Feb. 12, 1957 W. J. DWYER 2,781,277

METHOD OF MANUFACTURING ELECTRICAL RESISTORS

Filed Jan. 12, 1954

FIG. 1

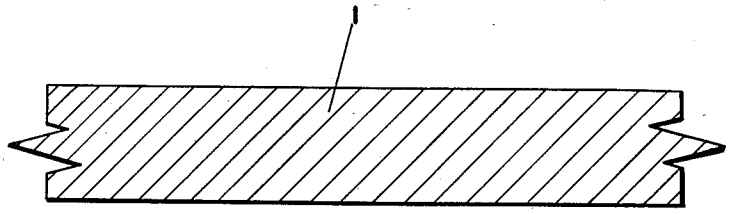


FIG. 2

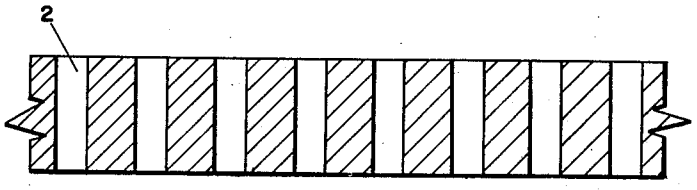


FIG. 3

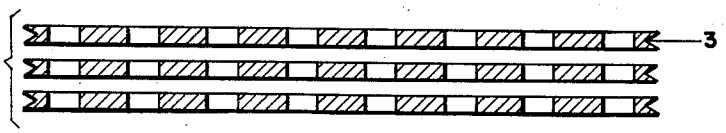
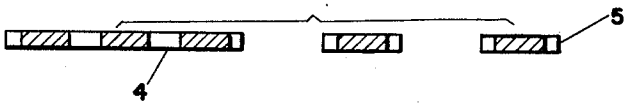


FIG. 4



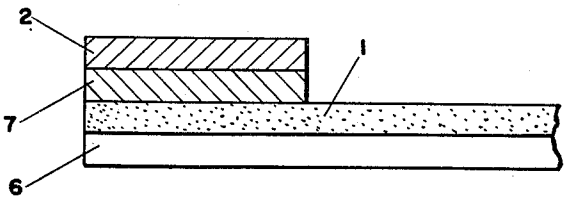


FIG. 5

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METHOD OF MANUFACTURING ELECTRICAL RESISTORS

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Application January 12, 1954, Serial No. 403,493

2 Claims. (Cl. 117—4)

This invention relates to components for electrical devices and the manufacture and assembly thereof. More particularly, this invention relates to tape resistors such as are used in printed and etched circuit assemblies.

In conventional practice, electric resistance components of the type used in radio, radar, and like systems have wire connection elements which are mechanically and electrically connected with other desired parts by soldered connections and/or mechanical pressure connections.

Briefly, the present system employs an improved resistance component embodying an electrical and mechanical connection which may be made in a single operation and is a further development of the principles outlined in copending application Serial No. 397,232.

In the prior art the adhesive quality of tape resistors is unstable under varying temperature conditions.

An object of the present invention is to provide an improved resistor of the type described that will permit more reliable connections.

A further object of the present invention is to provide an improved electrical resistor which has associated therewith an adhesive agent permitting its assembly with the utmost facility.

Other objects of the invention will be apparent from the following description of a typical embodiment thereof, taken in connection with the accompanying drawings.

In accordance with this invention there is provided a method of manufacturing resistor elements which comprises moving a tape of asbestos material along a path at a predetermined speed. The tape is sprayed with a mixture of finely ground carbon and liquid silicone in a series of layers. The resultant material is heated to a temperature sufficient to air-dry it and to drive off the solvent. The resultant material is then cured by further heating. A mixture of silicone resin and silver is applied to a part of the silver of the tape to provide a binding material. The binding material is cured at a temperature of approximately 300° C. A mixture of epoxy resin and silver is employed on the tape to provide contacts of adhesive material. The contacts are cured by applying heat at a temperature of approximately 180° C. and the tape is cut into desired resistor elements.

In the accompanying drawings:

Fig. 1 is a plan view of a portion of an asbestos-like tape having resistive material affixed thereto;

Fig. 2 is a similar view of the tape having contacts affixed thereto;

Fig. 3 is a plan view of a portion of typical resistor strips obtained by cutting the tape of Fig. 2 longitudinally;

Fig. 4 provides similar views of individual resistors obtained by cutting the longitudinal strips of Fig. 3 transversely; and

Fig. 5 is an enlarged fragmentary end view of a resistor of the present invention.

Referring now in more detail to the drawings, the development of an improved resistor embodying this invention is here illustrated. An asbestos tape, as shown in Fig. 1, is employed as a base for affixing electrically resistive material indicated by the cross-hatching at 1. Electrically conductive contacts 2 formed from an adhesive material, such as a suitable mixture of powdered silver and epoxy resin (commercially available as Hysol 2530), are applied to the tape as shown in Fig. 2. The tape may be then cut longitudinally into continuous strips 3 of resistors connected in series. Transverse cuts of the strips provide multiple element resistors 4 or single element resistors 5. An enlarged end view of the resistor 5 is shown in Fig. 5. The resistive material 1, typically composed of carbon compound using a silicone binder, is affixed to the asbestos supporting material 6. The adhesive contact 2 is affixed to an electrically conductive binding means 7, typically formed of a mixture of silver and silicone material.

In the preferred embodiment, the adhesive contacts 2 are designed to be thermosetting. Because of the presence of the silicone binder in resistive material 1, a high degree of heat is required for curing. After the resistive material 1 is cured, however, the contacts 2 composed of silver and Hysol 2530 do not adhere well. An intermediate binder is necessary that can be cured at the same temperature as the resistive material 1 and provide a good bond to the adhesive contacts 2. Adhesive contacts 2 composed of silver and Hysol 2530 can not be heated to the same temperature as the resistive material 1 without destroying the thermosetting properties. It is, therefore, necessary that the intermediate binder 7 be applied and affixed to the resistive material 1 and the adhesive contacts 2 be applied and affixed to the intermediate binder 7 subsequently. In the preferred embodiment, an intermediate binding means 7, formed of silver and silicone material, successfully performs this function.

In the manufacture and assembly of an improved resistor embodying the present invention, an asbestos tape, Fig. 1, is kept in continuous motion by means of a conveyor system. Electrically resistive materials such as carbon derivatives are ground into a very fine powder which is mixed with a binding agent such as silicone and, while in a liquid suspension, sprayed onto the moving tape. In order to obtain accurate control of the amount of the resistive powder, the suspension may be sprayed onto the tape in a series of layers. Solvents are driven off by an air-drying process which may be accelerated by the use of a suitable heat source. After the tape is dried, it is cured by further heating in a conveyor oven.

Various mechanisms currently available are suitable for applying the binder material 7 and contact material 2 to the resistive material 1. This may be accomplished with facility by means of the well known rotary printing process. The binding material 7 may be applied first and then cured at relatively high temperature such as 300° C. The contacts 2 may then be imprinted and cured at a lower temperature such as 180° C. The tape is cut into continuous longitudinal strips 3 and the strips are then cut transversely into resistors. The configuration may be varied as is illustrated by multiple element resistors 4 and single element resistors 5.

Many adhesive agents are thermoplastic or thermosetting and require the application of heat to effect adhesion. This may be readily accomplished by use of a heating device or iron which is adapted to apply heat to the contact areas only. A timing device may be employed to control the amount of heat and amount of pressure applied.

By utilizing groups of these component assemblies with printed circuits interconnecting them, complete circuit assemblies of great variety may be readily supplied. The precision, speed, and economy of manufacture and many other advantages provided by this system are obvious.

While there has been hereinbefore described what is at present considered a preferred embodiment of the invention, it will be apparent that many and various changes and modifications may be made with respect to the embodiment illustrated without departing from the spirit of the invention. It will be understood, therefore, that all and any such changes and modifications as fall fairly within the scope of the present invention, as defined in the appended claims are to be considered as a part of the present invention.

What is claimed is:

1. The method of manufacturing resistor elements which comprises moving a tape of asbestos material along a path at a predetermined speed; spraying a mixture of finely ground carbon and liquid silicone onto said tape in a series of layers; heating the resultant material to a temperature sufficient to air-dry it and drive off the solvent; curing the resultant material by further heating; applying a mixture of silicone resin and silver to provide a binding material to a part of said surface; curing said binding material at a temperature of approximately 300° C.; imprinting contacts of a mixture of epoxy resin and silver to provide an adhesive material on said binding material; curing said contacts by applying heat thereto

at a temperature of approximately 180° C.; and cutting the tape into the desired elements.

2. The method of manufacturing resistor elements which comprises moving a tape of asbestos material along a path at a predetermined speed; spraying a mixture of finely ground carbon and liquid silicone onto said tape in a series of layers; heating the resultant material to a temperature sufficient to air-dry it and drive off the solvent; curing the resultant material by further heating; applying a mixture of silicone resin and silver to provide a binding material to a part of said surface; curing said binding material at a relatively high temperature greater than 280° C.; imprinting contacts of a mixture of epoxy resin and silver to provide an adhesive material on said binding material; curing said contacts by applying heat thereto at a temperature of at least 50° C. less than first said temperature; and cutting the tape into the desired elements.

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