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## (54) Improved method for the connection of heater elements.

(57) A method for making connections between electric circuits (2) disposed on insulating supports (1), comprising the steps of mounting a plurality of terminals (7) on said insulating supports, and connecting the terminal ends (2a) of said electric circuits to said plurality of terminals (7), wherein the step of mounting said terminals is carried out by the application of a single conductive sheet member (5) shaped to present a plurality of outwards projecting tongues (6) and a suitable number of projecting tabs to be received in corresponding apertures (4) formed in said insulating support.
The sheet member is positioned so that said tongues (6) coincide with respective ones of said terminal ends (2a), said tongues being bent back 180° upon themselves to form a pair of legs to be clamped onto the respective terminal end (2a), said sheet member (5) being subsequently cut at selected locations to result in a number of separate sheet elements (6a, 6b and/or 6c).

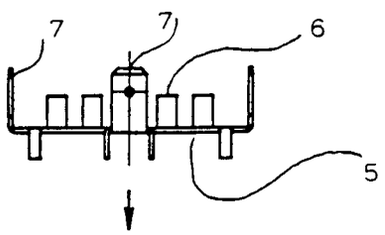


FIG. 1

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The present invention relates to a novel method for making connections to or between terminal ends of electric circuits in general, particularly of resistance elements, disposed on insulating supports, and connections thereof to an associated power supply, the invention also relating to products obtained by this method.

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 inavoidable occurrence of quality variations.

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.

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.

It is obvious that any method substantially in accordance with the present description and the appended claims, even when realized with non-significant and basically equivalent modifications, shall be included within the scope of protection of the present invention.

## Claims

**1.** A method for making connections between electric circuits disposed on insulating support, including the steps of applying a plurality of terminals to said insulating supports, and mechanically and electrically connecting terminal ends of said electric circuits to said plurality of terminals, characterized in that
said step of applying said plurality of terminals (7) is carried out by mounting at least one conductive sheet member (5) on said insulating support (1) by inserting projections extending therefrom into apertures (4) formed in said insulating support, said sheet member being formed with a plurality of outwards projecting tongues (6),
in 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,
in 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
in 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, characterized 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, characterized 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, characterized in that it is executed by a fully automatized plant.

5. An electric circuit (2) disposed on an insulating support (1) and connected to flat power supply terminals (7), characterized in that the connection to said flat terminals is made in accordance with the method of any of the preceding claims.

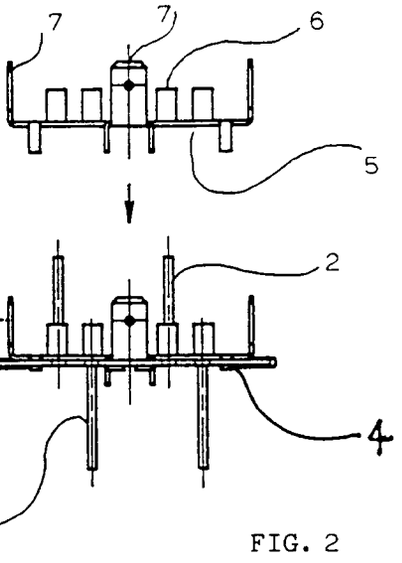


FIG. 1

FIG. 2

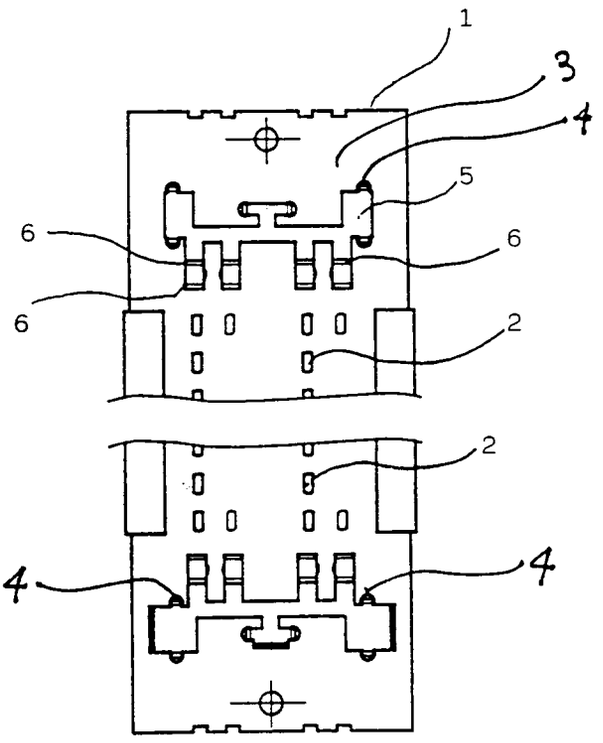


FIG. 3

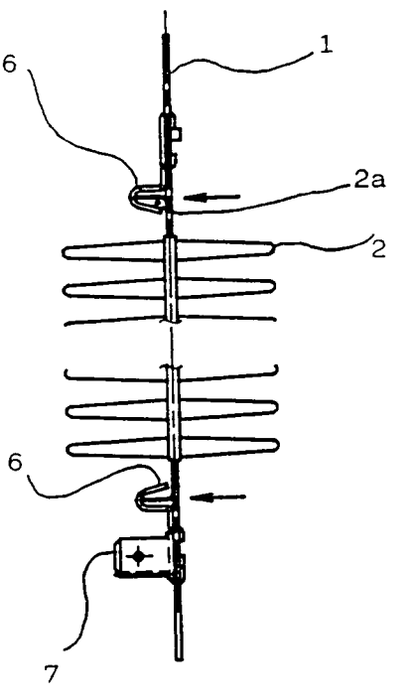


FIG. 4

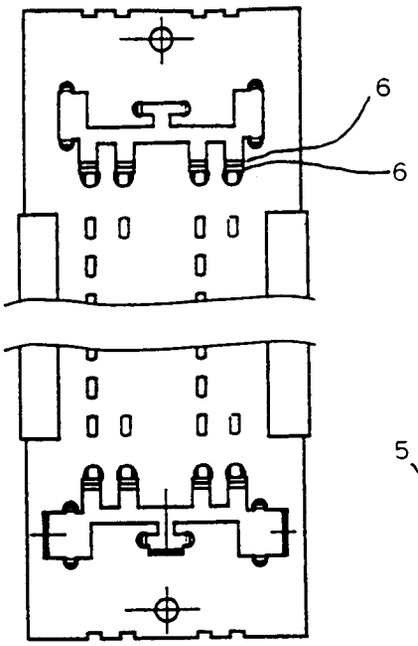


FIG. 5

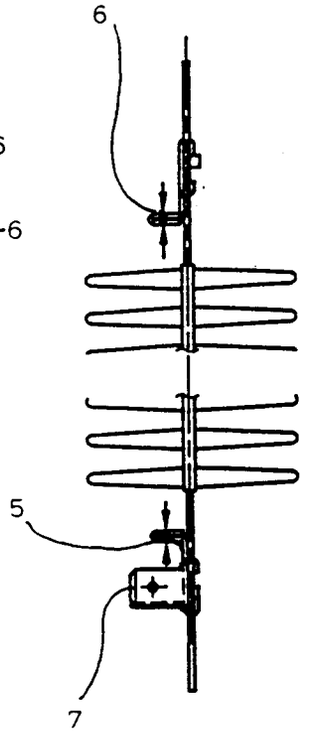


FIG.6

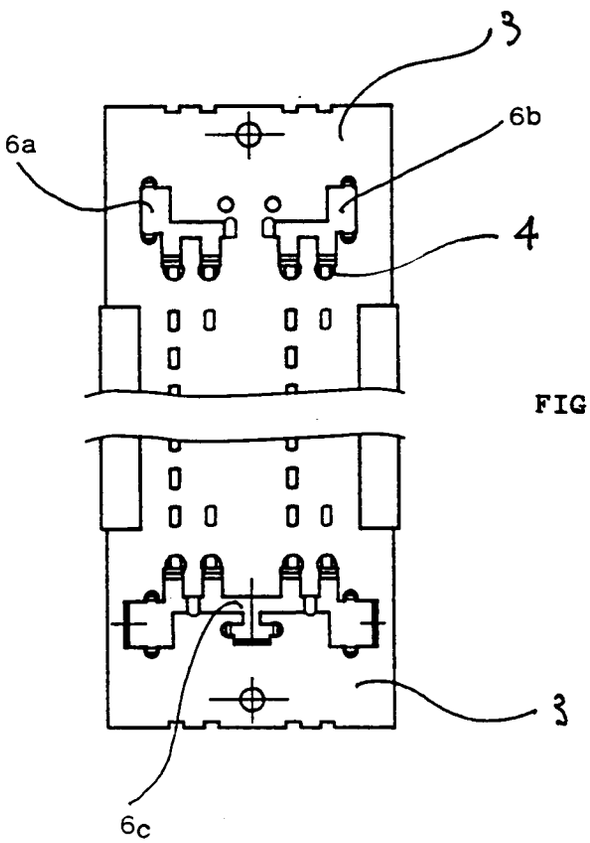


FIG. 7