

PATENT SPECIFICATION

(11) 1 490 274

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- (21) Application No. 12295/75 (22) Filed 25 March 1975
(31) Convention Application No. 455 762
(32) Filed 28 March 1974 in
(33) United States of America (US)
(44) Complete Specification published 26 Oct. 1977
(51) INT CL³ H05K 13/04//3/30
(52) Index at acceptance
B3A 26 49C 78B 78C
B3U 11

(72) Inventors ROBERT FRANKLIN COBAUGH and
JAMES RAY COLLER



(54) TERMINAL INSERTION APPARATUS

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for simultaneously inserting a plurality of electrical terminals into respective holes in a substrate, for example terminal posts into respective holes in a printed circuit board.

In the manufacture of printed circuit boards conductors are formed on an electrically insulating substrate by photo etching, or other well known techniques. Usually it is desired to make external connection to the conductors of the printed circuit board for such purposes as applying power from a power supply, or establishing connections to other circuit boards or other electrical circuitry.

One way in which such external connections are made is by providing a plurality of terminal posts on the printed circuit board to which posts connection can be made as by soldering, or by suitable mating plugs or by other well known techniques. The positions of such posts are determined by the conductor paths on the board, and the conductor paths are often designed so that the posts are positioned in a straight line and spaced apart equal distances. Holes are provided through the printed circuit board to receive the posts, which holes are usually plated through with the printed circuit board conductor material to enhance the electrical connection between the posts and the associated printed circuit board conductive paths.

Several methods of insertion of posts into holes in a printed circuit board are known. Often the posts are individually hand in-

serted into the printed circuit board holes. Otherwise machines have been used for automatic insertion of the posts, one by one, into the holes of the printed circuit board.

With either of these methods a considerable amount of time is involved in insertion of the posts.

To expedite the insertion processes, a terminal "comb" arrangement has been developed in which a plurality of side-by-side terminals are carried on a common carrier strip. Typically, such combs are stamped or machines from a single piece of conductive material, such as copper, or the like and physically resemble a common hair comb. Such combs are often of relatively thin material, for example having a thickness of 1/32 of an inch or less, and this causes handling difficulties in inserting the terminals, especially when the carrier strip is several inches long since the terminals tend to have a considerable degree of flexibility upon the carrier strip.

In the past, two individual tools have been used in sequence in the insertion of the posts of such a post comb into holes of a printed circuit board. First a combing tool is employed to straighten and align the posts and hold them for partial insertion into the holes of the printed circuit board. The combing tool is then removed and a push blade and carrier strip control blade tool is applied to complete the insertion.

Combing tools commonly used are configured much like a pair of pliers having elongate U-shaped jaws which resemble an elongate pair of tweezers, having serrations formed on their inner surfaces to surround and grip the posts, thereby straightening them upon the carrier strip, and positioning them along the desired centre line axis of the holes into which they are to be inserted.

After the combing tool has been removed, the push blade and carrier strip control blade tool is applied. The push blade is simply an elongate member which is located adjacent the posts and their carrier strip.

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The carrier strip control blade is attached to the push blade and is offset from the push blade to form a channel to receive the carrier strip. Thus, pressure can be applied to the push blade and carrier strip control blade to complete the insertion of the already partially inserted posts into the printed circuit board holes.

Thus, in the prior art, two separate tools, each requiring individual manipulation, are required to achieve the desired gang insertion of the posts into the printed circuit board holes, and thus time is required for interchange of the tools.

According to this invention there is provided apparatus for simultaneously inserting a plurality of electrical terminals into respective holes in a substrate, the terminals initially being carried in substantially parallel relationship by a common carrier strip, comprising a base having support means to receive and support the terminals and carrier strip, and to align the terminals relative to each other and the carrier strip; terminal securing means mounted on the base for movement relative thereto between a first position in which the securing means engages the terminals to hold the terminals on the support means, and a second position in which the securing means does not engage the terminals and the terminals are free on the support means; and locking means which co-operates with the base and the securing means to lock the securing means in its first position and to release the securing means from the base for movement to the second position after insertion of the terminals into holes in the substrate.

An embodiment of apparatus according to this invention will now be described by way of example with reference to the drawings, in which:—

FIGURE 1 is a plan view of a terminal post comb for use with the apparatus;

FIGURE 2 is a perspective view of the apparatus which is for inserting the posts of FIGURE 1 into holes of a printed circuit board;

FIGURE 3 is a perspective view of a portion of the apparatus of FIGURE 2 showing the post comb of FIGURE 1 mounted thereon;

FIGURE 4 is a sectional side elevation of the apparatus of FIGURE 2, with the post comb in an inserted, but unlocked position; and

FIGURE 5 is a sectional side elevation similar to FIGURE 4 but showing the post comb in a locked position.

Referring to FIGURE 1, this shows a terminal post comb 10, for insertion by the apparatus of the invention, the comb 10 being fabricated from a single piece of flat electrically conductive material, such as

copper, gold plated steel, or the like, which has been stamped, cut, or machined into the configuration shown. A number of posts 11 are outstanding from a carrier strip 12, which can be broken away from the posts 11 after insertion. Each of the posts 11 has an elongate portion 13 which is to be inserted into a preformed hole in a substrate, such as a printed circuit board (not shown). Shoulders 14 on the elongate portion 13 come to rest on the printed circuit board surface when the post 11 is fully inserted in a printed circuit board hole with a relatively wide portion 15 of the post 11 fitted in the hole. The elongate portion 13 of each post 11 is connected to the carrier strip 12 by way of a contact portion 16.

Holes 17 are formed in the carrier strip 12 during production of the comb 10, and are used principally for effecting movement of the comb 10 during production thereof. The holes 17 in the carrier strip 12, as will become apparent below, can additionally be used for facilitating the insertion of the comb 10 into the apparatus of the invention.

To enable the carrier strip 12 to be removed from the posts 11 easily, a score line 18 is provided on each of the posts 11. Thus, after insertion of the posts 11 into holes in a substrate, a transverse bending force can be applied to the carrier strip 12 to break it away from the posts 11.

Referring now to Figures 2 to 5, the apparatus here shown comprises a base 19 on which are mounted a support means comprising a comb push blade 20 and a carrier strip control blade 21 the push blade 20 has an edge formed with a plurality of pyramidal shaped projections 22 which, in use of the apparatus, are interleaved between the posts 11 of the comb 10, as shown in Figures 3, 4, and 5. The control blade 21 is located above the push blade 20, and has an overhanging lip 23 forming a groove 24 between the push blade 20 and the lip 23. Thus, the carrier strip 12 of the comb 10 is locatable within the groove 24 with the shoulders 14 of the posts 11 adjacent and in front of the projections 22 on the push blade 20.

In the embodiment shown in the drawings, the push blade 20 and control blade 21 are shown located within a channel in the base 19 and are attached to the base 19 by screws (not shown), although it will be appreciated that the base 19 and push and control blades 20 and 21 could otherwise be made from a single piece of material.

A securing blade assembly 25 is mounted on top of the base 19 and is operated by handle assembly 26. The securing blade assembly 25 is of generally "T" shaped configuration, and comprises a comb control bar 27 of a width approximately equal to that of the push blade 20, and

forming the top of the "T", and a rearwardly extending bearing portion 28 forming the leg of the "T". The handle assembly 26 includes an L-shaped base which rides with a portion 29 upon the top surface of the bearing portion 28 of the securing blade assembly 25, and with another portion 30 extending downwardly behind the free end of the bearing portion 28. A hand or machine operable upstanding handle 31 is attached to the portion 29 of the handle assembly 26. A nose 32 is attached to the base 19 to provide a bearing surface 33 above a complementary bearing surface 34 on top of the base 19, between which surfaces the handle assembly 26 and securing blade assembly 25 are slideably moveable.

A spring 35 is located between the nose 32 and the handle 31 to bias the handle assembly 26 normally to a rearward to unlocked position, as shown in Figures 2 and 4. A spring 36 is located between the bearing portion 28 of the blade assembly 25 and the downwardly extending portion 30 of the handle assembly 26 to bias the assemblies 25 and 26 apart.

A locking means in the form of a detent pin 37 is located in a slot 38 in the base of the handle assembly 26, as shown in Figures 4 and 5, and is of sufficient diameter to extend out of slot 38 into a channel 39 in the bearing portion 28 of the securing blade assembly 25 to lock the handle assembly 26 and securing blade assembly 25 together. Thus, movement of the handle assembly 26 to a first or second position forward or back respectively to the base 19 will cause corresponding movement of the securing blade assembly 25.

When the handle assembly 26 and securing blade assembly 25 are moved to the first forward position against the action of the spring 35, the forward position being shown in Figures 2 and 5, the detent pin 37 is caused to be moved upwardly in the slot 38 and into a channel 40 in the bearing surface 33 of the nose 32. This movement is assured by the sloping rear end of the channel 39 in the bearing portion 28 of the securing blade assembly 25. The securing blade assembly 25 is then freed from the handle assembly 26, and is moved by the spring 36 forward relative to the handle assembly 26, as shown in Figure 5. Thus, the detent pin 37 is located on the top surface of the bearing portion 28 of the securing blade assembly 25 and is in the slot 38 of the handle assembly 26 and the channel 40 in the nose 32, to lock the securing blade assembly 26 to the base 19. In this position, therefore the handle assembly 26 cannot be moved rearwardly relative to the base 19. Also in this position, the leading edge of the comb control bar 27 engages the posts 11 of the comb 10. The leading edge of comb control bar 27 has

grooves therein in which the posts 11 are received in order to align and support the posts 11.

To limit forward and rearward movement of the securing blade assembly 25 relative to the base 19, a pin 41 is provided in the portion 28 of the securing blade assembly 25. The pin 41 rides within a channel 42 in the base 19 and engages a forward end wall 43 of the channel 42 when the assembly 25 is in its forward position shown in Figure 5, and engages a rear end wall 44 of the channel 42 when the assembly is in its rearward position shown in Figure 4.

It can be seen that when the handle assembly 26 and securing blade assembly 25 are in the forward, or locked position, as shown in Figure 5, and a force is applied to the leading edge of the comb control bar 27, thereby overcoming the bias of the spring 36, the securing blade assembly 25 will be moved backwards with respect to the handle assembly 26, bringing the channel 39 into alignment with the slot 38 and with the channel 40. The detent pin 37 will then fall downwardly into the slot 38 and the channel 39, and out of the channel 40, to release the handle assembly 26 and securing blade assembly 25 from the base 19, which are then both moved to the second rearward or unlocked position, shown in Figure 4, by the action of the spring 35.

In use of the apparatus a comb 10 of posts 11 to be inserted into holes in a printed circuit board can be manually or automatically inserted between the push blade 20 and control blade 21, as shown in Figure 3, with the carrier strip 12 fitted into the groove 24, and the projections 22 serving to separate the posts 11 and generally align them along a desired centre line for insertion into the holes in the printed circuit board. The handle assembly 26 and securing blade assembly 25 are then moved to the locked position shown in Figures 2 and 5, bringing the comb control bar 27 into contact with the posts 11, thereby securing the comb 10 in the apparatus with the posts 11 properly aligned.

In this locked position, the detent pin 37 is located in the slot 38 of the handle assembly 26 and the channel 40 in the nose 32 of the base 19, and the spring 35 is in compression between the nose 32 and the handle 31. The posts 11 are then inserted into the holes in the printed circuit board, during which operation the printed circuit board comes to bear upon the leading edge of the comb control bar 27. The securing blade assembly 25 is then urged backwards by the printed circuit board against the bias of the spring 36, and the detent pin 37 falls back into the slot 38 and channel 39. The handle assembly 26 and the securing blade assembly 25 are then moved backwards relative shown in

Figure 4 to the unlocked position by the action of the spring 35. The unlocked position is shown in broken lines in Figure 2, and the locked position is shown in full line in Figure 2.

The insertion force upon the partially inserted comb 10 is then continued by the engagement between the shoulders 14 of the posts 11 and the projections 22 of the push blade 20, the insertion force being continued until the shoulders 14 of the posts 11 come to rest upon the surface of the printed circuit board. The entire apparatus is then simply removed from the comb 10.

The apparatus can be of any suitable material, such as plastics or metal, the particular material chosen being determined principally by the intended use of the apparatus.

The apparatus in accordance with the invention, described above, can be readily employed with automatic machinery, such as numerically controlled machines, with, for example, pneumatic or other type force being applied to the base 19 to drive the posts 11 into the board. This is possible by virtue of the fact that the posts 11 are automatically aligned upon insertion of the comb 10 into the apparatus, and are locked and held in the aligned position by the comb control bar 27, until after the insertion has commenced. Once insertion has begun, the comb control bar 27 is automatically returned to the unlocked position to enable the apparatus to continue to complete the insertion operation until the shoulders 14 of the posts 11 are in the desired final position in contact with the surface of the printed circuit board.

WHAT WE CLAIM IS:—

1. Apparatus for simultaneously inserting a plurality of electrical terminals into respective holes in a substrate, the terminals initially being carried in substantially parallel relationship by a common carrier strip, comprising a base having support means to receive and support the terminals and carrier strip, and to align the terminals relative to each other and the carrier strip; terminal securing means mounted on the base for movement relative thereto between a first position in which the securing means engages the terminals to hold the terminals on the support means, and a second position in which the securing means does not engage the terminals and the terminals are free on the support means; and locking means which cooperates with the base and the securing means to lock the securing means in its first position and to release the securing means from the base for movement to the second position after part insertion of the terminals into the holes in the substrate.

2. Apparatus as claimed in Claim 1, in

which the support means comprises a push blade which carries a plurality of projections which are interleaved with the terminals to align the terminals and which engage shoulders on the terminals whereby insertion force can be applied to the terminals, and a control blade which forms a groove with the push blade, in which groove the carrier strip is received.

3. Apparatus as claimed in Claim 1 or Claim 2, in which the securing means comprises a bearing member mounted on the base for sliding movement relative thereto between the first and second positions which are determined by a pin carried by the bearing member and received in a channel in the base, the member carrying a securing blade which in the second position engages the terminals.

4. Apparatus as claimed in Claim 3, in which the securing means includes a handle assembly by which the bearing member can be moved from the second to the first position, and a spring acting between the handle assembly and the base and serving to move the bearing member from the first to the second position.

5. Apparatus as claimed in Claim 4, in which the bearing member is locked to the handle assembly by the locking means when in the second position, but is not so locked in the first position, and the handle assembly is locked to the base by the locking means when in the first position, but is not locked in the second position, there being a spring acting between the bearing member and the handle assembly and serving to urge the bearing member towards the first position when in the first position.

6. Apparatus as claimed in Claim 5, in which the locking means comprises a detent pin positioned in a slot in the handle assembly and engaged in a channel in the base in the first position and held in the channel in the base by the bearing member to lock the securing means in the first position, and engaged in a channel in the bearing member in the second position and held in the channel in the bearing member by the base to lock the handle assembly to the bearing member with the spring acting therebetween in a loaded condition, the detent pin being free of the channel in the bearing member in the first position, and the bearing member being moveable relative to the handle assembly against the action of the spring acting therebetween when in the first position to engage the detent pin in the channel in the bearing member and release the detent pin from the channel in the base whereby the spring acting between the base and the handle assembly can move the handle assembly and bearing member together from the first to the second position.



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Figure 4 to the unlocked position by the action of the spring 35. The unlocked position is shown in broken lines in Figure 2, and the locked position is shown in full line in Figure 2.

The insertion force upon the partially inserted comb 10 is then continued by the engagement between the shoulders 14 of the posts 11 and the projections 22 of the push blade 20, the insertion force being continued until the shoulders 14 of the posts 11 come to rest upon the surface of the printed circuit board. The entire apparatus is then simply removed from the comb 10.

The apparatus can be of any suitable material, such as plastics or metal, the particular material chosen being determined principally by the intended use of the apparatus.

The apparatus in accordance with the invention, described above, can be readily employed with automatic machinery, such as numerically controlled machines, with, for example, pneumatic or other type force being applied to the base 19 to drive the posts 11 into the board. This is possible by virtue of the fact that the posts 11 are automatically aligned upon insertion of the comb 10 into the apparatus, and are locked and held in the aligned position by the comb control bar 27, until after the insertion has commenced. Once insertion has begun, the comb control bar 27 is automatically returned to the unlocked position to enable the apparatus to continue to complete the insertion operation until the shoulders 14 of the posts 11 are in the desired final position in contact with the surface of the printed circuit board.

WHAT WE CLAIM IS:—

1. Apparatus for simultaneously inserting a plurality of electrical terminals into respective holes in a substrate, the terminals initially being carried in substantially parallel relationship by a common carrier strip, comprising a base having support means to receive and support the terminals and carrier strip, and to align the terminals relative to each other and the carrier strip; terminal securing means mounted on the base for movement relative thereto between a first position in which the securing means engages the terminals to hold the terminals on the support means, and a second position in which the securing means does not engage the terminals and the terminals are free on the support means; and locking means which cooperates with the base and the securing means to lock the securing means in its first position and to release the securing means from the base for movement to the second position after part insertion of the terminals into the holes in the substrate.

2. Apparatus as claimed in Claim 1, in

which the support means comprises a push blade which carries a plurality of projections which are interleaved with the terminals to align the terminals and which engage shoulders on the terminals whereby insertion force can be applied to the terminals, and a control blade which forms a groove with the push blade, in which groove the carrier strip is received.

3. Apparatus as claimed in Claim 1 or Claim 2, in which the securing means comprises a bearing member mounted on the base for sliding movement relative thereto between the first and second positions which are determined by a pin carried by the bearing member and received in a channel in the base, the member carrying a securing blade which in the second position engages the terminals.

4. Apparatus as claimed in Claim 3, in which the securing means includes a handle assembly by which the bearing member can be moved from the second to the first position, and a spring acting between the handle assembly and the base and serving to move the bearing member from the first to the second position.

5. Apparatus as claimed in Claim 4, in which the bearing member is locked to the handle assembly by the locking means when in the second position, but is not so locked in the first position, and the handle assembly is locked to the base by the locking means when in the first position, but is not locked in the second position, there being a spring acting between the bearing member and the handle assembly and serving to urge the bearing member towards the first position when in the first position.

6. Apparatus as claimed in Claim 5, in which the locking means comprises a detent pin positioned in a slot in the handle assembly and engaged in a channel in the base in the first position and held in the channel in the base by the bearing member to lock the securing means in the first position, and engaged in a channel in the bearing member in the second position and held in the channel in the bearing member by the base to lock the handle assembly to the bearing member with the spring acting therebetween in a loaded condition, the detent pin being free of the channel in the bearing member in the first position, and the bearing member being moveable relative to the handle assembly against the action of the spring acting therebetween when in the first position to engage the detent pin in the channel in the bearing member and release the detent pin from the channel in the base whereby the spring acting between the base and the handle assembly can move the handle assembly and bearing member together from the first to the second position.



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7. Apparatus as claimed in Claim 6, in which the bearing member slides on the base between a part thereof carrying the support means and a part thereof containing the channel therein.

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8. Apparatus for simultaneously inserting a plurality of electrical terminals into

respective holes in a substrate, substantially as hereinbefore described with reference to Figures 2 to 5 of the drawings.

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For the Applicants:
R. G. STUART-PRINCE
Chartered Patent Agent.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1977.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.