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(54) **Improved method for the connection of heater elements**

Verbesserte Methode zur Verbindung von Heizelementen

Procédé amélioré pour la connexion d'éléments de chauffage

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Description

The present invention relates to a method for making connections between electric circuits disposed on an insulating support, including the steps of applying a plurality of terminals to said insulating support, said step of applying said plurality of terminals is carried out by mounting at least one conductive member on said insulating support by inserting projections extending therefrom into apertures formed in said insulating support, and mechanically and electrically connecting terminal ends of said electric circuits to said plurality of terminals.

The technology for making connections of this type is generally known, and is employed in practically identical manner by different manufacturers, apart from certain marginal variations mainly due to different physical configurations of the resistor elements and the associated supports.

This technology is substantially based on a manufacturing cycle which shall be briefly outlined in the following in order to facilitate comparison to the method of the present invention to be described subsequently.

In the known manufacturing cycle, the first step consists in forming the insulating support with a number of apertures at locations corresponding to the terminal ends of the resistance circuits; the second step consists in connecting the terminal ends of the resistance circuits to conductor elements adjacent the locations of respective apertures; the third step consists in rivetting the conductor elements to the insulating support by means of rivets passing through respective apertures, to thereby establish reliable mechanical and electrical connections of the conductor elements to the associated rivets; and the fourth step consists in connecting the rivets to respective power supply terminals in a per se known manner, for instance by soldering.

While this known process is sufficiently simple and safe, it suffers from the inconvenience of being a manual process throughout; in view of the severe competition in the field of large-scale industrial production, this extensive use of manual labour results in an inacceptable cost increase, apart from the unavoidable occurrence of quality variations.

In order to reduce the number of assembly steps, reference document DE-A-30 42 417 discloses a method for the connection of heater elements with terminals. The terminals are part of a conductive member which comprises a rivet type projection. In a first step, the rivet type projection is inserted in apertures of the insulating support. One end of the rivet type projection is formed like a flange and abuts against the insulating support. The other end projects through the insulating support. The diameter of the rivet type projection is about equal to the diameter of the apertures in the insulating support. In a consecutive step, the projecting end of the rivet type projection is bent over in order to clamp the insulating support between the flange and the bent over end of the rivet type projection. Even though the number of assembly steps is reduced, this method is still not satisfactory.

It would therefore be desirable, and is in fact the object of the present invention, to provide a method permitting resistance circuits and the like to be connected to respective power supply terminals in a fully automatic manner by the employ of actually available technologies.

This object is achieved by said conductive member being a sheet member being formed with a plurality of outwards projecting tongues, and that said sheet member being positioned so that said tongues coincide with respective terminal ends of said electric circuits, said tongues being bent 180° upon themselves to form two legs for said terminal ends to be received therebetween, and that said sheet member is divided into several separate sheet elements by the execution of multiple cuts at selected locations and the removal of sheet sections extending between adjacent cuts, and that said projections inserted into said apertures and projecting from said insulating support are bent over the edges of said apertures in a locking fit.

A method according to the present invention is preferably carried out by employing an electric circuit disposed on an insulating support and connected to a flat power supply terminal according to claim 5.

The invention will be more fully understood from the following description, given by way of example with reference to the accompanying drawings, wherein:

fig. 1	shows a component to be mounted on a support as a first step of the method according to the invention,
figs. 2 and 3	show and end view and a top plan view, respectively, of a heater circuit in a state attained in a second step of the method,
fig. 4	shows a longitudinally sectioned view of the assembly of fig. 3,
figs. 5 and 6	show the assembly of figs. 3 and 4 at the end of a subsequent step of the method, and
fig. 7	shows the assembly of fig. 5 in the state attained in a final step of the method.

The method according to the invention is substantially based on the provision that the connections between power supply conductors and the terminal ends of electric circuits are made by using one-piece conductive sheet members adapted to be automatically mounted in apertures suitably formed in an insulating suport and to be similarly connected to the terminal ends of electric circuits; for a better understanding of the invention, it shall be supposed that these electric circuits are resistor circuits, it being understood, however, that the invention is similarly applicable to any kind of electric circuits, and particularly to resistor circuits for air heating purposes.

With reference to the drawings, there is shown an insulating support 1, typically a mica plate, supporting one or several elongate resistor circuits 2 mounted in respective rows of apertures suitably formed therein. At the ends of support 1, each resistor circuit terminates in respective terminal ends 2a projecting from support 1 at the same side thereof.

In a first step of the method to be described, a single preferably metallic conductive sheet member 5 of elongate shape is attached to one or each end portion 3 of support 1 provided with suitable apertures 4. Each sheet member 5 is pre-shaped to present a plurality of tongues 6 projecting from its plane at right angles thereto to coincide with terminal ends 2a for connection there to, and a number of orthogonally extending projections to be received in apertures 4.

For reasons to be explained later, tongues 6 are formed on conductive sheet member 5 at sufficiently wide spacings. In addition, tongues 6 are pre-bent at 180° upon themselves to thus form a pair of legs adapted to embrace respective terminal ends 2a.

In the course of this first step, the projections extending from conductive sheet member 5 are inserted into apertures 4 of insulating support 1 and bent over the edges thereof so as to securely fix the sheet member on the support.

Sheet member 5 is additionally provided with flat terminal elements 7 likewise projecting therefrom at right angles and adapted to be used as male contacts in flat plug connectors.

As the second step of the method, terminal ends 2a are introduced between the pairs of legs formed by the tongues 6 of sheet member 5 (fig. 4).

In the third step of the method, the two legs formed by each tongue 6 are clamped together so that terminal ends 2a are firmly retained therebetween, thus providing at the same time a reliable electric connection (figs. 5 and 6).

In the fourth step, sheet member 5 is divided into several separate sheet elements 6a, 6b, 6c by performing, preferably simultaneously, multiple cuts at selected locations, and removing the sheet sections between adjacent cuts (fig.7).

The locations of the cuts are selected so that

a) there is obtained at least one pair of sheet elements 6a and 6b each connected to at least one of the above defined resistor circuits by the described clamped connection between respective tongues 6 and terminal ends 2a, and

b) each of the sheet elements 6a, 6b has at least one of the flat terminal elements 7 thereon so as to permit each resistor circuit to be independently energized.

In another solution shown at the bottom end of fig. 7, sheet member 5 may be cut to provide a centrally located sheet element 6c permitting to selectively connect two separate resistor circuits in series, or to connect the two circuits to the electric power supply by using the flat terminal element 7 provided on sheet element 6c.

If so required, sheet element 6c may be simplified for solely connecting two resistor circuits in series, without the provision of any external connections.

It is thus obvious that the described method may be employed by one skilled in the art for obtaining the greatest variety of of connections between any number of initially separate electric circuits in series, in parallel, and with electric power supply terminals at any desired location.

The described method may thus be accomplished by the operations of a) connecting and/or interconnecting electric circuits at selected locations thereof by means of a single conductive sheet member secured to the insulating support, and b), dividing the conductive sheet member into several separate sheet elements adapted to be selectively connected to one or more of the electric circuits, with the possibility of performing these operations in a fully automatized process without any manual intervention.

As a matter of fact, all of the operations described in connection with the four steps of the process as well as the ancillary operations (preparation of the conductive sheet member, drilling the apertures in the insulating support and so on) can be carried out by fully automatized programmable machinery. The construction of such machinery and of the asssociated tools and actuators as well as the composition of the required operating programmes are familiar to one skilled in the art and need therefore not be explained.

Those skilled in the art will in particular be capable of optimizing the sequence of the various steps with a view to the timing of their execution, or with a view to regrouping the operations into a reduced number of steps each including several elementary operations.

Claims

1. A method for making connections between electric circuits disposed on an insulating support (3) including the steps of applying a plurality of terminals (7) to said insulating support (3), said step of applying said plurality of terminals (7) is carried out by mounting at least one conductive member (5) on said insulating support (1) by inserting projections extending therefrom into apertures (4) formed in said insulating support (3), and mechanically and electrically connecting terminal ends of said electric circuits (2) to said plurality of terminals (7),
characterised in that

said conductive member being a sheet member being formed with a plurality of outwards projecting tongues (6),

and that said sheet member is positioned so that said tongues (6) coincide with respective terminal ends (2a) of said electric circuits (2), said tongues (6) being bent 180° upon themselves to form two legs for said terminal ends (2a) to be received therebetween,

and that said sheet member (5) is divided into several separate sheet elements (6a, 6b, 6c) by the execution of multiple cuts at selected locations and the removal of sheet sections extending between adjacent cuts, and

that said projections inserted into said apertures (4) and projecting from said insulating support are bent over the edges of said apertures in a locking fit.

2. A method according to claim 1, **characterised in that** at least one pair of separate sheet elements (6a, 6b) is devised to connect the terminal ends (2a) of at least one of said electric circuits (2), each of said sheet elements being provided with at least one flat terminal element (7).

3. A method according to any of the preceding claims, **characterised in that** at least one separate sheet element (6c) is connected to at least one pair of terminal ends (2a) of respective different electric circuit elements (2), and may be provided with one or several flat terminal elements (7).

4. A method according to any of the preceding claims, **characterised in that** it is executed by a fully automised plant.

5. An electric circuit (2) disposed on an insulating support (3) and connected to flat power supply terminals (7), said terminals (7) extending from a conductive member (5) which is mounted on said insulating support (3) by inserting projections extending therefrom into apertures (4) formed in said insulating support (3),
characterised by
said conductive member (5) being a sheet member being formed with a plurality of outwardly projecting tongues (6), and by said sheet member being positioned so that tongues (6) coincide with respective terminal ends (2a) of said electric circuits (2), said tongues (6) being bent 180° upon themselves to form two legs for said terminal ends (2a) to be received therebetween, and that said sheet member (5) being divided into several separate sheet elements (6a, 6b, 6c) after being mounted on said insulating support (3) by the execution of multiple cuts at selected locations and that the sheet sections extending between adjacent cuts are removed and that said projections inserted into said apertures (4) and projecting from said insulating support are bent over the edges of said apertures in a locking fit.

Patentansprüche

1. Verfahren zum Herstellen von Verbindungen zwischen elektrischen Schaltungen, die auf einem isolierenden Träger (3) angeordnet sind, welches Verfahren die Schritte des Anbringens einer Vielzahl von Anschlußenden (7) auf dem isolierenden Träger (3) einschließt, wobei der Schritt des Anbringens einer Vielzahl von Anschlüssen (7) durch Montieren von zumindest einem leitenden Bauteil (5) auf dem isolierenden Träger (1) durch Einsetzen von Vorsprüngen, die sich davon ausgehend in die Öffnungen (4) hineinerstrecken, die in dem isolierenden Träger (3) eingeformt sind, und durch mechanisches und elektrisches leitendes Verbinden der Anschlußenden und der elektrischen Schaltung mit der Vielzahl von Anschlüssen (7) durchgeführt wird,
dadurch gekennzeichnet,

daß das leitende Bauteil ein blattförmiges Bauteil ist, welches eine Vielzahl von nach außen vorspringenden Zungen (6) aufweist,

und daß das blattförmige Bauteil so angeordnet ist, daß die Zungen (6) mit den zugehörigen Anschlußenden (2a) der elektrischen Schaltungen (2) zusammentrifft, wobei die Zungen (6) um 180° auf sich selbst umgebogen werden, um zwei Schenkel für die Anschlußenden (2a) zu bilden, die dazwischen aufgenommen werden sollen,

und daß das blattförmige Bauteil (5) in mehrere getrennte blattförmige Elemente (6a, 6b, 6c) unterteilt ist durch mehrfache Schnitte an vorherbestimmten Stellen und durch das Entfernen der blattförmigen Abschnitte, die sich zwischen den angrenzenden Schnitten erstrekken, und

daß die Vorsprünge, die in die Öffnungen (4) eingesetzt werden und von dem isolierenden Träger vorspringen, über die Kante die Öffnungen umgebogen werden, um einen Klemmsitz zu erzeugen.

2. Verfahren nach Anspruch 1,
dadurch gekennzeichnet,
daß zumindest ein Paar von getrennten blattförmigen Elementen (6a, 6b) vorgesehen ist, um die Anschlußenden (2a) von zumindest einem der elektrischen Schaltkreise (2) zu verbinden, wobei jedes der blattförmigen Elemente mit zumindest einem

flachen Anschlußelement (7) versehen ist.

3. Verfahren nach einem der vorangegangenen Ansprüche,
dadurch gekennzeichnet,
daß zumindest ein getrenntes blattförmiges Element (6c) mit zumindest einem Paar von Anschlußenden (2a) von zugehörigen unterschiedlichen elektrischen Schaltkreiselementen (2) verbunden ist, und mit einem oder mehreren flachen Anschlußelementen (7) versehen sein kann.

4. Verfahren nach einem der vorangegangenen Ansprüche,
dadurch gekennzeichnet,
daß es durch eine vollautomatische Anlage durchgeführt wird.

5. Ein elektrischer Schaltkreis (2), der auf einem isolierenden Träger (3) angeordnet ist und mit flachen Stromversorgungsanschlüssen (7) verbunden ist, wobei die Anschlüsse (7) sich von einem leitenden Bauteil (5) aus erstrecken, welches auf dem isolierenden Träger (3) angebracht ist durch Einsetzen von Vorsprüngen, die sich davon ausgehend erstrecken in Öffnungen (4), die in den isolierenden Träger (3) eingeformt sind,
dadurch gekennzeichnet,
daß das leitende Bauteil (5) ein blattförmiges Bauteil ist, welches mit einer Vielzahl von nach außen sich erstreckenden Zungen (6) versehen ist, und daß das blattförmige Bauteil so angeordnet ist, daß Zungen (6) mit zugehörigen Anschlußenden (2a) der elektrischen Schaltkreise (2) zusammentreffen, wobei die Zungen (6) um 180° auf sich selbst umgebogen sind, um zwei Schenkel zu bilden, zwischen welchen die Anschlußenden (2a) aufgenommen werden, und daß das blattförmige Bauteil (5) in verschiedene getrennte blattförmige Elemente (6a, 6b, 6c), nachdem es auf dem isolierenden Träger (3) montiert ist, durch das Ausführen von mehrfachen Schnitten an vorbestimmten Stellen unterteilt ist, und daß die blattförmigen Abschnitte, die sich zwischen den angrenzenden Schnitten erstrecken, entfernt werden, und daß die Vorsprünge, welche in die Öffnung (4) eingesetzt sind und von dem isolierenden Träger vorstehen, über die Kanten der Öffnungen in einen Klemmsitz umgebogen sind.

Revendications

1. Procédé de réalisation de connexions entre des circuits électriques placés sur un support isolant (3), comprenant une étape d'application d'une série de bornes (7) sur le support isolant (3), cette étape étant exécutée par montage d'au moins un élément conducteur (5) sur le support isolant (1) par introduction de saillies s'étendant à partir de celui-ci dans des ouvertures (4) formées dans le support isolant (3), et une étape de connexion mécanique et électrique de bornes des circuits électriques (2) à la série de bornes (7),
caractérisé par le fait que

l'élément conducteur est un élément en feuille pourvu d'une série de languettes (6) saillant vers l'extérieur,

cet élément en feuille est placé de façon que les languettes (6) coïncident avec des bornes respectives (2a) des circuits électriques (2), les languettes (6) étant pliées à 180° sur elles-mêmes pour former deux branches pour la réception des bornes (2a) entre celles-ci,

l'élément en feuille (5) est divisé en plusieurs éléments en feuille séparés (6a, 6b, 6c) par exécution de coupes multiples à des endroits choisis et enlèvement des parties de feuille situées entre les coupes voisines, et

les saillies introduites dans les ouvertures (4) et saillant du support isolant sont repliées sur les bords des ouvertures dans un ajustement de blocage.

2. Procédé selon la revendication 1, caractérisé par le fait qu'au moins une paire d'éléments en feuille séparés (6a, 6b) est conçue pour connecter les bornes (2a) d'au moins un des circuits électriques, chacun des éléments en feuille étant pourvu d'au moins un élément borne plat (7).

3. Procédé selon l'une des revendications précédentes, caractérisé par le fait qu'au moins un élément en feuille séparé (6c) est connecté à au moins une paire de bornes (2a) d'éléments de circuit électrique différents respectifs (2) et peut être pourvu d'une ou de plusieurs éléments bornes plats (7).

4. Procédé selon l'une des revendications précédentes, caractérisé par le fait qu'il est mis en oeuvre par une installation entièrement automatisée.

5. Circuit électrique (2) placé sur un support isolant (3) et connecté à des bornes d'alimentation plates (7), ces bornes (7) s'étendant à partir d'un élément conducteur (5) qui est monté sur le support isolant (3) par introduction de saillies s'étendant à partir de lui dans des ouvertures (4) formées dans le support isolant (3),
caractérisé par le fait
que l'élément conducteur (5) est un élément en feuille pourvu d'une série de languettes (6) saillant

vers l'extérieur, et cet élément en feuille est placé de façon que les languettes (6) coïncident avec des bornes respectives (2a) des circuits électriques (2), les languettes (6) étant pliées à 180° sur elles-mêmes pour former deux branches destinées à recevoir les bornes (2a) entre elles, que l'élément en feuille (5), après avoir été monté sur le support isolant (3), est divisé en plusieurs éléments en feuille séparés (6a, 6b, 6c) par exécution de coupes multiples à des endroits choisis et enlèvement des parties de feuille s'étendant entre les coupes voisines, et que les saillies introduites dans les ouvertures (4) et saillant du support isolant sont repliées sur les bords des ouvertures dans un ajustement de blocage.

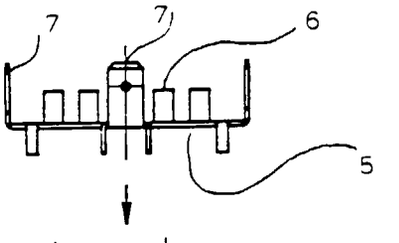

FIG. 1

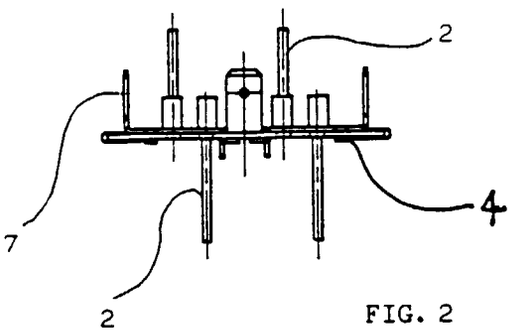

FIG. 2

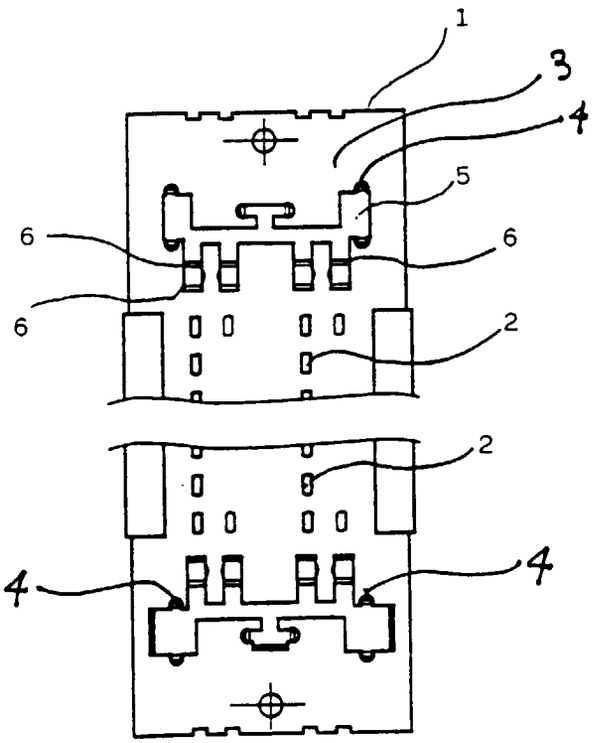

FIG. 3

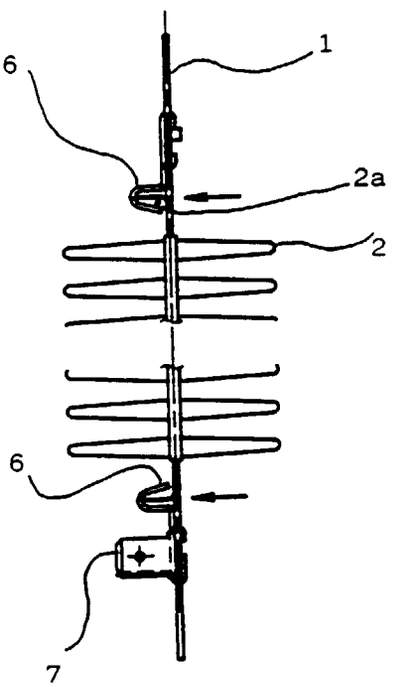

FIG. 4

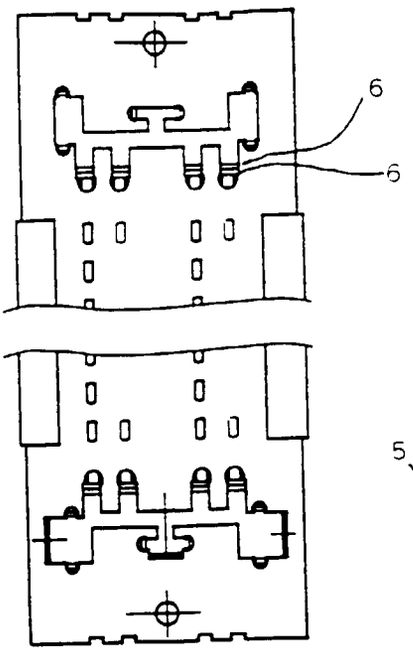

FIG. 5

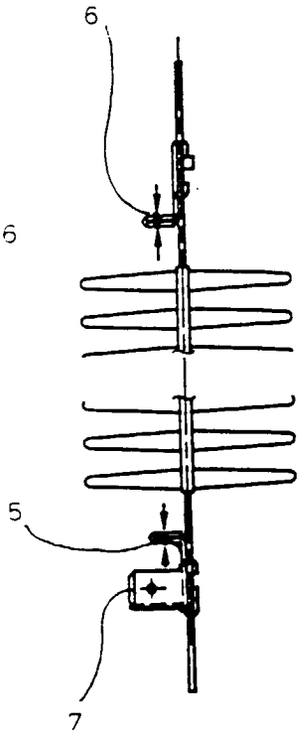

FIG.6

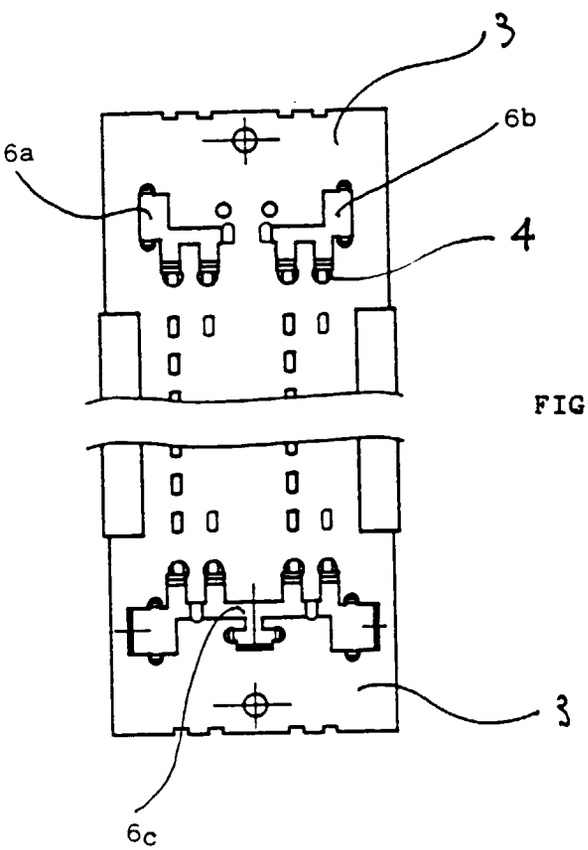

FIG. 7