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PROCESS FOR MAKING RESISTORS

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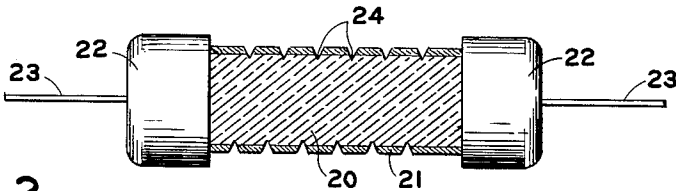


FIG. 2

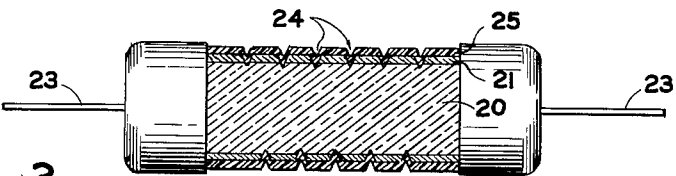


FIG. 3

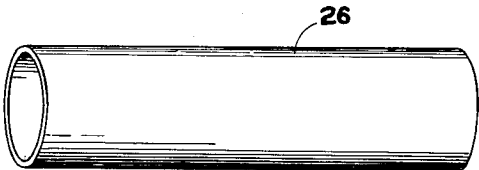


FIG. 4

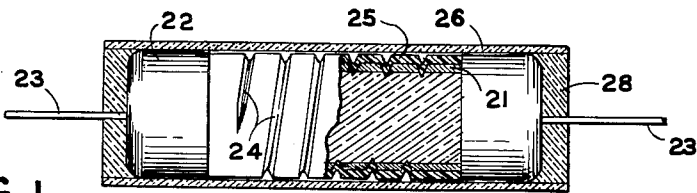


FIG. 1

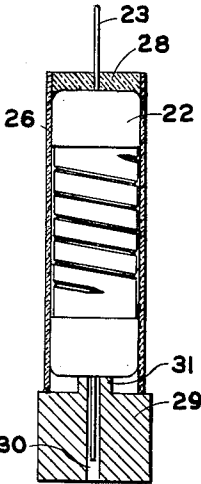


FIG. 5

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1

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PROCESS FOR MAKING RESISTORS
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1 Claim. (Cl. 29—155.63)

The invention relates in general to resistors and more particularly to protective tubular casings for resistors and the process for making same.

An object of my invention is to provide a resistor with a protective tubular casing.

Another object of my invention is to provide a resistor with a protective coating and a protective tubular casing.

Another object of my invention is to provide a means of sealing the open ends of the tubular casing containing a resistor element.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claim, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 shows a longitudinal view of a resistance unit embodying the features of my invention, partly in section;

FIGURES 2 and 3 show the steps by which my invention is constructed; the coatings and end-caps are exaggerated in thickness;

FIGURE 4 shows a section of a hollow tubular casing; and

FIGURE 5 shows a convenient way of sealing the open ends of the tubular casing containing a resistor element.

With reference to FIGURE 1, my invention comprises a non-conducting rod 20, preferably porcelain or steatite, a thin current-conducting film 21 deposited on the surface of the rod 20, end-caps 22 having terminal wires 23 electrically connected to the thin current-conducting film 21, a protective coating 25 mounted on the current-conducting surface, and a tubular casing 26 mounted around the protective coating 25.

The rod 20 may be made of suitable material of a ceramic nature such as porcelain or steatite, upon which the film 21 may adhere. The film 21 is very thin and is exaggerated in thickness in the drawings. The thin current-conducting film 21 is preferably carbon, or metal, or it may be a mixture of carbon and metal, and may also include sulphur.

The next general series of steps in my process is to connect the end-caps 22 to the end portions of the thin film 21 by depositing an electrical substance between the current-conducting film and the end-caps 22 and pressing the end-caps 22 over the electrical substance. The resistor element may or may not be spiraled at 24 depending upon the resistance value desired.

The next general series of steps consist of providing a coating and a tubular casing for the resistor element, indicated respectively by the reference characters 25 and 26. The coating 25 is deposited on the resistor element and the casing 26 is mounted around the coating 25.

The coating 25 comprises a silicone material preferably a silicone resin, and is referred to in the trade as a heat resistant, water-repellent silicone electrical varnish. More specifically, the varnish is a phenyl-methyl-silicone resin. In the silicone molecular structure, the silicon alternates with an oxygen atom so that the silicon atoms are not bonded to each other. In a phenyl-methyl-silicone resin, one methyl group and one phenyl group are bonded to each silicon atom. I find that a silicone resin made by Dow Corning Corporation, Midland, Michigan, and sold under a designation number "994 varnish" is satisfactory for my invention. The

2

coating 25 is preferably deposited on the current-conducting film 21 by spraying the phenyl-methyl-silicone thereon, and then baking the resistor element with the phenyl-methyl-silicone deposited thereon for a duration of approximately one-half hour at about 400° F. to provide a semi-cured coating.

The casing 26 is in the form of a tube and may be made of a ceramic, steatite, porcelain, or a glass material.

The tube 26 is slightly longer and slightly larger in diameter than the resistor element. The tube 26 may be slid easily over the resistor element and when completely slid over the resistor, it covers the resistor element as shown in FIGURE 1. The open end portions of the tube are extended farther than the end-caps 22, whereby a sealing material 28 may be deposited in the space provided between the end-caps 22 and the extended tube portions to completely enclose the resistor element.

The sealing material 28 is made of a mixture of the following ingredients; a powder glass, a silicone resin and a silicone varnish. The powdered glass that I use in my invention is made by grinding broken scrap glass. The glass is ground so fine that a person can run his hand through it and will not receive any scratches.

The silicone resin that I mix with the powdered glass is preferably a polysiloxane silicone resin and contains dimethylsiloxane, methylsiloxane, phenylsiloxane, and diphenylsiloxane, and is prepared by the co-hydrolysis and co-condensation of a mixture containing dimethyldichlorosilane, methyltrichlorosilane, phenyltrichlorosilane, and diphenyldichlorosilane. I find that a polysiloxane resin suitable for my invention may be obtained from Union Carbide Corporation, New York, N.Y., Silicone Division and sold under a designation number R-620.

The silicone varnish that I use in mixing with powdered glass and silicone resin, is a low temperature curing silicone varnish. It is a companion product to the polysiloxane resin designation number R-620. It contains 60% silicone resin by weight in a solvent xylene. I find that a silicone varnish suitable for my invention may be obtained from Union Carbide Corporation, New York, N.Y., Silicone Division and sold under a designation number XR-622.

In making the sealing material, I mix the powder glass with the silicone resin R-620. In mixing the two together, I do not necessarily use a definite ratio to determine how much I should use of each, but instead I just mix enough polysiloxane resin to moisten each particle of powder glass to obtain a glass-silicone mixture. In order to make the glass-silicone mixture more applicable or workable, I mix XR-622 into the glass-silicone mixture to obtain a workable sealing material. Here again I do not use any definite amount of silicone varnish, but I add just enough to make the glass-silicone mixture applicable.

Even though a definite amount of each is not required I generally mix in about 50% by volume of powdered glass with 50% by volume of polysiloxane resin. Then I generally mix in about 20% by volume of silicone varnish into about 80% by volume of the glass-silicone mixture.

With reference to FIGURE 5, the diagram shows a resistor carrier 30 constituting a convenient way of applying the sealing material 28 into an open end portion of the resistor element. The resistor carrier 30 may be made of any suitable material or any shape or size. The main purpose is to hold a resistance element with a ceramic tube 26 thereon and having the upper end of the tube extending farther than the end-caps 22. The resistor element may be held in place by extending the bottom lead terminals 23 into a hole 30. The reference

3

character 31 shows a shoulder whereby the lower end-cap of a resistance element may rest thereupon. Another use for the shoulder 31 is to provide a means of centering the resistor element inside of the tube, whereby both ends of the tube extend an equal distance from the end-caps 22.

The sealing material 28 may be applied into the upper open end portion by means of any suitable tool, preferably a spatula. After I seal the upper end portions, I allow the resistor to set on the resistor carrier 30 anywhere from 2 to 24 hours. Then I bake the resistor element containing the sealed end portion for about one hour at approximately 400° F., with the resistor element still mounted on the carrier 30.

Next in the series of steps, I seal the lower end portion of the tube containing a resistor element in the same manner as I sealed the top end portion. The lower end portion of the resistor element that was holding it in place during the first operation, is the upper end during the second operation, and is sealed accordingly.

During the actual operation, a plurality of resistors carriers 30 are used in order to provide for an efficient and economical resistor sealing process. In this invention, the polysiloxane resin R-620 and the silicone varnish 994 may be interchangeably used, as they both have similar chemical and physical properties.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

The process of providing a protective casing on the surface of a resistor element comprising a non-conductive element having a current conductive film thereon with hollow terminal end-caps surrounding and electrically connected to the film on the ends of said element,

4

said end-caps having a larger external diameter than that of the film between said end caps, said process comprising the steps of providing a phenyl-methyl-silicone resin, spraying said silicone resin on said film between said end-caps to provide a coating thereon, then baking said resistor element with said coating thereon at approximately 400° F. for about one-half hour to cure said coating, providing a tubular casing having an internal diameter slightly larger than the external diameter of said end-caps and sliding said casing over said end-caps with the open end portions of said casing extending beyond said end-caps and with said end-caps fitting closely within the internal surface of said casing and concentrically supporting said internal surface of said casing around said film at a circumferential clearance space therefrom, sealing the open end portions of said casing to enclose said resistor element therein, the steps of sealing including the following method, providing a powder glass material, a polysiloxane resin, and a silicone varnish, mixing about fifty percent by volume of powder glass with about same amount of polysiloxane resin to obtain a glass-silicone mixture, mixing in 20 percent by volume of said silicone varnish with about 80 percent by volume of said glass-silicone mixture to obtain a sealing material, applying said sealing material in said open end portions of said casing against said closely fitting end-caps so as to block said sealing material from contacting said film to enclose said resistor element therein, air setting said sealing material for about twenty-four hours and then baking said sealing material in said end portions at approximately 400° F., for approximately one hour to seal said resistor element in said casing.

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