Aug. 20, 1974 W. LE ROY BUSLER ET AL Re. 28,119
METHOD AND APPARATUS FOR INSERTING CONTACT MEMBERS INTO INSULATING BLOCKS
Original Filed July 31, 1968 12 Sheets-Sheet 1

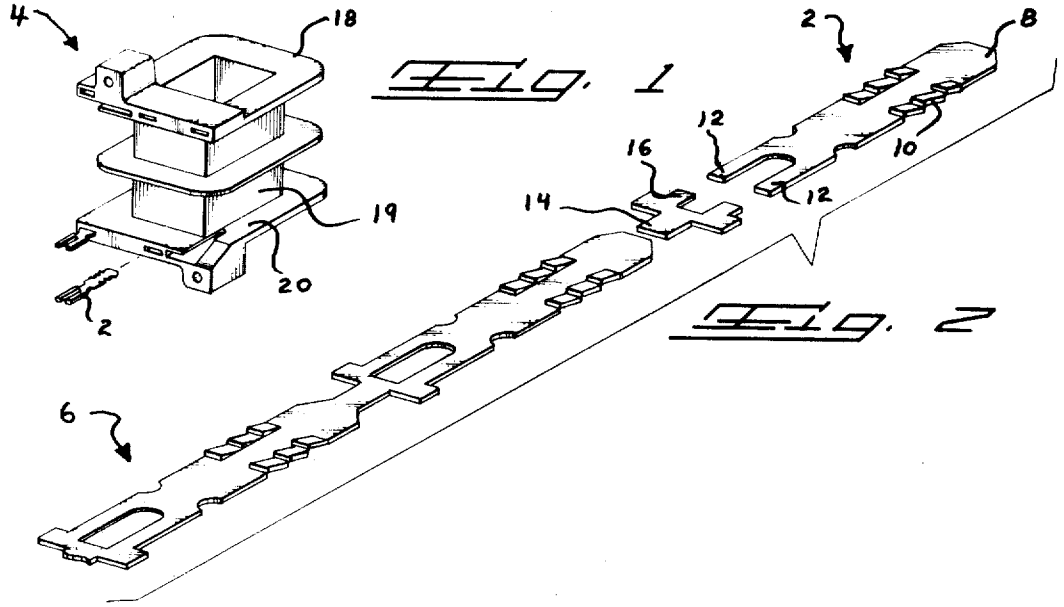


Fig. 1

Fig. 2

Fig. 3

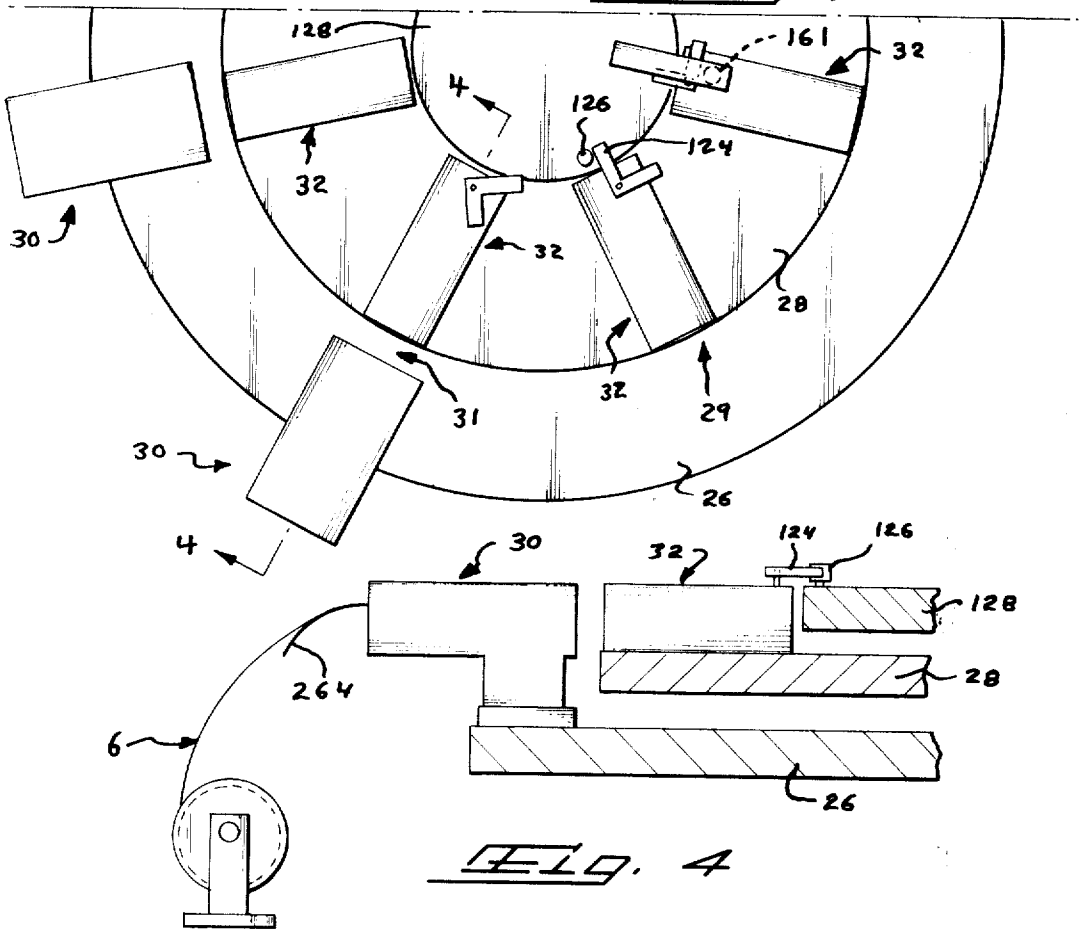


Fig. 4

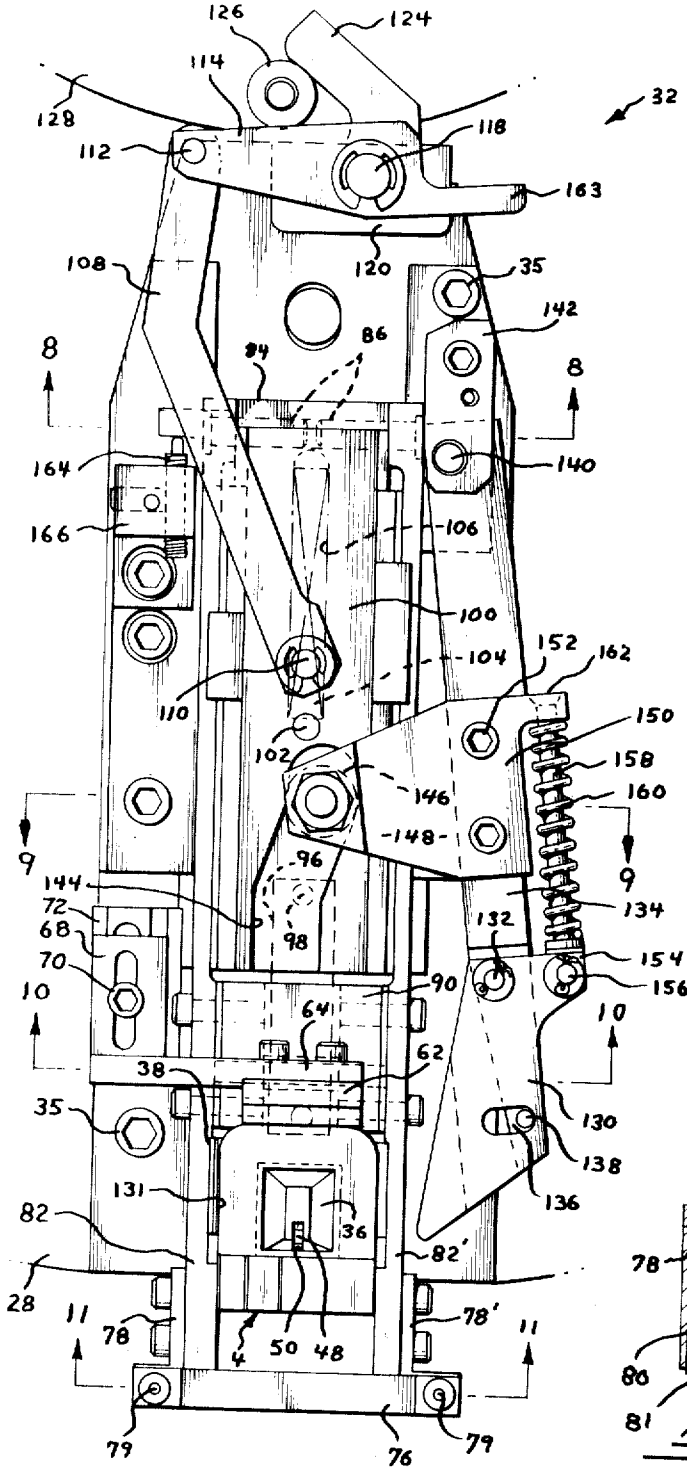

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162
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102
158
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72
98
134
68
132
70
154
156
10
90
10
64
62
38
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130
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136
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82'
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11
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78'
11
4
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48
79
76
79

Fig. 5

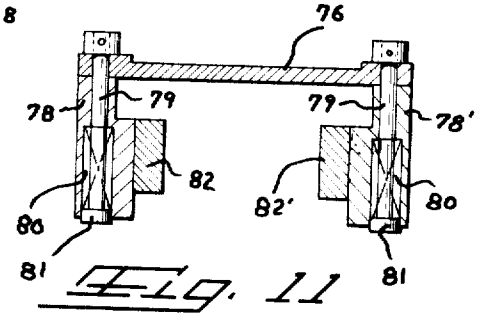

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79
79
78'
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82'
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80
81
81

Fig. 11

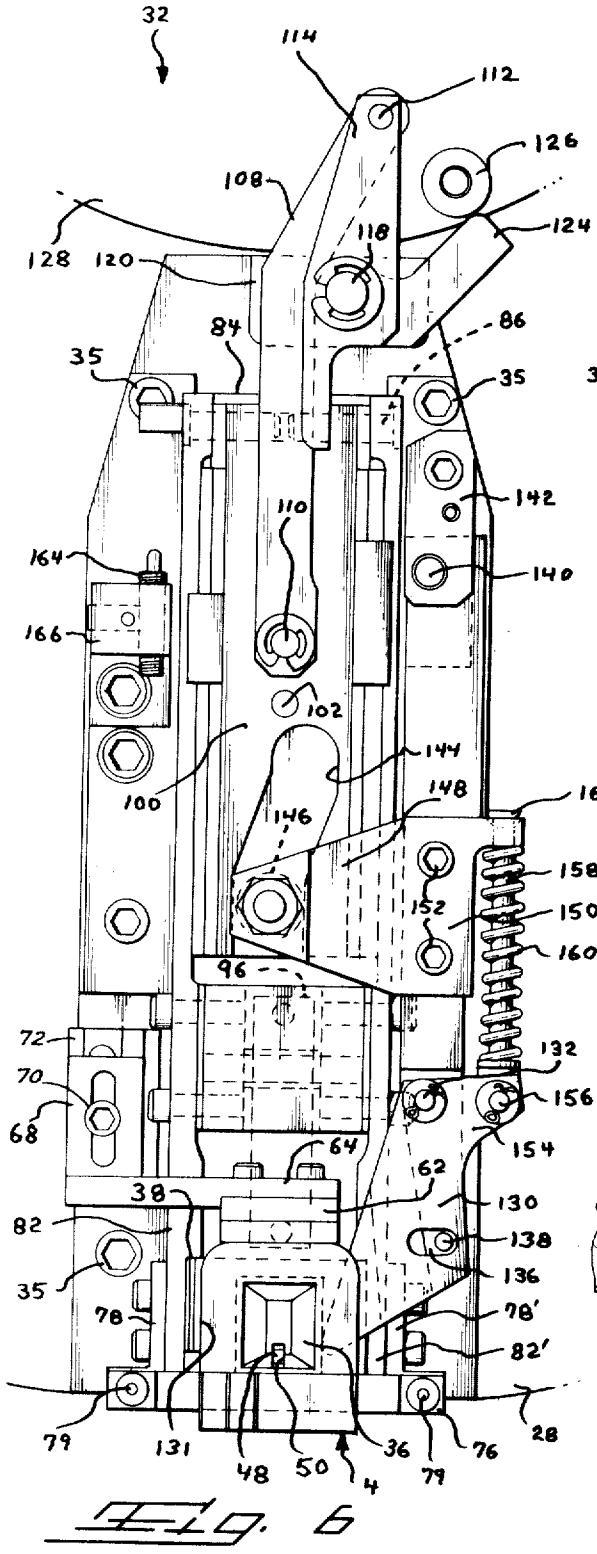


Fig. 6

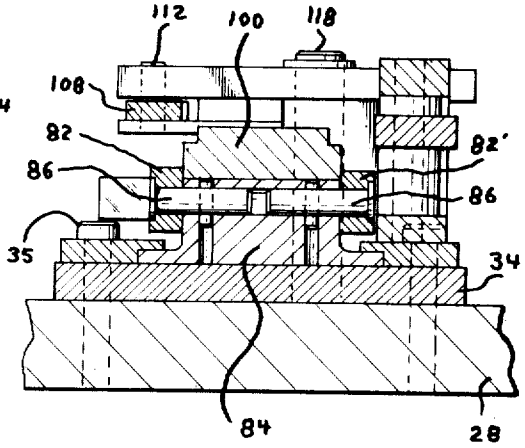


Fig. 8

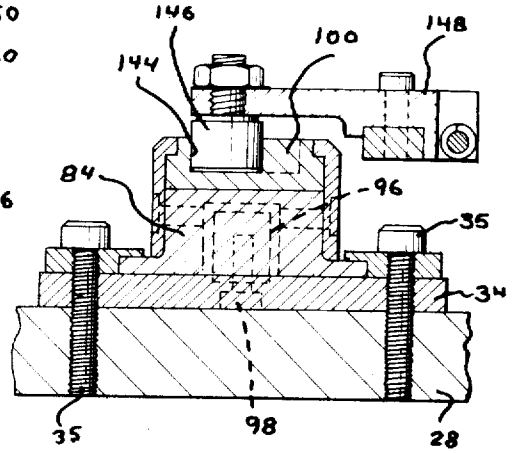


Fig. 9

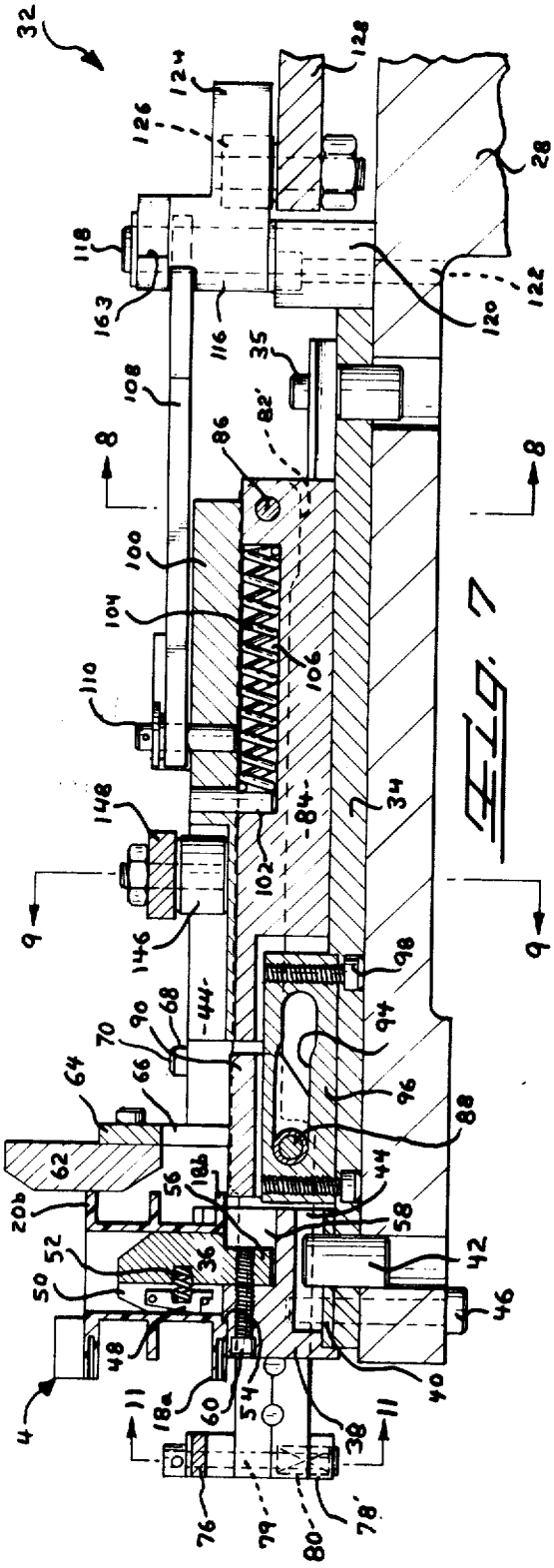


FIG. 7

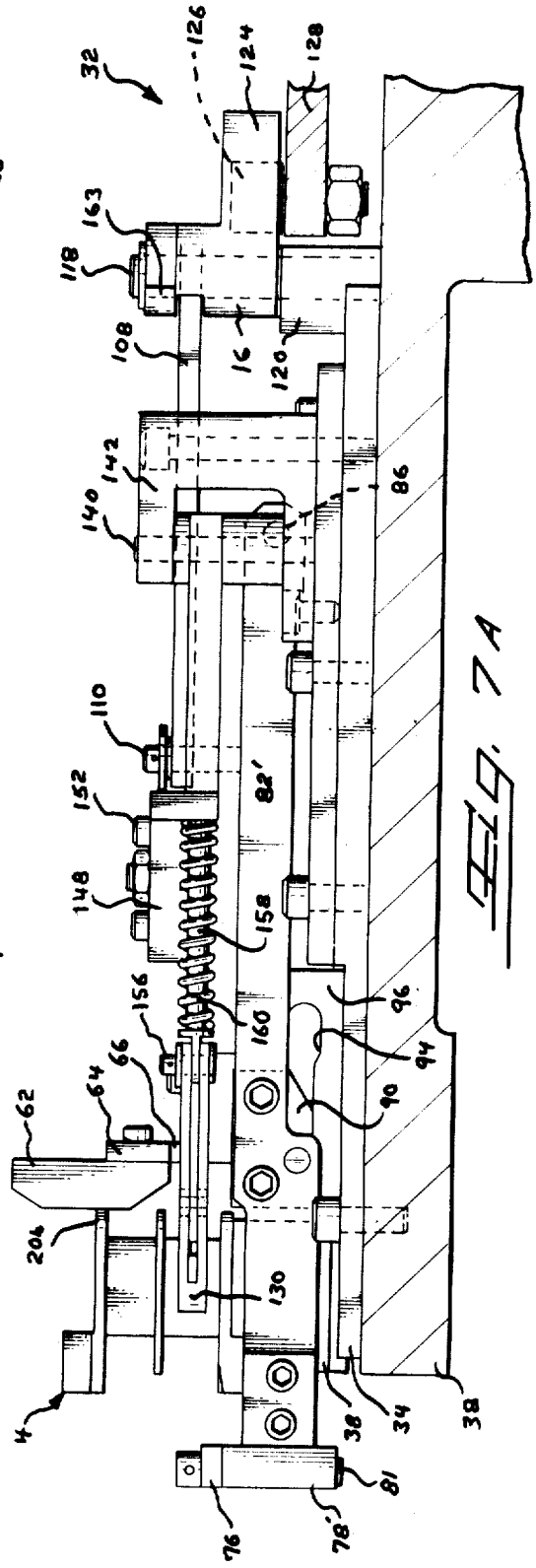


FIG. 7A

FIG. 10

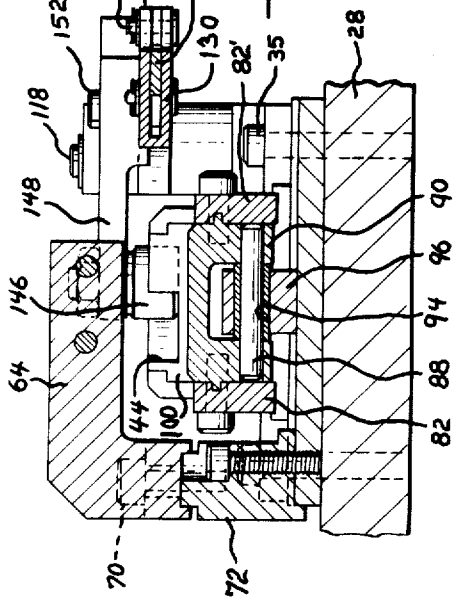
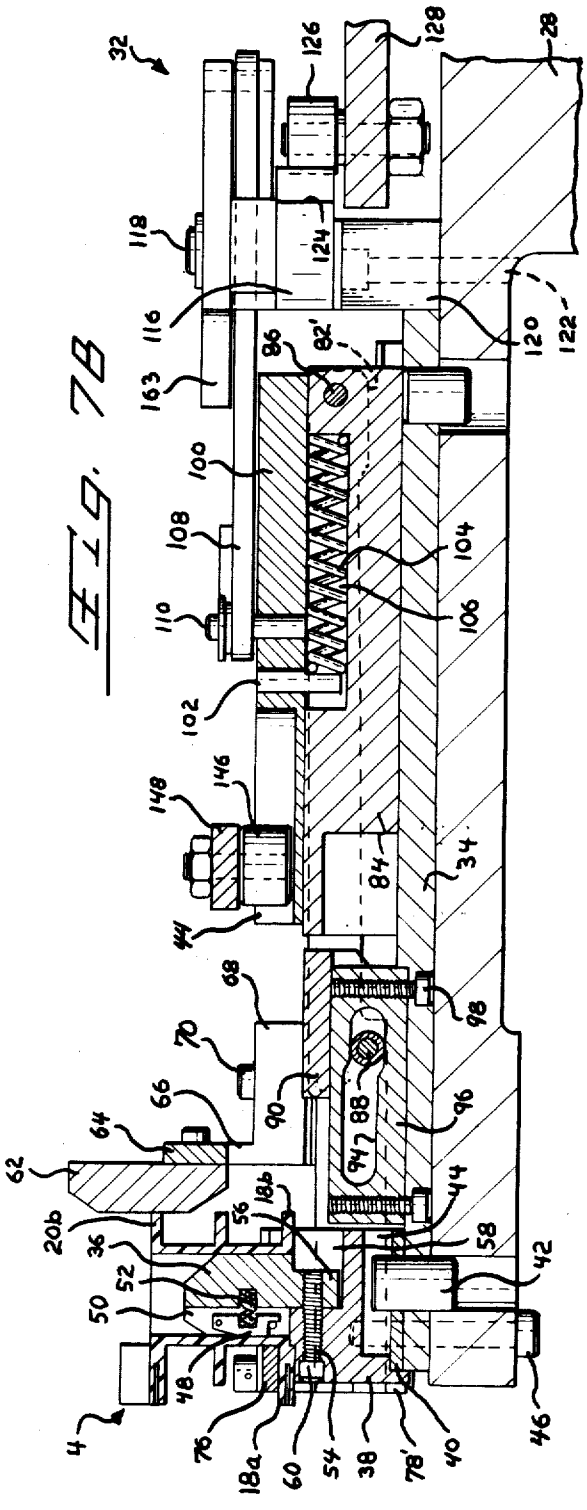

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136
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82'
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118
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64
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FIG. 7B


32
126
128
28
118
124
116
120
122
163
86
82'
100
108
104
106
110
102
148
146
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34
44
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66
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90
88
96
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20b
18b
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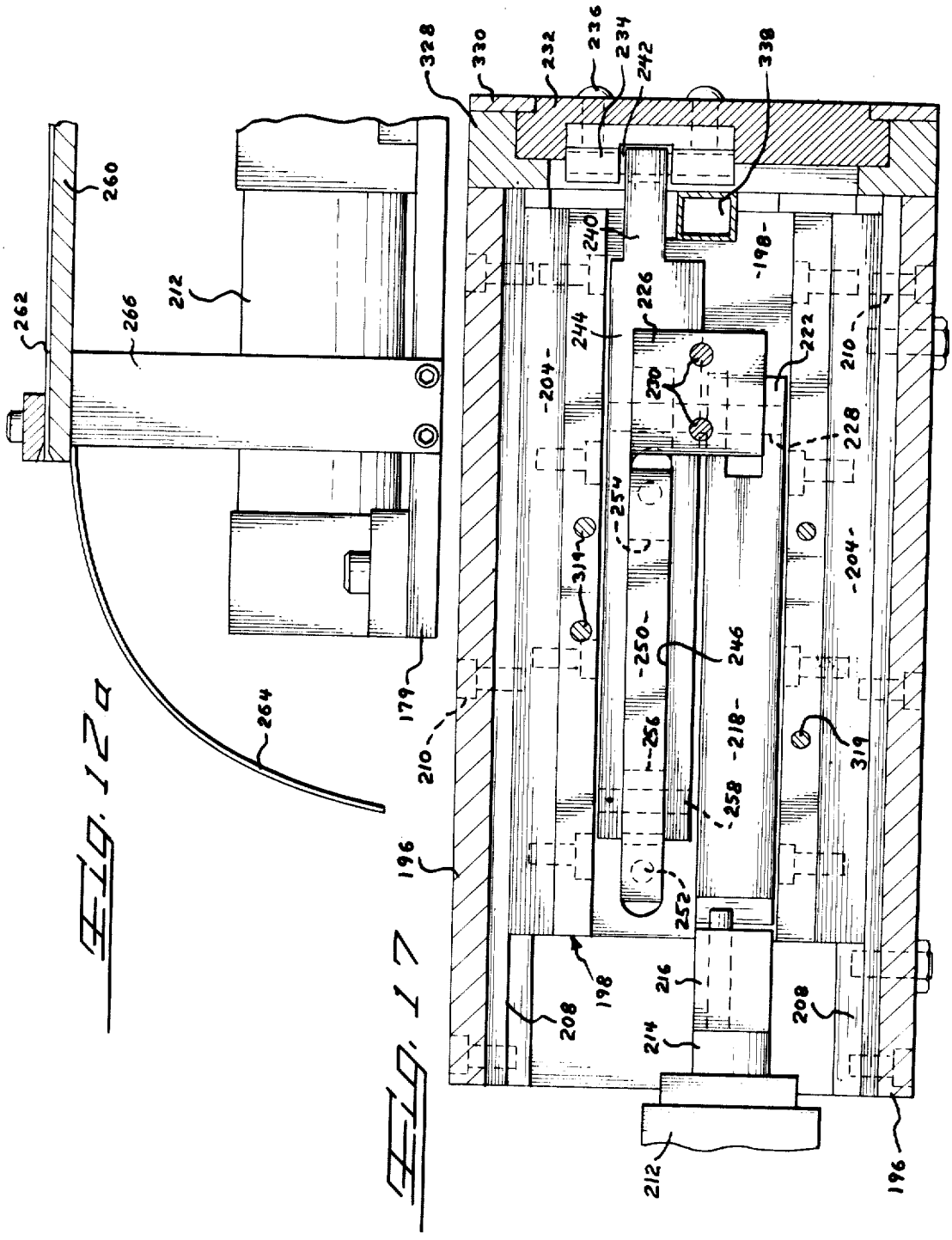


FIG. 12a

FIG. 12

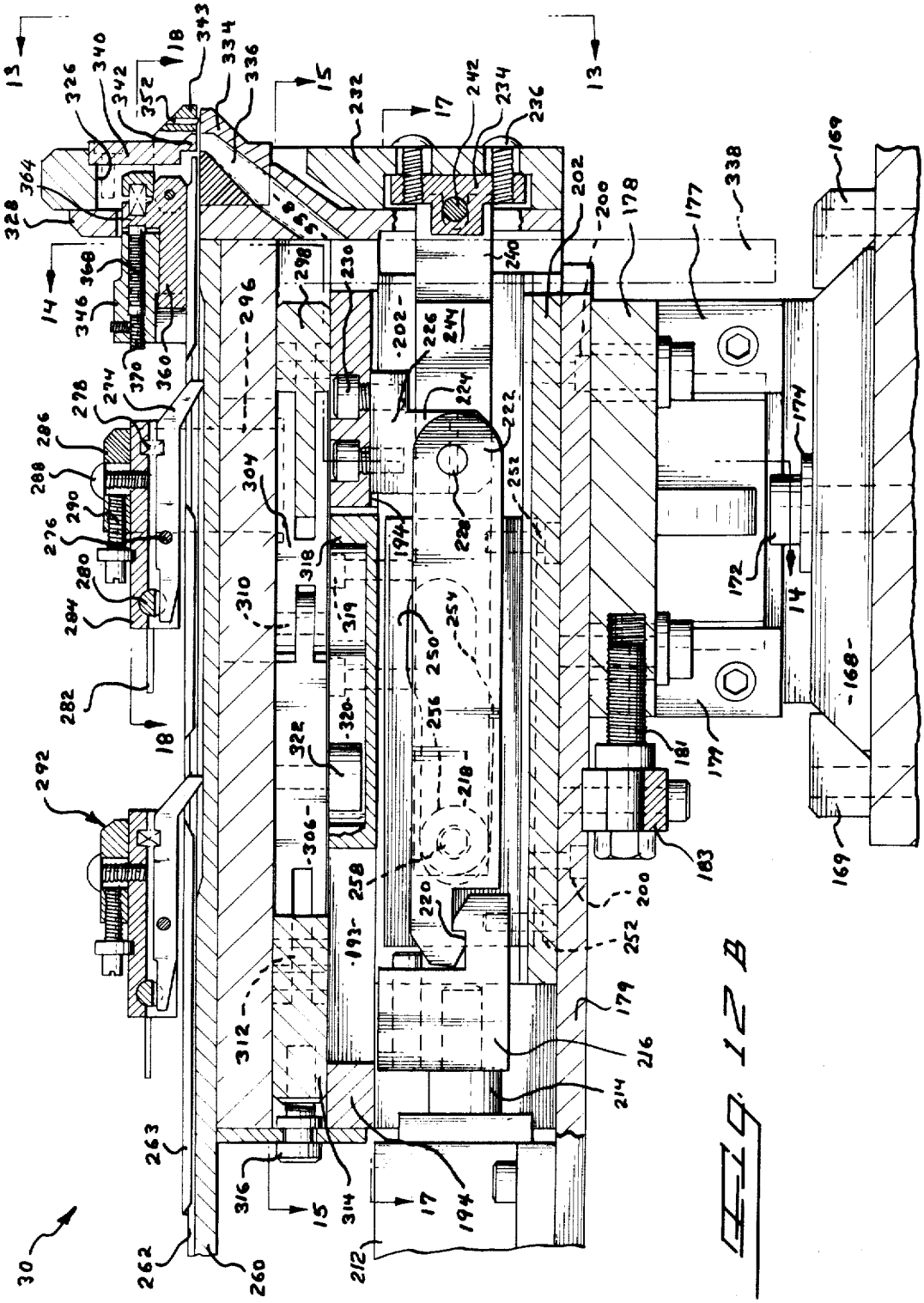

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FIG. 17B

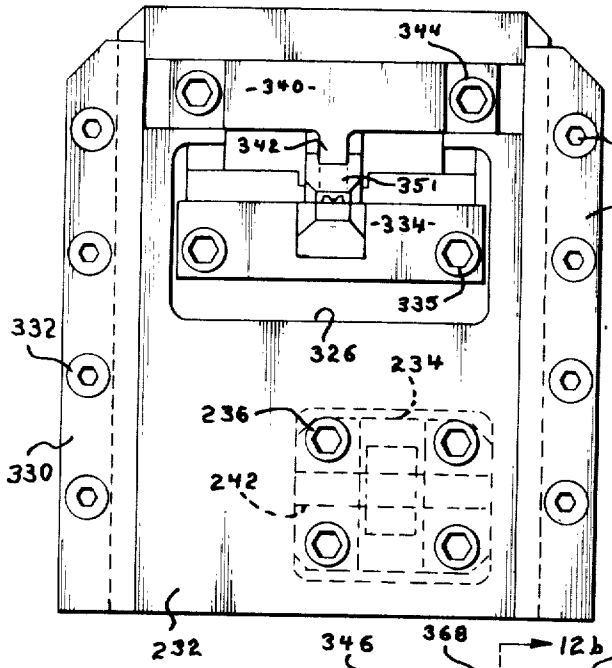

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Fig. 13

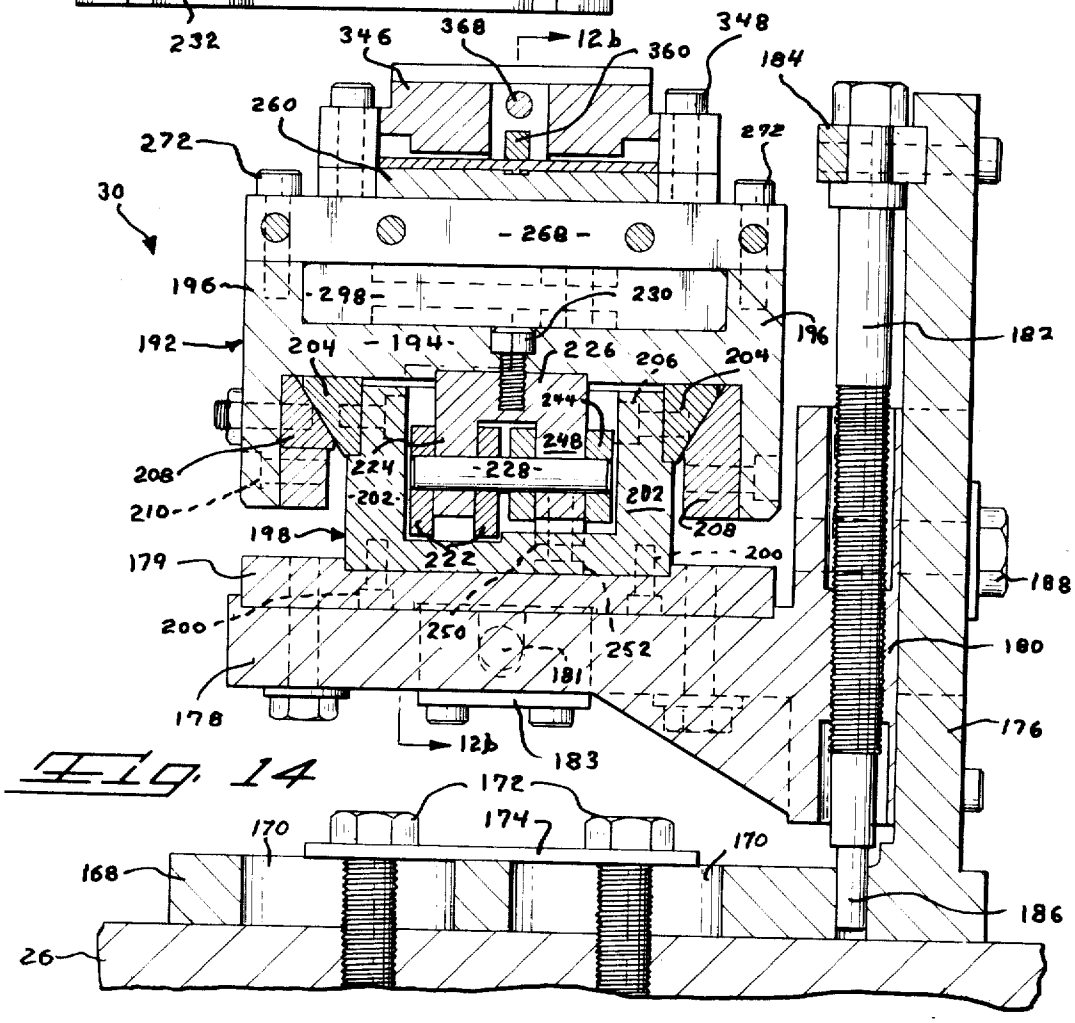

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12b
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Fig. 14

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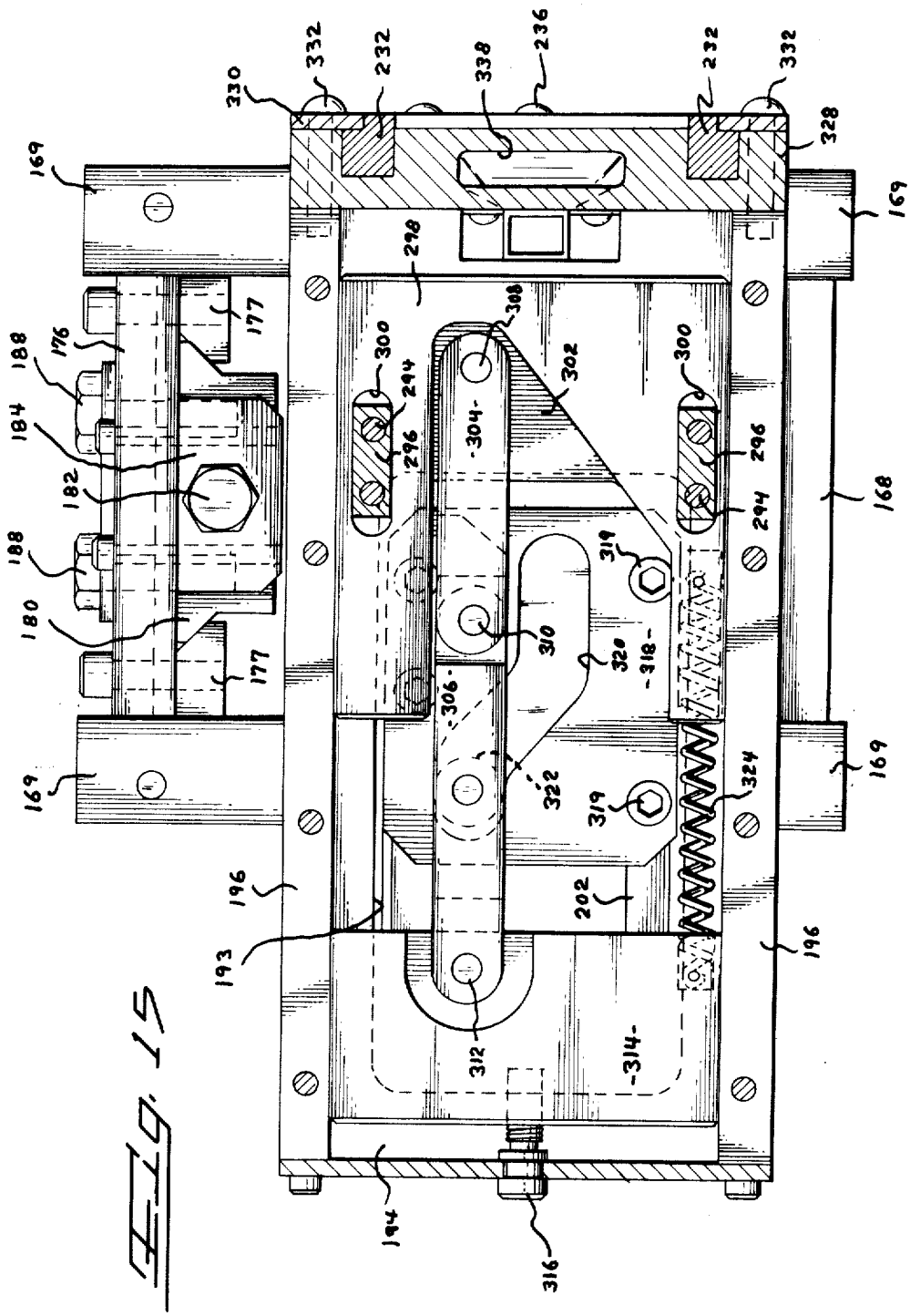

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FIG. 15

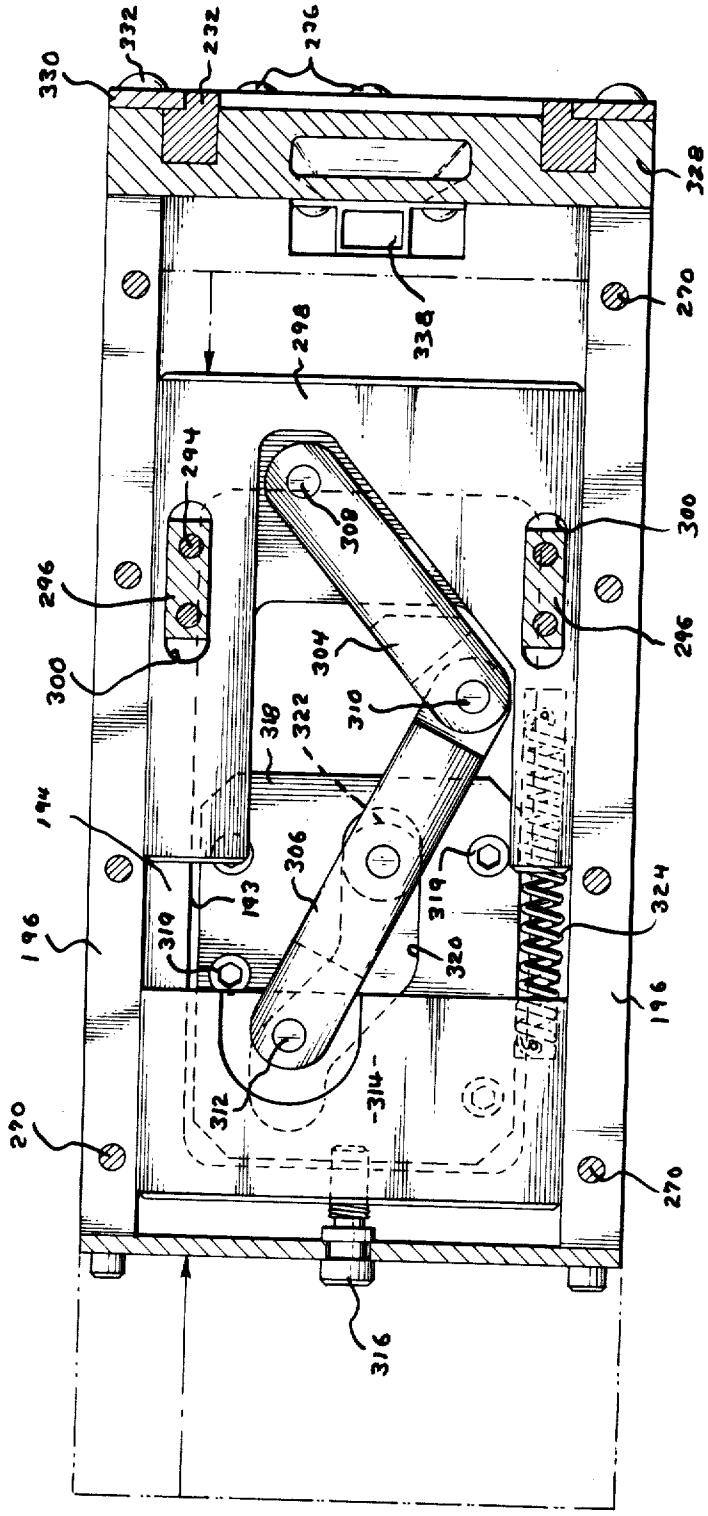

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FIG 16

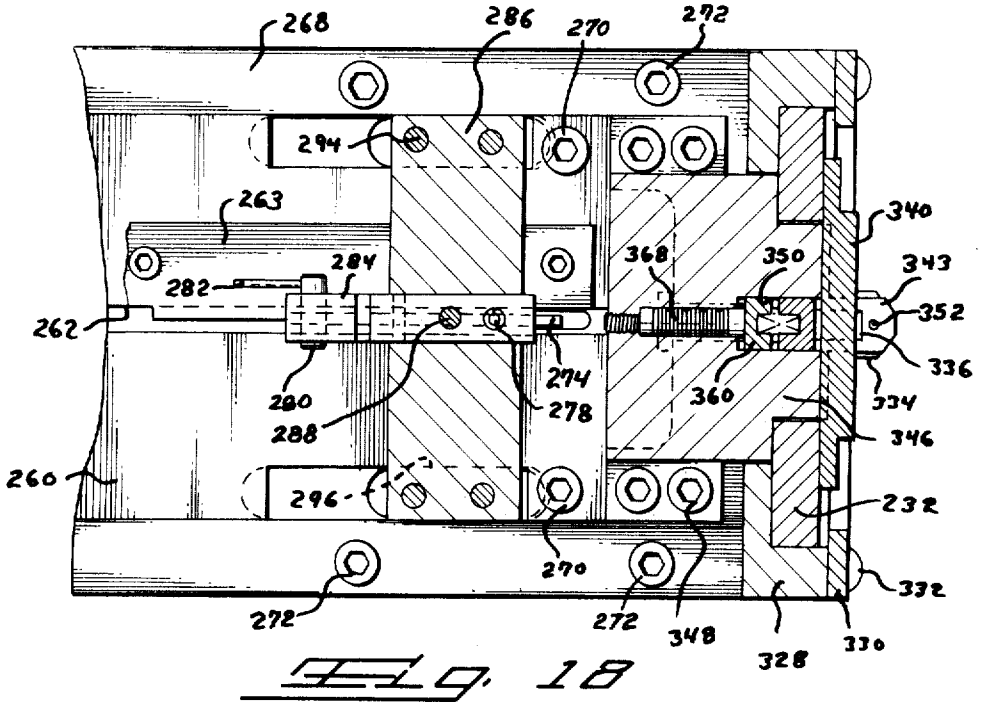

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Fig. 18

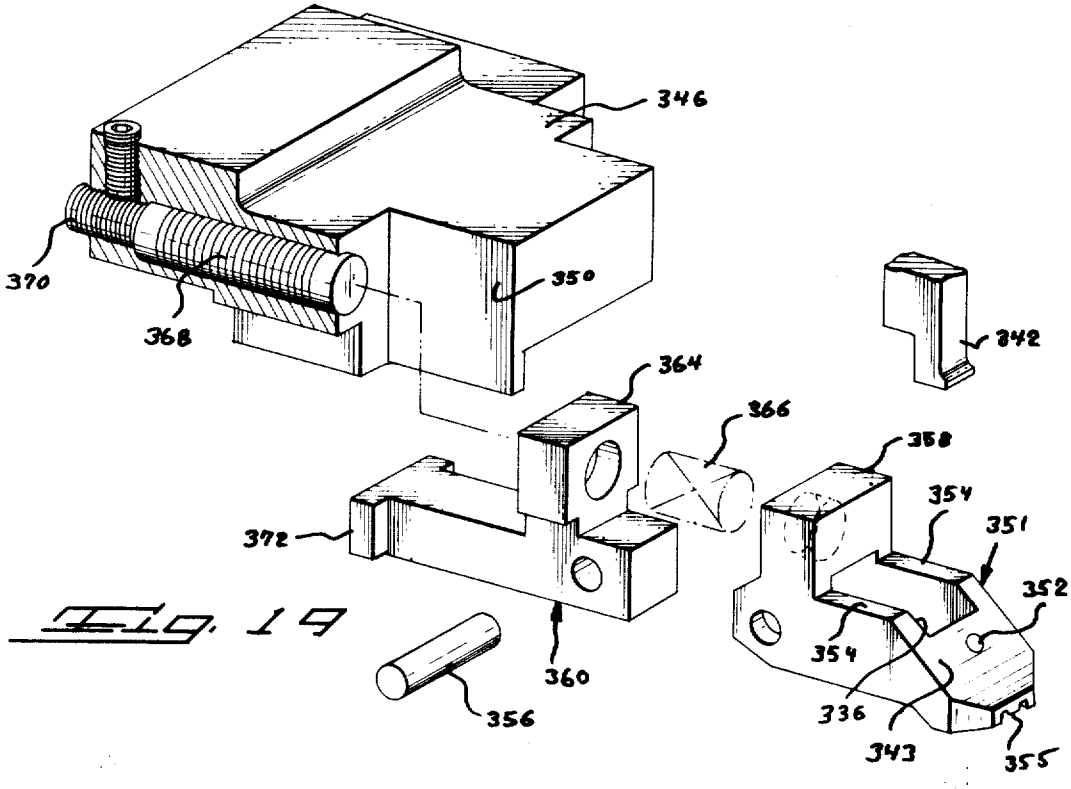

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Fig. 19

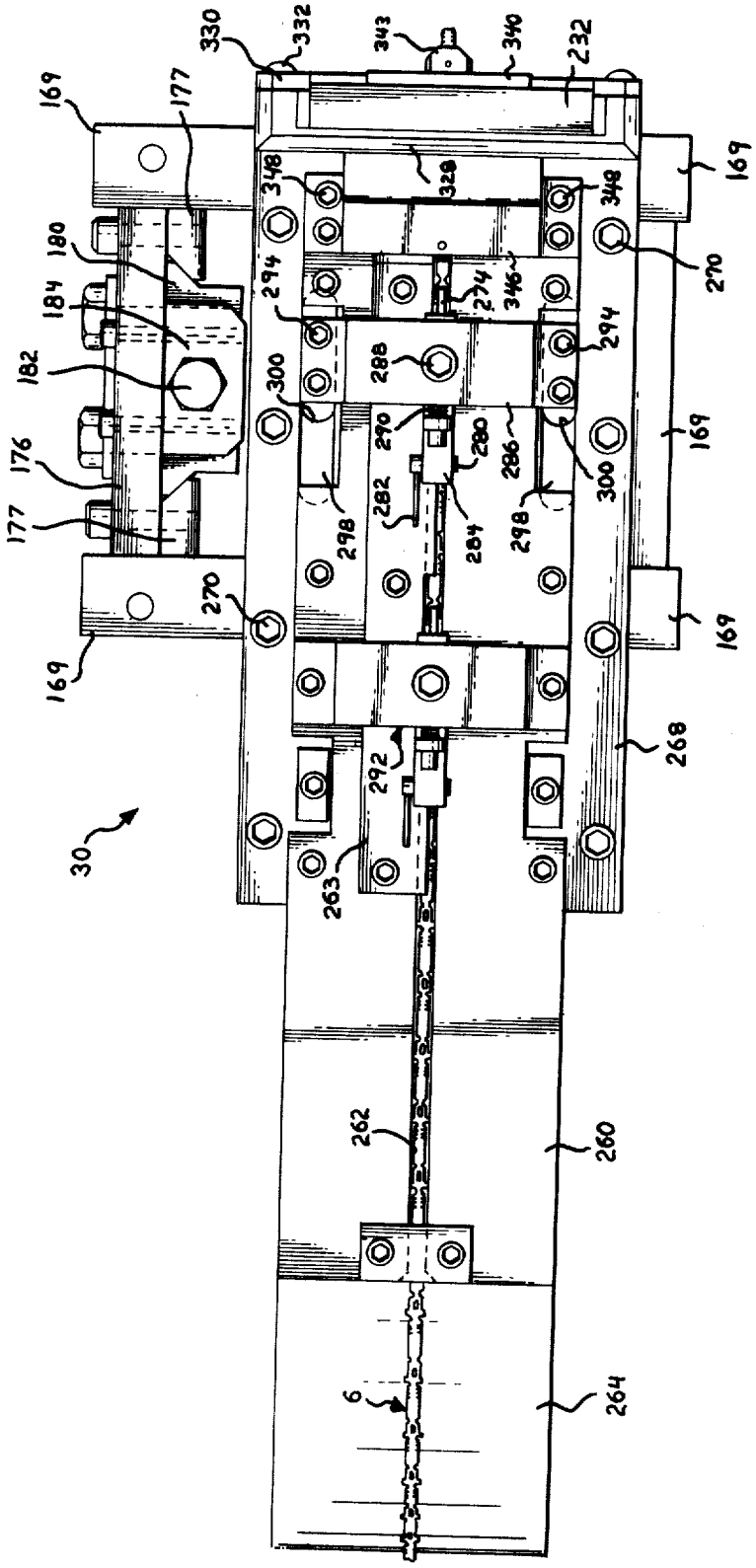

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FIG. 20

United States Patent Office

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28,119

METHOD AND APPARATUS FOR INSERTING CONTACT MEMBERS INTO INSULATING BLOCKS

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Original No. 3,556,382, dated Jan. 19, 1971, Ser. No. 749,122, July 31, 1968. Application for reissue July 6, 1971, Ser. No. 160,224

Int. Cl. H05k *3/00, 13/04*

U.S. Cl. 29—625 10 Claims

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

ABSTRACT OF THE DISCLOSURE

A method and apparatus for inserting contact terminals into coil bobbins is disclosed. Apparatus comprises an indexible turntable having a plurality of bobbin holding jigs. A fixed table, located beneath the indexible turntable, has a plurality of bobbin inserters thereon. Bobbins are positioned in jigs and carried to inserters where terminals are inserted. In accordance with method aspect, the bobbins are moved towards the terminals to accomplish the inserting operation.

[Apparatus for inserting contact terminals into insulating blocks, such as bobbins, comprises an indexible turntable, having a plurality of bobbin holding jigs mounted thereon, and a fixed table, located beneath the turntable, on which a plurality of terminal applicators are mounted. Bobbins are approximately positioned in the jigs at a loading station and are carried past the several inserting stations. Each bobbin jig has clamping means which is actuated between the loading station and the first inserting station and which clamps the bobbin to the jig and accurately positions it on the periphery of the turntable so that the bobbins are precisely located with respect to the several applicators at the inserting stations. The applicators are adjusted to insert a terminal into each of the several terminal receiving openings in the bobbins, each applicator being movable relatively towards and away from the turntable during an operating cycle to insert a single terminal.]

BACKGROUND OF THE INVENTION

The present invention is directed generally to apparatus for inserting terminals into insulating blocks and particularly for inserting terminals into coil bobbins or the like. The principles of the invention are also applicable to machines for inserting, for example, contact terminals into printed circuit board edge connectors and similar devices.

Vast numbers of electrical coils are used in, for example, the communications industry, and in the manufacture of motors, solenoids, and relays. These coils are ordinarily of small size and are wound on plastic bobbins which have a plurality of terminals mounted in their flanges. The terminals are used to connect the taps from the coil to the lead wires from the external circuits. The relatively small coils used are of widely varying configurations although vast numbers of such coils will lie within a relatively small range of dimensions. Because of the variations in the bobbin configurations, the operation of inserting the terminals into the coil bobbin flanges has heretofore constituted a relatively expensive and time consuming portion of the total cost of the bobbin. For this reason, there is a need for a versatile high speed inserting apparatus which is capable of automatically inserting terminals into

coil bobbins or similar insulating blocks of varying shapes and sizes.

It is accordingly an object of the invention to provide an improved apparatus for inserting terminals into insulating blocks. A further object is to provide an automatic apparatus for inserting terminals into bobbins. A still further object is to provide a terminal inserting apparatus for coil bobbins which is adaptable of bobbins of varying sizes and shapes. A still further object is the provision of an apparatus capable of inserting terminals into bobbins at several nonaligned locations on the bobbin flange.

A further object of the invention is to provide an improved method of inserting terminal members into insulating blocks such as bobbins.

These and other objects of the invention are achieved in a preferred embodiment thereof comprising a rotatable and indexible turntable having a plurality of bobbin holding jigs mounted at spaced intervals on its periphery. Each bobbin holding jig is adapted to receive an approximately located bobbin and has means thereon for clamping the bobbin during an indexing cycle of the table in a manner such that the bobbin is precisely located and firmly clamped at a predetermined position on the periphery of the turntable. A plurality of inserting mechanisms or applicators are provided on a fixed table which is mounted below the turntable and located at each of the several inserting stations so that as the bobbins are presented to each inserting station, a single terminal will be inserted into one opening in the bobbin. The inidividual applicators are adjustably mounted on the fixed table so that they are capable of inserting a terminal at any location within a predetermined area which is representative of the area occupied by the bobbins at the insertion station. In this manner, it is merely necessary to adjust the position of each applicator relative to the turntable to insert terminals into any one or all of several openings which are in the bobbins which are adapted to receive terminals. By virtue of this feature, and other features described more specifically below, an apparatus in accordance with the invention can be adapted to accommodate bobbins of varying sizes and shapes with equal efficiency.

IN THE DRAWINGS

FIG. 1 is a perspective view of one type of coil bobbin having openings in its flanges which are adapted to receive terminals;

FIG. 2 is a perspective view of a short section of terminal strip, one terminal being broken away from the strip to illustrate the manner in which the strip is severed in the apparatus in accordance with the invention.

FIG. 3 is a diagrammatic plan view showing one-half section of an apparatus in accordance with the invention;

FIG. 4 is a sectional side view of the apparatus of FIG 3;

FIG. 5 is a plan view of a bobbin holding jig, this view showing the positions of the parts when the jig is opened and prior to clamping of the bobbin;

FIG. 6 is a view similar to FIG. 5 but showing the positions of the parts when the clamping mechanism on the jig is closed;

FIG. 7 is a sectional side view of the jig of FIGS. 5 and 6 showing the positions of the parts prior to clamping of the bobbin;

FIG. 7A is an unsectioned side view of the jig showing the positions of the parts prior to clamping of the bobbin;

FIG. 7B is a sectional view similar to FIG. 7 but showing the positions of the parts after the bobbin has been clamped;

FIGS. 8, 9, 10, and 11 are views taken along the lines **8—8**, **9—9**, **10—10**, and **11—11** of FIGS. 5 and 7;

FIGS. 12A and 12B (which are intended to be placed beside each other) present a sectional side view of an inserter of applicator in accordance with the invention;

FIGS. 13, 14, 15, 17, and 18 are sectional views taken along the lines **13—13**, **14—14**, **15—15**, **17—17**, and **18—18** of FIG. 12;

FIG. 16 is a view similar to FIG. 15 but showing the positions of the parts at an intermediate stage of the operating cycle;

FIG. 19 is an exploded perspective view showing details of a terminal clamping means; and

FIG. 20 is a top plan view of the inserter shown in FIGS. 12A and 12B.

Referring first to FIGS. 1 and 2, the disclosed embodiment of the invention is adapted to insert terminals **2** into bobbins which are generally indicated at **4**. Each bobbin comprises a transversely extending spool portion **19** having flanges generally indicated at **18** and **20** on its ends, at least one of these flanges being provided with a plurality of openings in its edge which are adapted to receive individual contact terminals **2**. The terminals are manufactured in the form of a continuous strip **6**, each terminal comprising a leading end **8** which is inserted into the bobbin hole having a plurality of lances **10** on its sides which prevent removal of the bobbin from the hole after insertion. The trailing end of the terminal, which projects from the bobbin opening after insertion, is in the form of a spade having spaced-apart tynes **12**. The individual terminals are connected to each other by transition pieces **14, 16** which are slugged or severed from the strip in a manner described below at the time of insertion.

As shown in FIGS. 3 and 4, the disclosed embodiment of the invention comprises a fixed circular table **26** and a turntable **28** mounted above the fixed table. The turntable is adapted to be indexed at periodic intervals by any suitable indexing means to present the individual bobbins mounted on work holding jigs **32** successively to each of the several insertion heads or applicators **30** mounted on the fixed table **26**. The bobbins **4** are loaded in the work holding jigs **32** at the loading station indicated at **29** in FIG. 3 and while the jig is moving from the loading station to the first insertion station **31**, the bobbin is firmly clamped and accurately positioned on the periphery of the turntable so that it will be precisely located with respect to the applicators. In the description which follows, the work holding jigs will first be described in detail and a description of the structural features of the applicators will be presented following this description of the work holding jigs.

Referring now to FIGS. 5–11, each work holding jig **32** is mounted on the upper surface of the turntable **28** and arranged radially with respect to the turntable so that its bobbin holding elements are disposed adjacent to the periphery of the turntable. Each jig comprises a base plate **34** secured to the turntable by fasteners **35** and having a mandrel, generally indicated at **36**, at its left-hand end as viewed in FIG. 7. The mandrel **36** is a cross section conforming to the opening which extends through the spool portion of the bobbin and is mounted on, and removably secured to, a mandrel block or base **38** which rests upon a spacer plate **40**, fasteners **46** extending through the turntable, through the base plate, through the spacer plate, and into the mandrel block to secure the mandrel block in position. Accurate location of the mandrel block on the base plate is achieved by means of a pin **42** mounted in an opening in the turntable and extending into an elongated slot **44** on the underside of the mandrel block. A detent **48** is mounted in a slot **50** on the left hands side of the mandrel and is resiliently biased leftwardly by means of a spring **52**, to bias the bobbin mounted on the mandrel leftwardly and facilitate its removal, after the terminals have been inserted, at the removal station of the apparatus. Accurate location of the bobbin is also achieved by means of a shoulder **54** on the lower most flange in FIG. 7 which bears against a corresponding shoulder on the upper surface of the mandrel block. This shoulder on the mandrel block extends entirely across the flange and is commonly provided in order to permit positioning of a bobbin on a suitable work holder.

Advantageously, the mandrel is removable from the mandrel block **38** in order to permit use of mandrels of different shapes or sizes for different types of bobbins. In the disclosed embodiment, the mandrel has a depending boss **56** which extends into a slot **58** in the upper surface of the mandrel block and is secured in this slot by means of a fastener **60** extending inwardly from the front side of the mandrel block.

When the individual bobbins are mounted or positioned on the mandrel at the loading station, one of the rearwardly extending flanges **20*b***, as viewed in FIG. 7, is located against a surface of a positioning block **62** which is secured to, and extends from, an arm **64** of a bracket. This bracket extends upwardly as shown at **66** from a base **68** and is secured to the base plate and to a support block **72** by suitable fasteners **70**. As will be apparent from the description which folows, when the bobbin is firmly clamped on the jig, the flange **20*b*** is moved firmly against the surface of the block **62** by a clamping mechanism.

The bobbin mounted on the mandrel is clamped firmly against the surface of the block **62** and its shoulder **54** is clamped against the shoulder on the upper surface of the mandrel block by means of a clamping bar **76** which extends transversely of the bobbin and above the inner surface of the flange indicated at **18*a***. Referring to FIG. **11**, the ends of the clamping bar **76** are supported on blocks **78, 78'** by means of pins **79** which extend through the ends of the clamping block and through recesses in the lower ends of the blocks **78, 78'**. Springs **80** surround the lower ends of these pins and bear against the inner surfaces of these recesses and against the lower heads **81** of the pins. This construction permits the clamping bar **76** to be displaced relatively upwardly with respect to the blocks **78, 78'**, by a slight amount against the biasing force of the springs **80** when the clamping bar moves inwardly and against the inner surface of the flange **18*a*** as will be apparent from the description which follows.

The blocks **78, 78'** are secured to the ends of arms **82, 82'** which are mounted on each side of a main slide block **84**. These arms extend rearwardly toward the right-hand end of this slide block as viewed in FIG. 7, the ends of the arms **82, 82'** being pivotally mounted on pins **86** (see FIG. 8) thereby to permit a slight downward pivoting of the arms and the clamping bar **76** when the slide block **84** moves rightwardly as viewed in FIG. 7.

The arms **82, 82'** are swung through a slight arc, to move the clamping bar **76** downwardly, by means of a cam roller **88** contained in a housing **90** which extends between, and is interengaged at **92** with the arms **82, 82'** at the left-hand hand end of the slide block **84**, see FIG. 10. The block **90** has a central recess on its underside which straddles a fixed cam block **96** secured by fasteners **98** to the base plate **34**. This cam block has a slot **94** through which the roller extends, this slot being contoured such that a slight downward movement of the arms will take place during the rightward movement of the slide block **84** which will be apparent from FIG. 7.

The slide block **84** is moved rightwardly, while the turntable transports the jig from the loading station to the first insertion station, by means of a connecting rod **108** which is coupled to the slide block **84** by means of an additional block **100**. The block **100** is slidably mounted on the upper surface of the slide block **84** and has a pin **102** extending downwardly intermediate its ends and into a slot **106** in the upper surface of the slide block. A spring **104** is contained in the slot **106** and bears at one end against the lower end of the pin **102** and at its other end against the rearward wall of the slot **106**. Spring **104** is relatively stiff so that relative rightward movement of the link **108** will initially cause rightward movement of the slide block but when the slide block reaches the limit of its travel as determined by a stop described below, further move-

ment of the link and the block **100** relative to the slide block is permitted with concomitant compression of the spring.

The connecting rod **108** has one of its ends pivotally connected to the projecting end of the pin **110** and is pivotally connected at its other end **112** to one arm **114** of a bell crank. As shown best in FIG. 5, the connecting rod **108** is of dog-leg shape to permit overtravel of the block **100** in a manner which will be described below.

The arm **114** of the bell crank is integral with, and extends from, a central bearing boss portion **116** which is mounted on a pin **118** extending into a support block **120** which, in turn, is mounted on the upper surface of the turntable **28** by fasteners **122**. The other arm **124** of the bell crank structure, which is angularly spaced from the arm **114**, is disposed in a plane beneath the plane of the arm **114** and is adapted to be engaged by a cam roller **126** mounted on a fixed plate **128**. The cam roller **126** is disposed between the loading station and the first insertion station of the apparatus so that when the turntable indexes and a bobbin holding jig moves from the loading station to the first insertion station, the bell crank **124**, **114** will be swung through a clockwise arc as viewed in FIG. 5 to move the slide member **84** rearwardly to the position of FIG. 6. As previously explained, this results in rightward movement, as viewed in FIG. 7, of the clamping bar **76** so that it moves against the inner surface of the flange **18***a* of the bobbin, clamps the bobbin flange **20***b* against the surface of the block **62**, and at the same time, clamps the flange **18***a* against the shoulder on the upper surface of the mandrel block **38**.

The bobbin which is mounted on the mandrel is also positioned and clamped accurately in a horizontal plane and along the line extending at right angles to the direction of movement of the clamping bar **76** by means of a side clamp member **130** which moves leftwardly from the position of FIG. 5 to the position of FIG. 6 to push the bobbin against the surface of a clamping plate **131** mounted on and extending from the base plate **34**. The clamping member **130** comprises a pair of spaced apart relatively thin plates which are pivotally mounted at **132** on the opposite sides of the reduced diameter end portion **136** of a clamping arm **134**. The pivotal movement of the clamping member **130** is limited by means of a pin **138** mounted in the reduced diameter end **136** of the clamping arm which extends through suitable slots in the clamping member **130**. The clamping arm **134** extends alongside the arm **82'** obliquely in FIG. 5 towards the rearward end of the positioning and holding jig and is pivotally mounted at its end **140** on a bracket **142** secured to the base plate **34**. The arm **134** is swung through a slight clockwise arc during rearward movement of the slide block **84** by means of a cam slot **144** on the upper surface of the block **100**. The cam slot **144** receives a cam follower **146** which is mounted in the end of a laterally extending bracket **148** which is secured, in turn, to the arm **134** intermediate its ends by fasteners **152**. It will thus be apparent that upon rearward movement of the slide block **84**, the follower **146** will move leftwardly as viewed in FIGS. 5 and 6, by virtue of the contour of cam slot **144**, to swing the arm **134** through the clockwise arc which causes movement of the clamping member **130** against the right-hand side of the bobbin. In the event of overtravel of the slide member, as will be explained below, the clamping members **130** are permitted to remain stationary and resiliently biased against the side of the spool portions of the bobbin by virtue of the pivotal connection **132** between these clamping members and the arm **134**. In the disclosed embodiment, the clamping members **130** have laterally extending ears **154** to which a rod **158** is pivotally connected at **156**. The opposite end of this rod is mounted at **162** in an extension on the base portion **150** of the bracket **148** and a spring **160** surrounds this rod and bears against a suitable collar adjacent to the ear **154**. If overtravel of the arm **134** takes place, the clamping members **130** pivot slightly with respect to the arm **134** and the spring **162** will be compressed. When the parts return to their normal positions, the clamping members **130** are returned to the position shown in FIG. 5 by the spring **160**.

The forward movement of the slide block **84** is limited by an adjustable stop pin **164** which is threaded into a bracket **166** mounted on the upper surface of the base plate **34**.

It will be apparent from the foregoing description that when a bobbin is placed on the mandrel at the loading station, it need only be approximately positioned and properly orientated by the operator. As the jig on which the bobbin has been placed moves from the loading station to the first insertion station, the connecting rod **108** will be moved from the position of FIG. 5 to the position of FIG. 6 thereby effecting clamping of the bobbin securely to the mandrel by both the clamping member **130** and the clamping bar **76**. As best shown in FIG. 6, the pivotal connections **110**, **118**, and **112** are in substantial alignment with each other when the bobbin is clamped in the jig and, in fact, there may be some overtravel so that the pivotal connection **112** between the belt crank arm **114** and the connecting rod **108** would be slightly to the right of the position shown in FIG. 6. The bobbin will thus be resiliently and firmly held in position. At the unloading station, a suitable opening cam roller **161**, which is also mounted on the plate **128**, engages an additional arm **163** extending from the bearing boss portion **116** of the bell crank. This additional follower swings the bell crank **114**, **124** to the position shown in FIG. 5 thereby to release the clamping pressure on the bobbin and permit its removal.

Referring now to FIGS. 12A–20, the individual inserting mechanisms **30** are each mounted on the fixed table **26** by means of adjustable pedestal structures so that they can be individually adjusted to insert a terminal at any location within a predetermined target area occupied by the bobbins. As shown best in FIGS. 12B, 14, and 15, each adjustable supporting structure comprises a base plate **168** mounted on the upper surface of the fixed table **26** between gibs **169** and clamped to the upper surface of the fixed table by means of fasteners **172** which extend through a clamping plate **174** and through slots **170** in the base plate **168**. Each base plate has a vertically extending support flange **176** against which a vertically adjustable applicator support plate **178** is mounted. The vertically adjustable plate **178** has a side portion **180** which is slidably contained between gibs **177** on the sides of the flange **176**. Vertical adjustment of the positions of the plate **178** is achieved by means of a jackscrew **182** which is threaded through the side portion **180** of the plate **178** and has a reduced diameter end **186** which is received in a suitable opening in the base plate **168**. The upper end of this jackscrew is rotatably supported in a fixed bearing block **184** mounted on the upper end of the flange **176**. Plate **178** can be clamped in any desired position of adjustment by means of clamping screws **188** which extend through suitable slots in the flange **176** and are threaded in the side portion **180** of the plate **178**.

The inserter itself is mounted on a support plate **179** which, in turn, is adjustably supported on the upper surface of the plate **178**, precise adjustment may be achieved by means of a screw **181** which extends through a yolk **183** on the underside of the support plate **179** and is threaded into the vertically adjustable support plate **178**. Again, suitable clamping screws are provided to clamp the applicator or inserter in a precise position of adjustment.

It will be apparent from the inspection of FIGS. 12B, 14, and 15 that the inserter can be adjusted towards and away from the turntable by means of the screw **181**. Vertical adjustment of the position of the inserting head is achieved by means of the vertically adjustable support plate **178**, and horizontal adjustment in a direction at right angles to the direction of movement of the plate **179** can be achieved by virtue of the plate **168**. When the apparatus is being set up for a particular embodiment, the posi-

tions of each of the inserting mechanisms will be adjusted to insert a terminal into each of the openings in the bobbin being processed.

Each inserting mechanism or applicator is mounted on a generally H-shaped frame block **192** (FIG. 14) having a horizontally extending web **194** and sides **196**. Web **194** is provided with an opening **193** intermediate its ends as shown best in FIG. 15. This frame block **192**, in turn, is slidably mounted on a channellike support block **198**, which is secured to the applicator base plate **179** by suitable fasteners **200**. The sides **202** of the support block **198** have beveled bearing blocks **204** secured to their external surfaces by fasteners **206** and the lower portions of the sides **196** of the frame block **192** have complementary bearing members **208** secured thereto by fasteners **210**. The support block **198** is thus anchored to the fixed applicator base plate **179** while the frame block **192**, and the structure described below which is mounted thereon, is reciprocable towards and away from the turntable and towards a bobbin held on the turntable.

Reciprocation of frame block **192** is achieved by means of a piston cylinder **212** suitably mounted on the upper surface of the applicator support plate **179** and having a piston rod **214** with a coupling head **216** on its end. The head **216** is coupled at **220** to a connecting rod **218** which extends forwardly between the sides **202** of the support block **198** and which is bifurcated at its end as shown at **222** (FIG. 14). The spaced-apart ears on the end of this connecting rod straddle one side **224** of a U-shaped clevis block **226** and are pivotally connected to this side of the clevis block by means of a pin **228**. The clevis block **226**, in turn, is secured to the underside of the web **194** of the frame block **192** by suitable fasteners **230**. It will be apparent that upon rightward and leftward movement of the piston rod **214**, the applicator frame block **192** will be moved towards and away from the turntable. The shearing and terminal feeding mechanisms mounted on the applicator are actuated during such reciprocation of the piston rod by linkages which are described below.

A vertically reciprocable ram plate **232** is mounted slidably against the right-hand end of the applicator as viewed in FIG. 12B and is reciprocated by means of a lever **244** which extends beneath the web **194** of the frame member **192**. The end portion **240** of this lever is of reduced thickness and is pivoted at **242** between a pair of spaced-apart ears of a coupling block **234**. The coupling block, in turn, is secured by suitable fasteners **236** to the rearwardly facing side of the ram plate **232** as best shown in FIG. 12B.

The lever **244** has an opening **246** (see FIG. 17) extending for a substantial portion of its length and one leg **248** of the previously identified clevis block **226** extends into this opening adjacent to the right-hand end of the lever as viewed in FIG. 17. Lever **244** is pivotally mounted on the previously identified pin **228** which extends through both legs **224**, **248** of the clevis block **226** as best shown in FIG. 14. A fixed cam block **250** is secured to the support block **198** by means of suitable fasteners **252** and extends into the opening **246** of lever **244** on the left-hand side of block **226**. This cam block is provided with a horizontally extending cam slot **254** which receives a cam follower **256**. The cam follower **256** is mounted on a pin **258** which is mounted in the left-hand end of the lever **244** and which extends through the opening **246** in this lever and through the cam slot **254** as shown best in FIG. 17. As will be apparent from FIG. 12B, the shape of the cam slot **254** is such that when the lever moves rightwardly from the position of FIG. 12B, it will be rocked about its pivotal axis **228** through a slight clockwise arc thereby causing the ram plate **232** to be moved downwardly. Rearward movement of the lever with respect to this fixed cam plate **250** returns the ram plate **232** to its initial position. Since the lever **244** is secured to the reciprocable frame block **192** by means of the mounting block **226**, such rocking of the lever takes place during each operating cycle. The downward movement of the ram plate **232** effects severing of the leading terminal of the strip from the next adjacent terminal as will be described below.

The terminal strip is fed toward the right-hand end of the applicator, as viewed in FIGS. 12A and 20 over the upper surface of the feed platform **260** having a groove **262** on its upper surface which serves as a guide. Additional guide means **263** in the form of flanges adapted to extend over the groove **262** are secured to the platform as best shown in FIG. 18. The terminal strip is fed from a suitable supply reel (not specifically shown) over an arcuate guide plate **264** which is secured to, and supported on, a bracket **266** which is mounted on the stationary base plate **179**. It should be noted that the feed platform **260** reciprocates with the frame block **192** while this bracket **266** remains stationary. The feed platform **260** rests on a support block **268** and is secured thereto by fasteners **270**, the support block **268**, in turn, being secured by fasteners **272** to the upper ends of the sides **196** of the frame block **192**, see FIG. 14.

The terminal strip is advanced by means of a feed finger **274** pivotally mounted intermediate its ends on a pin **276** which extends transversely across a feed finger housing **284**. The forward end of this feed finger is biased downwardly by a spring **278** while the left-hand end, as viewed in FIG. 12B, bears against a slotted pin **280** mounted in the housing **284**. An arm **282** extends laterally from the pin **280** so that upon rotation of the pin, the feed finger is moved upwardly against the biasing force of spring **278** to disengage it from the strip. Such disengagement of the finger from the strip is necessary when a new strip of terminals is being threaded through the applicator or when the applicator is otherwise being serviced.

Feed finger housing **284** is mounted in a reciprocable feed carriage **286** by means of a clamping screw **288** which extends downwardly through the carriage and into the housing, an adjusting screw **290** being provided in the carriage to accurately locate the housing, and, therefore, the stroke limits of the feed finger with respect to the carriage. The feed finger is reciprocated by means of the piston cylinder **212** in a manner which will be described below.

The feed finger and the feed carriage **286** move with the applicator towards and away from the turntable, and, in addition, move with respect to the applicator to advance the strip during the operating cycle. It is desirable to provide a pawl or detent mechanism on the applicator which is not moved with respect to the applicator and which permits feeding of the strip towards the right-hand end of the applicator prevents retractile movement of the strip. In the disclosed embodiment, a detent mechanism **292** is provided which is fixed to the upper surface of the platform **260**. The parts of this detent or antibackup mechanism are precisely the same as the parts described above of the feed finger and need not, therefore, be specifically identified or described in detail. It need only be remembered, that this detent moves with the applicator but not with respect to the applicator as does the feeding mechanism.

Carriage **286** extends across the upper surface of the platform **260** and has its ends secured by fasteners **294** to a pair of downwardly extending straps **296**, see FIGS. 15 and 18. The lower ends of these straps have a relatively snug fit in openings **300** in a feed slide **298** (see FIG. 15) which is disposed between the sides **196** of the H-shaped frame block **192** and which rests on the web portion of this block. A shallow recess **302** is provided on the right-hand end of the slide **298** and a link **304** has one of its ends pivoted in this recess as shown at **308**. Link **304** is pivotally connected to an additional link **306** which, in turn, extends rearwardly of the applicator as viewed in FIG. 15 and is pivotally connected at **312** to a block **214**. The block **314** is adjustably mounted, by means of an

adjusting screw **316**, between the sides **196** of the frame block so that it reciprocated with the frame block during operation. The link **306** has a cam follower **322** on its underside which is received in a cam slot **320** of a cam block **318**. This cam block is secured by fasteners **319** to the upper surfaces of the sides **202** of the block **198** and extends into the opening **193** of the web portions of the frame block. It will be recalled that this block, in turn, is fixed to the applicator base plate **179** so that the cam block **318** does not reciprocate during the operating cycle.

FIG. 15 shows the positions of the parts at the beginning of the operating cycle and when the applicator is in its retracted position with respect to the turntable. During the operating cycle, the applicator moves rightwardly to the position of FIG. 16 and the cam follower **322** is required to move along the cam slot **320** in the block **318**. Since the cam block **318** is fixed and does not move with the applicator, the toggle mechanism, comprising the links **304**, **306**, is broken (see FIG. 16) so that the slide **298** is moved relatively leftwardly with respect to the frame block **192**. The feed carriage **286** is carried leftwardly with respect to the frame block since this carriage is rigidly connected to slide **298** by means of the straps **296** as previously explained. It will thus be apparent that the retraction of the feed carriage **286**, that is, the movement of the carriage leftwardly with respect to the reciprocable frame block **192**, takes place while the frame block itself is moving rightwardly as viewed in FIGS. 12 and 15, that is, towards the turntable. Feeding of the terminal strip takes place while the applicator is moving away from the turntable while retraction of the feed carriage takes place while the applicator is moving towards the turntable.

From the foregoing description, it will be apparent that the motion for the feed stroke is obtained from the reciprocable feed block by means of the block **314** and the toggle mechanism **304**, **306** and the strips **296**. It is desirable to provide a spring **324** which is effective between the slide **298** and the block **314** to bias these moving parts in one direction in order to take up any looseness in the drive train for the feed finger and to insure smooth operation thereof. In the disclosed embodiment, the spring **324** is interposed between the forwardly facing side of the block **314** and one side of the arm **298**.

The shearing mechanism which shears the leading terminal of the strip from the next adjacent terminal is actuated at the beginning of the operating cycle by the lever **244** as previously described. The strip is fed through an opening **326** in the face of the reciprocable ram **232**, the ram, in turn, being slidably mounted against the face of a housing **328** by means of clamping plates **330** and fasteners **332**. As best shown in FIG. 15, the plates **330** retain the ram in the housing and the fasteners **332** function to hold the plates **330** and the housing **328** against the forward end of the reciprocable frame block. An insert **334** is mounted in the housing **328** by fasteners **335** (see FIG. 13) and has a downwardly and rearwardly extending opening **336**, the edges of which cooperate with the shearing member **342** to sever the leading terminal from the strip and slug out the connecting slug between the adjacent terminals. The chip opening communicates with a chute **338** which extends downwardly to discharge the slugs as shown in FIG. 12.

The shearing member **342** is integral with, and depends from, a shearing block **340** which is secured by fasteners **344** to the face of the ram **232**. At the beginning of the operating cycle, the strip will have been fed during the previous operating cycle so that the leading terminal will extend rightwardly as viewed in FIG. 12 beyond the opening **336**. During downward movement of the ram then, the shearing member **342** will move into the opening **336** to effect the shearing operation and the connecting slug will drop downwardly and will be discharged through the chute **338**. After the leading terminal has been severed from the strip and while it is being carried towards the bobbin and inserted into the bobbin opening, it is clamped on the upper surface of the insert **334** by a clamping structure which now will be described.

The clamping means for clamping the severed terminal is mounted on a block **346** (FIGS. 12, 18, and 19) which is contained between the sides of the reciprocable frame block and which is secured by fasteners **348** to the frame. Block **346** has an inwardly extending recess **350** centrally located on its right-hand side adjacent to the ram as shown in FIG. 18, this recess **350** accommodating a clamping member **351** and a slide member **360**. As shown in FIG. 19, the clamping member **351** is in the form of a yolk having spaced-apart arms **354** which straddle the shear blade **342** and which are connected at their forward end as shown at **343**. A locating pin **352** is mounted in the forward end of the clamp and extends downwardly against the surface of the insert **334**, this pin being adjusted to enter the severed terminal between the trailing legs thereof to support it while it is being pushed into the bobbin. The underside of the forward section **343** of the clamping member is recessed as shown at **355** so that it will straddle the terminal and support it against lateral movement.

Clamping member **351** has an upstanding ear **358** at its rearward end and is pivotally connected by a pin **356** to the slide member **360**. The slide member is slidably mounted in the lower portion of the recess **350** and has laterally extending flanges **372** at its rearward end which limit its rightward movement as viewed in FIGURE 12B beyond the position shown in that Figure. Slide member **360** is provided with an upstanding ear **364** which is opposed to the ear **352** and a compression spring **366** is interposed between these two ears so that the clamping member **351** is biased in a clockwise direction about the pivot pin **356**, which connects the slide to the clamping member. Such biasing of the clamping member urges it against the surface of the leading terminal and urges the pin downwardly against the surface of the insert **334** so that it will back up the leading terminal. It will be apparent that this clamping member **351** can be displaced upwardly when the strip is fed to locate a terminal at the end of the applicator.

It is desirable to provide for a limited amount of overtravel of the applicator with respect to the bobbin into which the terminal is being inserted. The openings in the bobbins into which the terminals are inserted are not always of precisely the same depth and if the applicator is adjusted to insert a terminal fully into an opening of a precisely positioned bobbin, the next bobbin may have a shallower opening so that full insertion of the terminal will have been achieved before the applicator has reached the limit of its travel. In order to provide with such overtravel of the applicator, the center portion of the block **346**, which is behind the ear **364**, is provided with a drilled opening in which a plurality of compressible washers are mounted. A plug, as indicated, is mounted in the end of this opening and bears against the rearwardly facing side of the ear **364** and a set screw **370** is mounted in the opposite end of the opening to contain the washers. If a terminal is fully inserted prior to the end of the stroke of the applicator towards the turntable, the slide member **360** will thus be permitted to remain stationary relative to the applicator and the washers **368** will be compressed as is apparent from FIG. 12B. Only a slight clearance is provided between the left-hand side of the ear **364** and the opposed surface of the upper portion of the block **346**. This clearance is adequate to provide for the limited overtravel which occasionally takes place.

The briefly review of the operating cycle of the disclosed embodiment, the bobbins are positioned on the bobbin mandrels of the holding jigs at a loading station. This may be carried out manually or by a suitable loading apparatus as desired. In any event, only approximate positioning of the bobbins is required for the reason that

while the turntable indexes, and a previously loaded bobbin is carried to the first insertion station, the bobbin will be firmly clamped and precisely positioned on the mandrel **36** by the associated side clamp member **130** and clamping bar **76** (see FIGS. 5 and 6). As the bobbin is presented to each of the insertion stations, the applicators located at the stations move inwardly towards the turntable to insert a terminal. At the beginning of the operating cycle of each applicator, the terminal strip will have been fed so that the leading terminal extends beyond the end of the applicator. This leading terminal is sheared from the next adjacent terminal during movement of the applicator by the shearing blade **342** on block **340**. The block **340** is mounted on the upper end of ram plate **232** which is moved downardly by lever **244** as the lever is swung about a slight clockwise arc (as viewed in FIG. 12B) by cam slot **254**. After this leading terminal has been severed from the terminal strip, it is resiliently held against the upper surface of insert **334** by clamping member **351** until it is inserted into the bobbin.

The terminal strip is fed by the feed finger **274** which is pivotally mounted on the reciprocable feed carriage **286** by means of the feed finger housing **284**. During movement of the applicator towards the turntable (i.e., during the insertion stroke of the applicator) the carriage and finger are retracted or moved a short distance away from the turntable by the toggle **304, 306** which is broken by cam slot **320**. During retractile movement of the applicator, the toggle is straightened thereby to move the carriage and feed finger towards the turntable to feed the terminal strip relative to the applicator.

Any desired control and safety devices may be provided on the disclosed form of apparatus to detect, for example, the improper positioning of a bobbin on a holding jig of the end of a strip of terminals in any of the applicators and to shut down the machine upon receipt of a signal indicating such events. The only essential control circuitry required is for the piston cylinder **212** which is preferably of a double acting type and which is actuated at the beginning of the cycle to move the piston rod **214** rightwardly and is again actuated to move the piston rod **214** leftwardly after the terminal has been inserted into the bobbin. Such actuation of this piston cylinder can be achieved by a suitable solenoid controlled valve, which, in turn, is controlled by the turntable. The indexing mechanism for the turntable can be of any conventional type. It will be understood that any desired number of applicators can be mounted on the fixed table and that, if desired, the bobbins can be reversed or inverted after terminals have been inserted into one of the flanges to present a different flange to the succeeding applicators. The bobbins may be inverted by a suitable automatic mechanism or can be inverted manually and then repositioned in the holding jigs if desired. Finally, the bobbins can be automatically ejected for they are unclamped as previously described from the jigs after the final terminal has been inserted.

While the applicators of the disclosed embodiment are adapted to feed a single terminal strip, it will be apparent that the principles of the invention can be applied to the feeding of a plurality of terminal strips in each applicator. In other words, the applicator could be designed to feed two or more terminal strips along parallel paths and simultaneously insert two or more terminals into the bobbin or other insulating block. A modification of this type would be particularly beneficial for the insertion of contact terminals into printed circuit board connectors for the reason that connectors of this type commonly have 10, 20 or more terminals therein.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only.

We claim:

1. Apparatus for inserting contact members into insulating blocks comprising:

a turntable;

a plurality of block holding jigs mounted on said turntable at spaced-apart intervals on the periphery thereof;

a plurality of contact member inserters positioned at spaced locations around the periphery of said turntable, each of said inserters being movable relatively towards and away from said turntable and each inserter having means for feeding a strip of said terminal members, means for severing the leading terminal from said strip, and means for holding said leading terminal until it is inserted into an insulating block which is in alignment with said one inserting means; and

said inserter being adjustably mounted to permit adjustment in three directions whereby said terminals can be inserted into openings at different locations on said block.

2. Apparatus for inserting terminals into bobbins comprising:

a turntable;

a plurality of terminal inserters, said inserters being located at spaced intervals around said turntable, each inserter comprising means for moving an individual terminal towards said turntable and into a predetermined target area;

a plurality of bobbin holding jigs on said turntable, each jig being adapted to hold a bobbin within said target area, and

means for adjusting the positions of said terminal inserters to insert terminals at precisely predetermined locations in said target area thereby to permit insertion of terminals into each of several terminal-receiving openings in said bobbin.

3. Apparatus as set forth in claim **2** wherein each of said bobbin holding jigs has clamping means for clamping a bobbin in said predetermined target area, said apparatus including means actuated concomitantly with indexing of said turntable for actuating said clamping means while an individual jig is moving from a loading station to a first insertion station of said apparatus.

4. Apparatus as set forth in claim **3** wherein each of said jigs comprises a mandrel for supporting a bobbin, said clamping means on each jig comprising means for clamping said bobbin against said mandrel.

5. Apparatus as set forth in claim **2** wherein each of said inserters is reciprocable towards and away from said turntable during each operating cycle, terminal strip feeding means on each of said inserters, each of said feeding means being reciprocably mounted on said inserters to feed terminal strip relative to said inserters towards said turntable.

6. Apparatus as set forth in claim **5** wherein each of said inserters has severing means for severing the leading terminal from said strip and clamping means for resiliently clamping said severed terminal during movement of said inserter towards said turntable.

7. Apparatus as set forth in claim **6** wherein said clamping means, on each of said inserters, is slidably mounted on said inserter, and including resilient means biasing said clamping means relative to said turntable, towards said turntable, whereby said inserter is permitted to move relative to said clamping means in the event of complete insertion of a terminal prior to the completion of movement of said inserter towards said turntable.

8. An applicator for inserting a terminal into a bobbin, said bobbin being held in a fixed relationship with respect to said applicator, said apparatus comprising:

a slide member;

means for reciprocating said slide member towards and away from said bobbin;

strip feeding means on said slide member for feeding a

strip of terminals towards and away from said bobbin with respect to said slide member;

severing means on said side member for severing the leading terminal from said strip; and

clamping means for clamping said several terminal during movement of said slide member towards said bobbin, said clamping means being slidably mounted on said slide member and being resiliently biased towards said bobbin, whereby upon complete insertion of said terminal into said bobbin prior to the completion of movement of said slide member towards said bobbin, said slide member is permitted to move with respect to said clamping means until movement of said slide member towards said bobbin is completed.

9. The method of attaching a contact element to a substrate comprising the steps of locating a substrate in a work position, feeding a contact element to a position adjacent the substrate, clamping the element between a pair of jaws in a fixed location relative to the substrate with a portion of the element exposed to the substrate, moving the jaws with the element clamped therebetween toward the substrate to attach the exposed portion of the element to the substrate at a desired location, and releasing the jaws.

10. The method of attaching a lug to a bobbin comprising the steps of mounting a bobbin in a work position,

feeding a strip of lugs toward the bobbin to position the lead lug of said strip adjacent the bobbin, clamping the lead lug between a pair of jaws with a portion thereof projecting from between the jaws toward the bobbin, severing the lead lug from the strip while clamped, moving said jaws with the lead lug clamped therebetween toward the bobbin to seat said lug portion in a lug-receiving pocket on the bobbin, and opening said jaws to release the lug.

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