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E. R. STOEKLE

2,005,922

RESISTANCE ELEMENT AND METHOD OF MAKING SAME

Original Filed Nov. 18, 1929

Fig. 1

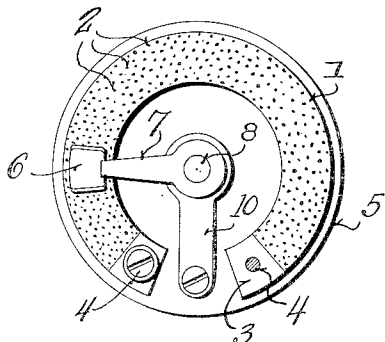


Fig. 2

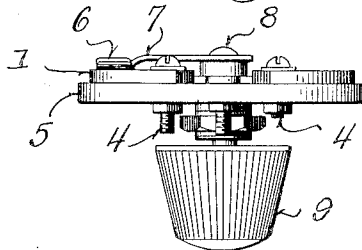


Fig. 3

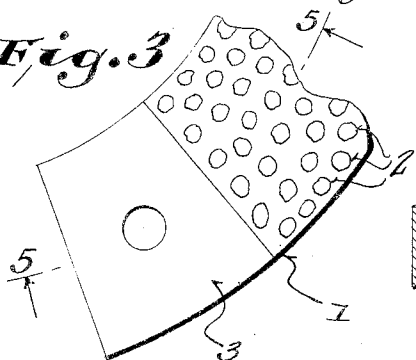


Fig. 5

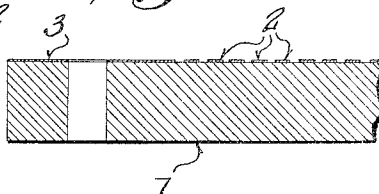


Fig. 4

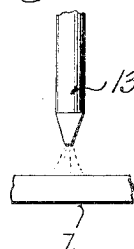


Fig. 6

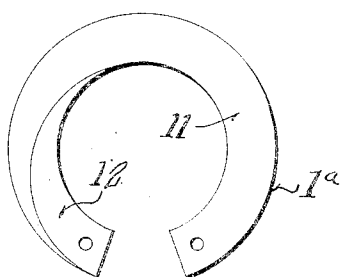
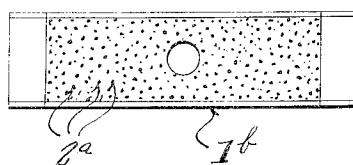


Fig. 7



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RESISTANCE ELEMENT AND METHOD OF
MAKING SAMEErwin R. Stockle, Milwaukee, Wis., assignor to
Central Radio Laboratories, Milwaukee, Wis., a
corporation of WisconsinApplication November 18, 1929, Serial No. 407,840
Renewed August 18, 1933

12 Claims. (Cl. 201-76)

This invention relates to electrical resistance elements and to the method of making the same, and also to rheostats embodying such elements.

The invention has particular reference to resistance elements of a high resistance type, such as are made of a high resistance material, as carbon, graphite or other carbonaceous material.

The nature of the material referred to necessarily makes the contact surface of the element relatively rough and uneven which prevents the obtaining of good electrical contact between the element and the adjustable contact member used therewith in a rheostat or other unit. In radio and telephone circuits this unevenness of contact is evidenced by the so-called microphonic noises produced as the adjustable contact member is moved over the surface of the high resistance element. To eliminate these noises, which are very objectionable in such circuits, it is essential that a specially good electrical contact be had at all times between the high resistance element and the adjustable contact member.

In accordance with my invention, I accomplish this result by providing the high resistance element on its contact surface with a multiplicity of isolated or separated areas or spots of good electrical conductivity so that a good electrical contact is provided for the adjustable contact member as the latter is moved or slid over the contact face of the element. These areas or spots are separated by the high resistance material between and about them and being negatively small, do not affect the resisting property of the element as the contact member passes from one spot or area to another. The areas are substantially flush with the contact face of the element and eliminate the noises referred to by eliminating the uncertainty of contact of the adjustable contact member with the high resistance material.

In accordance with my invention I make these areas or spots of metal of the desired electrical conductivity and apply the metal to the contact surface of the high resistance material by a metal spray process. In this process many of the common metals can be atomized into a fine spray and the molten droplets of the metal can be impinged against the surface of the resistor with such force as to cause the patches of metal to permanently adhere to the resistant material. A very short exposure of the surface to the spray causes patches of metal to form where the molten droplets impinge on the surface. A longer exposure, of course, results in a complete metallic coating on the surface, which application can be confined to the ends of the resistor element where

the conductor wires of the circuit are attached thereto. By exposing the high resistor element for a brief time to the metal spray, a large number of fine metallic patches are applied to the surface without substantially changing the total resistance of the resistor.

The invention consists further in the matters hereinafter described and claimed.

In the accompanying drawing:

Fig. 1 is a plan view of a rheostat unit embodying a high resistance element of my invention;

Fig. 2 is a side view of the unit;

Fig. 3 is an enlarged face view of the element to show the disposition or arrangement of the contact areas or spots thereon;

Fig. 4 illustrates the manner in which the metal is sprayed on the contact surface of the resistor element;

Fig. 5 is a sectional view taken through the element on line 5-5 of Fig. 3;

Fig. 6 is a plan view of a high resistance element in which the sprayed metal is so applied as to taper the resistance to a point at one end of the resistor; and

Fig. 7 shows a resistor element in straight bar or strip form.

In Figs. 1 to 5 of the drawing, 1 indicates the resistance element of my invention. The element is shown in flat arcuate form and is made of a high resistance material, such as graphite, carbon, or other carbonaceous material, in compact, solid form. 2, 2 indicate the metallic patches or islands deposited on the contact surface of the element 1 by the metal spraying process heretofore described. These metallic patches or islands are distributed or scattered over the surface of the element in isolated or separated relation with the high resistance material of the element between and about them, as clearly shown in Fig. 3. Since these patches or islands of metal are formed of molten droplets of metal impinged on the surface of the element at high velocity they are very adherent to the surface. If the surface of the element is somewhat rough, adherence of these metallic patches to the surface is greatly increased. The number of metal spots per square inch may be increased as the ends of the element are approached, thus effecting somewhat of a decrease in the resistance per unit length of path by producing the so-called tapered resistance so frequently required in resistances of this character when used in radio and telephone circuits. The ends of the element may be completely coated with the metal spray as shown at 3, 3 in Figs. 1 and 3, thereby assur-

ing a zero value of resistance at the terminals of the element, and also insuring good electrical contact between the element and the terminal members 4, 4 by which the element is fastened or secured to a supporting base 5 of insulating material in a rheostat unit as shown in Figs. 1 and 2. The metal coatings 3, which provide the terminals for the contact surface of the resistor element, are, as shown in Fig. 5, relatively thin and substantially co-planar with the contact surface of the element, whereby the adjustable contact member usable with the element and movable over its contact surface may be moved into and out of contact with the terminals 3 without mechanical or electrical discontinuity.

In this unit the adjustable contact member 6 is at the outer end of an arm 7 which, by being connected with the rotatable shaft 8 of the rheostat may be slid or moved over the surface of the resistor 1 on turning the shaft by the knob 9. One wire of the circuit is connected to one terminal 4 of the resistor and the other wire is connected to a conductor strip 10, which is secured to the base 5 between the separated ends of the resistor 1 and leads to the arm 7 at the shaft 8 to provide a path for current flow as the arm is turned to vary the amount of high resistance material desired in the circuit.

The resistor element 1 of my invention may be used in various forms of rheostat units and I am not limited to the form shown in Figs. 1 and 2. The element may be used in the form of rheostat shown, described and claimed in my prior Patent No. 1,653,745, granted December 27, 1927. In this form, the adjustable contact member is in the form of a rocking or rolling contact disc which is brought into contact with the element along an adjustable location on the resistor by means of a spring arm and a friction pad, which bears on the outer conical edge of the disc.

The element 1 may also be used in the form of unit disclosed in my Patent No. 1,704,154, granted March 9, 1929. In this form the element 1 will be made ring shape and have the contact areas 2, 2 disposed about the outer peripheral surface of the ring.

Other forms may be devised, the principle of the element remaining the same in having the contact areas distributed over the contact surface of the element to eliminate noises by providing good electrical contact for the adjustable contact member. Moreover, with the contact areas 2 of the element wholly supported by the body of the element at the contact surface thereof and confined to said surface, as shown in the drawing, the element may be made in film or relatively thin layer-like form as required for radio and telephone installations.

In Fig. 6 I have shown a resistance element 1^a in arcuate form as before, and made of a high resistance material. A portion of the contact surface 11 of the element adjacent one end is sprayed with metal, as at 12, to provide a tapered resistance. The element 1^a is exposed long enough to the spray to form a complete coating of metal over the portion to be covered thereby. This coating is shown as being tapered from one end or terminal of the element to a point intermediate the ends of the same, and which point is at the inner edge of the element. The remaining surface of the resistor is not coated with metal, and it will be noted that the portion of such surface which follows the coated portion gradually tapers to a point where the coated portion approaches the terminal end of the resistor,

thereby allowing the adjustable contact member to gradually taper off the resistance as such member is adjusted toward the completely covered end of the resistor.

In Fig. 7, the resistor element 1^b is made of a high resistance material the same as before. The element, however, is in straight bar or strip form and has isolated areas of metal 2^a sprayed on its contact surface similar to the element 1 in Figs. 1 to 5. The terminal ends of the strip are completely covered with metal, as shown.

Fig. 4 illustrates the spraying process. 13 indicates a metal spray gun or tool of a character by which molten metal may be sprayed on the contact surface of the resistor element in preparing the same in accordance with my invention.

I claim as my invention:

1. An electrical resistance element comprising a body composed of a high resistance material and having a contact surface, and relatively small particles of metal of good electrical conductivity adhering to the body on said surface and distributed thereover in isolated relation, the particles being confined to the surface and disposed in decreasing spaced relation toward one end of the surface to thereby effect an electrical taper for the resistor.

2. An electrical resistance element comprising a body composed of a high resistance material and having a contact surface, a metal coating on the surface providing a terminal therefor, and relatively small particles of metal of good electrical conductivity adhering to the body on said surface and distributed thereover in isolated relation beyond said terminal, said particles being confined to the surface and disposed thereon in decreasing spaced relation toward the terminal to thereby effect an electrical taper for the resistor.

3. An electrical resistance element composed of a high resistance material, and a metal of good electrical conductivity sprayed on the contact surface of the element from end to end to provide isolated areas between the ends of the element and solid coatings at the ends of the element.

4. The method of making an electrical resistance element which consists in spraying a multiplicity of relatively small metallic particles of good electrical conductivity on the surface of the element in isolated relation.

5. The method of making an electrical resistance element which consists in spraying on the surface of a high resistance element, a multiplicity of relatively small metallic particles in molten form in isolated relation.

6. The method of making an electrical resistance element which consists in spraying on the contact surface of the element a multiplicity of relatively small metallic particles of good electrical conductivity in isolated or scattered form.

7. The method of making an electrical resistance element which consists in spraying molten metal on the element, the ends of the element being exposed longer to the spray than the intermediate portion of the element so as to provide metallic coatings over the ends of the element and isolated areas of metal elsewhere on the surface of the element to afford a variable resistance therefor.

8. An electrical resistance element comprising a body composed of a high resistance material and having a contact surface, and relatively small particles of metal of good electrical conductivity adhering to and wholly supported by

the body at said surface, said particles being confined to said surface and distributed thereover in isolated relation.

5 9. An electrical resistance element comprising a body composed of a high resistance material and having a contact surface, and relatively small particles of metal of good electrical conductivity adhering to the body at said surface and distributed thereover in isolated relation, 10 said particles being confined to said surface whereby the resistor element may be made in relatively thin layer-like form.

15 10. An electrical resistance element comprising a body composed of a high resistance material and having a contact surface, and relatively small particles of metal of good electrical conductivity adhering to the body at said surface and distributed thereover in isolated relation, said particles being confined to said surface 20 whereby the resistor element may be made in relatively thin layer-like form, the distribution of the particles over said surface being such as to give a varied resistance to the resistor over said surface.

25 11. An electrical resistance element comprising a body adapted for use with a movable con-

tact member, said element composed of a high resistance material, terminals for said element adjacent the ends of the body, and a tapered metallic coating in electrical contact with one of said terminals, said metallic coating extending with an edge on the surface of the element over which the contact member is movable, said edge intersecting the path of movement of the contact member at an acute angle whereby the contact member will approach contact with said 10 metallic coating very gradually and thus produce a gradual approach of the resistance in the rheostat to zero.

12. A rheostat employing a resistance element comprising a body composed of a high resistance 15 material and having a contact surface, relatively small particles of metal of good electrical conductivity adhering to the body at said surface and distributed thereover in isolated relation, said particles being confined to said surface 20 whereby the resistor element may be made in relatively thin layer-like form, and means adjustable over said surface to make electrical contact with the resistor at said particles at a variable location along the surface of the element. 25

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