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RESISTANCE ELEMENT

Newton C. Schellenger and Willis E. Haselwood, Elkhart, Ind., assignors to Chicago Telephone Supply Company, Elkhart, Ind., a corporation of Indiana

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Our invention relates to resistance elements, and more particularly to resistance elements formed by combining conductive particles and synthetic resins.

Heretofore, resistance elements of the class described have been formed by incorporating in a phenol-formaldehyde condensation product suitable pulverulent conducting materials; such as, lamp black, graphite, etc., and by molding the mass thus obtained in any desired shape or size.

In view of the strict requirements imposed by the radio trade, resistance elements must possess certain characteristics that adapt them to the highly sensitive circuits with which they are associated, and they must be so constructed as to retain substantially all of such characteristics after long periods of use. Any departures from the predetermined characteristics of a resistance element; such as those that are occasioned by wear, or by reactionary changes within the materials of which the element is composed, will immediately be reflected in the associated circuit. As in the case of the present day highly sensitive radio receiver, such changes in the resistance element will react to materially and detrimentally impair proper functioning of the reproducer circuit.

It has been found that resistance elements formed from phenol-formaldehyde condensation products containing a conductive pigment are not capable, due to the inherent properties of the resin employed, of maintaining the same resistance characteristics with which they are initially endowed.

The reason for this instability of resistance values has been traced and ascribed to the fact that the condensation products of phenols and formaldehyde, by which the conductive particles are carried, never completely consummate their reaction; i. e., they are never completely reacted or cured into a state of quiescence and stability.

The continuous reactions that are present in resistors formed from conductive particles and synthetic resins of the phenol-formaldehyde group tend to either raise or lower the resistance values of the resistors. Obviously, any resistor so constituted is ill-fitted to control sensitive radio circuits, and it is toward the end of overcoming these difficulties that the present invention is directed.

It is, therefore, an object of our invention to provide a resistance element formed from a synthetic resin and a conductive material, which will have a stabilized resistance value.

It is another object of our invention to provide resistance elements of the class described that may have resistance values covering a wide range; from a few ohms to several megohms.

It is still another object of our invention to provide a resistance element that is durable and sturdy in construction, economical to manufacture, and which will function with the maximum degree of accuracy and efficiency.

With the above objects in view, and others that will be brought out as the description progresses, we prefer to accomplish one embodiment of our invention as follows:

We employ a vinyl resin for the body and binding constituent of our element, and incorporate therein any suitable conductive material in such proportion as will afford the resistance value desired.

The compound may then be molded into any desired shape, with or without heat treatment, to provide a finished element having stable properties and values.

If desired, the vinyl resin may be employed in a suitable solvent, and the conductive material may be mixed with it in its fluent state. The conductive varnish or lacquer thus formed may be deposited on a suitable strip or base in a film-like layer, and then subjected to heat curing, as by placing the coated strip or base within an oven.

The vinyl resins are found to complete substantially all inherent reactions within a relatively short period of time, and are thereby better adapted for use in resistors than the synthetic resins of phenol and formaldehyde. Resistance elements formed from the vinyl resins are highly stable and substantially no drift in resistance values is realized in the elements formed therewith.

Whereas, the present invention contemplates the use of vinyl resins in general for the purposes set forth, certain examples will be given hereinafter for the purpose of aiding those skilled in the art in understanding and practicing our invention.

We have found vinyl acetate possessed of the properties which make it particularly adapted for use in a resistance element.

A vinyl acetate ester, before polymerization has been effected, may be combined with a suitable conductive pigment; such as, lamp black, carbon black or graphite, in such proportions as will give a resistance element of the desired, predetermined value.

The substance may then be intimately mixed in any suitable manner, and placed in a mold. Since polymerization of vinyl acetate may be ef-

fected by the application of heat alone, the mold may be subjected to heat. However, since polymerization is considerably expedited by oxidizing agents, such agents may be employed. We have found those agents best adapted to assist the polymerization of the vinyl acetate to be organic peroxides, ozonides, or acid anhydrides in conjunction with percarbonates, perborates, or the metallic oxides that are capable of yielding oxygen.

Whereas, any suitable conductive material may be employed, we have found certain forms of carbon to be highly satisfactory. The crystalline forms of carbon afford the lower resistance values, and the amorphous forms of carbon the higher values.

Graphite may be used where low resistance values are desired, and carbon black may be used for the higher values. Lamp black has a specific resistance less than the latter though greater than the former, and may be used to attain resistance values of an intermediate order.

By mixing the above forms of carbon with the resinous binder, either jointly or severally, and by varying the proportion of binder to the conductive material, resistance elements of practically any resistance value may be made; ranging in resistance values from but a few ohms to several megohms.

Where it is desirable to provide resistance elements of the thin, disc-like variety, a conductive paint may be made by dissolving a vinyl acetate resin in a suitable solvent; such as, methyl isobutyl ketone, and mixing therewith any suitable conductive pigment; such as, any or all of the forms of carbon outlined above, and by depositing the paint thus formed upon a suitable mounting sheet, strip or base member. Preferably, a heavy paper is employed to mount the resistance paint.

The coated mounting material is then subjected to heat treatment to effect curing of the coating. This may be accomplished in any suitable manner, as by placing the coated material within an oven.

The nature of the resin permits it to be subjected to such temperatures as will drive off the solvent without causing any deleterious reactions to be set up within it. But if desired, it can be heated to such a degree as to not only drive off the solvent, but, also, to convert the resin to an infusible compound.

Resistance elements in any desired shape or form may be cut or punched from the coated material after the heat curing process is completed.

It is to be understood that any of the vinyl compounds may be employed. For instance, the products obtained by the polymerization of vinyl halides may be used, although, vinyl esters, particularly the acetate or chloracetate, are perhaps better suited for the purposes set forth than are the halide compounds.

Resistance elements made in accordance with the present invention have exceedingly stable resistance values; may be economically and expeditiously produced, and are adapted to be made with resistance values covering such a wide range as to meet practically every commercial demand.

We claim:

1. A resistance element composed of conductive material and a vinyl resin.

2. A resistance element composed of pulverulent carbon and a vinyl resin.

3. A resistance element comprising a base, a resistance material deposited on said base comprising pulverulent carbon and a vinyl resin.

4. In a resistance element, a resistance mixture composed of a pulverulent conducting material and vinyl acetate.

5. In a resistance element, a resistance mixture composed of finely divided carbon particles and vinyl acetate.

6. A conductive paint for resistance elements consisting of the following ingredients: a pulverulent conductor, a vinyl resin and a solvent for said resin.

7. A conductive paint for resistance elements consisting of the following ingredients: finely divided carbonaceous material, a vinyl resin and a solvent for said resin.

8. A conductive paint for resistance elements consisting of the following ingredients: powdered carbon, vinyl acetate, and a ketone.

NEWTON C. SCHELLENGER.
WILLIS E. HASELWOOD.