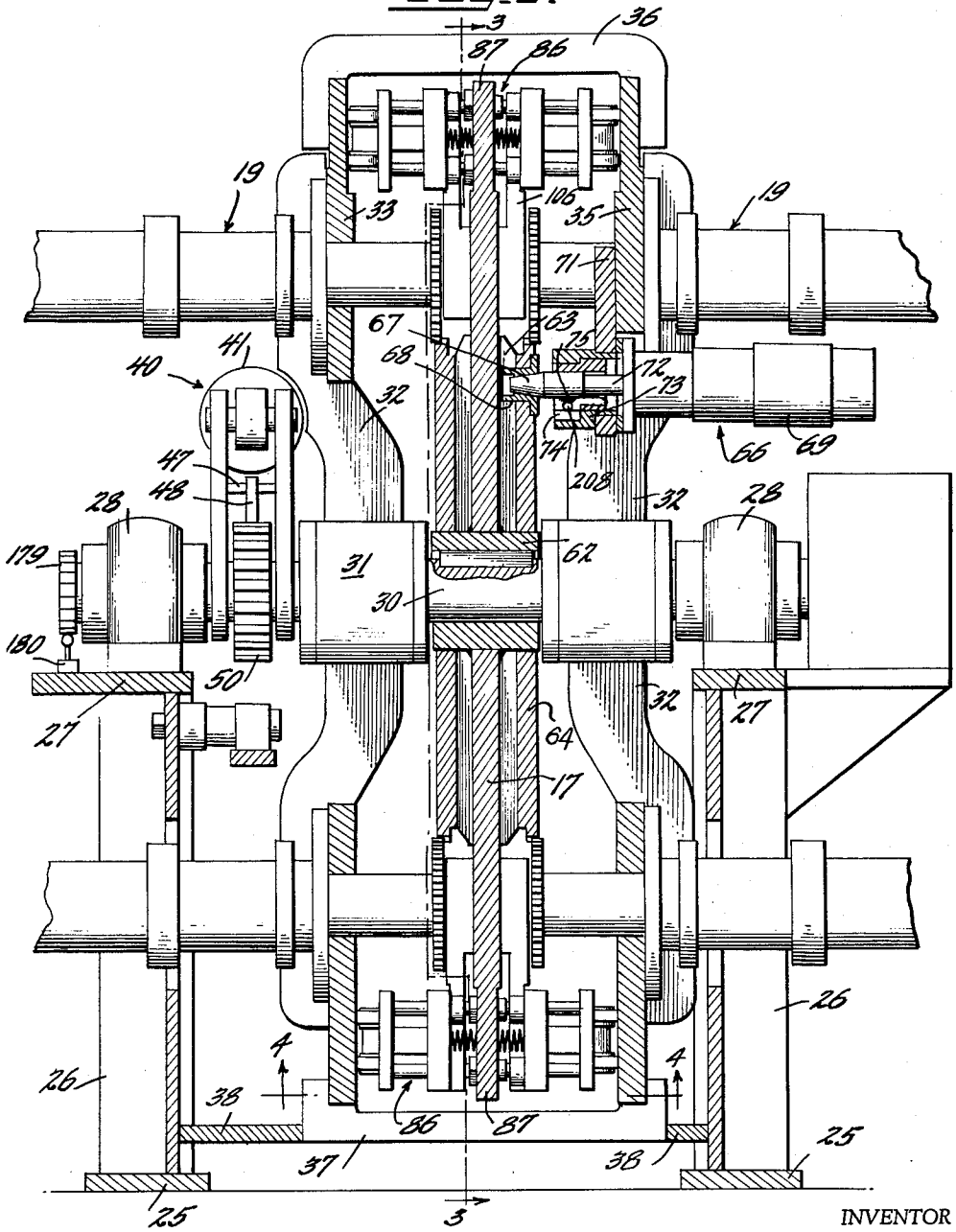
ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 2

Fig. 2.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

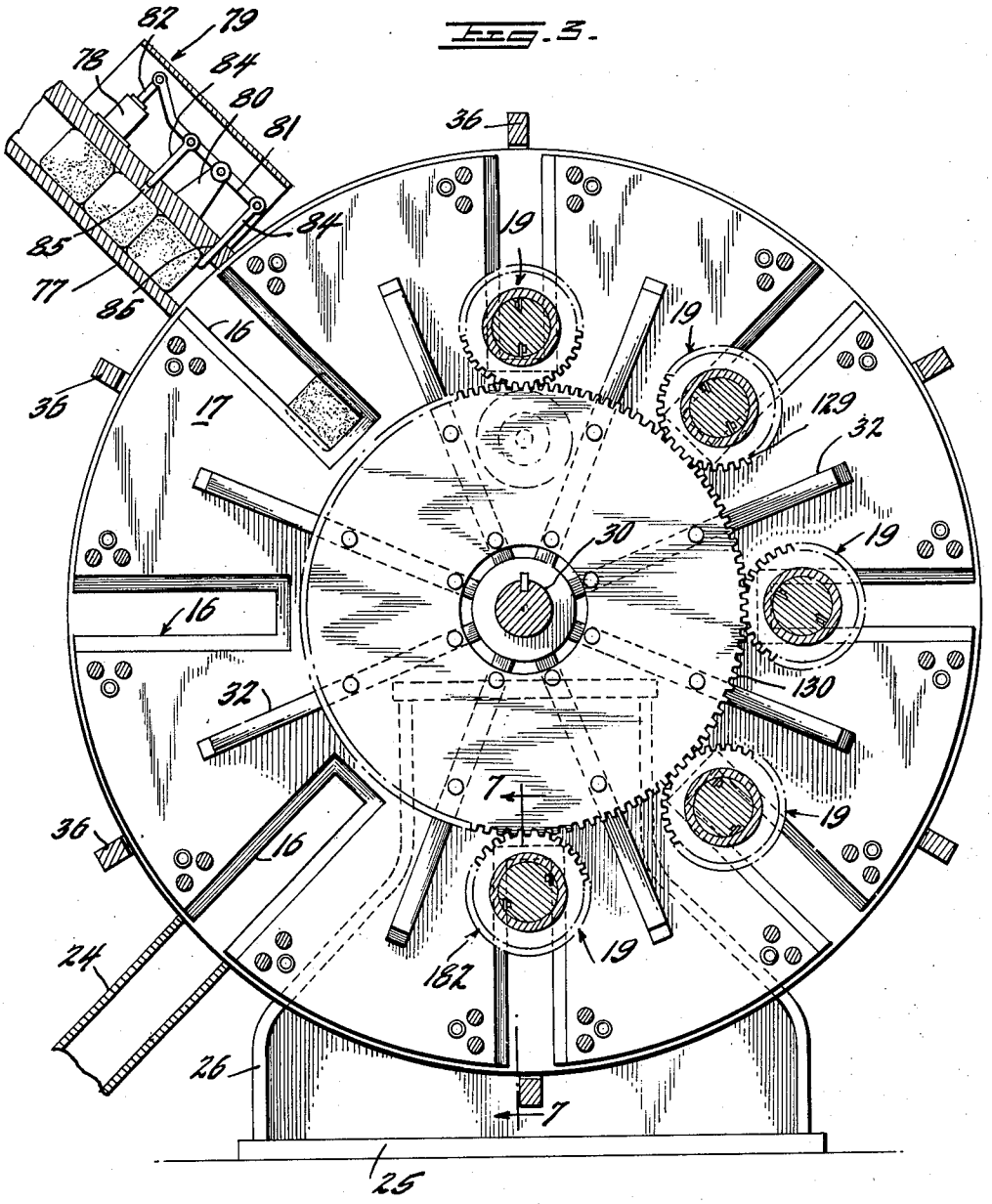
ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 3

Fig. 3.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 4

FIG. 4.

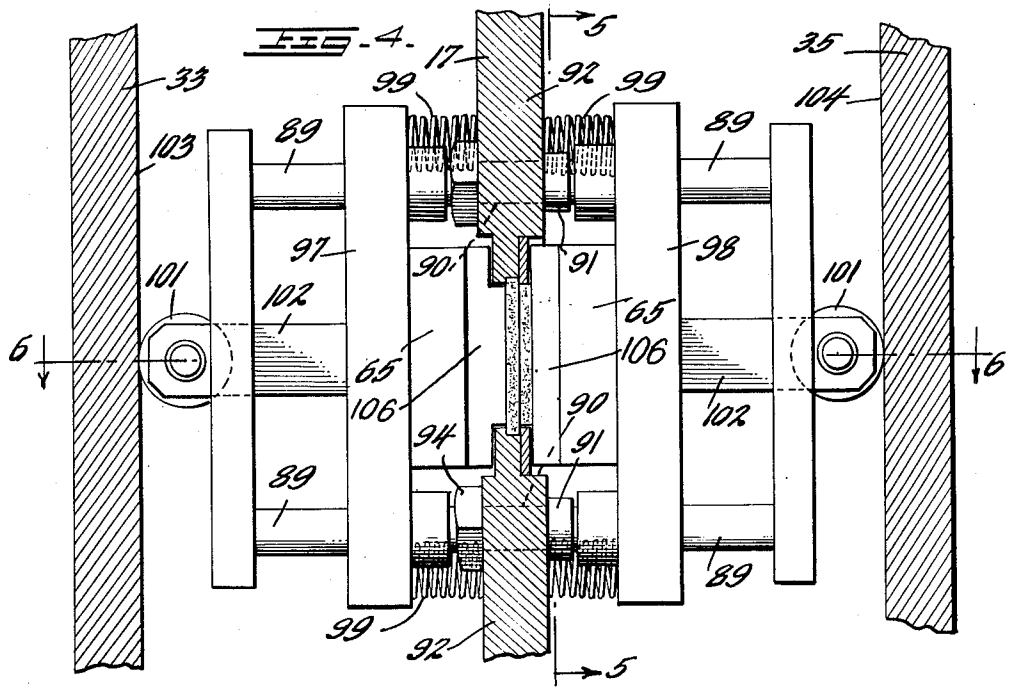
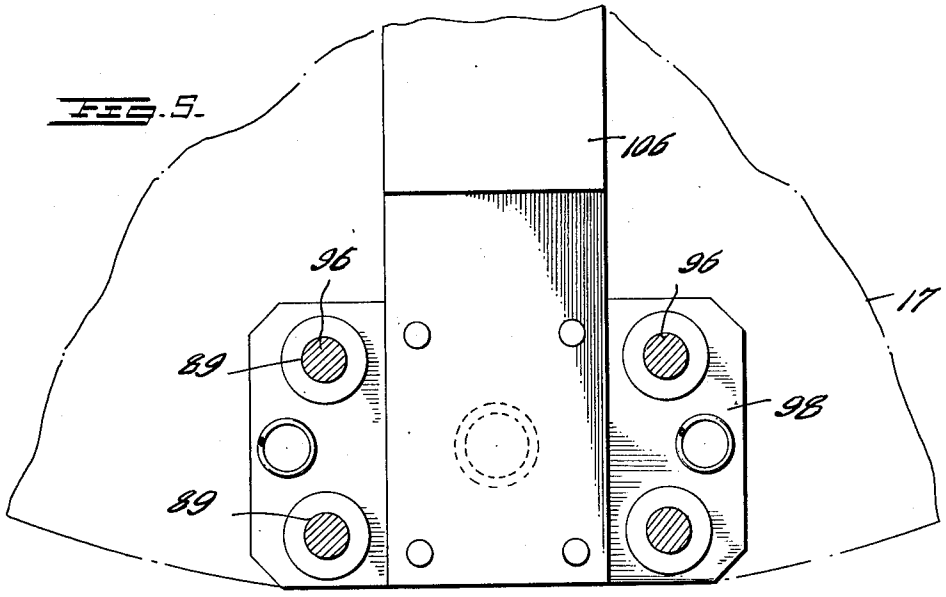


FIG. 5.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

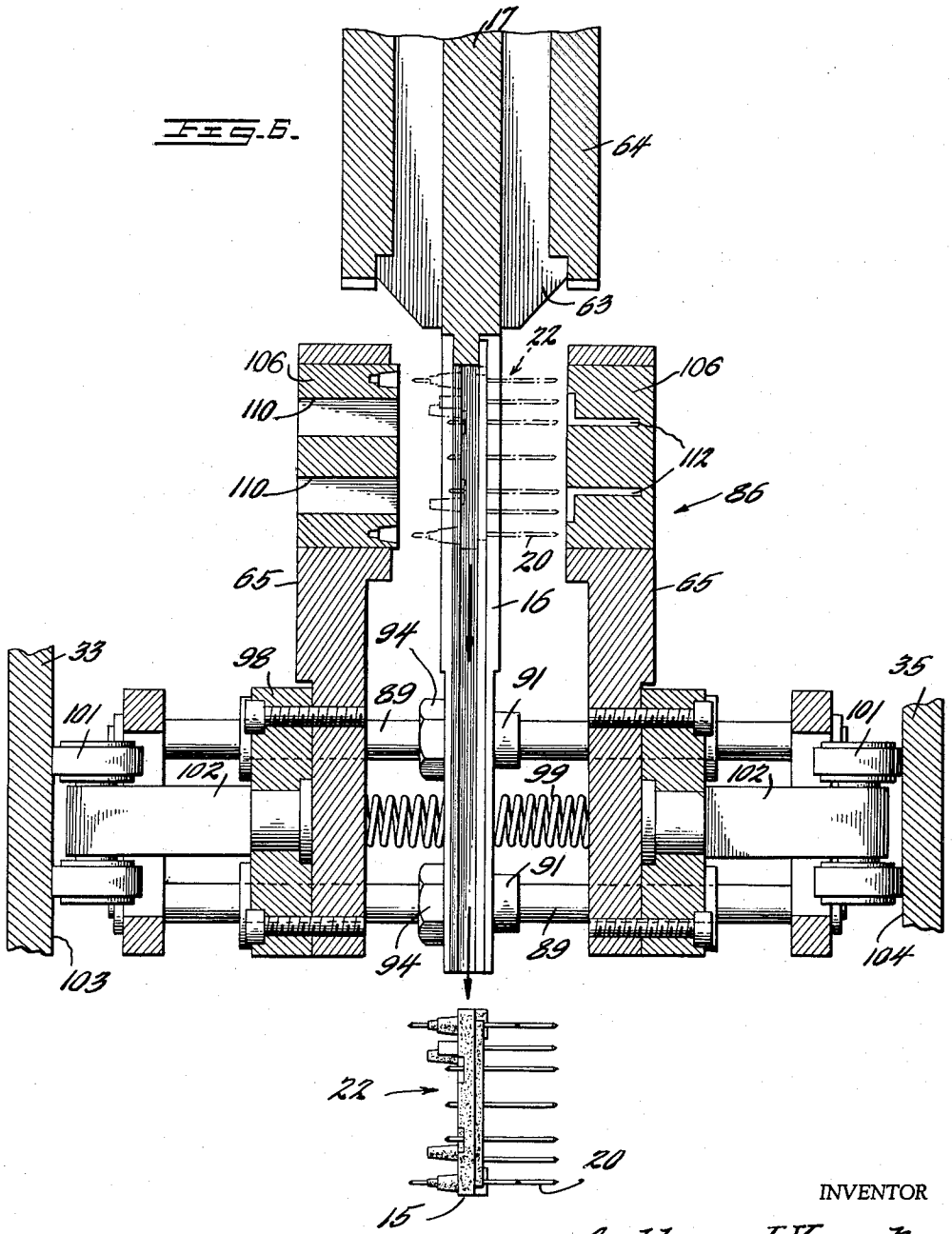
ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 5

FIG. 5.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 6

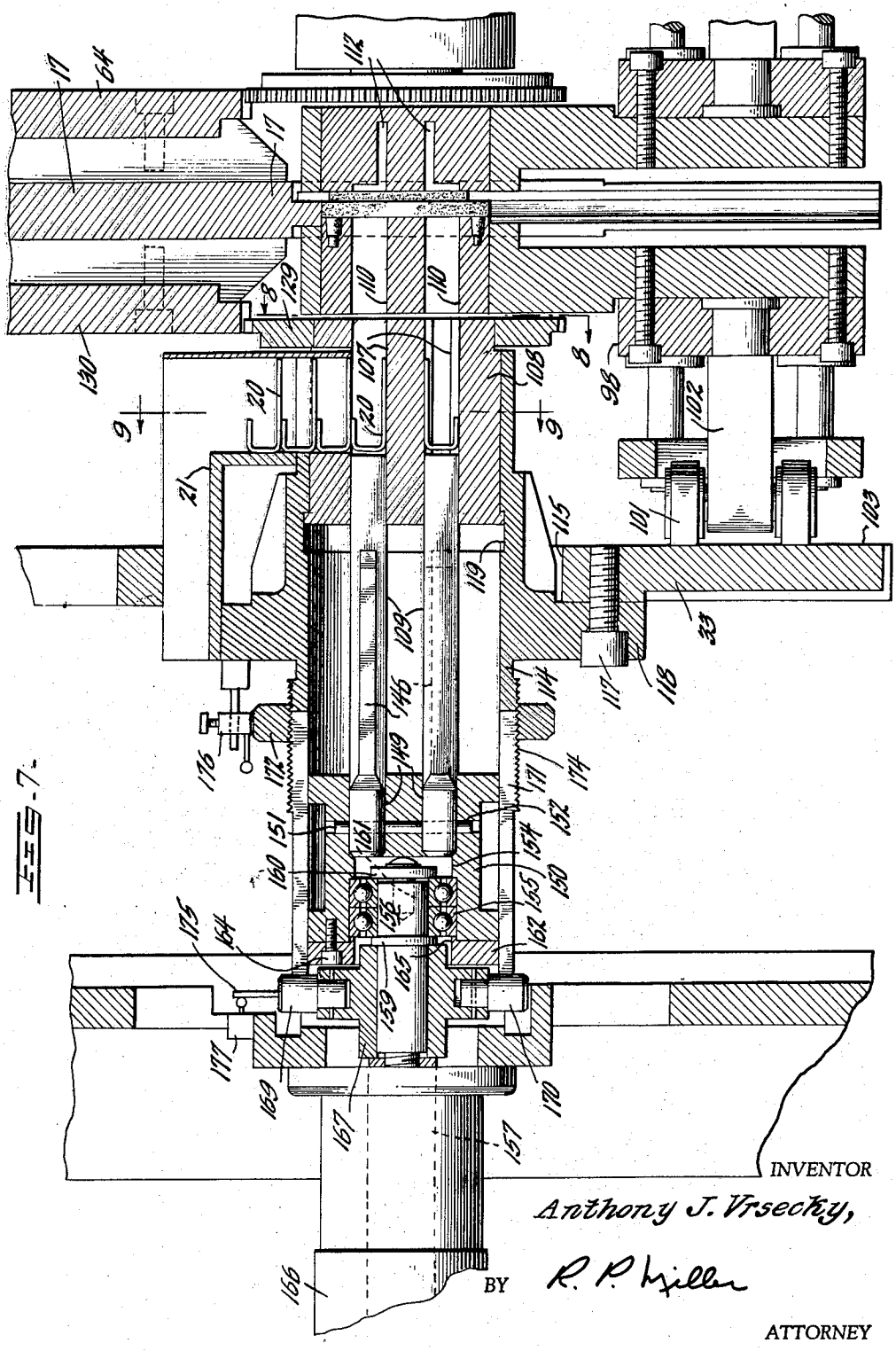


FIG. 7.

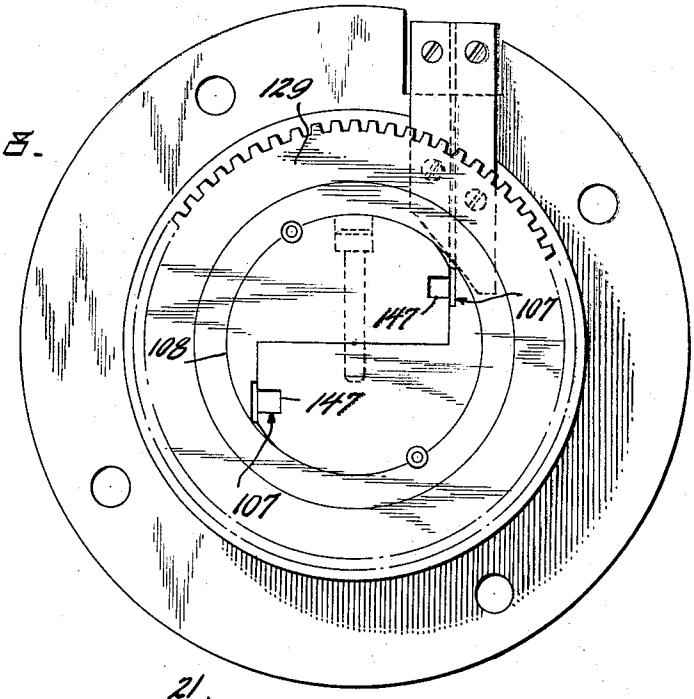
INVENTOR
Anthony J. Vrsecky,
BY R. P. Miller
ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 7

FIG. 8.



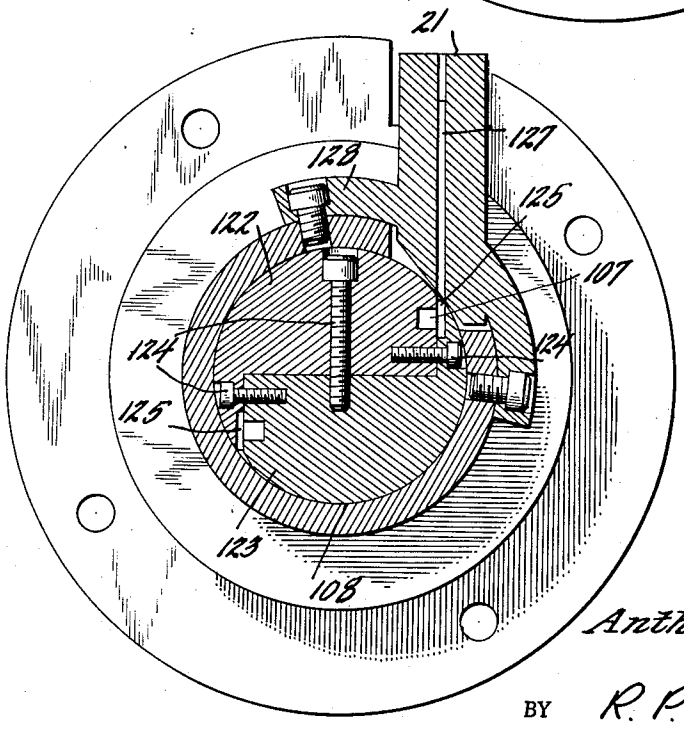


FIG. 9.

INVENTOR
Anthony J. Vrsecky,

BY R. P. Miller

ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 8

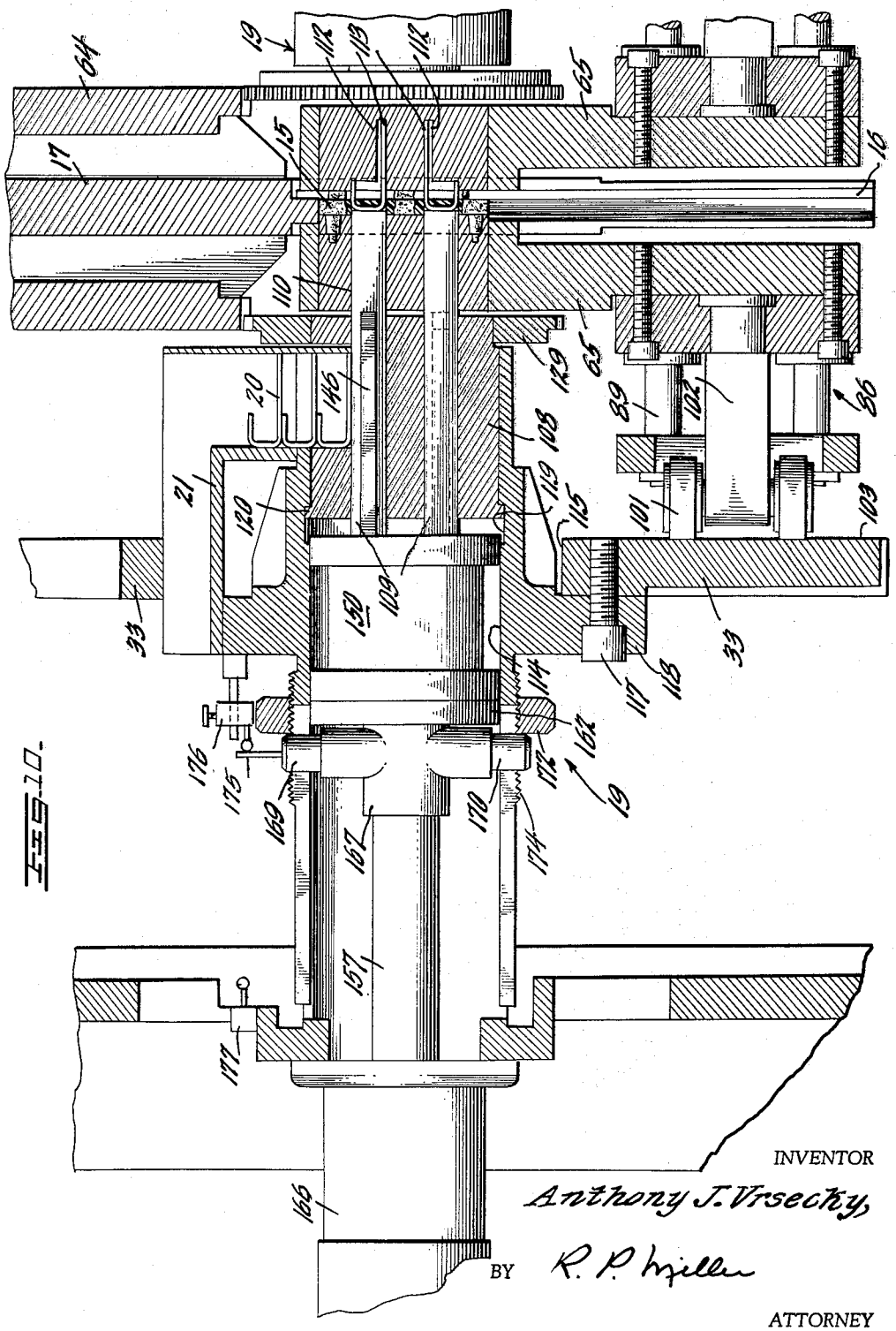


FIG. 10.

INVENTOR
Anthony J. Vrsecky,
BY R. P. Miller
ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 9

FIG. 11.

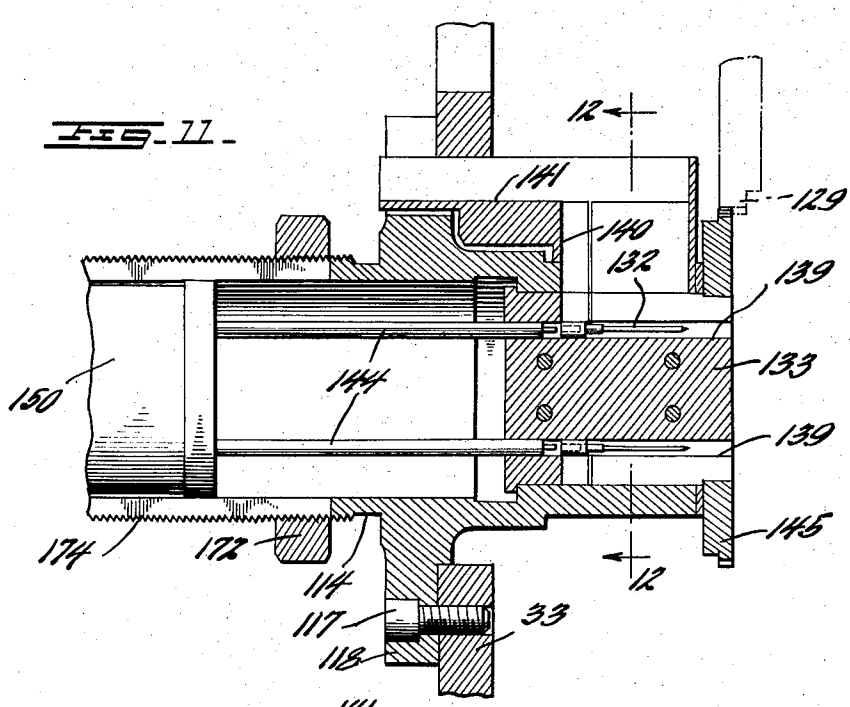
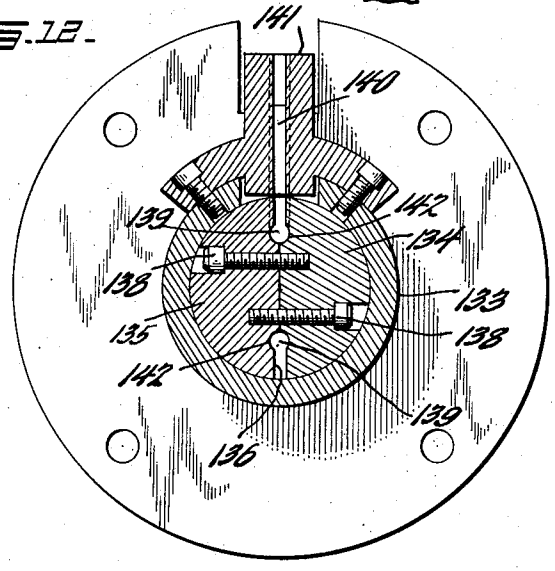


FIG. 12.



INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

ATTORNEY

Aug. 18, 1964 A. J. VRSECKY 3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Filed June 9, 1961 10 Sheets-Sheet 10

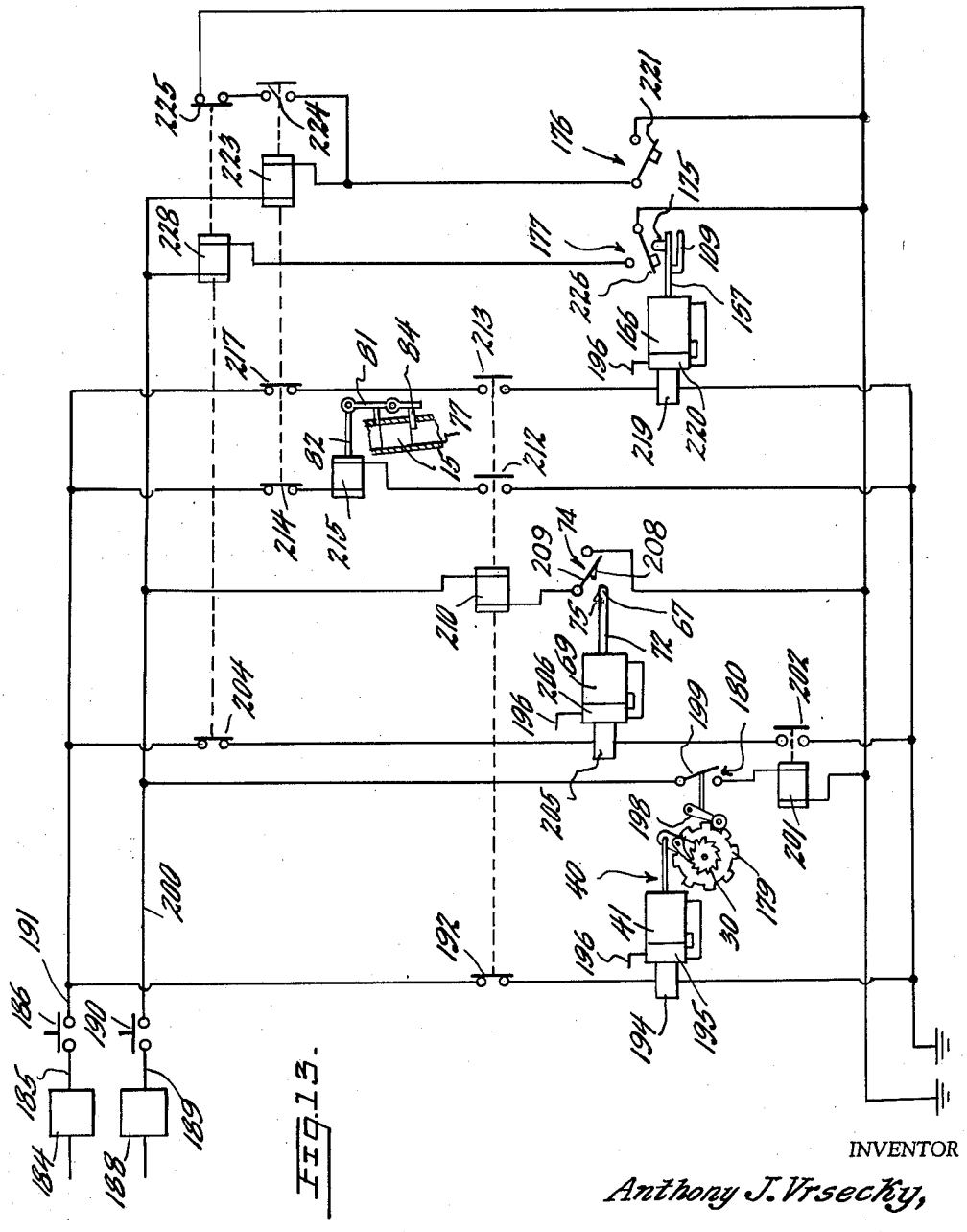


FIG. 13.

INVENTOR

Anthony J. Vrsecky,

BY R. P. Miller

ATTORNEY

United States Patent Office 3,144,706 Patented Aug. 18, 1964

3,144,706

APPARATUS FOR DRIVING COMPONENTS INTO A WORKPIECE

Anthony J. Vrsecky, Winston-Salem, N.C., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed June 9, 1961, Ser. No. 116,203
14 Claims. (Cl. 29—203)

This invention relates to an apparatus for driving components into a workpiece, and more particularly to a mechanism for setting an array of terminals into apertures provided in a terminal board.

In the manufacture of electrical components such as terminal boards, a large number of terminals must be sequentially aligned with and driven into the terminal board. Hand operations wherein pliers and hammers have been employed for holding the terminal blocks and driving the terminals into the blocks have proven grossly incapable of meeting volume production demands.

An object of this invention is to provide a new and improved device for driving components into a workpiece.

Another object of this invention is to provide a terminal setting mechanism for advancing predetermined arrays of terminals into an array of apertures formed in a terminal block.

Still another object of this invention is the provision of an indexing carrier for successively advancing a terminal block into position for receiving a set of terminals from a group of terminal setting mechanisms.

A further object of this invention resides in the provision of a terminal block carrier having facilities for actuating a terminal feed device during advancement of a terminal block into alignment with the terminal feed device.

A still further object of this invention is to provide a plurality of terminal guides, each having a terminal advancing device movable therethrough for driving terminals received in the terminal guides into terminal blocks aligned therewith by an indexing carrier.

An additional object of this invention resides in the provision of a terminal guide cylinder rotated for receiving terminals during advancement of a terminal block into alignment therewith wherein terminal pushers received in the guide cylinder are rendered effective upon alignment of the terminal block with the guide cylinder to advance the terminals into the aligned terminal block.

With these and other objects in view, the present invention contemplates a device for feeding terminal blocks into slots successively advanced thereto by an indexing carrier. Clamps provided on the carrier hold each block in the slots as the carrier advances the blocks into successive alignment with a group of opposed pairs of terminal setting devices. Advancement of the carrier actuates terminal guide devices, provided in each of the terminal setting devices, for receiving terminals whereupon terminal advancing blades received in each guide device are actuated for advancing the terminals through the guide devices and into assembled relationship with the aligned terminal blocks.

A complete understanding of this invention may be had by referring to the following detailed description and the accompanying drawings illustrating a preferred embodiment thereof in which:

FIG. 1 is a side elevational view of a frame for supporting a group of opposed pairs of terminal setting mechanisms and an indexing drive for rotating a carrier relative to the terminal setting mechanisms according to the principles of the invention;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1, showing a device for locking the carrier against rotation wherein a slot provided in the carrier is held in alignment with one of the opposed pairs of terminal setting mechanisms;

FIG. 3 is a partially sectioned elevational view taken on line 3—3 of FIG. 2 showing a terminal block feeding mechanism for serially feeding terminal blocks into the slots provided in the carrier;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 2 showing a clamping device rendered effective by cam surfaces attached to the frame for clamping a terminal block in one of the slots provided in the carrier;

FIG. 5 is a partially sectioned side view taken on line 5—5 of FIG. 3 showing spaced guide members slidably supporting one of a pair of opposed clamping members of the clamping device;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 4 showing a completely assembled terminal block that has been released by retraction of the pair of opposed clamping members into a non-clamping position;

FIG. 7 is a sectional view taken on line 7—7 of FIG. 1 showing a terminal guide cylinder having terminals received therein for advancement by a pair of pusher blades through chambers provided in the guide cylinder into a terminal block held in alignment with the chambers by the clamping members;

FIG. 8 is a front elevational view of the guide cylinder showing a chute for feeding terminals from a terminal supply to the chambers provided in the guide cylinder;

FIG. 9 is a sectional view taken along lines 9—9 of FIG. 7 showing a pair of semicylindrical members held together by fasteners for forming the guide cylinder wherein recesses machined in each of the semicylindrical members form the terminal receiving guide chambers;

FIG. 10 is a view of the same apparatus disclosed in FIG. 7 wherein the pusher blades have been actuated to advance the terminals through the guide cylinder and into the terminal block;

FIG. 11 is a view of an alternate embodiment of the guide cylinder disclosed in FIGS. 7 and 9, showing cylindrical pushrods received in cylindrical guide chambers formed in a guide cylinder for advancing pin-like terminals through the guide chambers;

FIG. 12 is a sectional view taken along lines 12—12 of FIG. 11 showing a pair of opposed semicylindrical members held together by fasteners for forming the alternate embodiment of the guide cylinder shown in FIG. 11; and

FIG. 13 is a schematic diagram of an electropneumatic control circuit showing switches actuated by various mechanisms of the terminal setting apparatus for controlling the operation of the terminal setting mechanisms and the indexing carrier.

Referring to the drawings, there is shown in FIGS. 1 and 3 a device **14** for feeding workpieces, which may, for the purposes of description, be electrical terminal blocks **15**. The device **14** feeds the terminal blocks **15** into receiving slots **16** provided in an indexing disk or carrier plate **17**. The indexing plate **17** advances the terminal blocks **15** received in the slots **16** into successive alignment with five opposed pairs of terminal setting mechanisms **19** (FIGS. 2, 3, and 10) which are actuated to advance a set of elongated components or terminals **20** (FIG. 10) from a terminal supply source **21** into the terminal blocks **15**. When the last terminal **20** of each set of terminals has been advanced into a terminal block **15**, the completed assembly **22** (FIG. 6) is discharged from the terminal setting apparatus through an unloading chute **24** (FIGS. 1 and 3).

Referring to FIGS. 1 and 2, there is shown a base **25** supporting opposed upright frame members **26**, each of which support on an upper horizontal surface **27** thereof a journal **28**. A main drive shaft **30** is mounted between the members **26** for rotation in the journals **28**. Bearings **31**, mounted on the shaft **30**, each support eight ribs **32** which extend radially outward therefrom. The ribs **32** that are mounted on the left-hand bearing **31** (as viewed in FIG. 2), support a cam plate **33**. In a similar manner, the ribs **32** that are mounted to the right-hand bearing **31** (as viewed in FIG. 2), support a second cam plate **35** mounted opposite to the first cam plate **33**. Bridge members **36** are fixed to and maintain the cam plates **33** and **35** in parallel relationship. The lowermost bridge member **37** (as viewed in FIG. 2) is connected to brackets **38** that are mounted to the upright frame members **26** for maintaining the bridge members **36**, and therefore the cam plates **33** and **35**, locked against rotation with the shaft **30**.

Drive Mechanism

The shaft **30** is indexed by a ratchet and pawl drive mechanism, generally referred to by the reference numeral **40**. The drive mechanism **40** includes an air cylinder **41** that is pivotally mounted on a pin **42** that depends from a bracket **43** fixed to the cam plate **33**. A piston rod **45** is reciprocated by actuation of the air cylinder **41** for oscillating levers **46** which are mounted for rotation on the shaft **30**. A pawl pin **47**, mounted between the levers **46**, supports a pawl **48** for cooperation with a ratchet gear **50** that is keyed to the shaft **30**. It may be appreciated that reciprocation of the piston rod **45** and consequent oscillation of the levers **46** on the shaft **30**, causes the pawl **48** to intermittently engage the teeth of the ratchet gear **50** for indexing the shaft **30** clockwise.

A mechanism **51** is provided for preventing retrograde movement of the shaft **30**. The locking mechanism **51** includes a lever **52** pivotally mounted on a stub shaft **53** that is fixed to the upright frame members **26**. A cam follower roller **55**, mounted on the lever **52**, is adapted to ride on the gear teeth of the ratchet gear **50** for rotating the lever **52** clockwise on the stub shaft **53**. A rod **56**, pivotally mounted to one of the ribs **32**, is received in an aperture **57** provided in one end of the lever **52**. A helical compression spring **58** is mounted on the rod **56** between the lever **52** and a nut **59** threaded onto the rod. The spring **58** is effective to urge the lever **52** counterclockwise for maintaining the roller **55** in engagement with recesses **61** provided between the teeth of the gear **50**. The roller **55** thus acts as a releasable locking member for holding the indexing disk **17** stationary under the action of the spring **58**. When the ratchet and pawl mechanism **40** is actuated, the locking force of the spring **58** is overcome and releases the disk **17** to permit indexing thereof. At the end of the stroke of the levers **46**, the roller **55** is received in one of the recesses **61** to once again releasably lock the disk **17** against rotation.

The indexing plate **17** is fixed to a hub **62** that is keyed to and is indexed by the shaft **30**. Spacers **63** project from the right face of the indexing plate **17** (as viewed in FIG. 2) for supporting a lock plate **64**. After the ratchet and pawl mechanism **40** has indexed the shaft **30** to advance the indexing plate **17** and the lock plate **64**, a locking mechanism, generally indicated by the reference numeral **66**, is actuated to advance a tapered shot pin **67** into a hollow bushing **68** mounted in the lock plate **64**. The locking mechanism **66** includes a pneumatic cylinder **69** supported on a bracket **71** that depends from the right cam plate **35**. Actuation of the pneumatic cylinder **69** advances a piston rod **72** to the left through a guide sleeve **73** that extends from the bracket **71**. As the tapered shot pin **67** is advanced by the piston rod **72** into the hollow bushing **68**, the tapered portion of the shot pin **67** cooperates with the bushing **68** to rotate the plate **64** slightly if the pin is not in exact alignment with the bushing.

Thus, the shot pin **67** is adapted to accurately locate and lock the plates **17** and **64** in position.

During a cycle of operation, the ratchet and pawl mechanism **40** and the locking mechanism **66** are alternately actuated for respectively advancing to and locking in alignment with the terminal setting mechanism **19** terminal blocks **15** received in the slots **16** of the indexing plate **17**. A switch **74** (FIG. 2), mounted in a slot formed in the guide sleeve **73**, is actuated by a cam **75** fixed to the shot pin **67**. Actuation of the switch **74** is effective to energize the control circuits shown in FIG. 13 for precluding operation of the indexing mechanism **40** when the shot pin **67** is received in the bushing **68**.

Terminal Block Feed Mechanism

At the completion of each indexing movement of the disk **17**, an empty slot **16** is positioned in alignment with a chute **77** of the terminal block feed mechanism **14**. The control circuit is further effective at this time to energize a solenoid **78** of an escapement device **79** that is provided in the chute **77**. The escapement **79** may be of the conventional type wherein a fulcrum support **80** pivotally supports a lever **81**. Energization of the solenoid **78** advances an armature **82** to rotate the lever **81** on the support **80**. Escapement bars **84**, mounted on the lever **81** on opposite sides of the fulcrum support **80**, are moved through apertures **85** provided in the chute **77** for feeding in seriatim terminal blocks **15** from the feed chute.

The solenoid **78** is energized each time a slot **16** is presented to the chute **77** so that the lowermost terminal block advances downwardly into an aligned slot **16**. The ratchet and pawl mechanism **40** is then actuated for indexing the disk **17** whereupon the next successive slot **16** is aligned with the chute **77** and the previously fed terminal block **15** is indexed into alignment with the first pair of terminal setting mechanisms **19**. At this time the terminal block **15** is held in a fixed position in the slot **16** by a clamping device **86** that is provided on the disk **17** in alignment with each of the slots **16**.

Clamping Device

The clamping device **86** is shown in detail in FIGS. 4, 5, and 6, wherein the outermost radial portion **87** of the disk **17** is shown supporting four guide rods **89**. Each guide rod **89** is received in an aperture **90** formed through the disk **17**. A shoulder **91** provided on each guide rod **89** is held against the right face **92** of the disk **17** by a nut **94** that is threaded onto the opposite end of the rod whereby the guide rod **89** is rigidly held to the disk **17** and projects perpendicularly outward from both sides of the disk. The guide rods **89** that project from the left side of the disk are received in apertures **96** formed through a support plate **97** which is adapted to slide on the pins. In a similar manner, a support plate **98** is adapted to slide on the guide rods **89** that extend from the right side of the disk **17**. Springs **99**, mounted on the guide rods **89** and interposed between the disk **17** and each of the support plates **97** and **98**, urge the latter outwardly from the disk. Cam followers **101** mounted for rotation on posts **102** that are fixed to each of the support plates **97** and **98** are urged outwardly by the action of the springs **99** into engagement with cam surfaces **103** and **104** of the cam plates **33** and **35**.

It may be appreciated that as the disk **17** is indexed, the cam follower rollers **101**, which are adapted to ride on the respective cam surfaces **103** and **104**, are effective to advance the support plates **97** and **98** toward or away from each other according to the configuration of the cam surfaces. In this manner, clamp blocks **106** mounted to each of the support plates **97** and **98** may be advanced, from the retracted position shown in FIG. 6, toward each other into a position for clamping a terminal block **15** therebetween as shown in FIG. 4.

The cam surfaces 103 and 104 are so designed as to maintain the clamping blocks 106 of each clamping device 86 in the clamping position during the five successive indexing movements of each slot 16 from the chute 77 whereby a terminal block 15 is rigidly and accurately clamped in each slot 16 for receiving terminal pins 20 from each of the five pairs of terminal setting devices 19.

Terminal Setting Mechanism

Referring to FIG. 7, one of the terminal setting mechanisms 19 is shown provided with the terminal supply receptacle 21 for feeding terminals 20 into chambers 107 of a magazine or guide cylinder 108 wherein pushrods or blades 109 are received. The pushrods 109 advance the terminals through the chambers 107, through apertures 110 provided in the clamp blocks 106, and into the apertures provided in the terminal block 15. As shown in FIG. 10, recesses 112 provided in the clamp blocks 106 receive the depending portions 113 of the terminals 20 that have been fully advanced into the terminal block 15. Subsequently the pushrods 109 are retracted and the disk 17 is indexed to successively align the partially assembled terminal block 15 with the next pair of terminal setting mechanisms 19. When a complete set of terminals 20 has been inserted into the terminal block 15, the disk 17 is indexed to align the fully assembled terminal block or assembly 22 with the discharge chute 24 whereupon the clamp blocks 106 are retracted and the completed terminal block assembly 22 drops through the slot 16 into the chute 24.

More specifically, referring again to FIG. 7, each of the terminal setting mechanisms 19 includes a hollow support cylinder 114 that is received in an aperture 115 formed through the cam plates 33 and 35. The support cylinder 114 is fixed to the cam plates by fasteners 117 that extend through a circumferential flange 118 formed integrally with the support cylinder. Toward the right extremity of the support cylinder 114 (as viewed in FIG. 7), an annular recess 119 is machined in the wall thereof for receiving a shoulder 120 that is formed integrally with the solid guide cylinder 108. The solid guide cylinder 108 is mounted for rotation within the rightward non-recessed diameter section of the support cylinder 114. The walls of the recess 119 and the shoulder 120 are designed to permit relative rotation between the guide cylinder 108 and the support cylinder 114, while limiting relative axial movement therebetween.

Referring to FIG. 9, the detailed structure of the guide cylinder 108 is shown including a pair of generally semi-cylindrical members 122 and 123 which define a solid cylinder when held together by fasteners 124. Generally T-shaped chambers 107 are machined in diametrically opposed portions of the guide cylinder 108 such that one edge of the cross-piece 125 of the T-shaped chamber 107 communicates with the periphery of the guide cylinder 108. When the guide cylinder 108 is in the position shown in FIG. 9, the cross-piece 125 is in alignment with a terminal feed slot or chute 127 that is formed in the terminal supply receptacle 21. The supply receptacle 21 is provided with flanges 128 that partially surround and are fixed to the outer periphery of the hollow cylinder 114 so that the feed slot 127 is maintained in a vertical position.

When the guide cylinder 108 is rotated within the support cylinder 114, the cross-pieces 125 of the chambers 107 are successively advanced into alignment with the feed slot 127 and receive a terminal therefrom. A gear 129 (FIGS. 7 and 8), welded or otherwise fixed to the outer periphery of the solid cylinder 108, is adapted to mesh with a sun gear 130 that is fixed to the disk 17 for rotation therewith. It may be appreciated that during indexing movement of the disk 17 and the consequent rotation of the sun gear 130, the sun gear is effective to rotate the gear 129. The gear 129 rotates the guide cylinder 108 within the support cylinder 114 whereby the cross-pieces 125 of the terminal receiving chambers 107 are successively aligned with and receive a terminal from the terminal feed chute 127.

An alternate embodiment of the terminal setting mechanism 19, which may be located at another of the terminal setting stations, is shown in FIGS. 11 and 12 for advancing nail-like components, rods or terminals 132 into the surface of workpieces which may be terminal blocks 15. It is noted that a magazine or solid guide cylinder 133 also includes two semicylindrical halves 134 and 135 having recesses 136 provided therein. Fasteners 138 hold the halves 134 and 135 together so that the recesses 136 form a chamber 139. The chamber 139 includes a feed slot 140 through which the terminals 132 are fed from the feed chute 141 into a cylindrical passageway 142. The terminals are advanced through the passageway into the terminal block by cylindrical pushrods 144 that slide in the passageways. A gear 145 cooperates with the sun gear 130 in the same manner as the gear 129 for rotating the guide cylinder 133 within the hollow cylinder 114.

Referring again to the first embodiment shown in FIG. 7, one end of each of the pushrods 109 is slidably mounted in each chamber 107. A reinforcing rib 146 provided on each of the pushrods 109, is received in a square guide portion 147 of each of the T-shaped chambers 107. The other end of each of the pushrods 109 is received in an aperture 149 machined in a piston 150 that is slidably received within the bore of the support cylinder 114. A pin 151 is passed through an aperture 152 formed transversely through the apertures 149 in the piston 150 and through apertures formed in the pushrods for securing the pushrods in the apertures 149.

A counterbored recess 154 is machined in the end of the piston 150 opposite to the end wherein the apertures 149 are formed. Ball bearings 155, mounted on an end 156 of a piston rod 157, are received in the counterbored portion of the recess 154. A flange 159 provided on the end 156 of the piston rod 157 is held against the left face of the bearings 155 by a headed fastener 160 that is threaded into a tapped aperture 161 formed in the end 156 of the piston rod 157. A retaining ring 162 is fastened to the left face of the piston 150 by fasteners 164. A shoulder 165, formed integrally with the retaining ring 162, engages and holds the bearings 155 within the counterbored portion of the recess 154.

Upon actuation of an air cylinder 166 for advancing the piston rod 157, the end 156 of the piston rod slides the piston 150 in the support cylinder 114. The piston 150 slides the pushrods 109 within the chambers 107 to advance terminals into the terminal block 15. It may be appreciated that the provision of the bearings 155 between the piston 150 and the end 156 of the piston rod 157 permits the piston 150 to rotate relative to the cylinder 114 without such rotation being transmitted to the piston rod 157. Thus, when the gear 129 rotates the solid guide cylinder 108, the pushrods 109 are free to rotate around the axis of the piston 150. In this manner, the pushrods 109 are constantly received in and rotate with the chambers 107 rather than being withdrawn from the chambers during rotation of the guide cylinder 108.

A collar 167 is firmly attached to the piston rod 157 intermediate its ends. Stop pins 169 and 170, mounted on the collar 167, slide within slots 171 provided in the walls of the hollow support cylinder 114. An internally threaded stop collar 172 is mounted on a threaded portion 174 formed on the outer periphery of the cylinder 114. The stop collar 172 cooperates with the stop pins 169 and 170 for stopping the advancement of the piston 150 at any desired position within the length of the threaded portion 174. Thus, according to the configuration of the terminals 20 and the terminal blocks 15, the stop collar 172 may be adjustably positioned on the support cylinder 114 for stopping the advancement of the pushrods 109 when the terminals have been fully advanced into the terminal blocks.

A switch actuator **175** mounted on one of the stop pins **169** is effective to actuate a switch **176** when the terminals have been fully advanced into the terminal block. Actuation of the switch **176** energizes the control circuits for reversing the air cylinder **166**. Reversal of the air cylinder **166** reverses the piston rod **157** whereupon the switch actuator **175** actuates a switch **177** when the piston rod **157** is fully retracted. The switch **177** energizes the control circuits for unlocking the indexing plate **17**.

Operation

The operation of the terminal setting apparatus may best be described by following the operation of the apparatus on a single terminal block. Assuming that the subject block is the lowermost terminal block **15** positioned in the chute **77** shown in FIG. 3, the operation is initiated with actuation of the air cylinder **41** of the drive mechanism **40**. The drive mechanism **40** indexes the plate **17** to advance a slot **16** into alignment with the chute **77**. A cam **179** (FIG. 2) mounted on the indexing shaft **30** then actuates a switch **180** of the control circuits. The control circuits actuate the air cylinder **69** of the locking mechanism **66** for advancing the shot pin **67** into the locking bushing **68**. Advancement of the shot pin **67** closes a contact **181** of the switch **74**, which causes the control circuits to actuate the escapement solenoid **78** (FIG. 3) for releasing the subject terminal block **15** which slides from the chute **77** into the slot **16**. The locking mechanism **66** then reverses to retract the shot pin **67**.

The drive mechanism **40** is then again actuated for advancing the subject terminal block **15** into alignment with the first of the five pairs of terminal setting mechanisms **19**.

During the indexing movement of the indexing plate **17**, the sun gear **130** rotates the gear **129** of the terminal setting mechanism **19**. Rotation of the gear **129** rotates the solid guide cylinder for successively aligning the cross-portions **125** (FIG. 9) of the T-shaped guide chambers **107** with the terminal feed slot **127**. At the completion of the indexing movement, the guide cylinder **108** has been rotated one revolution so that a terminal **20** is now received in each of the two guide chambers **107**.

In addition, during the indexing movement of the indexing plate **17**, the cam follower rollers **101** (FIG. 6) of the clamping device **86** are actuated by the cam surfaces **103** and **104** for moving the clamping blocks **106** into the clamping position shown in FIGS. 4 and 7. The terminal block **15** is thereby clamped in the slot **16** and is conditioned to receive terminal pins **20**.

When the clamped terminal block is aligned with the first pair of terminal setting mechanisms **19**, the locking mechanism **66** (FIG. 2) is again actuated for rigidly locking the terminal block in alignment therewith. The switch **74** is closed by advancement of the shot pin **67**, and energizes the control circuit which then actuates the air cylinders **166** of the five opposed pairs of terminal setting mechanisms **19**. Actuation of the air cylinders **166** advances the piston rod **157** into the position shown in FIG. 10.

During the advancement of the piston rods **157** (FIG. 10), the pushrods **109** are slidably advanced through the chambers **107** for advancing the terminals **20** therethrough, through the apertures **110** provided in the clamp blocks **106**, and into the terminal block **15**. When the terminals are fully advanced into the terminal block **15**, the switch **176** is actuated by the actuator **175** for reversing the air cylinders **166**. Reversal of the air cylinders **166** returns the piston rods **157** to the position shown in FIG. 7 whereupon the switch **177** is actuated by the actuator **175**. Actuation of the switch **177** further energizes the control circuits for reversing the air cylinder **69** (FIG. 2). Reversal of the air cylinder **69** removes the shot pin **67** from the bushing **68**. As the piston rod **72** reverses, the switch **74** is opened for energizing the control circuits to actuate the index cylinder **41** (FIG. 1). Actuation of the index cylinder **41** drives the ratchet and pawl mechanism **40** for indexing the now partially completed terminal block **15** into alignment with the next subsequent pair of terminal setting mechanisms **19**. During such movement between the indexing mechanisms, the clamping blocks are maintained in the clamping position to firmly hold the partially completed terminal block in the slot **16**.

At each of the four subsequent pairs of terminal setting mechanisms, an operation similar to the one above-described, is performed. The terminal block has received a full set of terminals and is thus completed when it is advanced from the lowermost or final terminal setting mechanism **182** toward the receiving chute **24**. When the completed terminal block or assembly **22** reaches the receiving chute **24**, the clamping device springs **99** (FIG. 4) are effective to retract the clamping blocks **106** for releasing the assembly **22**. The released assembly slides downwardly through the slot **16** and into the receiving chute **24**.

Electro-Pneumatic Control Circuits

The electro-pneumatic control circuits shown in FIG. 13 are provided for automatically controlling the operational cycle of the terminal setting apparatus. The control circuits include a high-current power supply **184** that is connected by a conductor **185** to a push button switch **186**. A second low-current power supply **188** is connected by a conductor **189** to a second push button switch **190**.

In the operation of the terminal setting apparatus, the operator closes the push button switch **186** to connect the power source **184** to a circuit that may be traced through a conductor **191**, through a normally closed contact **192**, and through a coil **194** of a solenoid valve **195** to ground. Energization of the solenoid coil **194** actuates the solenoid valve **195** to supply air pressure from a pneumatic supply condit **196** to the index cylinder **41**. The index cylinder **41** actuates the ratchet and pawl device **40** for indexing the shaft **30** one increment.

At the end of the indexing movement of the shaft **30**, the cam **179** actuates a switch actuator arm **198** to close a contact **199** of the switch **180**. Closing of the contact **199** completes a circuit that may be traced from a conductor **200**, through the now closed contact **199**, and through a relay **201** to ground. Energization of the relay **201** draws up a normally open contact **202** to complete a circuit that may be traced from the conductor **191**, through a normally closed contact **204**, through a coil **205** of a solenoid valve **206**, and through the now closed contact **202** to ground. Energization of the coil **205** actuates the solenoid valve **206** for supplying air pressure from the pneumatic supply conduit **196** to the air cylinder **69**. Actuation of the air cylinder **69** advances the piston rod **72** to insert the shot pin **67** into the bushing **68** of the lock plate **64** for holding the indexing plate **17** in its indexed position. As the shot pin **67** is inserted into the bushing **68**, the cam **75** mounted on the piston rod **72**, engages an actuator arm **208** of the switch **74** to close a contact **209**. Closure of the contact **209** completes a circuit that may be traced through from the conductor **200**, through a relay **210**, and through the now closed contact **209** to ground. Energization of the relay **210** opens the normally closed contact **192** and draws up normally open contacts **212** and **213**. Closure of the contact **192** deenergizes the solenoid coil **194**. Deenergization of the solenoid coil **194** releases the solenoid valve **195** which permits the pawl **48** to rotate counterclockwise in anticipation of the next subsequent indexing of the piston rod **45**.

Closure of the contact **212** completes a circuit that may be traced from the conductor **191**, through a normally closed contact **214**, through a coil **215** of the solenoid **78**, and through the now closed contact **212** to ground. Energization of the solenoid coil **215** actuates the solenoid armature **82** for pivoting the escapement lever **81**. The lowermost escapement bar **84** is thereby

retracted from the chute 77 to permit a terminal block to advance into one of the slots 16.

Closure of the contact 213 completes a circuit that may be traced from the conductor 191 through a normally closed contact 217, through the now closed contact 213, and through a solenoid coil 219. Energization of the solenoid coil 219 actuates a solenoid valve 220 for connecting the pneumatic supply conduit 195 to the terminal setting air cylinders 166 for advancing the blades 109 to perform the terminal setting operation.

It may be appreciated that the relay 210 in simultaneously releasing the contact 192 and drawing up the contact 212, prevents the indexing mechanism 40 from functioning not only while the terminal setting blades 109 are extended, but also while the shot pin 67 is inserted within the bushing 68. Thus the locking mechanism piston rod 72 is effective to preclude operation of the indexing mechanism 40 upon actuation of the air cylinder 69.

When the pushrods 109 are fully advanced to the right (as shown in FIG. 7) during the terminal setting operation, the switch actuator 175 positions a contact 221 of the switch 176 to complete a circuit that may be traced from the conductor 200, through a relay 223, and through the now closed contact 221 to ground. Energization of the relay 223 draws up a normally open contact 224 and opens the normally closed contacts 214 and 217. Closure of the contact 224 completes a holding circuit that may be traced from the conductor 200, through the relay 223, through the now closed contact 224, and through a normally closed contact 225 to ground. Thus when the air cylinder 166 reverses for moving the switch actuator 175 to the left out of engagement with the contact 221, the relay 223 is maintained energized.

Opening of the contact 214 is effective to deenergize the solenoid coil 215 whereby the escapement bars 84 are reversed in position to permit advancement of the terminal blocks to the lowermost escapement bar 84.

Opening the contact 217 is effective to deenergize the solenoid coil 219 for reversing the solenoid valve 220. Reversal of the solenoid valve 220 actuates the air cylinders 166 to advance the piston rods 157 to the left. When the piston rods 157 are fully advanced to the left (as shown in FIG. 7), the switch actuator 175 positions a contact 226 of the switch 177 to complete a circuit that may be traced from the conductor 200, through a time-delay relay 228, and through the contact 226 to ground. Energization of the time-delay relay 228 immediately opens both of the contacts 225 and 204. Opening of the contact 225 is effective to open the relay 223 holding circuit which deenergizes the relay 223. The normally open contact 224 is thereby released and opens, whereas the normally closed contact 214 is released and closes.

At the same time as the contact 225 opens, the contact 204 opens to open the circuit through the coil 205. Deenergization of the coil 205 is effective to advance the piston rod 72 to the left (as viewed in FIG. 13) for unlocking the indexing plate 17. Advancement of the piston rod 72 to the right moves the cam 75 out of engagement with the actuator arm 208. The arm 208 opens the contact 209 which deenergizes the relay 210. Deenergization of the relay 210 releases the normally open contacts 212 and 213. The normally open contacts 212 and 213 are opened so that the feeding solenoid coil 215 and the terminal setting device coil 219 may remain deenergized inasmuch as the normally closed contacts 214 and 217 have been released as an additional result of the deenergization of the relay 223.

Deenergization of the relay 210 releases the contact 192 to again complete the circuit through the solenoid coil 194 whereupon the ratchet and pawl indexing mechanism 40 is actuated to advance the indexing plate 17. When the solenoid coil 194 is reenergized, the time-delay relay 228 times out and releases the normally closed contacts 225 and 204. Closure of the contact 225 conditions the relay 223 holding circuit for subsequent completion upon actuation of the piston rod 157. Similarly, closure of the contact 204 conditions the circuit that may be traced from the conductor 191, through the now closed contact 204, through the solenoid coil 205, and through the contact 202 to ground. This circuit, it is noted, is now open because during the indexing of the shaft 30, the cam 179 maintains the contact 199 open, whereby the relay 201 is not energized. The relay 201 does not draw upon the contact 202 to complete the circuit, until the indexing movement is completed. At such time upon closure of the contact 202, the solenoid coil 205 is energized and the operational cycle continues.

It may be appreciated that the apparatus operates in the above-described cyclical manner so long as the operator maintains the push button switches 186 and 190 closed. If fully automatic operation is desired, toggle switches may be substituted for the push button switches 186 and 190.

It is to be understood that the above-described arrangements are simply illustrative of an application of the principles of the application. Numerous other arrangements may be devised by those skilled in the art which will embody the principles of the invention and will fall within the spirit and scope thereof.

What is claimed is:

1. In an apparatus for driving a slender component into a workpiece, means for feeding components, carrier means for advancing a workpiece, guide means actuated by said carrier means and moved relative to said carrier means for receiving components from said feeding means, means for driving the components through said guide means and into the workpiece, and means actuated by the carrier means upon advancement of a workpiece into alignment with the guide means for actuating the driving means.

2. In a device for driving slender articles arranged in a predetermined pattern into a workpiece, means for feeding articles, carrier means for advancing a workpiece, means actuated by the advancing carrier means and moved relative to said carrier means for receiving and arranging articles fed from said feeding means in said predetermined pattern, and means rendered effective upon advance of said carrier for driving said articles through said arranging means and into said workpiece.

3. In an apparatus for driving a slender component into a block, means for guiding a component, carrier means for advancing a block into alignment with the component guiding means, means rendered effective by said carrier means advancing said block for feeding components into said guiding means, means mounted in said guiding means for driving the components through said guiding means into said aligned block, and means actuated by the carrier means for moving said driving means to drive said component into said aligned block.

4. In a mechanism for assembling a component and a workpiece, means for feeding components, guide means having a chamber, means for movably mounting the guide means to advance the chamber into position to receive a component, carrier means for advancing workpieces into alignment with the guide means, means received in said chamber operated by an advance of the carrier means for driving a component through said chamber and into an aligned workpiece, means actuated by said driving means for indexing said carrier means to align a successive workpiece with the guide means; and means actuated by the indexing of the carrier means for moving said guide means relative to said carrier means to align said chamber with the feeding means.

5. In an article assembling machine, a plurality of chutes for first components, a plurality of magazines mounted for movement past said chutes to receive components from said chutes, a carrier for holding second components, means for successively advancing said carrier to move said second components into alignment with said magazines, means actuated by said advancing carrier for moving said magazines relative to said carrier and past said chutes to receive said first components, and means

rendered effective by each advance of said carrier for advancing said components from said magazines to the carrier and said second components.

6. In a device for seating inserts in an article, a rotatably mounted cylinder having a pair of diametrically opposed slots for receiving inserts, a carrier for advancing an article into register with said slots, means for advancing said carrier, means actuated by said advancing carrier for rotating said cylinder one half a revolution to move relative to said carrier, a pair of blades mounted within said cylinder for movement through said slots, and means operated by the advance of said carrier for advancing said blades through said slots.

7. In an apparatus for inserting rods into a block, chute means for feeding rods, a rotary cylinder provided with guide chambers movable into successive alignment with the chute means for receiving rods therefrom, carrier means for moving a block into alignment with the rotary cylinder, means actuated by said carrier means for rotating said rotary cylinder relative to the carrier means to feed rods into said chambers, pusher means slidably mounted in each of said chambers and rotated with the rotary cylinder for advancing rods through the chambers into the block, and means rendered effective after rotation of said pusher means for sliding said pusher means whereby the rods are advanced through the chambers and into the block.

8. In a device for setting terminals into apertures formed in a predetermined pattern in a terminal block, a guide cylinder having axially extending chambers formed therein in a pattern corresponding to said predetermined pattern for receiving terminals, carrier means having a terminal block receiving slot therein for advancing a terminal block into alignment with said guide cylinder, clamp means rendered effective by advancement of said carrier means for holding a terminal block in said slot, said clamp means having apertures provided therein in a pattern corresponding to said predetermined pattern, means slidably received in said chambers for advancing the terminals through the chambers and the apertures in the clamp means into said terminal block, and means rendered effective upon operation of said clamp means for actuating said advancing means to set the terminals in the terminal block.

9. In an apparatus for driving a terminal into a terminal block, a rotary cylinder having terminal receiving chambers formed therein, a chute for feeding terminals into said chambers, first gear means mounted on said rotary cylinder for rotating said cylinder to successively align said chambers with said chute, carrier means for advancing a terminal block into alignment with said cylinder, second gear means driven by said carrier means for rotating said first gear means, means slidable in said chambers operated by an advance of the carrier means for driving the terminals through said chambers into the aligned workpiece, means actuated by said driving means for reversing said driving means, and means actuated by said reversing means for indexing said carrier means.

10. In an apparatus for driving a terminal into a terminal block, a terminal feed chute, a rotary cylinder having guide chambers and passageways for feeding terminals from the chute to the guide chambers, a first gear fixed to said rotary cylinder, a carrier plate for advancing terminal blocks into alignment with said chambers, means for indexing said carrier plate, a second gear driven by said carrier plate for rotating said first gear to rotate said rotary cylinder relative to said carrier plate, blades slidably received in each guide chamber for driving the terminals therethrough into said blocks, means rendered effective upon rotation of said rotary cylinder for advancing said blades, and rotary coupling means mounted between said advancing means and said blades for transmitting axial motion therebetween and permitting said blades to rotate with the rotary cylinder relative to said advancing means.

11. In an apparatus for driving a set of terminals into a terminal block, a frame, a plurality of opposed pairs of terminal guide cylinders mounted at evenly spaced intervals on the frame, each of said cylinders having terminal guide chambers formed therein, carrier means mounted on the frame between the opposed pairs of terminal guide cylinders for advancing terminal blocks into alignment with each of said pairs of guide cylinders, said carrier means having terminal block receiving slots formed therein at intervals corresponding to said evenly spaced intervals, means rendered effective upon advancement of said terminal blocks for feeding terminals, means on the carrier for rotating said guide cylinders relative to said carrier means to position said chambers to receive terminals from said feeding means, means actuated by the carrier means for driving terminals through the chambers of each of the opposed pairs of guide cylinders into each of the aligned terminal blocks, and means actuated by said driving means for indexing said carrier means whereby a set of terminals is driven into each terminal block advanced past the opposed pairs of guide cylinders.

12. In an apparatus for feeding articles, a vertical chute for storing articles, a cylindrical member having diametrically-opposed slots extending inwardly from the periphery in line with said chute along the entire longitudinal length of the member, a casing partially surrounding said cylindrical member for rotatably mounting said cylindrical member to advance said slots past the lower terminus of said chute to receive said stored articles, a pair of pushers slidably mounted within said slots, a cyclically indexed carrier for advancing a terminal block into alignment with the cylindrical member, gear means advanced by the carrier for rotating said cylindrical member relative to said carrier, and means rendered effective by the completion of an index of said carrier for sliding said pushers through said slots to deliver said articles to the aligned terminal block.

13. In an apparatus for inserting a pair of terminals in a block, a chute for receiving a supply of terminals, a cylinder having a pair of opposed radial slots, means for rotatably mounting said cylinder to position one of said slots in register with the terminus of said chute to receive a first terminal, a pair of pushers mounted for movement with said cylinder and for movement through said slots, a first gear mounted on said cylinder for rotating the cylinder to position the other slot in register with the terminus of said chute, a carrier for receiving a block, means for advancing the carrier to position the block in alignment with the ends of radial slots formed in the cylinder, a second gear mounted on the carrier for advancing the first gear to move the second slot into register with the terminus of the chute to receive a second terminal, and means actuated by the advance of the carrier for moving the pushers through said slots to advance the first and second terminals into the block.

14. In an apparatus for driving terminals into a terminal board,

a chute for feeding terminals,

a hollow support cylinder having a slot to receive and pass terminals,

a solid guide cylinder rotatably mounted within said support cylinder, said guide cylinder having a diametrically opposed pair of dotted guide chambers for receiving the terminals passed through said slot from said chute,

a cyclically indexed carrier for advancing a terminal board into alignment with one end of the guide cyinder,

means actuated by said carrier for rotating said guide cylinder relative to said carrier to load the slotted guide chambers with terminals and position said terminals relative to the aligned terminal board,

a pair of pushrods slidably mounted within the slotted guide chambers of the guide cylinder for advancing the terminals into the terminal board,

a piston rod slidably mounted within the support cylinder,

means coupling said pushrods to said piston rod for rotative movement of said pushrods about the longitudinal axis of the piston rod with said guide cylinder, and

means rendered effective upon the completion of an index of said carrier for advancing said piston rod within said support cylinder to advance the pushrods to seat the terminals in said aligned board.

References Cited in the file of this patent

UNITED STATES PATENTS

2,192,106	Ross	Feb. 27, 1940
2,692,424	Habel	Oct. 26, 1954
3,054,167	Bryner et al.	Sept. 18, 1962

FOREIGN PATENTS

378,774	Great Britain	Aug. 18, 1932

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,144,706 August 18, 1964

Anthony J. Vrsecky

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 36, for "condit" read -- conduit --; column 12, line 63, for "dotted" read -- slotted --.

Signed and sealed this 24th day of November 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents