Feb. 28, 1939. H. F. FRUTH 2,148,453

RESISTANCE

Filed March 23, 1935

Fig. 1

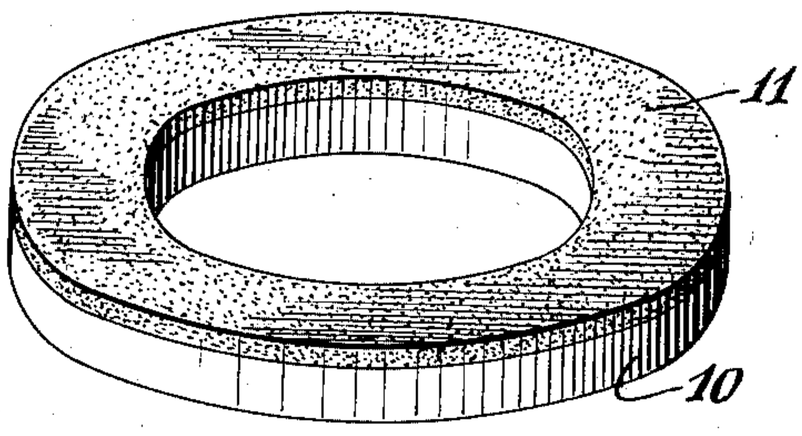


Fig. 3

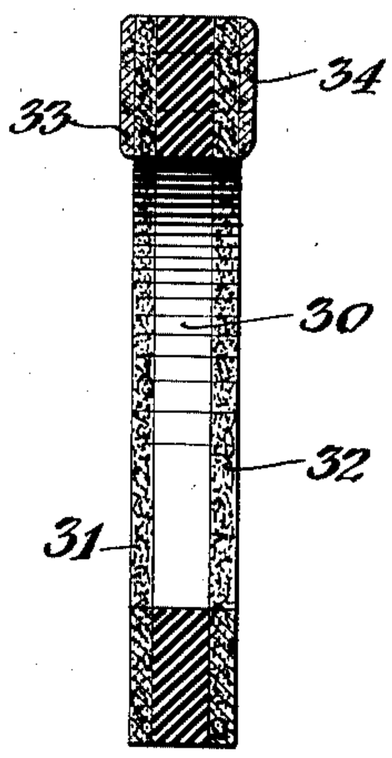


Fig. 2

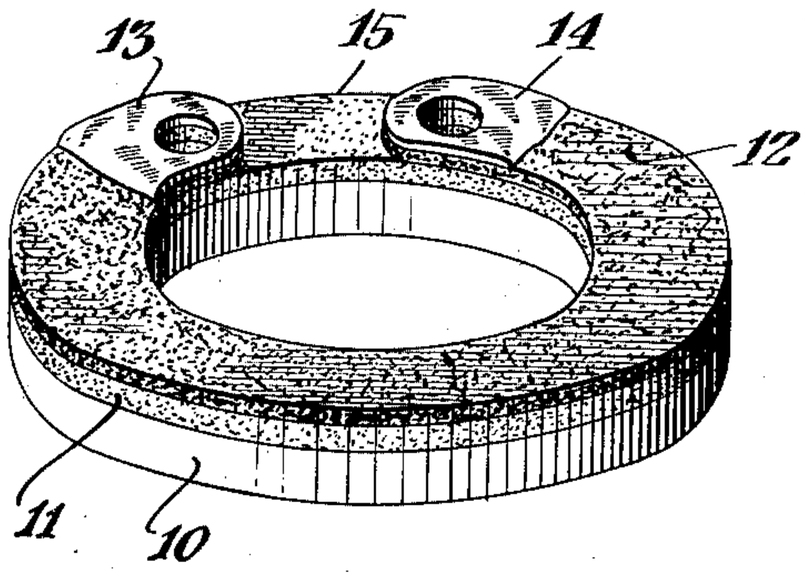
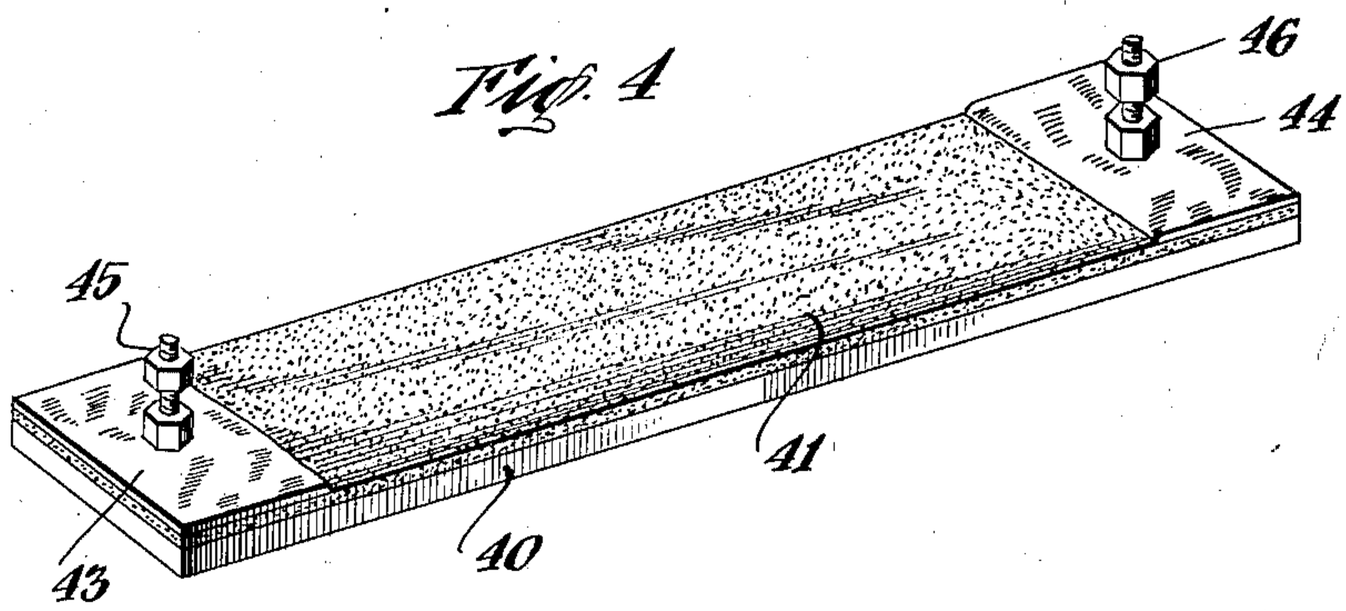


Fig. 4



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2,148,453

RESISTANCE

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Application March 23, 1935, Serial No. 12,594

7 Claims. (Cl. 201—76)

This invention relates to electrical resistances and particularly to resistance elements, resistance surfaces and the like.

An object of the invention is to produce an improved resistance element.

Another object is to produce an improved resistance material.

Further objects are to produce an improved material for the making of resistances and to improve the methods of making the resistance material.

Other objects of the invention will be apparent from the following description taken in connection with the appended claims.

The invention is applicable to the production of resistance units of the type commonly used in rheostats for radio purposes and the like and for volume control purposes in general applications to control the amount of current flowing in a circuit. In one form these devices may include a ring or disc of insulating material upon the surface of which is an adherent coating of the resistance material. A centrally pivoted arm is generally provided carrying a rider or contactor adapted to slide along the resistance coating to vary the amount of resistance in the circuit.

The present invention will in many instances be of advantage as well in the art of making fixed resistors and of variable resistors of different types.

The invention accordingly comprises the features of construction, combination of elements, arrangement of parts, and methods of manufacture referred to above or which will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawing, the scope of the invention being indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention as well as for specific fulfillment thereof, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 shows a base of insulating material adapted to receive a resistance surface;

Figure 2 shows the base with a layer of resistance material applied thereto;

Figure 3 shows a modified form of resistance unit; and

Figure 4 shows a further modified form of unit.

Like reference characters denote like parts in the several figures of the drawing.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

The resistance surface may be formed by suspending a finely-divided resistance material, such as carbon, in a suitable liquid carrier and painting or spraying the mixture onto the surface of an insulating base.

Preferably the carrier is of a type which will dry onto the surface or will leave an adherent binder to hold the particles of resistance material.

One method of applying the resistance surface may be as follows: A water-soluble resin composition is placed in aqueous solution and the finely divided resistance material is added thereto. The mixture is painted onto the surface to be coated, after which heat may be applied to drive off the water, leaving a resinous binder for the resistance material in the completed coating. The water-soluble salt may be made by placing wax-and-tar-free purified shellac or purified rosin in aqueous ammonia and heating the mixture until the resin-ammonia soap is formed. To the aqueous resin-ammonia soap solution thus formed may be added a finely divided petroleum carbon and/or a colloidal suspension of graphite in ammonia, known as "Aquadag". The water soluble resin-ammonia soap may also be formed by combining the resin or resin acid with other basic compounds such as potassium and sodium hydroxides and the like.

The subsequent heating or baking of the material after it is applied to the surface may cause a complete or partial decomposition of the soap. There is evidence, however, of a partial or complete polymerization of the resin material, depending upon the time and temperature of baking. The resulting substance forms the binder for the resistance material thereby forming a firm adherent and smooth resistance surface. This surface is apparently insoluble or only very slightly soluble in normal shellac or resin soluents such as alcohol or ammonia solution.

According to a modification other finely-divided conductive materials may be used in place of the carbon as the resistance material. Such a material may be finely divided metal, such as nichrome, iron, silver, metallic oxide, such as copper oxide, cadmium oxide, silver oxide or the like; metallic sulfide, such as copper, cadmium

or silver sulfide, or the like. These materials provide superior resistance surfaces for some applications and may be used in suspension in an aqueous, ammoniacal or other liquid carrier and in mixtures including a resin-ammonia soap as described for carbon. Likewise, the materials may be made of colloidal dimensions if desired to obtain a very smooth continuous surface.

The insulating backing to which the resistance surface is applied may be any of the kinds used in the prior art but may preferably comprise a sheet of resin-impregnated fibre having a sheet of absorbent or partly porous paper secured to its face. The paper may preferably be secured by molding directly onto the surface so that part of the resin partially impregnates the paper leaving its outer surface still absorbent.

Referring to the drawing, Figure 1 shows a suitable base or backing of the type described comprising a ring or disc 10 of "Bakelite" impregnated fibre with a sheet 11 of tissue paper molded directly to its surface so that a portion of the "Bakelite" resin penetrates a short distance into the tissue paper. Preferably, however, the resin does not pass completely through the paper but leaves the upper exposed face thereof absorbent.

Figure 2 shows the completed resistance unit comprising ring 10, paper surface 11 and resistance layer 12 applied to the surface of 11 and partially impregnating the same. Layer 12 is left off a short section 15 of the ring and two terminals are provided by metal paint or sprayed metal coatings 13 and 14.

Figure 3 shows a cross-section through a modified form of resistance unit comprising an insulating ring 30 having resistance coatings 31 and 32 which may be of paper impregnated with resistance material on both faces thereof. Metal coatings 33 and 34 provide terminals for the respective resistance surfaces.

A straight type resistance unit is shown in Figure 4 comprising an insulating base 40 having resistance coating 41 thereon. Metal coatings 43 and 44 and binding posts 45 and 46 provide for circuit connections.

Any of the forms shown can be used for fixed resistors or may be arranged with a sliding contactor to provide a rheostat or variable resistor device.

The use of an aqueous solution for applying the resistance material to the surface is highly advantageous in that it eliminates the fire hazard which is generally present when resin solvents are used. Furthermore it obtains better and more uniform penetration and dries slowly, allowing greater uniformity to be achieved.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of making an electrical resistance unit which comprises forming an aqueous solution of a water-soluble resin soap, adding conducting material thereto, applying the resultant mixture to a surface, and subsequently heating to bring about decomposition of said soap and form an adherent conductive surface.

2. The method of forming a conductive layer for resistance devices which comprises making a water solution of a water-soluble shellac soap, adding conductive particles thereto, applying said mixture to a supporting base, allowing said mixture to dry thereon, and heating to bring about decomposition of said soap and to form an adherent waterproof conductive surface.

3. The method of forming a conductive layer for resistance devices which comprises forming a resin composition of an ammonia-soluble resin and ammonia, mixing a conductive substance therewith, applying said mixture in water to a surface, allowing said mixture to dry on said surface and applying heat to decompose at least part of said salt.

4. The method of forming a conductive layer for resistance devices which comprises forming a shellac-ammonia soap of a shellac and ammonia, mixing a conductive substance therewith, applying said mixture in water to a surface, allowing said mixture to dry on said surface and applying heat to decompose at least part of said soap.

5. The method of forming a conductive layer which comprises treating a water-insoluble resin with a base adapted to make the resin water-soluble, dissolving the resultant product in water, adding a finely divided conductive material thereto and re-converting said product into a water-insoluble resin.

6. The method of forming a conductive layer which comprises treating a water-insoluble resin with ammonia solution adapted to make said resin water-soluble, dissolving the resultant product in water, adding a finely divided conductive material thereto and volatilizing said volatile substance to re-convert said product into a water-insoluble resin.

7. The method of making a resistance surface for variable resistance devices which comprises forming a mixture of Aquadag and shellac dissolved in ammonia, depositing the same on an insulating base and drying the deposit thereon, and further heating said deposit to drive off said ammonia and reconvert said shellac into a water insoluble resin.

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