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ELECTRICAL RESISTOR

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Fig. 1.

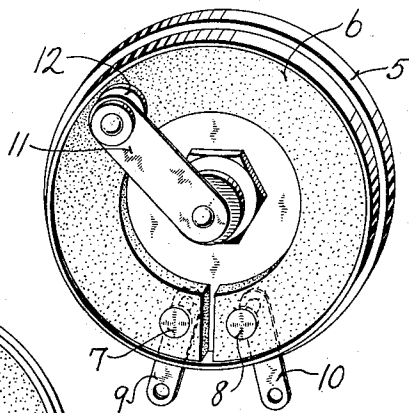


Fig. 4.

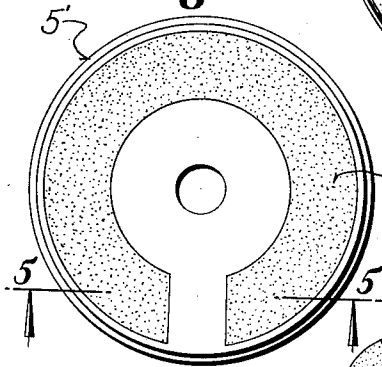


Fig. 5.

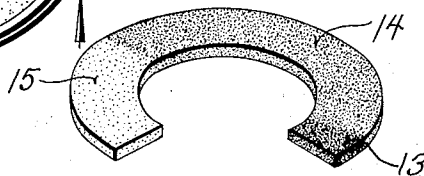
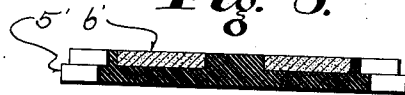


Fig. 2.



Fig. 3.

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ELECTRICAL RESISTOR

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6 Claims. (Cl. 201—76)

This invention relates to new and useful improvements in electrical resistors and refers more particularly to resistors of the molded type.

The continued and increasing demand of the radio industry for improvements in all qualifications of resistors, coupled with the requirement for smaller units but exceptionally high electrical resistance values, has taxed the ingenuity of the resistor manufacturer and brought about many important advances in the art.

A proper choice of materials entering into the manufacture of the units and particularly the use of materials of fine uniform texture has resulted in better stability against oscillatory discharge and has produced units having less variation of resistance with different frequencies and very low unobjectionable microphonic noise levels. However, notwithstanding these valuable improvements and substantial advances in the art, the desired stability as to the constant maintenance of its determined electrical characteristics could not be attained with existing materials and methods of manufacture.

It was found that this lack of stability both after the unit had been completely manufactured and during its progressive stages of manufacture, could be traced largely to the binder which was most generally a phenol-condensation product. Because of the use of this and similar materials as a binder, the finished unit was not as resistant to moisture as desired and was subject to chemical reactions and physical changes in its internal structure.

With these and other objections to existing electrical resistors in mind, it is an object of this invention to provide a molding compound for electrical resistors, composed of such ingredients that in its initial form and all through its formation into a finished resistor, it retains definite electrical characteristics which remain unchanged throughout the life of the resistor.

Another object of this invention is to provide an electrical resistor which is readily fusible at any stage of its manufacture or after complete formation without in any way affecting its electrical characteristics.

Another object of this invention is to provide a molded resistor formed of such materials as to permit the manufacture of composite units having sections of different electrical characteristics joined by fusion into a homogeneous mass.

A further object of this invention resides in the provision of a resistor having a supporting base integrally joined thereto by fusion.

The above and other objects which will appear

as the description proceeds, are attained by the substitution, for the binder now used in resistor molding compounds, of a thermoplastic substance which is a product of rubber.

This substance is a thermoplastic substance made from rubber, but contains no sulphur or sulphur bearing agents and requires no vulcanization and utilizes only heat and pressure to accomplish its function. Its softening temperature is well beyond the operating temperatures of electrical resistors so that there is no appreciable mechanical change in the unit under practical operating conditions. Proteins which might have deleterious effects in the manufacture of resistors, are substantially eliminated therefrom.

Specifically, this substance is a product of the chemical reaction between a solution of rubber and a halide solution of an amphoteric element. The reaction carried out under suitable conditions of control yields products in which the physical characteristics can be varied by means of this control. As an example, tin tetrachloride or a solution of chlorostannic acid is added to a benzol solution of crepe rubber and the reaction, exothermic in nature, is made to proceed for a certain length of time. The time of reaction controls the physical characteristics of the product. The halide salt is then split off with a suitable material such as alcohol, which precipitates the reacted rubber material. This material, washed and dried, is the product used.

The degree to which the solution of rubber is reacted controls the softening point of the finished product.

A very desirable attribute of this fusible binder and consequently a resistor molding compound formed with it as the binding agent, is that a plurality of solid molded sections may be joined by fusion into one homogeneous integral mass without in any way affecting the electrical characteristics of the individual sections.

The thermoplastic binder described is also a very good insulator and is admirably suited to the making of bases and supporting structures for resistors. When so used, the base and the resistor may be joined by fusion into one homogeneous body and may be molded in a single operation.

In practicing this invention, a quantity of the fusible binder material is mixed with carbon or some other suitable conductor in comminuted form and the mixture rolled on hot rolls or otherwise manipulated to thoroughly disperse the carbon. The resulting mass such as the rolled sheet is then pulverized and molded hot in dies to produce units of the desired shape and size, there be-

ing no curing or chemical setting of the binder at any time during the manufacturing process. Metallic terminals, if required, may be molded in place in the usual manner without danger of

corrosion because of chemical reactions.

Several specific embodiments of this invention in the form of finished resistors have been illustrated in the accompanying drawing in which:

Figure 1 is a perspective view of a rheostat incorporating a resistor formed in accordance with this invention;

Figure 2 is a perspective view of a resistor unit adapted for use in a rheostat such as shown in Figure 1, but formed of sections having different degrees of resistance;

Figure 3 is a side elevation of a conventional fixed electrical resistance unit, the body of which is formed in accordance with this invention;

Figure 4 is a plan view of a resistor similar to that shown in Figures 1 and 2, integrally joined to a supporting base; and

Figure 5 is a section view through Figure 4 on the plane of the line 5-5.

Referring now more particularly to the accompanying drawing, the numeral 5 represents the supporting base of a rheostat particularly adaptable for use with radio apparatus.

Mounted on the base is an annular resistor 6 molded from the compound hereinbefore described. The specific proportions of the ingredients of the compound depend, of course, upon the desired electrical characteristics of the unit. As a specific example, the unit may be molded from a compound comprising 100 parts by weight of the aforesaid fusible binder which as stated, is a thermoplastic product of rubber mixed with 75 parts of Acheson, No. 750 graphite.

The mixture is treated in the manner hereinbefore described and the compound molded to the required size and shape to fit the base as shown.

Special means may be provided to secure the resistor to the base, but it may be secured by its terminals 7 and 8 which have their heads imbedded in the resistor and extend through the back of the base to contact with conductor terminals 9 and 10, respectively.

A contactor arm 11 is mounted from the base for rotation about its central axis. The outer extremity of the arm carries a suitable contactor 12 which makes contact with the surface of the resistor.

As illustrated in Figure 2, the resistor used in the rheostat may be of sectional construction comprising a plurality of integrally connected sections 13, 14 and 15. Each of these sections is formed from a compound similar to that described, but having different degrees of electrical resistance.

The segment shown in Figure 2 may be made by cutting each section from a complete molded ring having the electrical characteristics of that particular section and joining the sections by fusion into a homogeneous integral unit. As explained hereinbefore, the joining of the sections by fusion does not in anywise affect the electrical characteristics of the various sections.

As an alternate method of making the sectional resistor, sufficient quantities of the different mixes of the compound may be deposited in a die in proper position and by a single operation, an integral ring or segment may be formed having sections or portions thereof of different specific resistances.

The unit shown in Figure 3 is a representative showing of the general type of fixed resistor unit.

A typical small unit of this character is $\frac{1}{8}$ of an inch long and $\frac{3}{64}$ of an inch in diameter. A unit of these dimensions and having an electrical resistance rating of six million (6,000,000) ohms may be molded from a compound comprising forty-three (43) parts of carbon black, fifty-seven (57) parts of the thermoplastic binder, and one hundred (100) parts of powdered silica. The powdered compound is molded to its finished size in the presence of heat.

In the rheostat illustrated in Figure 1, the resistor 6 is defined as a separate element manufactured independently of its base 5 and held assembled therewith either by the terminals 7 and 8 or other external means. In view of the fusibility and exceptional insulating qualities of the thermoplastic binder, it is possible and desirable to mold the resistor and its supporting base simultaneously into a solid homogeneous body, thus obviating the need for assembly of separate elements.

A rheostat formed in this manner is illustrated in Figures 4 and 5. As here shown, the resistor 6' is similar in shape to that shown in Figure 1, but instead of being independently formed, is an integral part of the base 5'. The exposed face of the resistor is flush with the adjacent face of the base, and while a definite parting line is shown between the resistor and the base, actually, no sharp division exists, as during the molding of the unit, the resistor forming mixture fuses with the thermoplastic material forming the base.

In making this unit, the resistor segment and the base may be separately shaped prior to their simultaneous final molding. In the shaping of the two elements, the material need not be compressed beyond the degree necessary to retain a definite form. With the two preformed elements properly assembled, the unit is subjected to the molding pressure in the presence of heat to effect the desired fusion and produce an integral homogeneous body of the desired size and shape.

From the foregoing description taken in connection with the accompanying drawing, it will be readily apparent to those skilled in the art, that this invention provides a novel resistor unit and method of making the same wherein stability throughout the entire manufacturing process is maintained and wherein chemical and mechanical changes in the finished unit are limited to a minor degree or are absent entirely.

It is, of course, understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

What we claim as our invention is:

1. As an article of manufacture, an electrical resistor of the molded type having as a binder, a thermoplastic substance composed essentially of rubber in the form of a synthetic resin containing no sulphur or sulphur bearing agents and which is fusible without affecting its electrical properties.

2. A molding compound from which electrical resistors may be formed by pressure in the presence of heat, which comprises a comminuted electrical conductor dispersed in a binder in the form of a synthetic resin which is a product of rubber, is free from sulphur and sulphur bearing agents, and is fusible at temperatures above the normal operating temperatures of electrical resistors without affecting its electrical characteristics and without chemical reactions.

3. The method of making an electrical resistor

which comprises dispersing a comminuted conductor in a rubber compound substantially free from sulphur and proteins so as to be free from chemical reactions produced by heat, and forming the mixture solely by heat and pressure into a predetermined finished form.

4. The method of making an electrical resistor which comprises dispersing a comminuted conductor in a thermo-plastic product of rubber, and forming the mixture by heat and pressure to a predetermined form, said thermo-plastic product of rubber containing no sulphur and being so treated as to be free of proteins whereby during the formation of the resistor by heat and pressure and during the use thereof, no chemical reactions take place within the resistor.

5. An electrical resistor comprising a solid body

consisting of a comminuted conductor dispersed in a thermoplastic product of rubber containing no sulphur or proteins whereby during use of the resistor no chemical reactions take place therein.

6. An electrical resistor comprising a comminuted conductor dispersed in a thermo-plastic product of rubber, said thermo-plastic product of rubber containing no sulphur or proteins which during the formation of the resistor by heat and pressure and during the use thereof would result in deleterious reactions, and being deformable at temperatures only above the operating temperature of the resistor and being hard and non-deformable at lower temperatures.

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