United States Patent

Giedd et al.

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[54] METHOD OF FABRICATING COAXIAL WIRES IN BACK PANELS

[72] Inventors: **Gary R. Giedd; Merlyn H. Perkins,** both of Wappingers Falls, N.Y.

[73] Assignee: **International Business Machines Corporation,** Armonk, N.Y.

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 606,129, Dec. 30, 1966, abandoned.

[52] **U.S. Cl.**.....**29/627,** 29/527.4, 29/604, 174/68.6, 174/35 R, 174/88 C, 174/102 C, 317/101 C, 117/114 A, 117/114 B, 264/272 R

[51] **Int. Cl.**.....**B41m 3/08,** H01b 13/00

[58] **Field of Search**.....117/217, 114 A, 114 B; 29/624–630, 604, 527.4; 174/68.5, 35; 317/101; 339/17, 18

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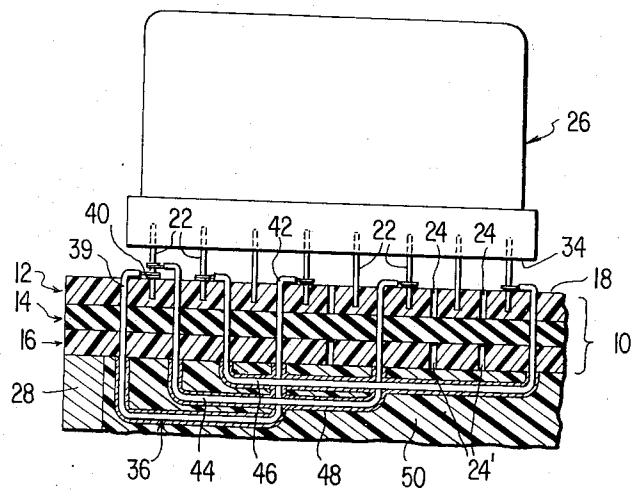
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Primary Examiner—John F. Campbell
Assistant Examiner—Robert W. Church
Attorney—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

The plastic insulated cross-connection wires on the backside of an electrical panel are coaxed by momentarily applying a mass of molten, low melting temperature metal to the backside of the panel with the major portion then removed. The adhering portion solidifies and the shielded cross-connections are potted in a plastic mass to maintain the wires in position and to protect the same against mechanical impact.

8 Claims, 3 Drawing Figures



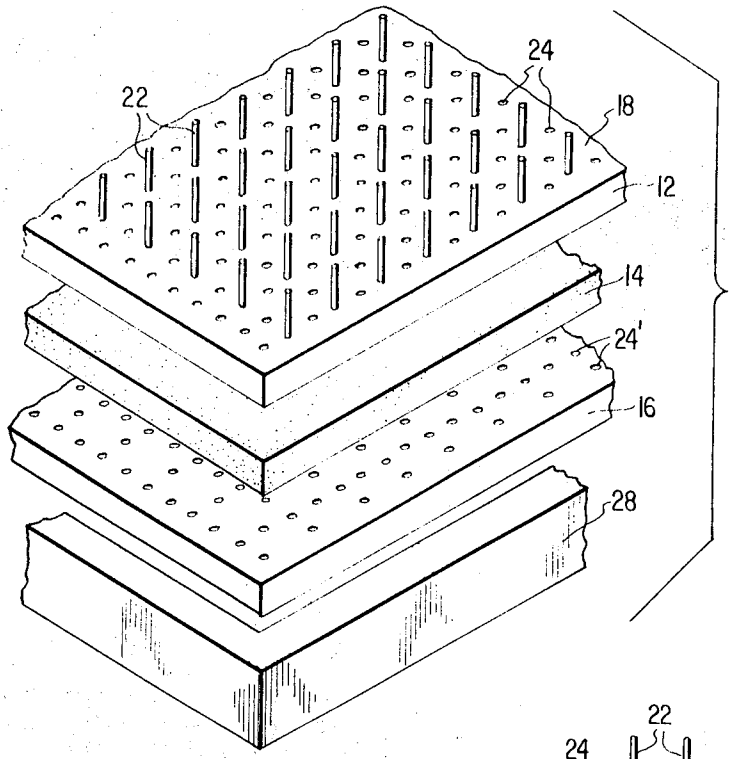


FIG. 1

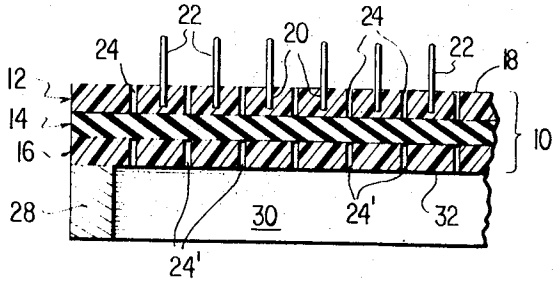
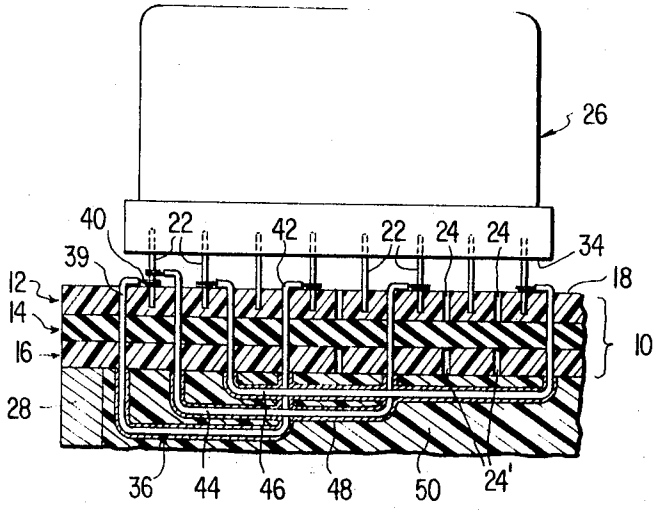


FIG. 2

FIG. 3



INVENTORS.
GARY R. GIEDD
MERLYN H. PERKINS

BY
Seyfarth, Rothwell, Dion, Zinn & Peapeak
ATTORNEYS.

METHOD OF FABRICATING COAXIAL WIRES IN BACK PANELS

This application is a continuation-in-part of abandoned application Ser. No. 606,129, filed Dec. 30, 1966 and entitled "Method of Fabricating Coaxial Wires in Back Panels."

CROSS REFERENCE TO RELATED APPLICATIONS

The present invention is an improvement over the method of coaxing back panel interconnections, set forth in United States application Ser. No. 606,099, filed Dec. 30, 1966, entitled "Method of Wiring and Metal Embedding an Electrical Back Panel" by F. Kurtz and J. C. Logue and assigned to the common assignee.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of back panel wiring by which standard, plastic insulated, interconnecting wires may be made coax, and more particularly, to an improved method which insures complete coaxing of the back panel interconnecting wire portions without materially increasing the overall weight of the panel.

2. Description of Prior Art

In the patent referred to above, the interconnecting wires on the backside of a panel carrying electronic components, were appropriately shielded by applying a mass of molten metal to that side of the panel and cooling the molten mass to embed the wires in solid metal. The panel itself may advantageously comprise a laminate structure including a central, imperforate, resilient sheet, sandwiched between sheets of insulative material carrying aligned through holes, whereby the terminal ends of the interconnecting wires are passed through aligned holes, piercing the imperforate resilient sheet with the resilient sheet effecting a seal about the outer surface of the wire, while frictionally maintaining the interconnecting wires in position. The terminal ends of the wires, after piercing the resilient sheet and emergence from the aligned through holes, are bared and connected to adjacent terminals carried by the panel. In the prior method, a relatively large mass of bonding material results in a rather heavy panel assembly which presents additional problems due to the thermal-coefficient of expansion mismatch between the metal and the epoxy.

SUMMARY OF THE INVENTION

In general, the present invention is directed to an improved method of electrically shielding the synthetic resinous insulated wires carried by an electrical panel on the backside thereof, involving the steps of momentarily applying a mass of molten metal having a low melting temperature to the side of the panel carrying the insulated wires, removing the portion of molten metal not adhering to the insulation surrounding the wire and solidifying the remnant metal to effectively shield the wires.

In one specific form, the method further involves the subsequent step of potting the now coaxed wire in a plastic mass to maintain the shielded wires in position, permitting ease in handling of the panel without danger of mechanical impact or abrasion of the coax wire interconnections.

The present invention provides an improved method of back panel wire shielding which insures complete shielding of the insulated wires carried by the panel without materially increasing the overall weight of the panel and without introducing thermal expansion problems due to the presence of the shielding metal. The present invention further provides an improved shielding method for back panel wiring in which the interconnection wires are securely maintained in position after shielding by means other than the metal coating the insulation of the individual wires.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective, exploded view of a component supporting panel which is back wired and shielded by the method of the present invention.

FIG. 2 is an elevational view, in section, of a portion of the panel of FIG. 1, prior to back wiring and shielding; and

FIG. 3 is the same view of the panel as FIG. 2, after back wiring and shielding.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, there is shown the improved back panel of the present invention, identified generally at **10**, which basically comprises first front sheet or board **12** formed of plastic or similar insulative material, a central sheet of silicon rubber **14** and a second insulative board or sheet **16**. The front sheet is first drilled with blind holes **20** on 100 mil. centers, for instance, from the outer surface **18** inwardly. Conductive metal pins **22** are inserted in the blind holes and extend perpendicular to surface **18**, as indicated best in FIG. **2**. Four or more through holes **24** are drilled around each pin, the holes acting as wire entrance holes. It is further noted that the bottom is also provided with a like number of through holes **24'**. When the three sheets **12**, **14** and **16** are sandwiched together, holes **24'** match the wire entrance holes **24** carried by the rear sheet **12**. The intermediate sheet of imperforate silicon rubber **14** is attached to the underside of the first plastic sheet **12** and the second plastic sheet **16** is placed on the rubber sheet **14** to form a plastic sheet-rubber sheet-plastic sheet laminate panel structure **10**.

The next step is the attachment of an open rectangular frame **28** to the periphery of the laminate structure **10** such that the rectangular frame **28** forms a well or void area **30**, on the backside of the panel, as further defined by the bottom surface **32** of the rear sheet **16**. The upstanding pins **22** are provided for physically supporting electronic components, such as component **26** in FIG. **3**, normally spaced slightly from the outer surface **18** of plastic sheet **12**. In addition, the pins make appropriate electrical connections to component circuitry (not shown) internally of each component.

Appropriate electrical interconnections are made between the space, insulated pins **22** in the manner shown in FIG. **3**. Interconnections are made by inserting a probe, such as a sewing needle, (not shown), from the backside of the panel assembly, through one of the holes **24'** carried by sheet **16** of the laminate structure. The needle pierces the imperforate rubber sheet **14** and passes next through an aligned hole **24** carried by the upper panel sheet **12**. For instance, end **38** of wire **36** is fed through associated aligned holes **24'** and **24** by the sewing needle with the left-hand end of the wire **38** protruding above the upper surface **18** of the panel assembly.

The panel or component receiving board of the present invention, which preferably comprises a laminate structure involving at least one predrilled sheet of insulative material and an imperforate sheet of resilient material overlying the drilled insulative sheet and covering the through holes, acts advantageously both to seal the non-used through holes, as well as to seal any conductor which passes through the through holes and pierces the imperforate, resilient layer. Further, in piercing the resilient layer, the resilient material closely hugs the conductor and frictionally maintains the inserted conductor in place, even though the conductor may be of a somewhat smaller diameter than the through hole. Obviously, were it not for the imperforate resilient material, the conductor may have a tendency to move from its prearranged position, prior to wire wrapping or other mode of connection to the adjacent terminal pins **22**. This is especially so where the panel is being used as shown, with the interconnecting wires positioned on the bottom side of the panel and the components **26** on the top side.

After stripping the insulation, the bared wire end **40** is wrapped about a nearby pin **22** in conventional fashion. The same procedure is repeated with the right-hand end **42** of wire

36 so that the wire now interconnects the first and fourth pins from the left, as shown in FIG. 3. Other interconnections involving, for instance, wires 44 and 46, are made in a similar manner.

Wires 36, 44, and 46 may, for instance, comprise single or multiple strands of copper coated by plastic insulation. Preferably, the wires carry a Teflon coating. Teflon is a registered trademark of the DuPont Corporation, its chemical composition is polytetrafluroethylene, its melting temperature is 327° C, and at temperatures above 350° C., it will tend to disintegrate or decompose. Alternatively, instead of Teflon, the interconnection wires may be coated with other suitable materials having electrical insulative qualities, these materials being butyl rubber, enamel, polyethylene, silicon rubber, and nylon.

With the interconnections completed, the intermediate, insulated portions of the wire extend across the back or rear side of the panel assembly 10 within the well area 30 formed by the rectangular frame 28. The next step involves the momentary filling of the well 30 with a low melting temperature molten metal mass to effectively coat the insulated wires with a thin layer of metal for electrically shielding the wires from each other. After wiring, the frame 28 may be inverted and a low melting temperature metal, in liquid form, is pured into the well 30, filling the same. Immediately, the frame 28 is turned over, that is, it is reverted to the original position shown in FIG. 2, thereby displacing all of the liquid metal from the well with the exception of a thin coat 48 which adheres to all exposed surfaces of the insulated wires carried at the backside of the panel. The metal 48 may comprise a low melting temperature material, for instance, alloys of bismuth with metal, such as tin, lead, cadmium or indium.

While, preferably, the low melting temperature material forming the coax metal coating 48 for the wire interconnections 36, 44 and 40 comprises alloys of bismuth, as stated above, alternative low melting temperature metal alloys such as indium based alloys and type metals may be employed. It is essential, however, that the melting temperature of the bath be less than the temperature which causes instantaneous decomposition or melting of the plastic insulation surrounding the cross wire interconnections on the back of the panel. For instance, the melting temperature of Teflon is well above the temperature of the molten bismuth alloy material which is applied to form the coax metal coating 48 on the interconnection wires. In this case, the melting temperature of the bismuth alloy is approximately 117° C. Further, since the application of the molten metal mass to the insulation interconnection wires on the backside of the panel 10 is only momentary, either by dipping the backside of the panel momentarily into the molten bath or material, or by inverting frame 28, pouring the same in liquid form into the well 30 and then immediately reverting the frame 28 to its original position shown in FIG. 2, it is apparent that extended contact between the resinous coated interconnection wire on the backside of the panel and the molten bath may result in decomposition or destruction of the insulation on the wire even though the temperature of the metal bath or coating material is insufficient to melt or otherwise destroy immediately the insulation of the wire upon contact therewith. Preferably, there should be a temperature gap of approximately 20° C. between the temperature of the bath and the melting or decomposition temperature of the synthetic resinous insulation material surrounding the interconnection wires 36, 44 and 46. Finally, it is important that the low melting temperature metal 48 have some affinity to the insulation material coating the interconnection wire so that under the flash coating technique of the present invention there is assurance that even as a result of the momentary contact between the interconnection wires on the backside of the panel and the mass of molten low melting temperature metal 48, a thin coating of the same readily applies and is evenly distributed over the same.

After the displacement of the major mass of the low temperature metal, the frame 28 may again be inverted so that the well area 30 is now in a position to receive potting material 50. In this case, instead of being metal, it is preferably plastic or other light weight insulator. The frame may be maintained in its inverted position until complete solidification of the plastic potting material occurs, thereby achieving a lighter weight, back panel assembly than that provided by the prior art process which omits the final two steps.

The plastic material may be similar to that of the plastic boards or sheets 12 and 16 and is both thermally and chemically compatible with the potting metal 48 covering the wires. The potting compound 50 protects the back wiring from physical damage since none of the wiring carrying the thin metal shield remains exposed. Since only a thin layer of metal remains, the use of a plastic potting material, rather than the employment of the metal potting technique of the above referred to application eliminates any thermal expansion problems which might occur if a panel carrying a large mass of metal were subjected to relatively high temperature. Since all of the exposed interconnecting wires are metal shielded, improved circuit performance is achieved.

Alternatively, instead of inverting the panel including the edge frame member 28 prior to momentarily allowing a mass of metal to fill the well area, the initial thin metal coating 48 may be applied to the insulated wires carried in the backside of the panel by the simple step of momentary immersion of this portion of the panel assembly 10 into a molten bath of metal (not shown). Upon removal, some metal will adhere to the surface of the insulated wire such that upon cooling, the insulated interconnection wire portions are metal coated or coaxed as described.

In fact, the plastic material 50 which embeds the now coaxed wire, may be applied by dipping of the metal coated, back wired panel into a second bath of molten plastic and cooling the molten plastic wire with the panel wire so immersed to produce a complete panel section, as indicated in FIG. 3.

While it is normally undesirable to make any wiring changes subsequent to plastic potting, wiring changes may be achieved upon removal of the plastic potting material 50. The application of high temperature melts the thin layer of shielding material 48 about the interconnecting portions of the wires, whereupon any wires which must be removed, may be readily pulled from the aligned through holes 24 and 24' after disconnecting the bared terminal ends from associated terminal pins. Further, in case the removed wires are not replaced, the wire entrance holes that had wires taken out will automatically be sealed by the resilient rubber sheet which retracts about the area of penetration and seals the vacant holes. After rewiring, the well 30 may again momentarily refilled with liquid metal to achieve shielding of the replaced insulated wires, after which the same area may be subsequently filled with plastic material to mechanically protect the shielded interconnecting wires.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that the foregoing and other changes in the form and details may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A method of electrically shielding insulated wires insulated by a synthetic resinous material and carried on one side of an electrical panel provided on an opposite side thereof with component mounting means having terminals for electrical connection to electronic components, comprising the steps of:

A. mounting a said wire through said panel with an end portion thereof extending above said opposite side;

B. securing said end portion in electrically conducting relation to a said terminal of said mounting means;

C. momentarily applying a mass of molten metal having a low temperature melting point to the said one side of said panel carrying said insulated wires and in contact therewith; and

D. coating the wire insulation with a thin metal film by

a. removing the major mass of said molten metal prior to any melting of the wire insulation, and

b. cooling the remnant metal on the wire insulation to effect coating of the wire insulation with said thin metal film.

2. The method as claimed in claim 1 wherein the temperature gap between the temperature of the applied molten metal and the melting temperature of the synthetic resinous wire insulation is approximately 20°.

3. The method as claimed in claim 1 wherein said low temperature melting point metal comprises alloys of bismuth with one metal of the group consisting of tin, lead, cadmium or indium, and said wires are coated by polytetraflorethylene insulation material.

4. The method as claimed in claim 1 further including the step of potting the metal coated wires with a mass of plastic material to embed the metal coated wires in a solid plastic mass to increase panel rigidity while physically protecting the interconnecting wires.

5. The method as claimed in claim 1 wherein the step of momentarily applying a mass of molten metal to the side of the panel carrying said insulated wires comprises momentary

dipping of said wired back panel into a bath of molten metal and immediately removing the same whereby a thin layer of molten material adheres to the insulation covering said wires.

6. The method as claimed in claim 1 for a back panel including a frame member extending about the periphery of said panel backside and acting in conjunction therewith to form a well area, said method further including the steps of; positioning said panel with the well side up, filling said well area with liquid plastic material and cooling said assembly to embed the coated insulated wire portions in a solid plastic mass to produce a high strength, light weight panel having metal shielded wire interconnections.

7. The method as claimed in claim 1 wherein said low melting temperature molten metal mass comprises one material of the group consisting of; alloys of bismuth with tin, lead, cadmium or indium, and antimony, and said wire is coated with one insulation material of the group consisting of polytetraflorethylene, butyl rubber, enamel, polyethylene, nylon and silicon rubber.

8. The method of claim 1 wherein said wire is mounted in sealing conformation through said panel.

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