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3,524,240

MACHINE FOR PRODUCING PRINTED CIRCUIT CONNECTORS

Filed June 21, 1968

2 Sheets-Sheet 1

FIG. 1

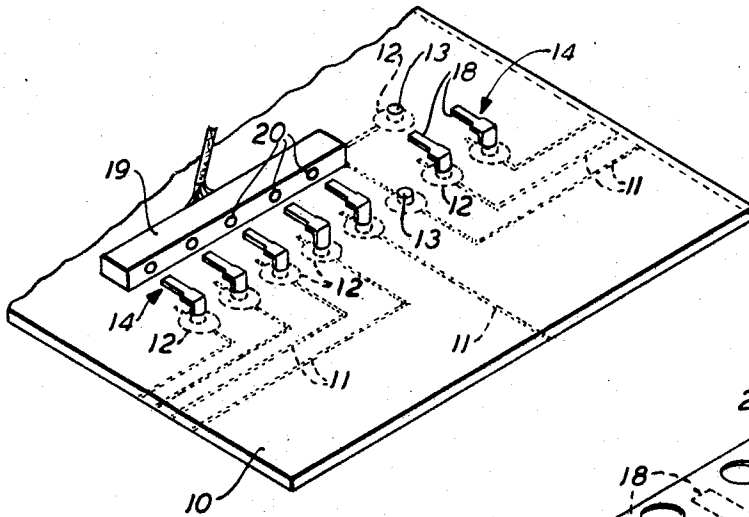


FIG. 3

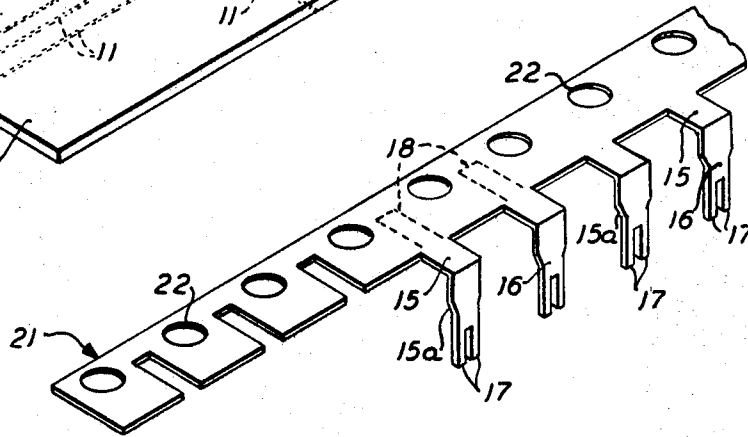


FIG. 4

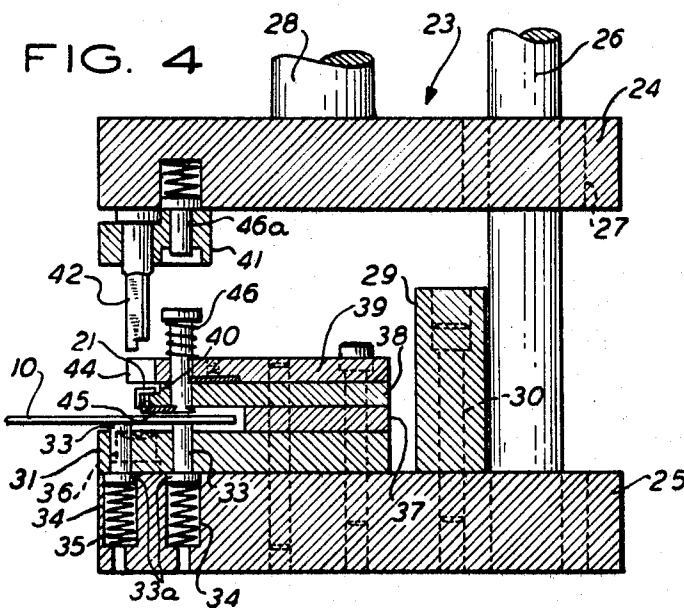


FIG. 2

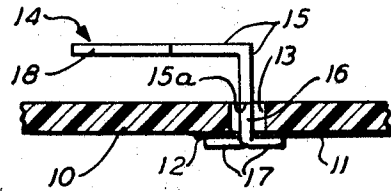
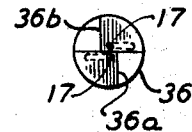


FIG. 4a



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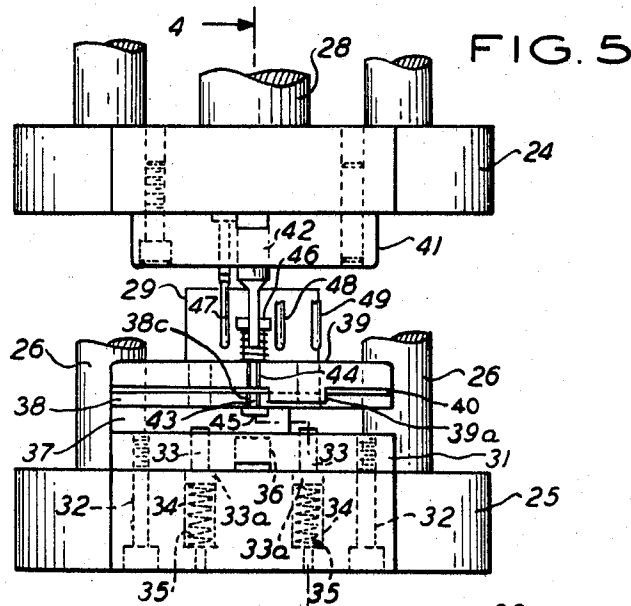
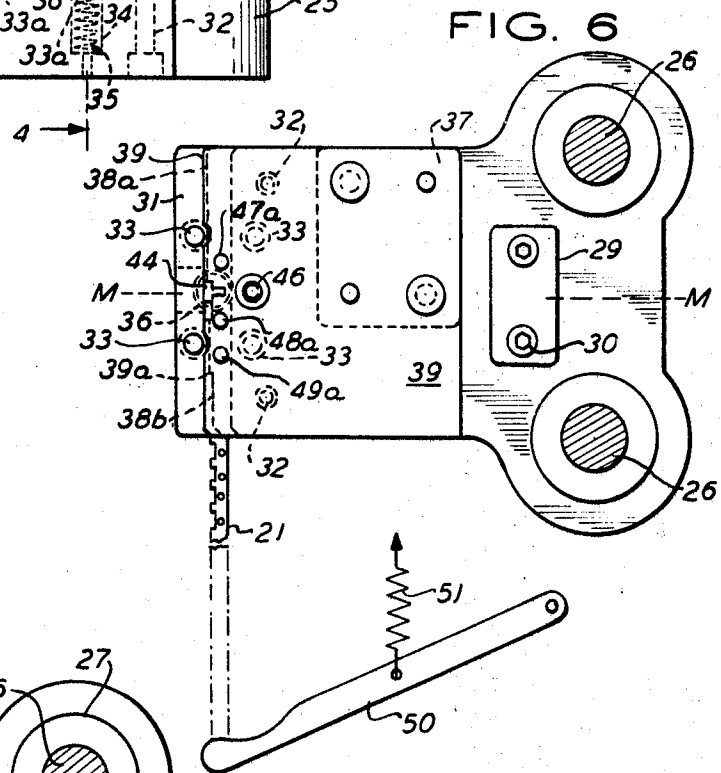
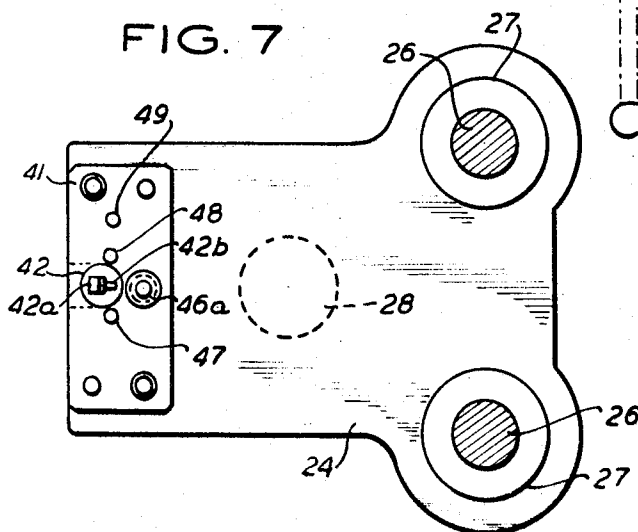
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MACHINE FOR PRODUCING PRINTED CIRCUIT CONNECTORS

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5 Claims

ABSTRACT OF THE DISCLOSURE

An assembling die is provided which receives at a lower level a printed circuit board having terminal holes and at a higher level a metal terminal strip. The terminal strip has side lugs constituting portions of successive terminals. The side lugs are bent downwardly at right angles immediately thereof and terminate in seating portions having side shoulders and extending staking tabs. On each operation of the assembling die a pilot enters a locating hole in the terminal strip and a punch then blanks a connector pin portion of a terminal from the metal strip extending from a corresponding side lug and drives the staking tabs of the terminal into the terminal hole while concurrently staking the terminal in seated engagement with the board.

An object is to provide a novel machine for producing such terminals and for staking the same one-by-one in a printed circuit board.

These and other objects and features of the invention will be apparent from the following description and the appended claims.

In the description of our invention reference is had to the accompanying drawings, of which:

FIG. 1 is a perspective view of a terminal board showing a series of connector terminals mounted on the board according to the invention and showing a receptacle block in position for engaging the terminals;

FIG. 2 is a section line through a terminal hole in the board showing a terminal to enlarged scale in staked relation to the board;

FIG. 3 is a perspective view of a preformed metal strip from which the pin portions of successive connector terminals are cut out and the terminals then staked into the circuit board;

FIG. 4 is a sectional view on the line 4—4 of FIG. 5 of a combination die for cutting out and staking the connector terminals from the preformed metal strip;

FIG. 4a is an end view of the staking tool to enlarged scale;

FIG. 5 is a front elevational view of the combination die;

FIG. 6 is a plan view of the lower section of the combination die; and

FIG. 7 is a bottom view of the upper punch section of the combination die.

A typical circuit board 10 shown in FIG. 1 has conductor strips 11 thereon leading to annular portions 12 surrounding respective terminal holes 13. Staked in these terminal holes are connector terminals 14 according to the invention. Each connector terminal comprises a right angle body portion 15 the vertical leg of which has seating shoulders 15a and an extending tab 16. The end portion of the tab is bifurcated forming two staking prongs 17 which are bent over in opposite directions (FIG. 2) to stake the terminal solidly in seated relation to the board. The solid portion of the tab has a length equal about to the thickness of the circuit board, typically $\frac{1}{16}$ " and the staking prongs have typically about the same length or more. The horizontal leg of the body portion

15 has an extending terminal pin 18 of reduced width in spaced parallel relation to the board. The connector terminals may be set in rows and any number of any particular row may be pointed in the same direction and be engaged by a single connector block 19. Such connector block is of a suitable insulating material provided with a series of pin receptacles 20 open at one end of the block and positioned at a distance from the bottom of the block equal to the height of the connector pins 18 from the circuit board, so that the block can be set on the circuit board and be slid into engagement with the respective pins. The provision of connector pins parallel to the board and of a receptacle block resting slidably on the board enables a detachable connection to be made easily within a minimum space limitation.

The connector terminals 14 are first partially formed as an integral part of a metal strip 21 shown in FIG. 3. This metal strip is provided with spaced right angle lugs at one side thereof forming the right-angle body portions 15, tab 16 and staking prongs 17 of the respective terminals. Between the successive lugs are holes 22 in the metal strip utilized for locating the metal strip as the individual terminals are completed and staked in place by a combination cutting-staking die 23 hereinafter described. This metal strip is produced in steps by a suitable blanking and bending die not herein necessary to show.

The combination cutting-staking die 23 comprises upper and lower blocks 24 and 25 of a die set guided by a pair of guide rods 26 secured to the lower block and received slidably by bushings 27 in the upper block. The die set is mounted in a power press with the lower block clamped or bolted to the bolster plate of the press and with a post 28 on the upper block clamped to the ram of the press. A rectangular post 29 secured by bolts 30 to the lower die block about midway between the guide rods 26 serves as a reference in setting the ram of the press to close the die set to the desired extent.

Mounted on the lower die block is a die plate 31 secured thereto by two bolts 32 extending up through the block and threaded into the die plate. Mounted slidably in the front portion of the die plate 31 are four pusher pins 33 of which the front two are equidistantly spaced from a medial plane M—M through the die block and the back two are directly behind the front two respectively. These pusher pins have heads 33a received in wells 34 in the die block. Between the heads and the bottom of the wells are compression springs 35 which normally hold the pusher pins in their upper positions determined by abutment of the heads 33a against the bottom of die plate 31. In this upward positioning of the pusher pins the same extend about $\frac{1}{16}$ " above the die plate.

At about a geometric center of the pusher pins 33 there is a staking pin 36. This pin seats on the die block (FIG. 4) and extends upwardly through an aperture in the die plate 31 to where it is about flush with the upper surface thereof. The upper end face of the staking pin has concave sections at the far sides of fractional chord lines 36a and 36b (FIG. 4a) which are offset from each other by several times the thickness of the metal terminal strip 21 but which terminate at a diameter line at right angles to the chord lines. The staking pin is oriented so that this diameter line is in the medial plane M—M. During a staking operation the metal strip 21 is positioned so that the staking prongs 17 of a connector terminal are located at opposite sides of this diameter line to cause the prongs to be bent in opposite directions by the respective concave sections of the staking pin 36. By bending the terminal prongs 17 in opposite directions in line with the connector pin 18 of each terminal the terminals are confined within a narrow width dimension to permit closer spacing on the circuit board. During a staking operation the circuit board is supported by the four pusher pins 33

which yield and allow the circuit board to come down flat against the lower die plate 31 by the staking pressure of a terminal against the board, as will appear.

Mounted on the left rearward portion of the die plate 31 is a spacer plate 37, and mounted on the spacer plate in the sequence here named is a second die plate 38 and a stripper plate 39. The second die plate and stripper plate conform along their side and back edges to those of the lower die plate but terminate short of the lower die plate at their front edges (FIG. 6). For instance, the front edge of the upper die plate has a step 38c (FIG. 5) at a point one-half the width of a terminal to the left of the axial center of the staking pin 36, with the edge 38a to the left of the step 38c positioned ahead of the axial center of the staking pin and the edge 38b to the right of the step 38c positioned rearwardly of the axial center of the staking pin by one-half the thickness of the terminal strip 21. Further, the front edge of the stripper plate 39 is at about a vertically projected tangent line of the staking pin (FIG. 6).

A rectangular groove 40 is cut in the front portion of the upper die plate 38 laterally thereof to a depth several times the thickness of the metal strip 21 and to a distance from the front edge equal to the width dimension of the metal strip 21. This groove forms a track for receiving the metal strip 21 in a feed direction laterally of the die set. A rectangular lug 39a depends from the front edge of the stripper plate 39 (FIG. 5) to confine the metal strip 21 in the feed track. This feed track locates the staking prongs 17 of the right angle side lugs of the metal strip 21 on a line through the center axis of the staking pin 36. The leading side lug of the metal strip 21 abuts against the step 38c to stop each feed of the metal strip in a position wherein the staking prongs 17 of the leading side lug are at opposite sides of the diameter line of the staking pin 36 at the medial plane M—M of the die set.

Secured to the underside of the upper die block 24 is a heavy plate 41 in which a drive and blanking punch 42 is mounted in centered relation to the staking pin 36. This punch has in cross section a front rectangular portion 42a conforming to the horizontal leg of the right angle portion 15 of a connector terminal 14 and has a rearwardly extending rectangular portion 42b of narrower width conforming to the terminal pin portion 18 of each connector pin. In the forward portion of the upper die plate 38 on which the metal strip 21 rests, there is a rectangular notch 43 with offset sidewalls to conform accurately to the cross sectional dimensions of the punch 42. Also, in the stripper plate is a similar notch 44 but with clearance dimensions relative to the punch. When the top die block is pressed downwardly the portion 42a of the punch comes to bear against the horizontal leg of the lug 15 of the metal strip 21 and the portion 42b of the punch moves concurrently through the metal strip and into the notch 43 to blank the pin portion 18 of a connector terminal from the metal strip. In the continuing downward movement of the punch 42 the connector terminal now totally divorced from the metal strip 21 is driven downwardly causing the staking prongs 17 first to move through a terminal hole 13 in the circuit board and the pin portion 18 to be moved against a spacer strip 45 at the bottom of the die plate 38. This spacer strip is staked to a spring-pressed plunger 46 which normally holds the spacer strip against the bottom side of the upper die plate. The spacer strip is moved against the circuit board by the downward driving of the terminal and by movement of a spring-pressed plunger 46a in the upper die block against the plunger 46 to set the spacing of the connector pin 18 of the terminal from the circuit board. In the further downward movement of the punch 42 the pushers 33 are pressed downwardly until the circuit board comes flat against the bottom die plate 31. During this movement of the circuit board against the lower die plate the staking prongs 17 are curled in opposite directions by the prongs being driven against the staking pin

36 causing thus the terminal to be staked solidly to the circuit board.

At the left of the punch 42 is a pointed pilot pin 47 and at the right thereof are two pointed pilot pins 48 and 49 all set within the mounting plate 41 on the upper die block. When the upper die block is pressed downwardly these pilot pins pass through respective openings 47a, 48a and 49a in the stripper plate 39 and in the upper and lower die plates 38 and 31 to engage the respective locating holes 22 in the metal strip 21 and finely locate the metal strip so that the two prongs 17 will engage the staking pin 36 in the right staking relationship. When a connector terminal has been blanked from the metal strip 21 and the upper die block is returned to disengage the pilot pins 47-49 from the locating holes in the metal strip, a feed force exerted against the end of the metal strip such as from a pusher lever 50 biased by a tension spring 51 will advance the metal strip until the next side lug abuts against the step 38c. Further, it will be seen that each cutting of the connector pin portion of a terminal from the metal strip and driving of the terminal downwardly from the feed track into staking engagement with the circuit board clears the way when the punch is returned for a next step advance of the metal strip. It will now be apparent that the metal strip 21 may be advanced intermittently in synchronism with the operation of the punch simply by a spring force exerted in an advancing direction on the strip or it may be advanced by any suitable intermittently driven stock feed not herein necessary to show. Still, further, when connector terminals are to be formed and staked into a terminal board on a production basis and the terminal boards are of a given dimension, an automatic feed may be provided to advance the terminal board step-by-step to bring successive terminal holes in line with the staking punch. Such intermittent feed of the terminal board may also be of standard construction and need not be herein disclosed.

The embodiment of our invention herein particularly shown and described is intended to be illustrative and not necessarily limitative of our invention since the same is subject to changes and modifications without departure from the scope of our invention, which we endeavor to express according to the following claims.

We claim:

1. A machine for forming and staking connector terminals in spaced parallel relation to a circuit board having individual mounting holes for said terminals comprising a die having a track for receiving said circuit board, another track above said first track for receiving a metal strip having spaced terminal lugs extending from one side thereof and bent intermediately thereof at right angles to said strip, said right angle portions having shoulders to seat on said board and staking tabs extending from said shoulders, a reciprocable punch in said die cooperating with said upper track for blanking terminal pin portions from said metal strip extending from said respective lugs to form complete terminals and driving the tabs of the individual terminals into said mounting holes during the driving strokes of said punch, and a staking tool in said die at the bottom of said first track in alignment with said punch for staking said tabs to secure said shouldered portions in seating engagement with said board as said tabs are driven into said mounting holes.

2. The machine set forth in claim 1 including a movable spacer strip between the connector pin portion of a terminal and the circuit board as each terminal is driven into staking engagement with the circuit board for establishing the connector pin portion of each staked terminal at a predetermined distance from the circuit board.

3. The machine set forth in claim 1 wherein each of said staking tabs is bifurcated forming two staking prongs, and said staking tool has an end face provided with concave portions at opposite sides of a diameter line thereof adapted for engaging said prongs respectively and bend-

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ing the same in opposite directions in parallel relation to said terminal pin.

4. The machine set forth in claim 1 including a stop for abutment against the leading side lug on said metal strip to stop movement of the metal strip in a position wherein the leading terminal to be cut from said metal strip is aligned with said punch, said strip having locating holes therein between successive side lugs, a pointed pilot pin carried with said punch for engaging a locating hole in said metal strip in advance to a side lug being cut off from said strip for finely centering the side lug in a staking position and for holding said strip against a step advance until said pilot pin is removed from said strip during the return stroke of said punch.

5. The machine set forth in claim 4 including yield- 15 29—206

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able feed means for advancing said strip as said pilot pin is disengaged from said metal strip by a stepped distance determined by abutment of the next side lug on the metal strip against said stop.

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U.S. Cl. X.R.