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## (54) ELECTRICAL CIRCUIT ELEMENT

(71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2, a British Company, 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:—

10 This invention relates to electrical circuit elements covered by a layer of insulating material through which at least two, partly parallel, connecting wires protrude.

15 One problem with electrical circuit elements, for example, capacitors, is that the circuit element does not have a defined abutment surface which is necessary for uniform mounting on a printed circuit board. This is due to the irregular shape which a circuit element obtains when it is  
 20 dipped in an insulating lacquer. This problem becomes particularly significant when circuit elements are mounted by automation. One known solution to this problem has been solved by means of providing a plate with apertures for the connecting wires which, prior to dipping, is slid over the connecting wires as far as the portion of the circuit element extending between the connecting wires. After that, the circuit element  
 30 is dipped into the lacquer, so that the lacquer progresses from the circuit element only as far as the plate, but does not cover the side of the plate remote from the circuit element. The uncovered side of the plate thus forms a flat, defined abutment for mounting on a printed circuit board.

35 One of the drawbacks of this known solution is that each circuit element has to be individually provided with a plate, whilst this plate must be fitted very accurately so as to prevent bending of the connecting wires and damaging of the connection of the wires to the circuit element. A further  
 45 drawback is that, owing to the presence of the plate, the insulating lacquer cannot always penetrate as far as that portion of the surface of the circuit element which surrounds the connecting wires, so that  
 50 proper insulation is not fully ensured. An-

other drawback yet is that the above described method of manufacturing the circuit element is less suitable for automation as the abutment plates have to be fitted individually per circuit element with great accuracy. Series production of these circuit elements leads to a comparatively high cost price per circuit element.

One of the objects of this invention is to provide a circuit element in which the said drawbacks are reduced.

According to this invention there is provided an electrical circuit element covered by a layer of insulating material through which parallel portions of two connecting wires protrude, a strip of insulating material extending diagonally between the parallel portions of the connecting wires such that the two connecting wires respectively engage opposite major faces of the strip, the strip substantially adjoining the circuit element surface situated between the connecting wires, said strip being partly embedded in the insulating material.

A further object of this invention is to provide a method of manufacturing circuit elements according to this invention enabling series production of comparatively inexpensive circuit elements.

According to another feature of this invention there is formed a chain of circuit elements, the connecting wires of which extend mutually parallel and transverse to the direction of the chain and engage a continuous strip of insulating material, which is common to all circuit elements, such that the two connecting wires of each element respectively engage opposite major faces of said continuous strip, the coherence of the chain of circuit elements being obtained by means of a locating strip on which the free ends of the connecting wires of the circuit elements are mounted and which locates and retains the elements in position in the chain, the chain of circuit elements then being dipped into an insulating lacquer so that each circuit element and part of the continuous strip adjacent the elements is covered by the insulating lacquer, the chain then being removed from the lacquer and

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dried, after which the locating strip is removed and the elements are separated by cutting the continuous strip between adjacent elements.

In order that this invention may be readily carried into effect, one embodiment thereof will now be described in detail, by way of example, with reference to the accompanying diagrammatic drawing, in which:—

Figure 1 shows, in enlarged scale, an electrical component according to this invention, the upper portion of the element being shown in a sectional view and the lower portion in a front view.

Figure 2 is an underside view of the circuit element shown in Figure 1.

Figure 3 is a front elevation of a chain of undipped circuit elements, formed with the aid of a method according to this invention.

The circuit element 1 shown in Figure 1 and Figure 2 is a disc-shaped capacitor having a layer of ceramic dielectric material 7 which is situated between two disc-shaped electrodes 3 and 5, and two mutually parallel connecting wires 9 and 11 which extend parallel, and are connected to the electrodes 3 and 5 respectively. Diagonally between the connecting wires 9 and 11 is situated a strip 13 of insulating material which engages with its respective opposing major surfaces the sides of the connecting wires 9 and 11 which face their respective electrodes. The capacitor 1, including the strip 13 provided thereon, is dipped into an insulating lacquer so that the lacquer 15 covers the capacitor as far as the indicated level denoted by the reference numeral 17, so that the lower edge 19 of the strip 13 remains free from lacquer. The strip 13 is thus embedded into the insulating lacquer 15 approximately as far as the level 17. The lower edge 19 of the strip 13 constitutes a defined flat abutment for mounting the capacitor on a printed-circuit board. Even though the strip 13 is preferably arranged against the side of the connecting wires 9 and 11 which face their respective electrodes 3 and 5, due to adhesion with the capacitor body, it is also possible to arrange the strip diagonally against the sides of the connecting wires remote from their respective electrodes.

Although this invention is illustrated with reference to a disc-shaped ceramic capacitor, it will be obvious that circuit elements of a different shape, for example, cylindrical elements having radially extending connecting wires, can also be provided with an abutment strip as described in the foregoing.

Fitting a diagonally-arranged abutment strip and dipping a circuit element may, of course, also be effected individually for each circuit element, but according to this invention this is preferably done for a number

of circuit elements simultaneously in the manner which is described with reference to Figure 3.

In Figure 3, only four circuit elements are shown of a chain having a much larger number of elements, the chain being formed by arranging the elements mutually parallel in the same plane, their connecting wires 23 and 25 extending in the same direction transverse to the longitudinal direction of the chain, and by subsequently interconnecting the connecting wires of the various elements by means of a locating strip 27. The locating strip 27 may comprise, for example, two strips of adhesive tape between which the connecting wires are secured. A continuous strip of insulating material 29 is fitted substantially adjacent to the sides of the circuit elements 21 from which the connecting wires 23 and 25 protrude, which extends diagonally between the connecting wires 23 and 25 of each of the circuit elements and which engages the connecting wires 23 and 25 with its opposing major surfaces respectively. The strip 29 may be woven between the connecting wires 23 and 25 after or before the locating strip 27 is fitted. If the circuit elements are placed in a suitable holding device, the strip 29 may be slid between the connecting wires of the circuit elements while lying in a flat plane. The mutually parallel connecting lines between the two connecting wires of the various circuit elements then cross the strip 29. If necessary, the circuit elements may be tilted simultaneously after the strip 29 has been fitted, so that the connecting wires engage the strip 29. It is furthermore possible to keep the strip 29 in a fixed position and to displace the circuit elements with respect to the strip by means of a holding device.

The insulating lacquer is applied by simultaneously dipping the circuit elements 21 in a lacquer bath while they are suspended from the connecting strip 27. The dipping depth is so selected that the lacquer cannot cover the edge 31 of the strip 29 which is remote from the circuit elements 21. As a result, the risk that the connecting wires are covered with lacquer is also eliminated. Dipping may be effected, for example, by lowering a chain of circuit elements which is situated in a flat plane into the lacquer. However, it is alternatively possible to form the chain of circuit elements into a coil, and to dip the coil subsequently into the lacquer. After drying of the lacquer, the connecting strip 27 may be immediately removed, if desired, for example, by cutting off a portion of the connecting wires, the abutment strip 29 being cut between the circuit elements.

It will be obvious that according to this invention a large number of circuit elements

can be provided with an abutment strip in series production in a very simple and inexpensive manner. Also because the fitting of a diagonally-extending strip does not require great accuracy, the method according to this invention provides a comparatively inexpensive circuit element provided with an abutment strip.

10 WHAT WE CLAIM IS:—

1. An electrical circuit element covered by a layer of insulating material through which parallel portions of two connecting wires protrude, a strip of insulating material  
15 extending diagonally between the parallel portions of the connecting wires such that the two connecting wires respectively engage opposite major surfaces of said strip, the strip substantially adjoining the circuit element at the surface situated between the  
20 connecting wires, said strip being partly embedded in the insulating material.

2. An electrical circuit element as claimed in Claim 1 in the form of a capacitor having a layer of dielectric material  
25 which is situated between two plate-shaped electrodes, and two connecting wires extending substantially parallel to the electrodes, each of the wires being connected to a respective one of the electrodes, wherein  
30 the strip of insulating material engages that side of each connecting wire on which its respective electrode is located.

3. A method of manufacturing an electrical circuit element as claimed in Claim 1 or 2, wherein a chain of circuit elements  
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the elements extend mutually parallel and transverse to the direction of the chain and engage a continuous strip of insulating material, which is common to all circuit elements, such that the two connecting wires of each element respectively engage opposite major surfaces of said strip, the coherence of the chain of circuit elements being obtained by means of a locating strip on which the free ends of the connecting wires of the circuit elements are mounted and which  
40 locates and retains the elements in position in the chain, the chain of circuit elements then being dipped into an insulating lacquer so far that each circuit element and part of the continuous strip adjacent the elements is covered by the insulating lacquer, the chain then being removed from the lacquer and dried, after which the locating strip is removed and the elements are separated by cutting the continuous strip between adjacent elements.  
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4. An electrical circuit element substantially as herein described with reference to the accompanying drawing.  
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5. A method of manufacturing an electrical circuit element substantially as herein described with reference to the accompanying drawing.  
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2. An electrical circuit element as claimed in Claim 1 in the form of a capacitor having a layer of dielectric material which is situated between two plate-shaped electrodes, and two connecting wires extending substantially parallel to the electrodes, each of the wires being connected to a respective one of the electrodes, wherein the strip of insulating material engages that side of each connecting wire on which its respective electrode is located.

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the elements extend mutually parallel and transverse to the direction of the chain and engage a continuous strip of insulating material, which is common to all circuit elements, such that the two connecting wires of each element respectively engage opposite major surfaces of said strip, the coherence of the chain of circuit elements being obtained by means of a locating strip on which the free ends of the connecting wires of the circuit elements are mounted and which locates and retains the elements in position in the chain, the chain of circuit elements then being dipped into an insulating lacquer so far that each circuit element and part of the continuous strip adjacent the elements is covered by the insulating lacquer, the chain then being removed from the lacquer and dried, after which the locating strip is removed and the elements are separated by cutting the continuous strip between adjacent elements.

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5. A method of manufacturing an electrical circuit element substantially as herein described with reference to the accompanying drawing.

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