

PATENT SPECIFICATION

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- (21) Application No. 20439/73 (22) Filed 30 April 1973
(31) Convention Application No. 249 305 (32) Filed 1 May 1972 in
(33) United States of America (US)
(44) Complete Specification published 24 March 1976
(51) INT. CL.² B23K 1/12
(52) Index at acceptance
B3R 22A 22G 23 24 26A
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(54) IMPROVEMENTS IN TERMINALS AND IN THE FORMATION OF ELECTRICAL CONNECTIONS BETWEEN TERMINALS AND CIRCUIT MEMBERS

(71) We, E. I. DU PONT DE NEMOURS AND COMPANY, a corporation organised and existing under the laws of the State of Delaware, located at Wilmington, State of Delaware, 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 a terminal assembly and to a method of forming soldered connections.

According to one aspect of the invention, there is provided a terminal assembly comprising a carrier strip having a plurality of terminals spaced along the carrier strip and removably attached thereto, each terminal including a contact for soldering in electrical connection with a circuit element, wherein a continuous solder wire extends along the terminal assembly in engagement with each terminal, such that upon positioning said contacts against circuit elements and heating the solder wire, the wire melts and the solder coalesces on each contact-circuit element pair to form independent soldered electrical connections.

In accordance with a further aspect of the invention there is provided a method of forming soldered connections between a plurality of terminals and a like number of contact pads on a circuit member comprising the steps of:

(a) positioning the terminals adjacent the circuit member with a contact of each terminal in physical engagement with a contact pad;

(b) heating a continuous solder wire secured to all the terminals to melt the solder; and

(c) allowing the molten solder on the individual pairs of terminal contacts and contact pads to coalesce to form independent soldered electrical connections

therebetween.

Preferably a terminal assembly of the invention is mounted so that the terminals are in physical engagement with contact pads on a circuit member. After the terminals are physically secured to the circuit member the terminals, solder wire and pads are heated to melt the solder which is then allowed to coalesce on the individual terminal contact-contact pad pairs to form soldered connections electrically independent of adjacent soldered connections. The terminals are attached to a carrier strip which may be removed after completion of the soldering operation.

This invention represents an improvement over terminals of the type disclosed in U.S. Patent No. 3,351,704 where an individual mass of solder is attached to each soldering terminal. When the terminal is heated the solder melts and forms the desired solder connection with a contact. U.S. Patent No. 3,381,372 discloses positioning a preformed solder ring between external leads and surface conductors of a micro-electronic circuit and then melting the solder ring to form individual solder connections between the leads and conductors.

A preferred embodiment of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a terminal assembly in position to be brought into physical engagement with a circuit member;

Figure 2 illustrates the terminal assembly mounted on the edge of the circuit member with the terminal contacts engaging contact pads on the circuit member;

Figure 3 is a side view of one of the terminals of the assembly mounted on the circuit member as illustrated in Figure 2;

Figure 4 illustrates the terminals and cir-

cuit member after the soldering operation;

Figure 5 is a view similar to that of Figure 3 after soldering; and

Figure 6 is similar to Figure 4 illustrating the soldered terminals following removal of the carrier strip.

As illustrated in Figure 1, a terminal assembly 10 includes a continuous carrier strip 12 with a number of individual terminals 14 extending along the strip at regular intervals. A leg 16 of each terminal 14 is secured to the carrier strip 12. Pilot holes 18 may be provided in strip 12 to facilitate indexing of the terminal assembly during manufacture and mounting of the terminals 14 on a circuit member.

The terminals 14 each include a pair of spring arms 20 and 22 extending to one side of the leg 16. The end of each spring arm is bent away from the adjacent spring arm to provide smooth contact surfaces 24 and 26 to facilitate moving the terminal over the edge of a circuit member such as a circuit board or a ceramic substrate. The free end of arm 20 is bent back toward the median portion of the arm to provide a solder wire receiving clip or recess 28. A smooth lead-in 30 is provided on both sides of the mouth of recess 28 to facilitate positioning a solder wire within the recess. A continuous solder wire 32 extends along the length of assembly 10 and is secured to the terminals 14 in recesses 28.

The closely spaced terminals 14 of Figure 1 are mounted on the edge 34 of circuit member 36 with the contact surface 24 of each spring arm 20 resting on a metal contact pad 38. The arms 20 and 22 form a clip for engaging the edge of member 36. The spacing between the spring arms 20 and 22 is somewhat less than the thickness of the circuit member 36 at pads 38 so that the arms are resiliently spread apart slightly when forced on to the pads and clamp the edge of the circuit member thus assuring a positive physical connection between each arm 20 and pad 38. Figure 2 illustrates the terminals after they have been physically mounted on circuit member 36. Carrier strip 12 holds the terminals in proper spaced relation to permit simultaneous mounting of a number of terminals on the member 36 with the contacts resting on pads 38.

The desired solder connections between terminals 14 and the individual pads 38 are achieved by heating the terminals and pads in Figure 2 to heat and therefore melt the solder wire. The heating of the solder wire is then discontinued to allow the solder to coalesce. As illustrated in Figures 4 and 5, the molten solder coalesces on the individual contact arms 20 and pads 38 to form independent soldered electrical connections 40 between terminals 14 and con-

tact pads 38. There are no solder connections between adjacent pads. The solder in the wire extending between the terminals is melted and is drawn by capillary action to one of the adjacent terminal-pad contacts preventing undesirable cross or short circuits. Depending upon the given application, the solder wire 32 may include a fluxing agent to facilitate the forming of the soldered joints.

When the soldering operation has been completed the terminals 14 are held on circuit member 36 by the soldered connections 40. Carrier strip 12 may then be broken away from the terminal legs 16 at weakened areas 42 so that the individual soldered terminals 14 are electrically isolated. The circuit member 36 with terminal legs 16 extending therefrom may then be mounted in a connector block or on another circuit member in a conventional manner.

The terminal assembly 10 greatly simplifies the job of soldering a number of terminals to closely spaced contact pads. The terminals 14 are carried on strip 12 at the same spacing as the spacing of the contact pads so that the soldering operation is performed by first engaging the terminals 14 on the contact pads at the edge of the circuit member and then heating the terminals so that the solder wire is heated and melts to automatically form the solder connections. No longer is it necessary to individually position each terminal on its respective contact pad and then hand solder the terminal to the pad.

On a production basis the terminals 14 can be mounted on a circuit member and soldered thereto completely automatically by machine. The assembly 10 is unwound from a supply reel and fed to a position where a lead group of terminals is to one side of the edge of a circuit member. The terminals are then automatically pushed on to the circuit member with the arms engaging the pads and then heated to form the solder connections. Subsequently the carrier strip 12 may be automatically cut from the legs 16 of the soldered terminals. This operation can be performed rapidly and reliably to reduce the cost of soldering terminals to a circuit member while also improving the reliability of the soldered connections.

While the disclosed terminals 14 are intended to be clipped on one edge of a circuit panel, the invention is not limited to such clip-type terminals. Other kinds of terminals can be soldered by the use of a continuous solder wire.

While there has been illustrated and described a preferred embodiment of this invention, it is understood that this is capable of modification and therefore the

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precise details set forth are to be regarded as exemplary rather than limiting, the scope of this invention being as defined by the following claims.

5 WHAT WE CLAIM IS:

1. A terminal assembly comprising a carrier strip having a plurality of terminals spaced along the carrier strip and removably attached thereto, each terminal including a contact for soldering in electrical connection with a circuit element, wherein a continuous solder wire extends along the terminal assembly in engagement with each terminal such that upon positioning said contacts against circuit elements and heating the solder wire, the wire melts and the solder coalesces on each contact-circuit element pair to form independent soldered electrical connections.

2. A terminal assembly as claimed in claim 1 wherein each terminal includes a pair of opposed spring arms adapted to resiliently engage the edge of a circuit panel.

3. A terminal assembly as claimed in claim 1 or 2 wherein each terminal includes holding means for physically securing the solder wire to the terminal.

4. A terminal assembly as claimed in claim 3 wherein each holding means comprises a wire receiving clip.

5. A terminal assembly as claimed in claim 4 adapted to be mounted on the edge of a circuit panel with one spring arm of each terminal engaging a circuit pad on the panel to form a contact pair, wherein said wire receiving clip is formed on said one spring arm of each terminal.

6. A terminal assembly substantially as herein described with reference to the accompanying drawings.

7. A method of forming soldered connections between a plurality of terminals and a like number of contact pads on a circuit member comprising the steps of:

(a) positioning the terminals adjacent

the circuit member with a contact of each terminal in physical engagement with a contact pad;

(b) heating a continuous solder wire secured to all the terminals to melt the solder; and

(c) allowing the molten solder on the individual pairs of terminal contacts and contact pads to coalesce to form independent soldered electrical connections therebetween.

8. A method of forming a plurality of soldered electrical connections comprising the steps of:

(a) providing a terminal assembly comprising a continuous carrier strip, a plurality of terminals removably secured to the carrier strip, and a continuous solder wire extending along the assembly and secured to the terminals;

(b) positioning each terminal against a corresponding contact pad on a circuit member with a contact on the terminal engaging the pad;

(c) heating the terminals, pads and solder wire to melt the solder; and

(d) allowing the solder on the individual terminal contact-contact pad pairs to coalesce to form independent soldered electrical connections therebetween.

9. A method as claimed in claim 7 or 8 including the step of removing the terminals from the carrier strip after the soldering operation.

10. A method of soldering a plurality of terminals to a plurality of circuit contacts substantially as herein described and illustrated by reference to the accompanying drawings.

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20 2. A terminal assembly as claimed in claim 1 wherein each terminal includes a pair of opposed spring arms adapted to resiliently engage the edge of a circuit panel.

25 3. A terminal assembly as claimed in claim 1 or 2 wherein each terminal includes holding means for physically securing the solder wire to the terminal.

4. A terminal assembly as claimed in claim 3 wherein each holding means comprises a wire receiving clip.

30 5. A terminal assembly as claimed in claim 4 adapted to be mounted on the edge of a circuit panel with one spring arm of each terminal engaging a circuit pad on the panel to form a contact pair, wherein said wire receiving clip is formed on said one spring arm of each terminal.

35 6. A terminal assembly substantially as herein described with reference to the accompanying drawings.

40 7. A method of forming soldered connections between a plurality of terminals and a like number of contact pads on a circuit member comprising the steps of:

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(b) positioning each terminal against a corresponding contact pad on a circuit member with a contact on the terminal engaging the pad;

(c) heating the terminals, pads and solder wire to melt the solder; and

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