

SPECIFICATION

Mechanism for cutting and clinching leads of electronic components

Printed circuit boards are extensively used in the electronics industry and they are usually provided with preformed holes to receive the leads of various components to be electrically interconnected by the printed circuitry. It has been found that such electronic components can be quickly and economically inserted into printed circuit boards through the use of automatic equipment which has been programmed to rapidly place the leads of the components into the proper holes. The leads that are provided on the components are of a generally standard length and are usually much longer than needed after the component has been placed into the board. With the automatic equipment, these excessive length leads are located in a position relative to the board and are then inserted through the holes. The equipment will then automatically trim and clinch the leads and careful trimming and clinching assures proper contact between the lead and the printed circuit board and also removal of excess wire thereby providing accurate, reliable and neat connections.

Although the cut and clinch mechanisms presently used effectively clinch the electronic component against the printed circuit board and also effectively trim the excess leads, it has been found that the operation sometimes fails because of a misalignment between the lead-in wire and the cut-clinch mechanism. Good cutting and clinching requires that the lead-in wires be inserted normal to the circuit board and from time to time, a wire becomes bent from that position prior to working upon it. Thus, the cut-clinch mechanism will not engage the wire and perform its function.

Component inserters of the type generally under consideration are described, for example in United Kingdom patent specification No. 1562413 and United States patent specification No. 3,429,170. These patent specifications disclose inserters that are rotatable and reciprocable upon an axis and they include a pair of reciprocal cutting and clinching elements that are mounted for angular rotation to orient the elements in accordance with the orientation of the leads passing through the board. When the inserter is reciprocated on its axis, the cutting elements move to shear unnecessary lengths of wire that extend through the circuit board and also crimp a small portion of the wire against the circuit board for securing the component and for the establishment of an electrical connection. Neither of these patents discloses a mechanism for detecting whether or not the lead-in wires which are inserted through the printed circuit board are actually in place to be shorn and clinched. In United States patent No. 4,165,557, a mechanism is disclosed for trimming and securing parallel lead-in wires of electronic components and sensing whether each lead-in wire is disposed

within the mechanism. In that patent, sensing is accomplished prior to the cutting and clinching by contact of the lead-in wires with electrical sensors that are disposed within the cut-clinch unit.

It is an object of the present invention to provide improved means for detecting misalignment of a component lead with a movable knife by which it is intended it should be cut and clinched.

The invention provides a mechanism for cutting and clinching a component lead projecting from a circuit board in which a movable knife is caused to advance towards a stationary one to cut and clinch the lead by means of a drive member, the drive member and movable knife being drivingly coupled with provision for lost motion by the knife as the drive member advances so that the knife retracts a limited distance relative thereto upon engagement with a component lead, and sensing means responsive to such relative retraction whereby a signal is generated or not according to whether or not a lead is in a position to be cut and clinched.

Preferably, in a mechanism in accordance with the invention the sensing means is carried by the drive member in a position to be engaged by the movable knife upon said relative retraction, and the movable knife is constantly urged forward relative to the drive member by spring means.

The sensing means of a mechanism in accordance with the invention preferably comprises an electrical contact arranged to generate a signal upon contact by the movable knife; the contact may be embedded in plastics material to insulate it from the drive member.

There now follows a detailed description to be read with reference to the accompanying drawings of a cut-clinch mechanism in accordance with the invention and illustrative thereof. It will be realised that this illustrative mechanism has been selected for description by way of example and not of limitation of the invention.

In the accompanying drawings:—

Figure 1 is an exploded view, partially in cross-section, showing the illustrative cut-clinch mechanism;

Figures 2, 3 and 4 are sequential elevational views, partially in cross-section, showing progressive stages in the operation of the illustrative cut-clinch mechanism;

Figure 5 shows a lead-in wire that is misaligned relative to the cut-clinch mechanism and the disposition of a movable knife relative to a sensor of the mechanism; and

Figure 6 is an enlarged view of the movable knife and sensor of the illustrative mechanism showing in detail the engagement of the movable knife by a spring and the positioning of a link pin between a drive member and the movable knife.

As shown in Figure 1, the cut-clinch mechanism of the present invention includes a cylinder block 10 that has a cylinder cap 7 mounted thereon and secured by cylinder cap screws 4. A gasket 18 is disposed between the cylinder cap 7 and the cylinder block 10, as is

conventional in the piston art. A piston 20 is slidably disposed within the cylinder block 10 and is surrounded by an 'O' ring 19 that engages the inner walls of the cylinder block 10. A piston rod 9 extends from each side of the piston 20 and is carried thereby in response to air pressure received and withdrawn through fittings 6 and 6a. One end of the piston rod 9 extends outwardly of the cylinder cap 7 and is seated therein. A bumper 3 is disposed immediately adjacent the exterior cylinder cap 7 and is fitted about the piston rod 9. A stop nut 2 is threaded upon the piston rod 9 and secured in place by a piston lock nut 1. The piston rod 9 has an axial bore 27 formed therein which is in communication with an enlargement 28. A sensor 15 is disposed in the enlargement 28 and a wire 29 extends through the bore 27 to an indicator mechanism (not shown). When nested in the enlargement 28, the sensor 15 is surrounded by a spring 16 that urges against the trailing end 25a of the movable knife 25.

A link pin 26 is disposed within a hole 30 that is formed in the trailing end 25a of the movable knife 25. The hole 30 has an inner diameter which is slightly greater than the outer diameter of the link 26, generally in the order of about 1/16 of an inch. The bottom of the trailing end 25a rests upon a flat surface 9a formed in the piston rod 9 and is free to move by the amount of free play between the link pin 26 and the walls of the hole 30. When assembled, the link pin 26 is slipped through the hole 30 and then into a hole 30a formed on the flat surface 9a. The internal diameter of the hole 30a is substantially the same as the outside diameter of the pin 26 so that a snug fitting is provided.

A fixed knife 11 having a slot 44 forming a cutting edge 11a is supported upon an extension 31 of the cylinder block 10 and is retained in place by a knife retainer 12 that is fitted thereover. The knife retainer 12 is secured to the fixed knife 11 by means of retainer screws 13 and fixed knife pins 14 that fit through holes formed in the respective parts, the screws being threaded into the extension 31 of the cylinder block 10. The movable knife 25 is free to slide in the direction of movement of rod 9 within a track 32 formed in the knife retainer 12.

In operation, the piston 20 travels within the cylinder block 10 and 'O' ring seals 5 and 8 are provided in the cylinder block 10 and the cylinder cap 7 to prevent leakage of pressurized air introduced through fittings 6 and 6a. The piston 20 is secured upon the piston rod 9 by means of a piston retaining nut 17, the piston retaining nut 17 being arranged to abut against a bumper 22 freely surrounding the rod 9 as the piston retracts from its forward position. As the piston 20 moves forward within the cylinder block 10, the rod 9 is moved forward carrying with it the movable knife 25 that is attached to the rod 9 by means of the link pin 26. As has been stated, the spring 16 continually urges the movable knife 25 away from the sensor 15 and if no obstruction is imposed in its path, a signal will not be transmitted through

the wire 29 which will indicate an improper insertion. If a lead-in wire is disposed between the cutting edge 11a of the fixed knife 11 and the movable knife 25, the trailing end 25a will overcome the resistance of spring 16, engage the sensor 15 and transmit a signal.

Referring now to Figures 2, 3 and 4 the cut-clinch mechanism is shown disposed beneath a circuit board 42 with a lead-in wire 40 of an electronic component disposed through one of the holes 41. The lead-in wire is placed in registry with the cut-clinch mechanism. It is to be appreciated that the cut-clinch mechanism is of a type usually set up in pairs so that they will simultaneously cut and clinch the two lead-in wires normally associated with electronic components. The board is held in a conventional retaining mechanism and the inserter, 43, which holds the component can also be of conventional design.

In Figure 2 the movable knife 25 is disposed in the retracted position and the lead-in wire 40 has been inserted within the hole 41 of the circuit board 42 by the inserter 43. The lead-in wire 40 is closely adjacent the cutting edge 11a of the fixed knife 11 and depends in the slot 44. The spring 16 urges the rear end of the hole 30 in the trailing end 25a of the movable knife 25 against the rear of the link pin 26 thereby leaving a small space between the front of the hole 30 and the link pin 26. The space is greater than the space between the trailing end 25a of the movable knife and the sensor 15.

After the lead-in wire 40 has been disposed in a cutting relationship against the cutting edge 11a of the fixed knife 11, the piston rod 9 is actuated by air pressure against the piston 20 and travels forward carrying with it the movable knife 25. As the cutting edge of the movable knife 25 engages the lead-in wire 40, the strength of spring 16 is overcome thereby causing the trailing end 25a to engage the sensor 15 and provide a signal to indicate that the lead-in wire 40 is properly disposed for cutting and clinching. The link pin 26 now engages the front of the hole 30 to cause forward movement of the knife 25 to continue under the influence of the piston 20.

As shown in Figure 4, the movable knife 25 has been extended to a position where the lead-in wire 40 has been bent beneath the circuit board 42, thus crimping it. At the same time, the excess lead-in wire 40b has been shorn and is shown dropping through the extension 31 of the cylinder block 10. As can be seen, the link pin 26 still engages the front of the hole 30 during the cut and clinch operation. Following the cutting and clinching, the rod 9 is retracted carrying with it the movable knife 25 which will resume the position shown in Figure 2 wherein the spring forces the movable knife 25 forward so that the link 26 engages the rear of hole 30 and the equipment is ready for another insertion operation.

In Figure 5 the movable knife 25 is shown in an extended position immediately adjacent the cutting edge 11a of fixed knife 11. In this figure

however, the lead-in wire was not correctly disposed immediately adjacent the cutting edge 11a. Instead, the lead-in wire 40 was inappropriately positioned more adjacent the circuit board (or as shown in dotted lines, above the circuit board) thereby not providing an obstacle to engage the cutting edge of the movable knife 25. Since no obstacle was placed in the path of the movable knife, the spring 16 was not overcome and the trailing end 25a did not engage the sensor 15 and also, the trailing end 25a did not slide over flat surface 9a. No signal was provided from contact between the sensor 15 and the trailing end 25a, thereby enabling the operator of the equipment to know that the wire had been improperly inserted and was not cut and clinched.

Figure 6 shows an enlargement of the cut and clinch mechanism shown in Figures 1 to 5. As can be seen, rod 9 has an axial bore 27 through which the insulated wire 29 extends to the sensor 15. The sensor 15 is formed of a probe 15a surrounded by a resinous material 15b which is sufficiently strong to withstand the shock of engagement with the trailing end 25a of the movable knife 25 and to provide electric insulation of the probe 15a from the rod 9. The trailing end 25a is free to move on the flat portion 9a of the rod 9 as the cutting edge of the movable knife 25 engages a lead-in wire of an electronic component (not shown). Such movement is limited by the free space 30b within the hole 30 which allows a limited amount of travel because the diameter of the link pin 26 is smaller than the inner diameter of the hole 30.

The sensor 15 is preferably made by placing a wire within a cup-like mould with one end of the wire extending through the bottom thereof. A soldered lead contact is crimped around the wire and will extend a short distance above the top of the mould. The wire and contact may be embedded in a urethane plastics which is poured into the mould. Air bubbles are broken up to ensure that the mould is completely filled around the contact and wire. Following the pouring of the

urethane, the material is cured and the sensor is ejected and inspected for complete insulation of the wire and contact and any voids in the moulded product. As shown in Figure 6, a small flange 15c can be formed in the moulded plastics and this flange can be made of a diameter substantially equal to the enlargement 28 so as to firmly seat the sensor therein. The flange 15c is also of sufficient size to accommodate the spring 16 around the probe so as to provide a recessable nesting for the parts.

CLAIMS

1. Mechanism for cutting and clinching a component lead projecting from a circuit board in which a movable knife is caused to advance towards a stationary one to cut and clinch the lead by means of a drive member, the drive member and movable knife being drivingly coupled with provision for lost motion by the knife as the drive member advances so that the knife retracts a limited distance relative thereto upon engagement with a component lead, and sensing means responsive to such relative retraction whereby a signal is generated or not according to whether or not a lead is in a position to be cut and clinched.

2. Mechanism according to Claim 1 in which the sensing means is carried by the drive member in a position to be engaged by the movable knife upon said relative retraction.

3. Mechanism according to Claim 2 in which the movable knife is constantly urged forward relative to said drive member by spring means.

4. Mechanism according to Claim 3 in which the sensing means comprises an electrical contact arranged to generate a signal on contact by the movable knife.

5. Mechanism according to Claim 4 in which said electrical contact is embedded in plastics material to insulate it from the drive member.

6. Mechanism for cutting and clinching a component lead constructed, arranged and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

however, the lead-in wire was not correctly disposed immediately adjacent the cutting edge 11a. Instead, the lead-in wire 40 was inappropriately positioned more adjacent the circuit board (or as shown in dotted lines, above the circuit board) thereby not providing an obstacle to engage the cutting edge of the movable knife 25. Since no obstacle was placed in the path of the movable knife, the spring 16 was not overcome and the trailing end 25a did not engage the sensor 15 and also, the trailing end 25a did not slide over flat surface 9a. No signal was provided from contact between the sensor 15 and the trailing end 25a, thereby enabling the operator of the equipment to know that the wire had been improperly inserted and was not cut and clinched.

Figure 6 shows an enlargement of the cut and clinch mechanism shown in Figures 1 to 5. As can be seen, rod 9 has an axial bore 27 through which the insulated wire 29 extends to the sensor 15. The sensor 15 is formed of a probe 15a surrounded by a resinous material 15b which is sufficiently strong to withstand the shock of engagement with the trailing end 25a of the movable knife 25 and to provide electric insulation of the probe 15a from the rod 9. The trailing end 25a is free to move on the flat portion 9a of the rod 9 as the cutting edge of the movable knife 25 engages a lead-in wire of an electronic component (not shown). Such movement is limited by the free space 30b within the hole 30 which allows a limited amount of travel because the diameter of the link pin 26 is smaller than the inner diameter of the hole 30.

The sensor 15 is preferably made by placing a wire within a cup-like mould with one end of the wire extending through the bottom thereof. A soldered lead contact is crimped around the wire and will extend a short distance above the top of the mould. The wire and contact may be embedded in a urethane plastics which is poured into the mould. Air bubbles are broken up to ensure that the mould is completely filled around the contact and wire. Following the pouring of the

urethane, the material is cured and the sensor is ejected and inspected for complete insulation of the wire and contact and any voids in the moulded product. As shown in Figure 6, a small flange 15c can be formed in the moulded plastics and this flange can be made of a diameter substantially equal to the enlargement 28 so as to firmly seat the sensor therein. The flange 15c is also of sufficient size to accommodate the spring 16 around the probe so as to provide a recessable nesting for the parts.

CLAIMS

1. Mechanism for cutting and clinching a component lead projecting from a circuit board in which a movable knife is caused to advance towards a stationary one to cut and clinch the lead by means of a drive member, the drive member and movable knife being drivingly coupled with provision for lost motion by the knife as the drive member advances so that the knife retracts a limited distance relative thereto upon engagement with a component lead, and sensing means responsive to such relative retraction whereby a signal is generated or not according to whether or not a lead is in a position to be cut and clinched.

2. Mechanism according to Claim 1 in which the sensing means is carried by the drive member in a position to be engaged by the movable knife upon said relative retraction.

3. Mechanism according to Claim 2 in which the movable knife is constantly urged forward relative to said drive member by spring means.

4. Mechanism according to Claim 3 in which the sensing means comprises an electrical contact arranged to generate a signal on contact by the movable knife.

5. Mechanism according to Claim 4 in which said electrical contact is embedded in plastics material to insulate it from the drive member.

6. Mechanism for cutting and clinching a component lead constructed, arranged and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

