

[54] **ASSEMBLING APPARATUS**

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[58] Field of Search ...29/203, 628, 626, 629; 227/21

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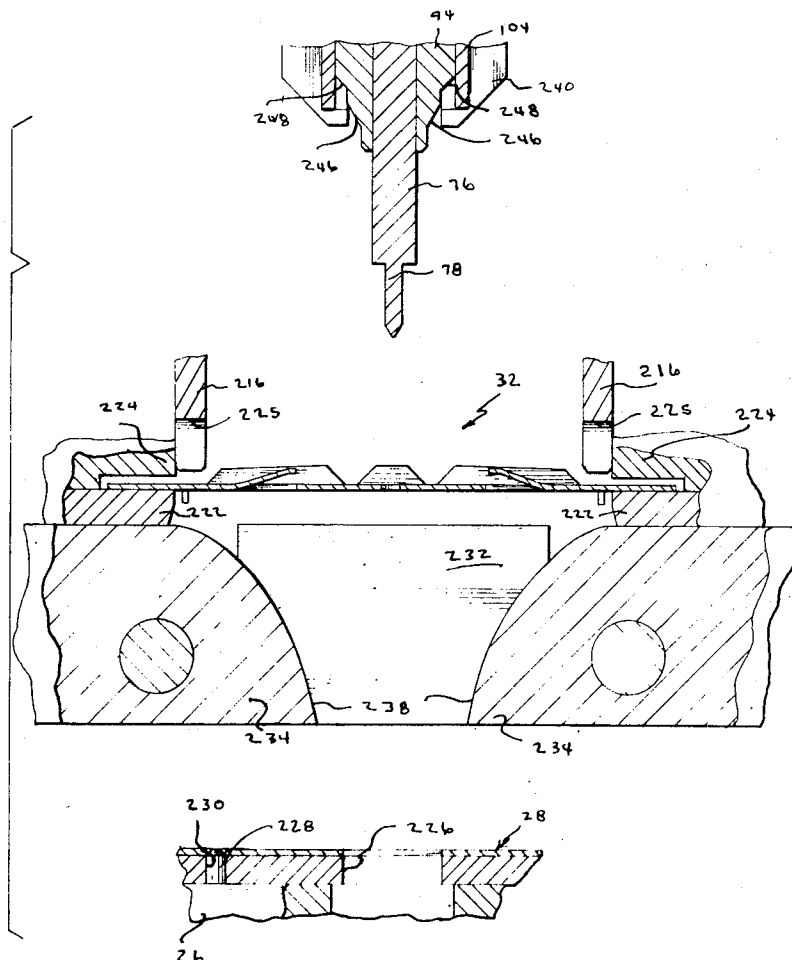
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[57]

ABSTRACT

An apparatus and method are disclosed for staking or assembling articles into an apertured member and particularly for assembling electrical contacts into a printed circuit board. The contacts are intermittently fed in strip form to a work station whereat they are severed from the strip for individual assembling into the board. The printed circuit board is provided with rows of apertures for receiving the contacts and the board is indexed either manually or automatically to successively move apertures into position at the work station for receiving a contact.

3 Claims, 17 Drawing Figures



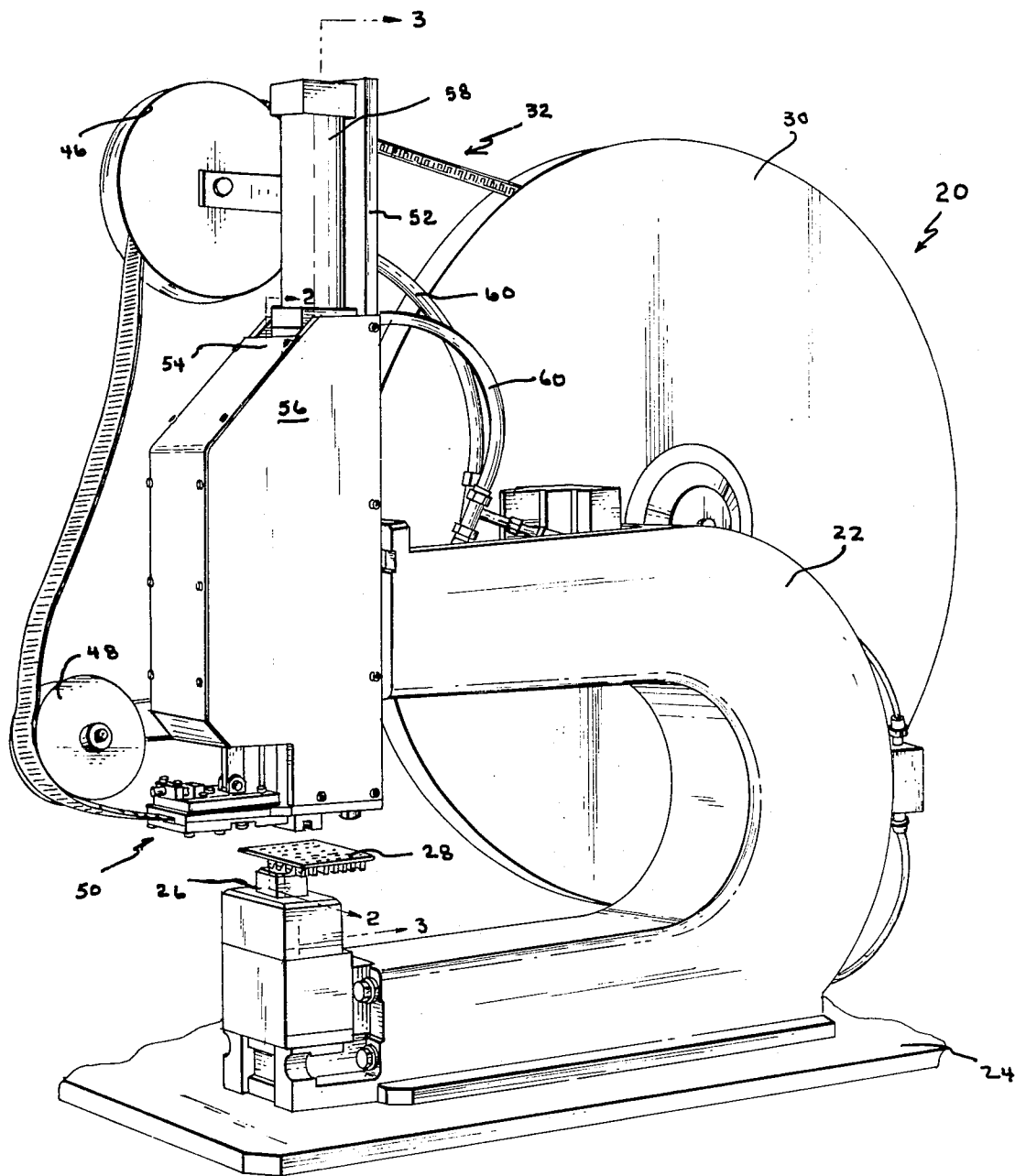
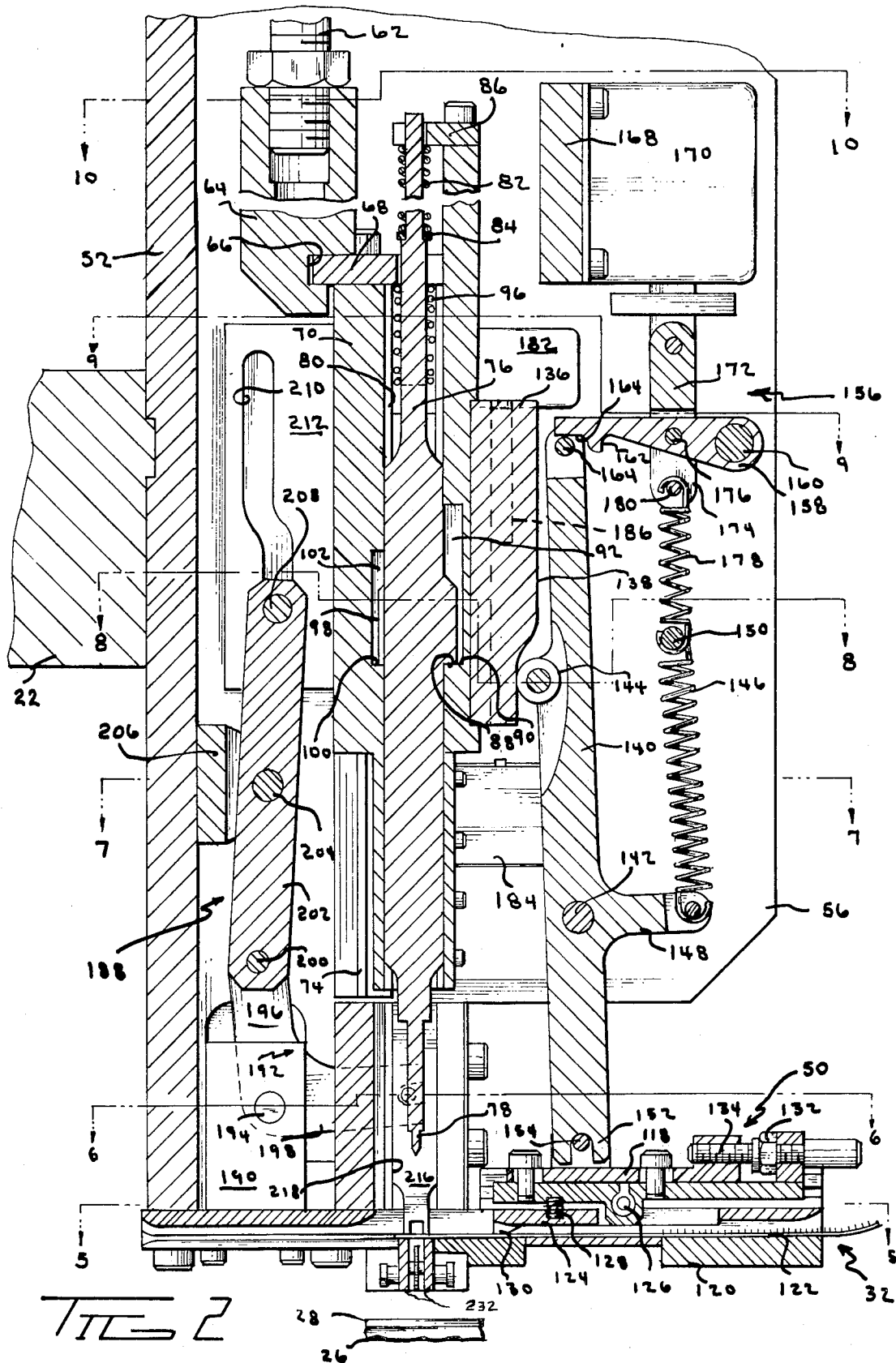


FIG. 1

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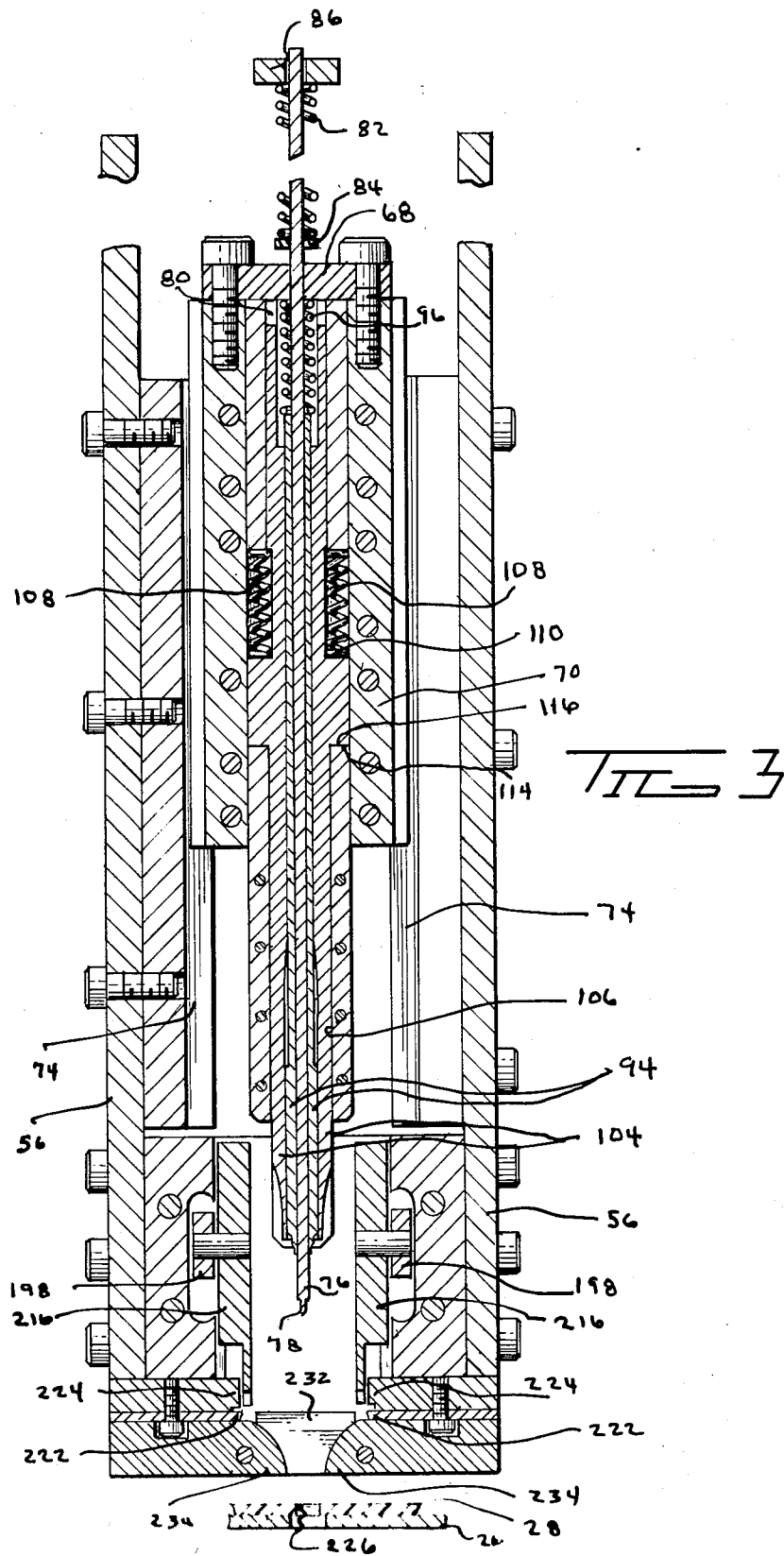
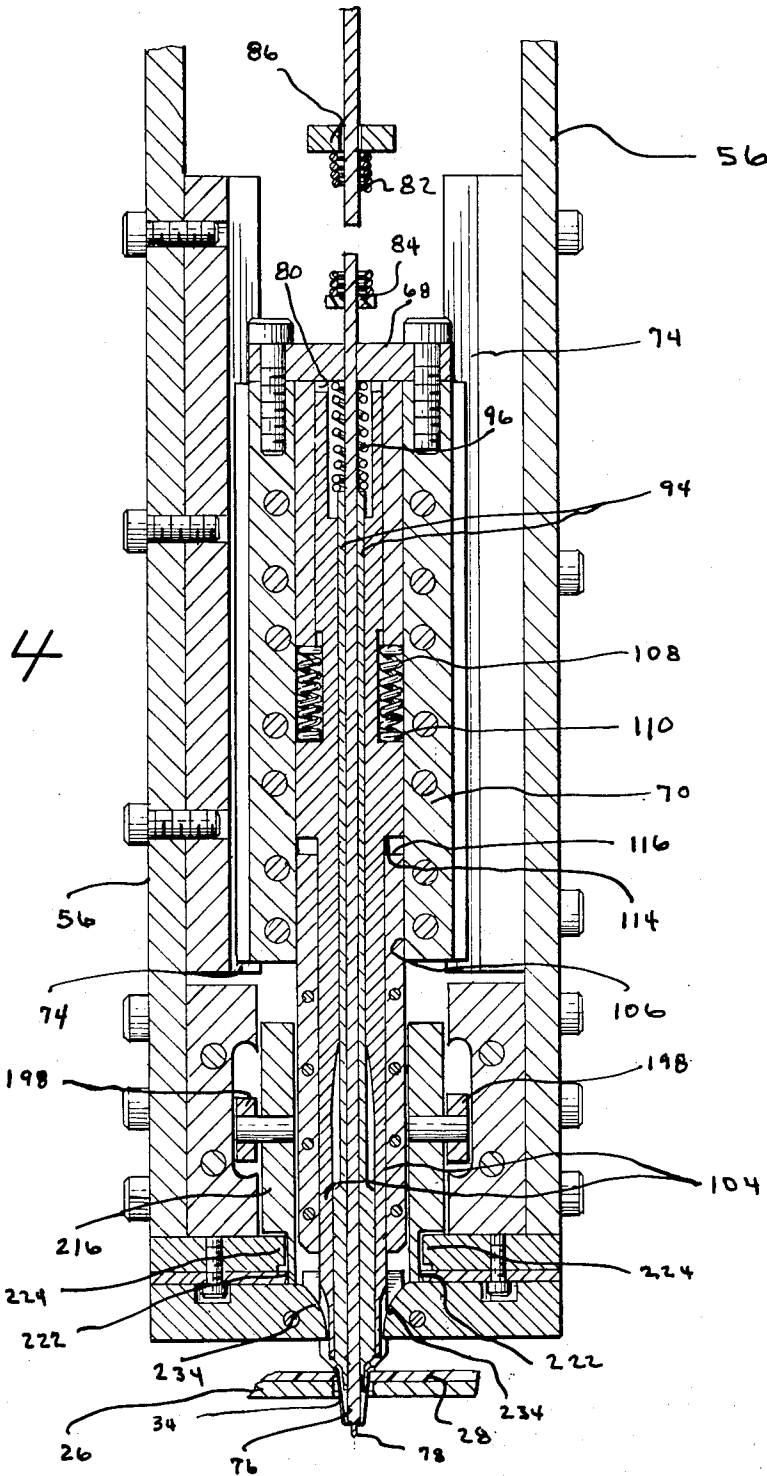
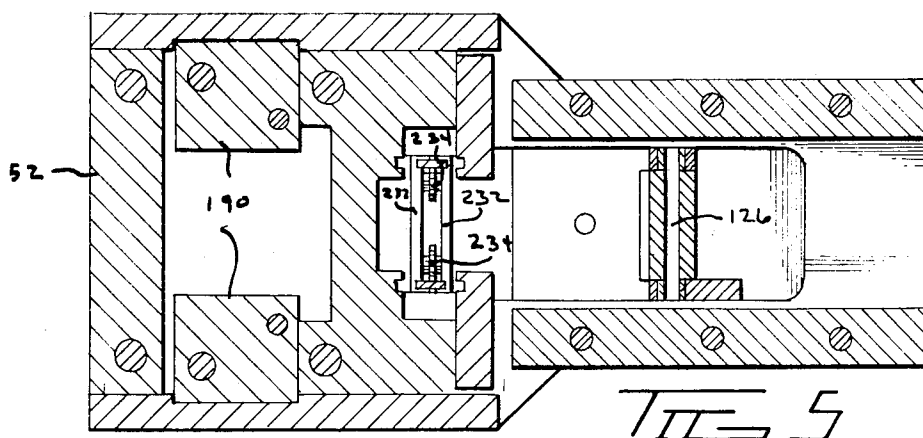
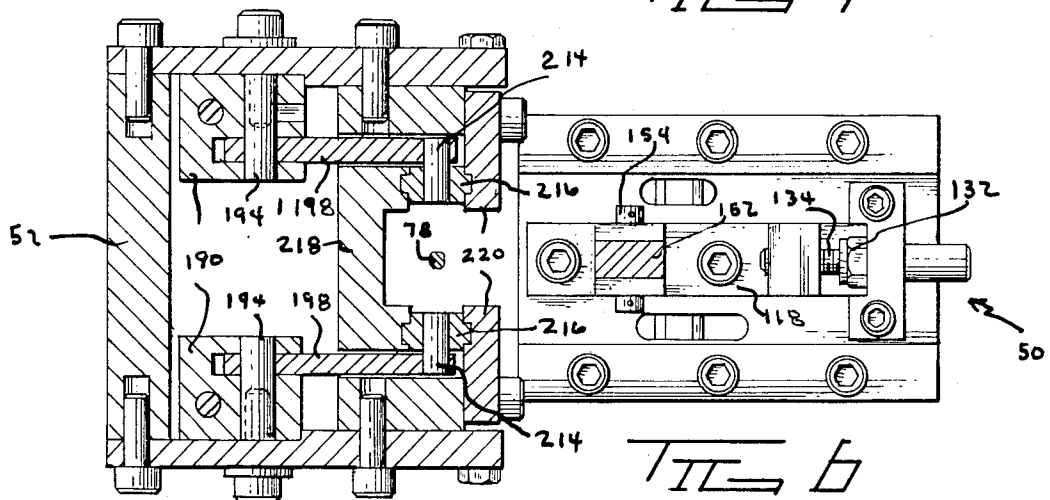
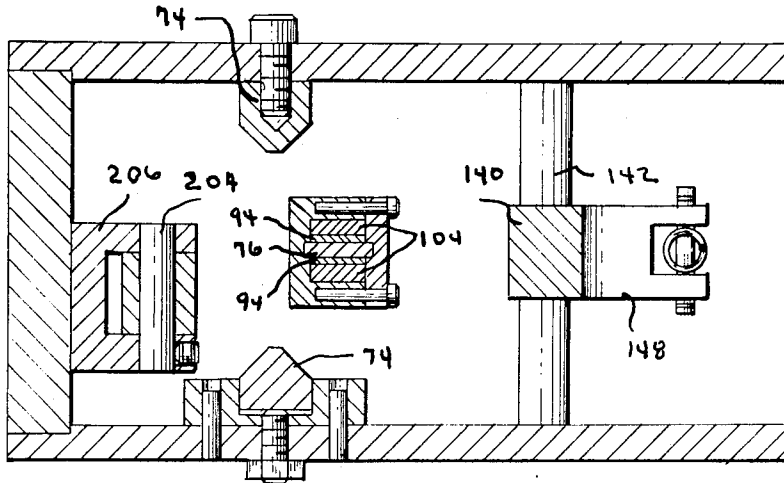
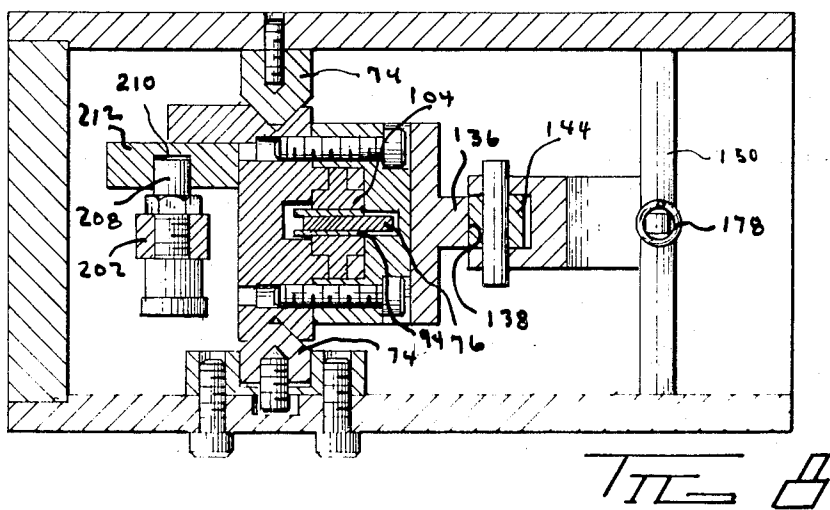
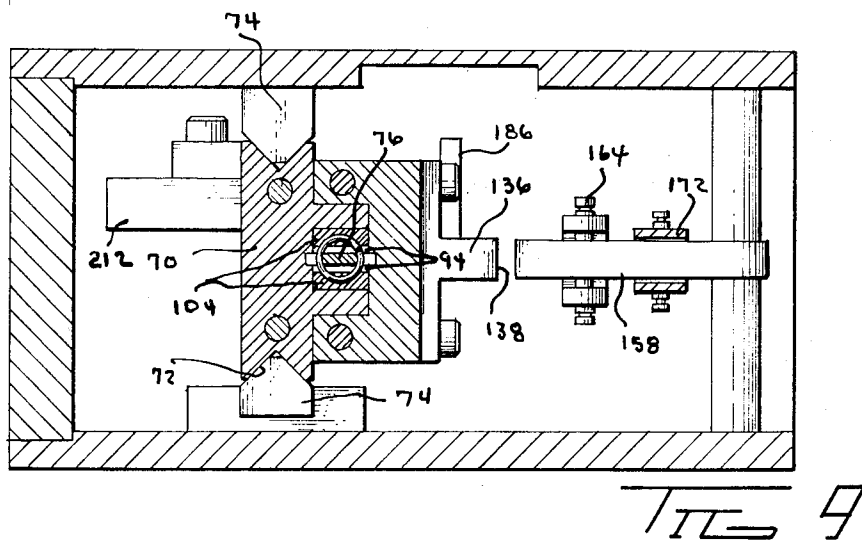
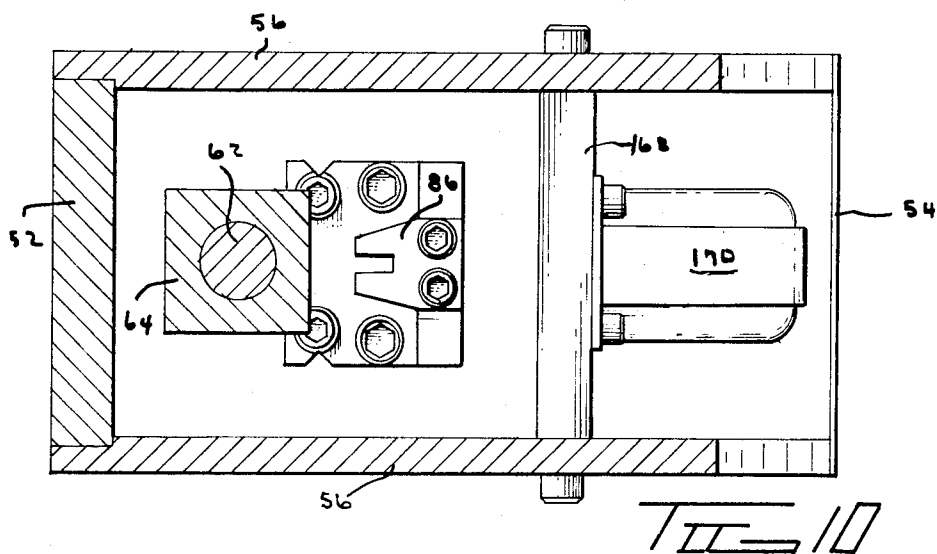
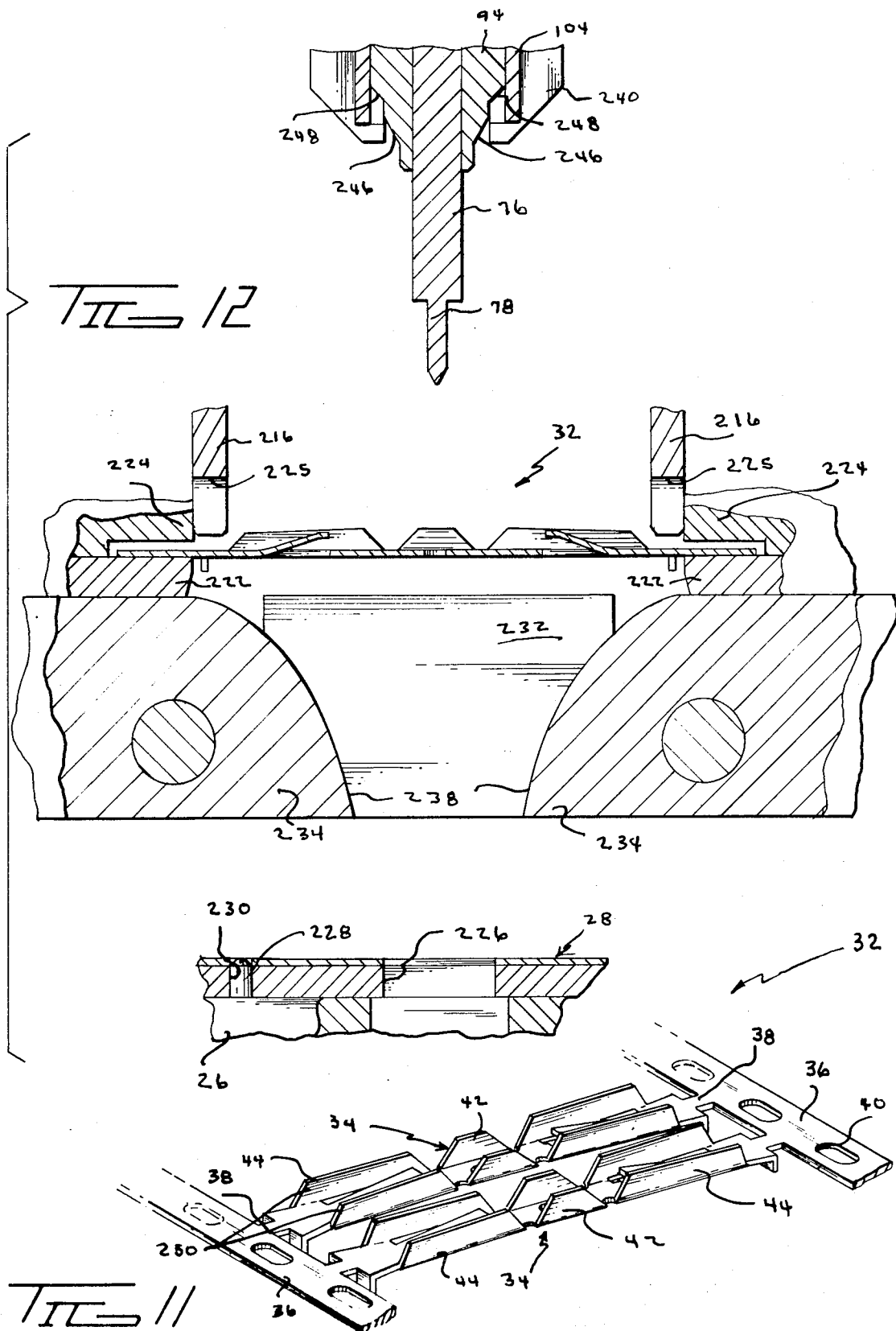


FIG 4









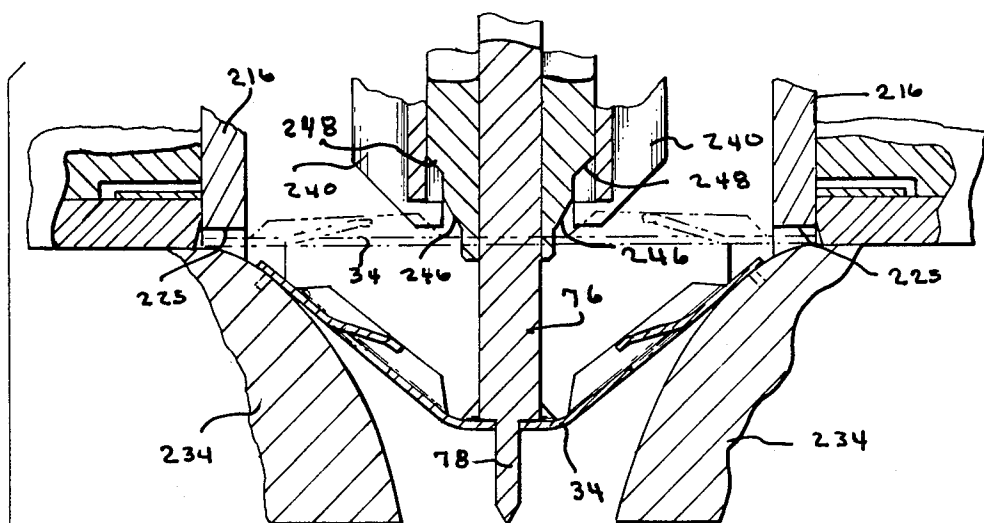


FIG 13

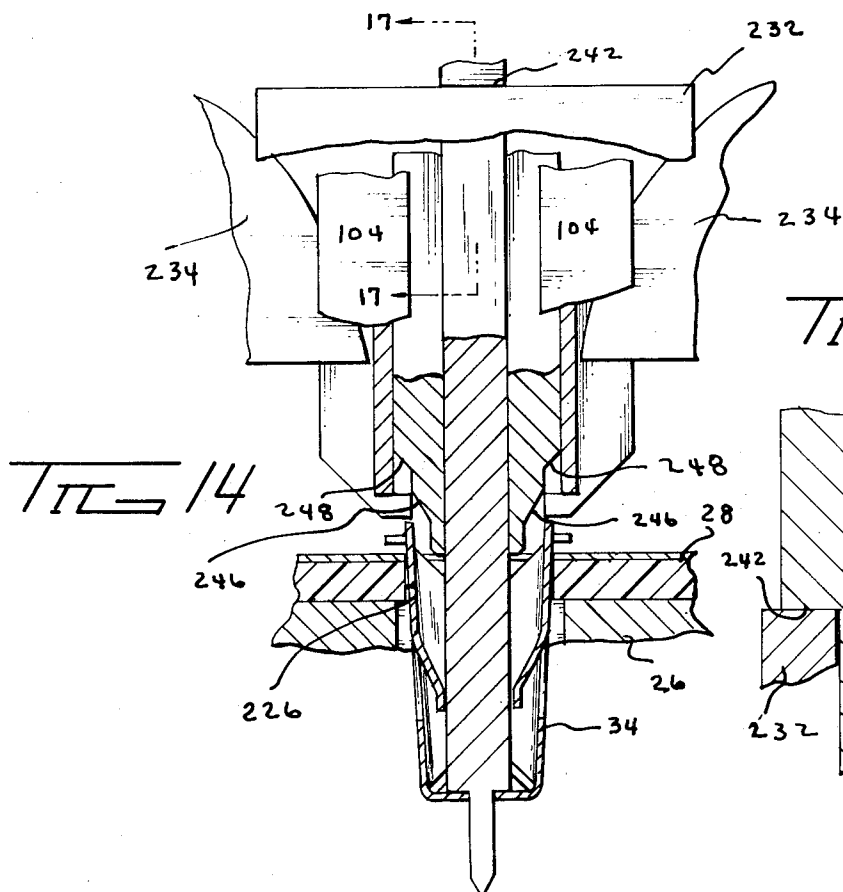
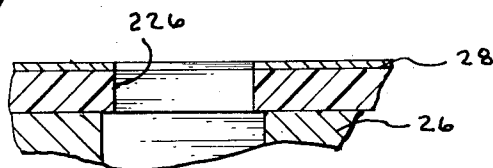
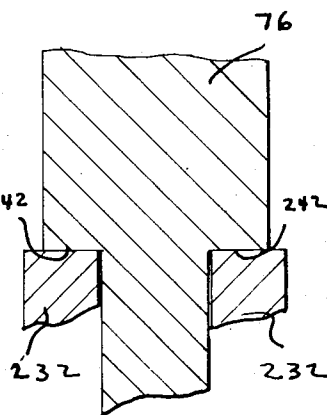
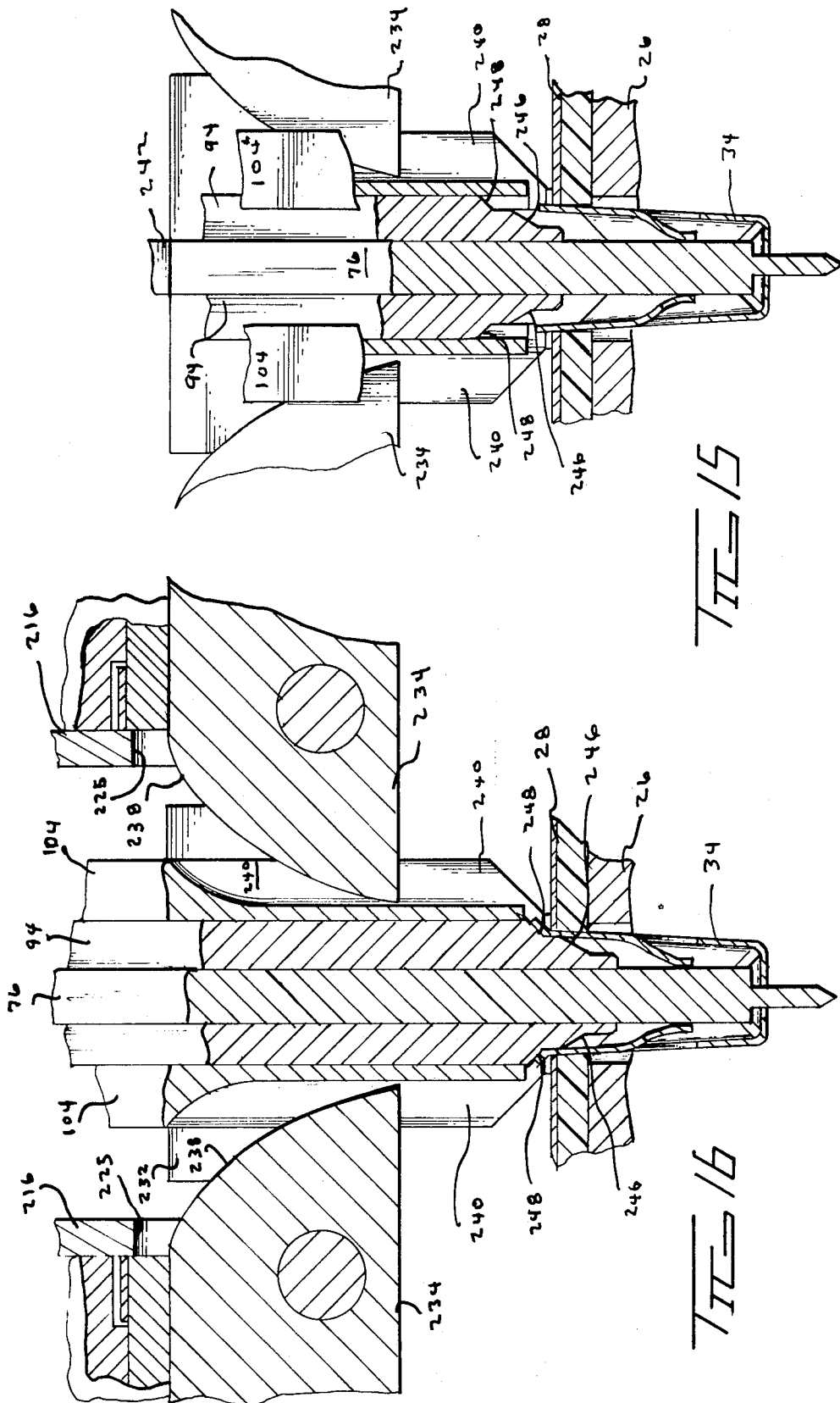


FIG 17





ASSEMBLING APPARATUS

This application is a continuation of Ser. No. 717,086, filed Mar. 29, 1968, now abandoned.

An assembling head is provided and comprises a plurality of slides for performing various operations on the article. An insertion slide moves the article into approximately its final position within the board aperture and cooperates with a forming guide to perform a forming operation on the contact during its movement into the board. A pair of holding slides are provided for placing the contact in its final position in the board aperture and a pair of staking slides are provided for securing the contact to a board and for performing a final forming operation on the contact. The slides are all resiliently mounted for controlling the forces exerted by the slides and for providing an overload release.

BRIEF DESCRIPTION OF THE DRAWING

In the drawings, in which like reference numerals refer to like parts:

FIG. 1 is a perspective view of the overall apparatus made in accordance with the teachings of this invention;

FIG. 2 is a cross-sectional view taken along the line 2—2 of FIG. 1 and shows details of the main driving portions of the apparatus;

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1 and shows details of the mounting arrangement for the various working slides of the apparatus;

FIG. 4 is a cross-sectional view similar to FIG. 3 and showing the parts in position subsequent to the assembling operation;

FIGS. 5 through 10 are cross-sectional views taken along the lines 5—5 through 10—10 respectively of FIG. 2 and show further details of the apparatus;

FIG. 11 is a fragmentary perspective view showing a strip of articles to be assembled by the apparatus of this invention;

FIG. 12 is an enlarged sectional view of the work station of the apparatus showing the parts in their position at the beginning of an operating cycle;

FIG. 13 is a view similar to FIG. 12 and showing the parts after an article has been severed from its strip and partially formed;

FIG. 14 is a view similar to FIG. 13 and shows the parts in position after the article has been approximately located in a board aperture;

FIG. 15 is a view similar to FIG. 14 and shows the parts in position after the article has been finally positioned in the board aperture;

FIG. 16 is a view similar to FIG. 15 and shows the parts in position after the article has been staked and expanded in the board aperture; and

FIG. 17 is a cross-sectional view taken along the line 17—17 of FIG. 14 showing further details of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention;

it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purpose of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

With reference first to FIG. 1 there is shown the overall apparatus 20 for assembling articles in accordance with the teachings of this invention. A C-shaped press frame 22 is provided and is suitably secured to a base or table 24. It is to be understood that the frame 22 could be replaced by other supporting means such as an overhead rail on which there could be mounted a plurality of assembling machines as will be described. A bed 26 is secured to the press frame, the bed serving to locate a printed circuit board or the like 28 which board is suitably provided with a plurality of apertures for receiving articles such as electrical contacts, all as will become apparent as the description proceeds. The bed 26 may be provided with a locating pin or the like for proper orientation of the board 28 or the bed may be positioned by automatic drive means controlled by a tape or other programmed device. There are various systems well known in the art to provide for proper positioning of the printed circuit board and therefore the means for positioning board 28 will not be described in detail.

A supply reel 30 is suitably mounted on the press frame and supplies a strip 32 of articles for assembly with the board 28. In the particular embodiment shown the strip 32 comprises a plurality of electrical contacts 34 of substantially flat configuration, which contacts are carried between a pair of carrier strips 36 by web portions 38. The carrier strips are provided with a series of slots 40, which slots cooperate with the article feeding mechanism to be described.

The electrical contacts 34 each comprise a center section 42 and a pair of outer sections 44. When the contacts are in their final form the two outer sections 44 are bent upwardly as seen in FIG. 11 to lie approximately in parallel planes, and the center section 42 serves as the base for what is then a substantially U-shaped contact.

With reference again to FIG. 1 the strip 32 is led over a pair of idler pulleys 46 and 48 and the lead end of the strip lies within the feeding assembly indicated generally at 50 for feeding the lead article of the strip to the machine work station. The pulleys 46 and 48 are rotatably mounted on a main bracket 52 secured to the upper portion of the press frame. The bracket 52 supports the main working parts of the apparatus which parts are hidden in FIG. 1 by the cover 54 and the side plates 56. A double-acting air cylinder 58 supplies the motive force to the apparatus and is controlled by air lines 60 connected to a suitable air source. It is to be understood, of course, that the cylinder 58 could be air or fluid operated without departing from the spirit of the invention.

In FIG. 2 there is shown the basic driving mechanism of the apparatus. The parts are shown in their position at the beginning of an operating cycle. The cylinder 58 which provides the basic driving force to the apparatus is provided with a cylinder rod 62 on the end of which

is secured a clevis 64. The clevis has a recessed portion 66 for receiving a plate 68 secured to the upper portion of the main slide 70. The slide 70 is provided with a pair of V-shaped grooves 72 for cooperating with a pair of gibs 74 secured to the side plates (see FIG. 9). The gibs 74 guide the main slide for rectilinear reciprocating motion.

Located within the main slide 70 are the working slides of the apparatus. The center working slide is an inserting slide 76. The slide 76 has an inserting head 78 at its lower end which head will engage one of the articles 32 for insertion into the printed circuit board. The slide 76 is movable along with the main slide 70 and is also capable of limited reciprocal movement relative to the main slide. The slide 76 is carried within a guideway 80 formed in the main slide and is normally biased in a downward direction by a spring means 82 located at the upper portion of the inserting slide and acting between a shoulder 84 on the inserting slide and a spring stop 86 fixed to the main slide 70. The inserting slide is limited in its downward movement relative to the main slide by a shoulder 88 extending laterally from the inserting slide and cooperating with a shoulder 90 formed in the main slide. The shoulder 90 is located at the bottom of a slot 92 formed in the main slide for permitting movement of the laterally extending shoulder 88 of the inserting slide.

Disposed on either side of the inserting slide is a pair of staking slides 94 (FIG. 3). The staking slides 94 are movable with the main slide 70 and like the inserting slide are capable of movement relative to the main slide. The staking slides are biased downwardly by spring means 96 acting between the upper portion of the staking slides and the plate 68 secured to the main slide. The staking slides are limited in their downward movement relative to the main slide by laterally extending shoulder means 98 extending from the staking slides and cooperating with a shoulder 100 formed in the lower end of a clearance slot 102 in the main slide.

Disposed on either side of the staking slides 94 is a pair of holding slides 104, the holding slides also serve as the drive means for the staking slides 94. The holding slides are movable with the main slide 70 and also are capable of limited motion relative to the main slide. The holding slides are disposed in a suitable guideway 106 formed in the main slide and are normally biased downwardly by spring means 108. The spring means are confined between a shoulder 110 located on the holding slides and a shoulder 112 located on the main slide 70. The extent of downward movement of the holding slides relative to the main slide is limited by a shoulder 114 formed on the holding slides and cooperating with a shoulder 116 on the main slide.

At this point it can be seen that the inserting slide, the two staking slides, and the two holding slides are all carried by the main slide 70, are all capable of independent movement relative to the main slide, and are all biased downwardly by individual spring means. The individual spring means 82, 96, and 108 serve several useful purposes. Aside from their biasing function the springs are chosen of appropriate size to control the ultimate force exerting capability of the various working slides. The force chain from the cylinder 58 to the working slides passes through the individual spring means and in this way the springs are capable of both

determining the force exerted by the slides and also are capable of functioning as overload release means. In the event that the articles to be assembled by the machine are improperly positioned, damage to the machine is avoided by the springs permitting the various working slides to retract upon reaching a certain pressure, which pressure is calculated to be below the point which would cause damage to the working parts of the machine.

In FIG. 4 the working slides are shown in their position at the completion of the working stroke of the machine and in this position the working slides have all retracted slightly relative to the main slide thus causing a spring means 82, 96, and 108 to be compressed. Reversal of the cylinder 58 will cause the main slide 70 to be elevated and the various spring means will then return the working slides to their lower-most position relative to the main slide.

The feeding mechanism 50 for feeding the strip of articles 32 to the work station of the apparatus is shown in FIG. 2. The work station is defined as the area directly beneath the working slides of the apparatus. The feed mechanism comprises a feed slide 118 mounted for sliding movement relative to a lower guide member 120 which member is secured to the bottom of the main bracket 52. The guide 120 has a guideway 122 through which the strip 32 travels on its way to the work station. The feed slide 118 carried a feed finger 124, which finger is pivotally mounted to the feed slide at 126 and is normally biased downwardly by spring means 128. The feed finger is provided with a bifurcated end 130 for engaging the slots 40 on the two carrier strips to which the articles are attached. The extent of movement of the feed slide is controlled by a stop member 132 secured to the feed slide which stop member cooperates with an adjustment means 134 fixed relative to the lower guide 120. Leftward movement of the feed slide as seen in FIG. 2 will cause the lead article 34 of the strip to be positioned at the work station. Retraction or rightward movement of the feed slide will cause the bifurcated end 130 of the feed finger to move out of the slots 40 of the carrier strip to engage the next succeeding slots of the strip in preparation for the next feeding cycle.

The reciprocating motion of the feed slide 118 is controlled by the main slide 70. A feed cam 136 is secured to the main slide and has a cam surface 138. A feed drive arm 140 is pivoted to the side plates 56 at 142 and carries a cam roller 144 which roller rides along the cam surface 138. The arm 140 is normally biased in a counter-clockwise direction by spring means 146 extending between an extension 148 of the feed arm and a pin 150 fixed to the side plates 56. This counter-clockwise bias can be seen to maintain the roller 144 in engagement with the feed cam. The lower end of the feed drive arm 140 is bifurcated at 152 and receives a pin 154 secured to the feed slide 118. It can be seen that downward movement of the main slide 70 will cause descent of the feed cam 136 thus causing the arm 140 to move in a clockwise direction against the force of spring 146. This clockwise rotation will cause the feed slide to move to the left as seen in FIG. 2 thus effecting a feeding stroke. Upward movement of the main slide will cause upward movement of feed cam 136 thus allowing the cam roller 144 to return to the

low portion of the cam surface to thereby allow the feed drive arm to move counter-clockwise under the force of spring 146 thereby effecting retracting movement of the feed slide.

A mechanism is provided for selectively disabling the feed mechanism in response to programmed information stored in an external control device to thereby provide for the presence or absence of a contact in each succeeding aperture of the printed circuit board according to a predetermined pattern. The mechanism is indicated generally at 156 in FIG. 2. It comprises a latch 158 pivotally secured to the side plates 56 at 160. The latch has a hook portion 162 which is located for cooperation with a pin 164 held in the upper bifurcated end of the feed drive arm 140. A shoulder 166 is provided at the outer end of the latch which shoulder normally rides along the upper surface of the pin 164. In the normal position of the arm 140 the latch is inoperative and merely rests on the top of the pin 164. However, during an operating cycle when the arm 140 swings in a clockwise direction to effect a feeding stroke the pin 164 moves to the right into a position to be engaged by the hooked portion 162 of the latch. In this position the arm 140 is prevented from returning to its normal position. A bracket 168 is secured to the side plates 156 and carries a solenoid 170. A solenoid link 172 is operatively connected to the solenoid and has a bifurcated lower portion 174 for receiving the latch 158. A pin 176 extends through the latch and through the lower portion 174 of the solenoid link whereby movement of the link will cause corresponding movement of the latch. A spring 178 extends between the pin 150 and a pin 180 on the solenoid link to thus normally bias the link to a downward position and the latch in a counter-clockwise direction. Therefore, when the feed drive arm moves clockwise during a feeding stroke the spring 178 will cause the latch to firmly engage the arm 140 by the hook portion 162 of the latch. The solenoid 170 is controlled by an external programmed control device as set forth above. If a contact is to be inserted in the next succeeding aperture in the printed circuit board the solenoid 170 will be actuated to raise link 172 thus causing the latch to release the feed arm 140 thus permitting the arm to move counter-clockwise as seen in FIG. 2 into position for the next feeding cycle. However, if the next succeeding aperture should not contain a contact then the solenoid 170 will not be actuated. The latch 158 will thus continue to remain in its downward position holding the feed arm 140 out of contact with the feed cam 136 and arm 140 will remain held by the latch 158 until a signal is sent to the solenoid 170 that a contact is to be inserted in the following board aperture.

The cylinder 58 is controlled by a pair of limit switches actuated by the reciprocation of slide 70. Thus, an upper limit switch 182 is secured to plate 56 and a lower limit switch 184 is also secured to the plate at a distance below the switch 182 which is proportionate to the desired stroke length of slide 70. An actuator 186 is secured to slide 70 and contacts the limit switches, which switches are suitably connected to the air source for cylinder 58 to control the direction in which the cylinder acts.

The lead article on the strip 32 which is positioned at the work station must be severed from the strip prior to

insertion into the printed circuit board. To accomplish this there is provided a shear assembly indicated generally at 188 in FIG. 2. A pair of pivot blocks 190 are secured to the side plates 56, each block being substantially U-shaped and accommodating a shear drive link 192. The links 192 are pivotally secured to the blocks at 194 and have a pair of legs 196 and 198 extending on opposite sides of the pivot point. The leg 196 is pivotally connected at 200 to a shear drive arm 202. The arm 202 is mounted for rocking movement about a pivot 204 connecting the arm to a pivot block 206. The block 206 is mounted on the main bracket 52. The upper portion of arm 202 carries a cam follower 208 which rides in a cam track 210 formed in the shear cam 212 secured to the main slide. The legs 198 of the shear drive links are bifurcated at their ends for receiving pins 214 secured to a pair of movable shear blades 216. The two shear blades are mounted for reciprocating rectilinear movement and are guided in their movement by guide blocks 218 and 220. It can be seen that lowering of the main slide 70 will cause the shear drive arm to pivot counter-clockwise (FIG. 2) as follower 208 follows the cam track 210 and the counter-clockwise movement of arm 202 will cause clockwise movement of the links 192 thereby causing the shear blades 216 to descend through a shearing stroke. Subsequent lifting of the main slide 70 will reverse the process and raise the shear blades to their starting position.

The two shear blades 216 operate to sever the webs 38 which connect the individual articles 34 to the carrier strip. The shearing operation is best seen in FIGS. 12 and 13 wherein the pair of shear blades are shown as cooperating with a pair of lower stationary shear plates 222 for severing the article from the carrier strip. The stationary shear plates also cooperate with guide plates 224 to form the passageway for the carrier strip through the work station or assembly zone of the machine. Each movable shear blade 216 has a bifurcated lower surface for straddling the web 38 during descent of the blade, the shearing being effected by the cutting edge 225 located within the end of each of the shear blades.

The above description sets forth the various moving parts of the apparatus and the means for effecting movement of those parts. At this point reference is made to FIGS. 12 through 16 for a description of how these parts operate on an individual article for assembling the article in an apertured member. The description will be made with reference to assembling an electrical contact into an appropriate aperture in a printed circuit board. In FIG. 12 the parts are in their position at the beginning of an operating cycle. A lead article 34 is positioned at the work station indicating through the programmed controlled solenoid 170 that an article is to be assembled in the aperture 226 of the printed circuit board. The board 28 in FIG. 12 is shown resting on the bed 26 and properly oriented by the pilot pin 228 and pilot hole 230. It is to be understood that this means of orienting the board 28 is for illustrative purposes only and that in actual practice the bed 26 could be oriented by conventional indexing mechanism or the like.

The inserting slide 76, staking slides 94, and holding slides 104 reciprocate through the work station located

between the guide plates 224 and toward the aperture 226 in the printed circuit board. The slides pass between a pair of stationary plates 232 located beneath the plane of strip 32, the plates 232 being spaced sufficiently to permit passage of the working slides and the article 34 therebetween. The plates 232 are disposed in parallel relation (see also FIGS. 5 and 17). Lying between the plates are a pair of forming guides 234, the forming guides lying directly beneath the contact 34.

As the tool slide 70 begins its descent under the influence of the cylinder 58, the inserting head 78 enters an aperture 236 formed in the center section 42 of the contact and the movable shear blades 216 are actuated to sever the web portions 38 of the contact thus freeing the contact from the carrier strip. The working slides are all moving in unison at this point and the contact 34 is forced downward and into engagement with the gradually sloping surfaces 238 of the forming guides. These surfaces gradually form the contact into a generally U-shaped configuration in preparation for entry of the contact into the aperture 226 in the printed circuit board.

The working slides continue to descend in unison until the article is inserted in the printed circuit board to the extent shown in FIG. 14. The working slides at this point have moved beyond the forming guides 234, the holding slides having slots 240 formed therein for permitting the slides to clear the forming guides. When the inserting slide 76 reaches the position shown in FIG. 14 its descent is arrested by means of a pair of shoulders 242 extending laterally from the slide and engaging the upper surface of the stationary plates 232 (see also FIG. 17). After this point in the cycle any further descent of the tool slide will cause compression of the biasing spring 82 acting on the upper surface of the inserting slide to thereby maintain the force being exerted by the slide.

Continued descent of the tool slide 70 causes the holding slides 104 to engage tabs 244 on the contact 34 to thereby insert the contact the remaining distance into the printed circuit board and subsequently to hold the contact in this position. This two step insertion of the contact into the board will compensate for tolerance variations in either the board or the articles to insure proper placing of the contacts in the board. The position of the slides at this point in the cycle is shown in FIG. 15. As the main slide 70 continues its descent the holding slides 104 can no longer descend and therefore the spring means 108 begin to compress thereby maintaining force between the holding slides and the tabs 244 of the contact. The staking slides 94 however continue to descend from their position shown in FIG. 15 to the position shown in FIG. 16 whereat it can be seen that the slides have moved inside the confines of the contact 34. A pair of shoulders 246 on the staking slides urge the sides of the contact outwardly into firm engagement with the sides of the aperture in the printed circuit board thereby causing the contact to expand slightly and to insure that the contact is of proper shape to receive its mating connector (not shown). A second pair of shoulders 248 on the staking slides engage the web portions 38 of the contact and bend the webs outwardly at approximately 45° to thereby stake the contact to the printed circuit board. The contact is locked in the aperture by wing members

250 whose resiliency causes them to spring outwardly after insertion through aperture 226 for engagement with the lower surface of the printed circuit board.

The staking slides can no longer descend and therefore any further descent of the main slide 70 will cause compression of the biasing springs 96. When the slide 70 descends sufficiently for the actuator 186 to contact the lower limit switch 184 the flow of air to cylinder 58 will be reversed and the main slide together with the various working slides will then be raised until the actuator 186 contacts the upper limit switch 182 which will then reverse the air supply once more to the cylinder 58 and the machine is ready for its next cycle. The program controlled solenoid 170 will raise latch 158 to free the feed arm if an article is to be inserted in the next succeeding aperture in the printed circuit board. However, if no article is to be placed then the solenoid 170 will not be actuated and the feed mechanism will remain in the disabled condition.

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. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

We claim:

1. A machine for assembling a plurality of electrical contacts in apertures in a printed circuit board or the like, said machine comprising a frame, feed means mounted on said frame for feeding a strip of partially formed, substantially flat contacts to a work station on said machine, a bed on said frame for receiving said printed circuit board at said work station, locating means on said bed for locating an aperture of said printed circuit board in alignment with one of the contacts of said strip, an insertion member mounted for reciprocating motion on said frame towards and away from said bed, said insertion member being operative to insert said one partially formed contact into said aperture in a given direction, forming means mounted on said frame above said bed, said forming means having a pair of forming surfaces located on opposite sides of the path of movement of said insertion member for forming said one contact during insertion thereof into said aperture whereby said contact assumes a substantially U-shaped configuration with the bight portion of the contact opening in a direction opposite to the said given direction, a securing member mounted on said frame for reciprocating movement relative thereto, said securing member being operative to secure said contact to said printed circuit board, said inserting member, forming means, and securing member being mounted for reciprocating movement together and for reciprocating movement relative to each other.

2. A machine as set forth in claim 1 further comprising an expanding member mounted on said frame and reciprocable relative thereto for expanding said one contact after insertion into said aperture.

3. A machine as set forth in claim 1 further comprising means for selectively disabling said feeding means, said disabling means being actuated by programed means for determining the location of contacts in said printed circuit board.