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METHOD OF MANUFACTURING A LAMINATED FOIL RESISTOR

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ABSTRACT OF THE DISCLOSURE

This invention relates to the manufacture of a laminnated foil resistor. Either one sheet, or a plurality of stacked sheets of foil are placed in a forming die commensurately shaped to correspond to a base lamina. The foil is heated in the forming die to the recrystallization temperature of the foil and then the foil is removed from the die and adhered to the base lamina. The base lamina can be made of glass, ceramic or plastic. If the base lamina is made of metal, then an intermediate insulating layer must be interposed between the base lamina and the foil.

This invention relates to instrument-making and radio engineering, and more particularly to manufacturing of materials for high precision electrical resistors applied in measuring instruments and radio engineering devices.

Wire-wound resistors are known to be the most stable at present.

High stability of wire-wound resistors is provided by an elaborate, long and expensive processing of wire and the resistors made thereof.

After the wire-drawing process the wire is stabilized by annealing to eliminate the internal mechanical stresses which are the main cause for non-stability of the electrical resistor. However the wire is oxidized when being annealed and certain components of the alloy of which the wire is made evaporate. This causes changes in the temperature coefficient of the resistor and deterioration in the temperature characteristic of the wire due to changes in the composition of the surface layer of the wire.

Another disadvantage of annealing is that the changes in the surface layer of the wire cause a subsequent prolonged process of spontaneous diffusion equalizing the composition (homogenization). This process is accompanied by undesirable changes in the electrical resistor in the course of time, affecting its stability.

In further processing of the wire internal mechanical stresses may appear again. The repeated annealing of the insulated wire is not allowed for the insulation will not withstand high temperatures.

Manufactured resistors are stabilized in two steps: by an artificial ageing by heat treatment at definite temperatures (below the temperatures of the annealing of the metal), and then by a natural ageing by prolonged seasoning (during several months or years). The same reasons make the manufacture of precision resistors from thin metal sheets e.g. foil, still more difficult. Significant mechanical stresses appear during the rewinding of foil, its annealing being greatly hampered by the thinness of the material.

Therefore when using known methods for manufacturing materials for resistors it is impossible to get stable resistors without time-consuming procedures of stabilization of the material and the resistors after they have been given the final shape.

Attempts to overcome the difficulties and disadvantages mentioned above did not give positive results. Now this problem is successfully solved and the method is brought to practical implementation.

It is established that by manufacturing materials for electrical resistors from thin metal sheets heated in a forming press and glued to the rigid supporting base, the stability of the resistance of the material is provided for a long period of time.

An object of this invention is to simplify and speed up the process of producing stable materials for precise electrical resistors.

Another object of the invention is to make unnecessary the procedures of ageing the resistors made of the proposed material.

In accordance with the objects stated above the invention is based on the technological operations which make it possible to eliminate mechanical stresses in the material and avoid riveting in its subsequent processing.

The essence of the proposed method is in the following. A thin sheet of metal intended for the manufacture of resistors is pressed in a forming die between the working surfaces of the plates corresponding in their form to the surface of a rigid supporting base said sheet will be glued onto. The sheet pressed in the forming die is heated to the temperatures necessary for lessening or a complete elimination of the internal mechanical stresses in the sheet material. After cooling the sheet in the forming die the sheet is glued onto the rigid supporting base.

To preclude the arising of internal mechanical stresses in the material of the sheet the latter is pressed in the process of gluing to the supporting base by a rigid auxiliary element, the surface of which contacting the sheet corresponds to it in shape.

For a better protection of the surface of the sheets from undesirable changes in the process of heating, the sheets may be put into the forming die in a pile.

Tight pressing of the sheets hinders oxidation when heating the sheets in a medium containing oxygen, or decreases the evaporation of unstable components of the material of the sheets e.g. of manganese, when heating the sheets in a vacuum.

The highest stability of the material of the sheets is provided by heating it in the forming die to the temperature of recrystallization of the material.

The rigid supporting base the sheet is glued to must be made of a material which does not change its dimensions with time or under the influence of humidity, and the thermal expansion coefficient of which is close to that of the material of the sheet. As such materials either metals can be used, or insulation materials e.g. glass, ceramics or plastics.

In embodying the invention it is preferable to make the supporting base of metal that has the same composition as the sheet. In this case the sheet is glued to the element with an intermediate layer of insulation material e.g. thin glass cloth or glass fabric. When the supporting base of insulation material is used the sheet can be glued to the base without the insulating layer.

The present invention is intended for the manufacture of material for precise electrical resistors, which is a sheet of metal glued to a rigid supporting base, free from internal mechanical stresses, homogeneous in composition and preserving high stabiltiy for a long period of time.

This material can be used for rapid production of high precision electrical resistors e.g. 0.001% of a required value of resistance or even higher, without carrying out the process of ageing and prolonged seasoning of the produced resistors.

When manufacturing resistors from such material it is preferable to use only those technological processes which do not require riveting of the material e.g. chemical, electrochemical and electroerosion processing.

It should be noted that the present invention makes it possible to speed up and facilitate the production of high precision resistors (of any configuration) and provides

new wide opportunities for the application of the printed circuit techniques in precision instrument engineering.

Though the present invention is described in accordance with the preferred embodiment, various changes and modifications can be made without departing from the spirit and scope of the invention as those skilled in the art will easily understand.

Such changes and modifications are regarded as falling within the scope of the invention and the appended claims.

What we claim is:

1. A method of manufacturing a laminated foil resistor comprising providing a sheet of resistor foil, placing said foil in a forming die commensurately shaped to correspond to a base lamina, pressing while heating the foil in said forming die to a temperature at least equal to the foil recrystallization temperature to substantially free said foil of internal stresses and shape said foil, removing the shaped foil from said forming die and adhering said foil to said base lamina which is made of a rigid supportng material that does not change its dimensions with time or humidity and has a thermal expansion coefficient close to that of said foil.

2. A method as claimed in claim 1 wherein a plurality of foil sheets are placed in stacked relationship in said forming die.

3. A method as claimed in claim 1 wherein said base lamina is selected from a group consisting of glass, ceramic or plastic.

4. A method as claimed in claim 1 wherein said base lamina is metal and has a layer of insulation material interposed between it and said foil.

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