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PYROLYTIC CARBON RESISTORS

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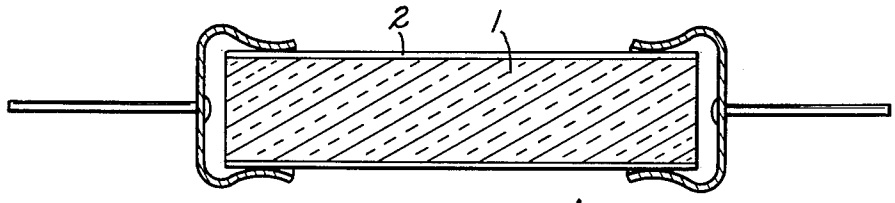


FIG. 1

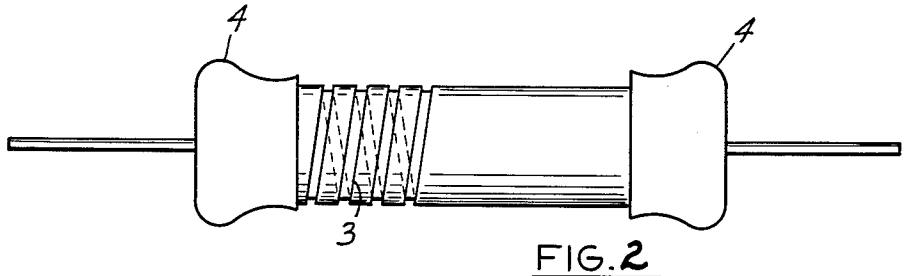


FIG. 2

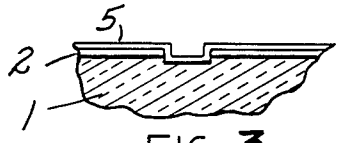


FIG. 3

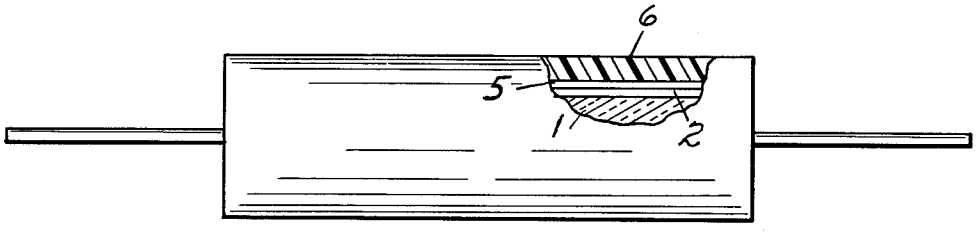


FIG. 4

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PYROLYTIC CARBON RESISTORS

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2 Claims. (Cl. 201—75)

This invention is intended to provide pyrolytic carbon resistors with a molded plastic case mechanically and electrically protecting the resistance film. The resistance film is first sealed with a thin varnish coating and the case molded over the coated resistor is of a plastic which does not chemically unite with the varnish coating and which sets up without the evolution of moisture.

In the accompanying drawing, Fig. 1 is a section of a pyrolytic carbon resistor; Fig. 2 is a side view of the resistor after the resistance has been adjusted by a helical groove cut through the resistance film; Fig. 3 is a fragmentary view after the sealing varnish is applied; and Fig. 4 is a side view, party broken away, of the completed resistor with the molded insulating case.

In the typical pyrolytic resistor shown in Fig. 1, there is a cylindrical ceramic body **1** on the outer surface of which is deposited a resistance film **2** which may consist of carbon or a mixture of carbon and other materials. The film is deposited by a cracking process in which a hydrocarbon in gaseous form is brought into contact with the heated ceramic body **1**. The hydrocarbon breaks down or cracks on the surface of the ceramic body producing the resistance film **2**. Other gaseous ingredients may be mixed with the hydrocarbon so that the resultant composition of the film **2** may consist of a mixture of carbon and other material such as boron. The manufacture of the pyrolytic or cracked carbon resistors is well understood and has been practiced for many years.

The value of the resistance of the carbon film **2** is adjusted to secure the desired resistance by cutting a spiral groove **3** in the resistance film starting from one end of the resistor. The resistor is then completed by attaching terminal caps **4** to each end. The resistor is then in the state of completion indicated in Fig. 2 where the resistance between the two terminal caps **4** is very close to the desired value so that the resistor can be sold as a precision resistor. In this condition, however, the resistor cannot be used because the resistance film is not protected from atmospheric conditions or from mechanical abrasion. For this reason, this type of resistor has heretofore been mounted in an enclosing ceramic case. Efforts to provide the conventional molded plastic case have not been successful. During the molding operation, an unpredictable change has taken place so that at the end of the molding operation, the resistance value between the end terminals **4** is no longer close enough to the desired value. This effect is particularly noticeable in the higher resistance values, e. g. 200,000 ohms.

While the direct molding of a plastic around the pyrolytic carbon resistor is not feasible because of the unpredictable change in the resistance values, the plastic case can be molded if the resistance film is first sealed by a varnish coating which is chemically inert with respect to the molded plastic case. Such a varnish coating is indicated in Fig. 3 where an epoxy resin varnish coating **5** is applied directly over the carbon resistance film and in the grooves **3**. While the epoxy resin varnish belongs to the solventless varnish class, it is preferable that the varnish be thinned with a suitable evaporating thinner before application so that the varnish will be thin enough so that it can uniformly coat not only the outer surface of the carbon film, but also the complete surfaces of the spiral or helical grooves **3** cut through the film. The epoxy resin varnish film is set by baking during which the solvent evaporates and the epoxy resin sets up by polymerization.

After the varnish coating **5** is applied, the entire outer surface of the resistor is sealed and the resistance film **2** is stabilized. The varnish coating **5** will be very thin (of the order of .002" thick). The purpose of the varnish film is to prevent changes in the resistance film **2** which would alter the resistance value when the plastic case **6** is molded around the varnish-coated resistor, as shown in Fig. 4.

The plastic case **6** should, of course, have the desired electrical and mechanical properties for protecting the resistor. However, there are additional requirements which are not present in the ordinary resistor. The plastic case should be of a plastic which does not chemically combine or unite with the varnish coating **5** during the molding operation. This means that if the varnish coating **5** is an epoxy resin, the molded case **6** should not be an epoxy resin. There is a further requirement that the plastic case **6** be of a plastic which does not give off moisture as it sets up. The moisture might be trapped within the case and penetrate to the resistance film **2** and destroy or change the resistance properties. This eliminates the thermo-setting phenolic resins. Where the varnish coating **5** is an epoxy resin, the plastic case **6** may be made of a condensation type alkyd resin, which sets up without the evolution of moisture, although some gas may be given off. Another resin, which is chemically inert insofar as the epoxy resin varnish coating **5** is concerned, is monochlorotrifluoroethylene, a thermoplastic resin. Both of these plastic resins are chemically inert insofar as the epoxy resin varnish coating **5** is concerned and have the desired mechanical and electrical properties for protecting the resistor. When the varnish coating is of the polyester resin type, an alkyd resin cannot be used for the plastic case **6**, since the alkyd resin belongs to the polyester family and chemically unites with the varnish coating **5** making an unpredictable and erratic change in the resistance values.

What is claimed as new is:

1. A pyrolytic carbon resistor comprising a body of insulating material with a carbon film thereon, a varnish coating on the resistor, and an outer plastic case molded around the resistor, said case being of a plastic chemically inert or inactive to the varnish during the molding operation and of the type not evolving water vapor during molding.

2. A pyrolytic carbon resistor comprising a body of insulating material with a carbon film thereon, an epoxy resin varnish coating on the resistor, and an outer plastic case molded around the resistor, said case being of a plastic chemically inert to the varnish and of the type not evolving water vapor during molding selected from the group consisting of condensation type alkyd resin and monochlorotrifluoroethylene.

References Cited in the file of this patent

UNITED STATES PATENTS

1,859,112	Silberstein	May 17, 1932
2,500,449	Bradley	Mar. 14, 1950
2,617,149	Rubin	Nov. 11, 1952