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PREPARATION OF ELECTRICAL RESISTANCE UNITS

No Drawing.

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This invention relates to the preparation of electrical resistance coatings, and has special reference to the manufacture of capacity and inductance-free high resistances.

- As is well known, capacity and inductance-free high resistance elements are made in the art by any of a number of methods, such as by impregnating paper strips or other material with various kinds of carbon inks, by surfacing paper or the like with graphite streaks or lines, by painting insulating bases with graphite and other compositions or by depositing thin films of metal on insulating bases such as glass tubes or the like. These resistances, although compact, inductance and capacity-free, possess a number of disadvantages either in the process of manufacture of the same or in service, the inked and graphited paper resistances being, for instance, quite microphonic, generally destructible in use, and incapable of carrying any considerable current, the metallic film resistances being unstable by reason of the change in the resistance value thereof which takes place due to the crystallization or oxidation of the thin metal film, and the graphited painted or coated resistances being comparatively difficult to make, due to the necessity of compacting the graphite layer by hand or other means. Some of these resistance elements are also open to the common and serious objection that the resistance values thereof for a given type or make vary within wide limits, it being difficult to manufacture the resistances of uniform value, especially where the same are produced by quantity production methods.

The manufacture of resistance units which do not possess the above-stated objections and drawbacks, and which are characterized by being non-microphonic, stable in value or magnitude, of large current-carrying capacity, durable, and capable of being manufactured uniformly in desired values within wide ranges, and especially without the necessity of manual or mechanical compacting operations, is a prime desideratum of our present invention.

A further prime object of our present invention relates to the production of a re-

sistance material capable of being applied to almost any insulating substance such as glass, porcelain, bakelite, paper or fibre, capable of being applied by simply coating or painting the same onto the insulating base to produce the resistance element, and having the property of compacting the conducting material into a homogeneous layer upon drying and capable of withstanding high temperatures in use without noticeable deterioration.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, our invention consists in the method, the resistance elements and resistance material hereinafter particularly described and sought to be defined in the claims.

We have discovered that the desired objects of the invention may be attained by employing a resistance material composed of graphite, and preferably of finely divided graphite, mixed with a binder capable of compacting the graphite particles into a homogeneous layer upon drying, and capable of withstanding high temperatures without deterioration, the said binder consisting of a morphous silicate of sodium or water glass.

In compounding the resistance material, the graphite is mixed with the water glass in proportions corresponding to the resistance desired, and we have found that almost any ratio of graphite to water glass may be used down to about one part of graphite to seven parts of water glass by volume. This mixture of water glass and graphite which forms a suspended graphite solution produces an excellent resistance paint, which may be applied by coating to almost any insulating substance, the same adhering firmly to glass, porcelain, bakelite, paper, fibre and the like. The water glass tends to form a smooth, even film when brushed on smooth surfaces, and in drying has the property of compacting the graphite into a homogeneous and durable layer, so that manual or other compacting operations hitherto found necessary to produce a uniform and homogeneous layer are obviated.

We have also found that after coating the resistance material on a base and drying the

same, a more perfect coating may be obtained in forming a more homogeneous layer which is substantially non-microphonic and which adheres very firmly to the insulating base by heating the coating or film of resistance material by external heat or by the passage of an electric current through the resistance unit or element. By subjecting the coated resistance element to such heat, which is preferably at high temperatures, such for example as 300° centigrade, a permanent drop of resistance of the order of from one-half to one-fifth the original value is obtained, and the resistance coating becomes very hard, dense and homogeneous.

In lieu of the ordinary air floated pulverized graphite, we may employ colloidal graphite, known commercially as Kollag. When the resistance paint or material comprises a mixture of Kollag and water glass forming a suspended or colloidal graphite solution, the resulting coating is found to be exceptionally uniform in its resistance properties and appearance. When the insulating base to which the coating is applied is of a material such as glass or porcelain, which will withstand high temperatures, we have found that the baking of the coated bases up to temperatures of the order of 300° centigrade for about one-half an hour produces an exceptionally hard surface coating which polishes readily under a buffing wheel with practically no change of resistance, the graphite being so densely compacted that the same cannot be removed even when rubbed with considerable vigor.

Preferably the resistance elements thus formed are covered with a coating so as to protect the same from mechanical or other injury, and desirably such coating consists of a covering of water glass over the baked and finished resistance element, water glass being preferred because of its advantage of being able to withstand high temperatures.

The manner of compounding the resistance material and the making of the resistance elements will in the main be fully apparent from the above detailed description thereof. It will be further apparent that the resistance elements may be manufactured with great ease and facility by the use of our resistance material, the operations of coating or painting the resistance bases and of baking or otherwise heating the so treated bases being possible of being carried out with ease and rapidity and consequent economy by quantity production methods. The resulting resistance elements have resistance values which may be predetermined with accuracy, the said resistances being stable in value or magnitude and of large current-carrying capacity. A further important advantage of the resistance units or elements so obtained is the ability to connect the same

in circuit, for on account of the high temperatures to which the coating may be subjected, it is perfectly feasible to employ solder for attaching conducting elements to the resistance coating. This is not only an important advantage from the viewpoint of economy, but from that of use, since the solder permits the units to be used at a high current rating, as distinguished for example from the use of woods-metal, which latter has a low melting point. As an instance of the durability and capability of withstanding high temperatures of the resistance unit, it may be stated that when glass tubes employed for grid leak resistances are coated with the resistance material of our invention, giving a value of two thousand ohms, a current of 60 or 70 milli-amperes may be passed through the resistance, giving from 5 to 8 watts load; and in so doing, the glass becomes red-hot in the center portion without any deterioration of the resistance coating. While we have described the preferred form of our invention, it will be apparent that many modifications and changes may be made therein without departing from the spirit of the invention, defined in the following claims.

We claim:

1. A free flowing electrically conductive paint adapted to be applied in a thin homogeneous layer to a surface for the manufacture of resistances comprising a mixture of one part of colloidal graphite, by volume, with about seven parts of water glass, by volume, the mixture being proportioned to obtain a consistency such that when applied a smooth even film of desired uniform thinness is produced.

2. The method of making a resistance element which includes coating a base with a free flowing electrically conductive paint comprising a mixture of about one part of colloidal graphite, by volume, with about seven parts of water glass, by volume, the mixture being proportioned to obtain a consistency such that when applied a smooth even film of desired uniform thinness is produced, and thereafter heating the painted base to a temperature of about 300° C. or higher in order to compact the graphite film.

Signed at New York city, in the county of New York and State of New York this 5th day of October, A.D. 1925.

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