

May 24, 1938.

N. C. SCHELLENGER

2,118,112

VARIABLE RESISTANCE DEVICE

Filed June 27, 1934

2 Sheets-Sheet 1

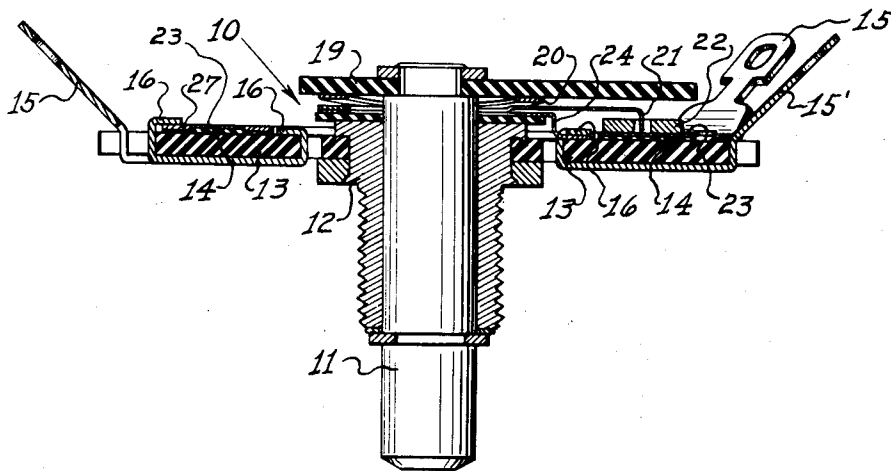


FIG. 1.

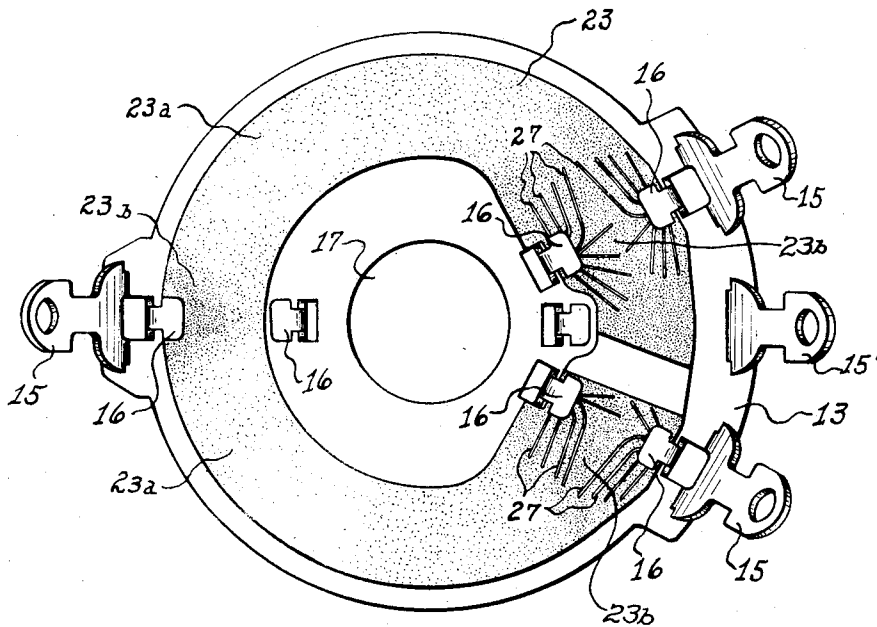


FIG. 2.

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2 Sheets-Sheet 2

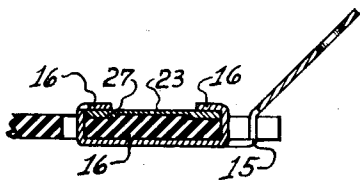


FIG. 3.

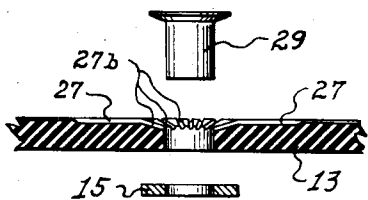


FIG. 5.

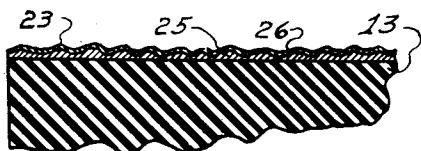


FIG. 6.



FIG. 7.

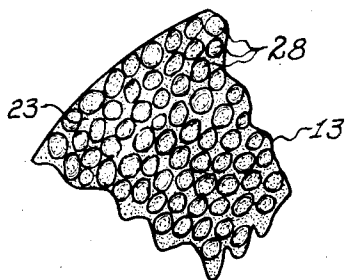


FIG. 8.

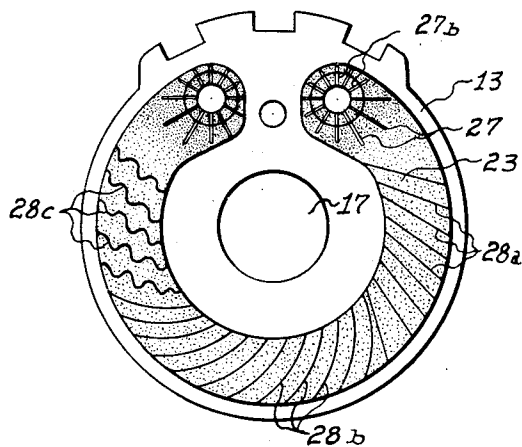


FIG. 4.

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UNITED STATES PATENT OFFICE

2,118,112

VARIABLE RESISTANCE DEVICE

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Application June 27, 1934, Serial No. 732,604

9 Claims. (Cl. 201—55)

This invention relates to variable resistance devices, more particularly to variable resistance devices of the type employing a resistance element of carbonaceous material and in which a contactor slidingly sweeps over the carbonaceous material.

In the present day development of the radio art, variable resistance devices are desirable in which there is a great divergence of electrical resistance between different sections of the surface of the resistance element. That is, some sections of the path of contact of the contactor on the resistance element must have a much higher or lower unitary resistance than other sections whereby a varying resistance gradient may be produced in the resistance device with uniform movement of the contactor over the resistance element.

I have found that if a comparatively few particles of low resistance material, especially if it contains graphite, are carried onto the high resistance section of the resistance element and rubbed along this section by a sliding contactor, considerable change in the resistance of this high resistance section will result.

My present invention provides a resistance element of such form that there is practically no variation in the maximum resistance of the rheostat caused by particles of low specific resistance material being carried over onto the high resistance section of the resistance element by the contactor as it is moved back and forth over the resistance element.

I have found that this shifting of carbonaceous particles can be prevented from destroying the resistance characteristics of the high resistance sections by the surprisingly simple expedient of constructing the carbonaceous coating of the resistance element with a comparatively rough or uneven surface, especially at the boundary between such sections as may differ considerably in unitary resistance. This roughness may vary from the finish of the surface of an egg shell to substantial craters, cuts or other decided indentations in the surface of the resistance element.

It is therefore one object of my invention to provide a variable resistance device having a carbonaceous resistance element of varying resistance gradient and a slidingly engageable contactor, and in which the varying resistance gradients will be maintained substantially constant over long periods of operation.

It is another object of my invention to provide a resistance element for a variable resistance

device with a comparatively rough or uneven surface of carbonaceous material.

It is another object of my invention to provide a new method of constructing resistance elements having a rough or uneven surface of carbonaceous material.

It is a further object of my invention to provide a resistance element with indentations in the surface of a supporting base and having a layer of carbonaceous material on the indented supporting base surface.

It is yet another object of my invention to construct a resistance element having a carbonaceous resistance material thereon and provided with conducting elements which are connected to the carbonaceous material of the resistance element in such a manner as to make a more uniform and positive contact therewith.

Still further objects and advantages of my invention will become apparent upon consideration of the following detailed description and accompanying illustrations of a few representative embodiments thereof, it being understood that the scope of the invention is to be limited only as defined by the appended claims.

In the drawings, which illustrate the invention on a substantially enlarged scale,

Fig. 1 is a vertical sectional view of a variable resistance mechanism of the type adapted to incorporate my invention;

Fig. 2 is top plan view of a supporting base and resistance element constructed in accordance with my invention and showing current conducting terminals fastened thereto;

Fig. 3 is a fragmentary sectional view showing a conducting terminal fastened to a modified form of resistance element and supporting base;

Fig. 4 is a top plan view on a slightly reduced scale showing a modified form of supporting base and resistance element;

Fig. 5 is a fragmentary sectional view of a supporting base and resistance element and showing rivet means for fastening the conducting terminal to the element;

Fig. 6 is a highly magnified fragmentary section through a portion of the supporting base and resistance element;

Fig. 7 is a highly magnified fragmentary section through a portion of another modification of supporting base and resistance element;

Fig. 8 is a highly magnified fragmentary plan view of a supporting base and resistance element showing the indentations in the surface thereof.

Referring in more specific detail to the accompanying illustrations, reference character 10 des-

ignates generally the essential mechanism of a variable resistance device of the type using a resistance element of so-called "carbonaceous" type in combination with a slidably engageable contactor.

A rotatable shaft 11 is journaled in a bushing 12 which in turn is secured to the side walls of an aperture 17 in a supporting base 13. A resistance element 23 of carbonaceous material such as graphite supported by a binder is placed on a strip 14 of any suitable insulating material which, for example, may be parchment paper or other comparatively dense flexible substance. The strip 14 is mounted on the supporting base 13 and to which may be connected a number of conductor terminals 15. The terminals 15 may be connected to the supporting base and resistance element (as shown in Fig. 1) by means of ears or tabs 16 which are clamped over into engagement with the resistance element. An actuating arm 19 is firmly secured to a reduced end of the shaft 11. The actuating arm 19 is connected in driving engagement with a contact arm 21 which in turn engages a contactor 22. The contactor 22 is in sliding or wiping engagement with the resistance element 23, and is moved over the resistance by means of the contact arm 21. The coupling connection between the contact arm 21 and the contactor 22 is preferably of the universal or self-adjusting type as more particularly set forth in Letters Patent No. 1,920,217, issued August 1, 1933 to Newton C. Schellenger. The contact arm 21 is maintained in engagement with the contactor 22 by means of the spring 20 and by its own spring action. The current passing from the resistance element 23 to the contactor 22 and contact arm 21 is conducted to the terminal 15' by means of the fixed collector ring 24. Obviously, the terminal 15' must be insulated from the resistance element and is connected to the supporting base and collector ring only.

For further details of this particular variable resistance device and the mechanical arrangement of its various parts, reference is made to my co-pending application Serial No. 711,644, filed February 17, 1934.

The present invention is not confined to the use of the particular variable resistance device above referred to but may clearly be incorporated in any carbonaceous type variable resistance device.

The resistance element may comprise a layer or coating of suitable carbonaceous material, such as air-floated graphite with a binding medium, applied directly to the supporting base or it may comprise such a coating applied to a thin insulating support such as paper, which coated insulating support is fixed on the supporting base.

As shown in Fig. 2 the supporting base 13 is provided with a number of cuts or grooves 27. This supporting base is also provided with a plurality of very small indentations or craters 28 (see the magnified view, Fig. 8). These cuts or grooves 27 and indentations 28 may be formed in the base 13 prior to the application of the carbonaceous resistance material. The cuts 27 are formed on the base for the purpose of making a more positive and uniform contact of the conducting terminal ears 16 with the resistance. The cuts 27 are substantially filled with the resistance material whereby a good low resistance contact is made with the terminals. Instead of grooves or cuts, the indentations 27 may have any de-

sired shape or configuration so that a material amount of carbonaceous material may be brought into contact with the ears 16.

The indentations or craters 28 on the other hand are not filled with the carbonaceous resistance material as are cuts 27, but have a substantially uniform depth of coating over the entire surface thereof (see Fig. 7), whereby very distinct depressions, craters or crevices are provided in the surface of the resistance element. These depressions are provided for the purpose of catching or trapping the minute particles of carbonaceous material which are dislodged by the wiping action of the contactor on the resistance element. The depressions may be of comparatively small size, for example, the size of pin holes or pin scratches, to successfully carry out the purpose for which they are designed. On the other hand, they may be of comparatively large size, for example, craters up to one sixteenth inch in diameter, without materially interfering with the operation of the variable resistance device. It is also possible to use cuts or grooves 28a, 28b, or 28c (see Fig. 4) in place of the indentations or craters 28. Such cuts or grooves may be straight as designated by 28a, arcuate such as 28b, or undulated as 28c and may have a depth and width from the size of pin scratches up to one thirty second inch. The size of the depressions must not be so large as to destroy the smooth resistance gradient of the resistance element and cause distinct steps in the resistance to the flow of electric current. Furthermore, when the depressions are of considerable size it is preferable that the cuts or grooves be arranged at an oblique angle to the path of movement of the contactor.

It is especially desirable that depressions are provided approximately at the boundary or line of junction between sections of the resistance element having different unitary resistances. In Fig. 2, 23a designates lightly coated high unitary resistance sections of the resistance element whereas 23b designates a heavily coated low resistance section. The approximate boundary between these sections should have one or more of the depressions or cuts 28, 28a, 28b or 28c to prevent particles of carbonaceous material from being wiped from the low resistance section 23b to the high resistance section 23a.

The rough or uneven surface of the resistance element as shown in Fig. 2 may be produced in a number of different ways. Perhaps the simplest and most economical manner of producing the same consists in the particular way in which the carbonaceous material is applied to the supporting base. The graphite, or other suitable carbonaceous material, is first preferably mixed with a liquid binding material, for example, cellulose lacquer. The specific resistance of the carbonaceous mixture can be governed largely by the proportion of the graphite to the binding material in the mixture. The resistance per unit area of the resistance element is governed by the specific resistance of the carbonaceous mixture and the thickness of the coating. The first coating to be applied to the supporting base is preferably made with a very high specific resistance or with a layer of insulating material. This coating may be applied with a spray gun so as to leave droplets on the supporting base or by applying the mixture with a brush by stippling the surface, or any other manner of application whereby a comparatively rough or uneven surface is produced. This rough surface

may vary from an egg-shell finish to decided indentations in the surface.

I have found that when the supporting base is to be sprayed, a desirable coating may be produced by positioning the spray gun a greater distance from the base to be sprayed than would be the case if a smooth, even surface were desired.

Another method whereby the desired roughness may be produced at the surface of the resistance element is by first subjecting the supporting base to a roughening operation such as by forcing the same against a correspondingly roughened roll or die, or by subjecting the base to a sand-blasting or scratch-brushing operation.

After the desired roughness has been produced on the surface of the supporting base, the carbonaceous material will be applied thereto with a substantially uniform thickness, at any particular section, although different sections may have thicker coatings or a different number of coatings so as to produce the desired resistance gradients.

In the drawings, Fig. 6 illustrates in greatly magnified section a resistance element 23 upon supporting base 13 and to which first a roughening layer 25 of high resistance or insulating material has been secured on top of which layer a further layer 26 of resistance material has been applied. Fig. 7 illustrates in similarly magnified section a combination resistance element and supporting base which has first been subjected to a mechanical roughening operation and a layer 26 of resistance material applied to the roughened surface.

The highly magnified plan view shown by Fig. 8 illustrates the rough uneven surface such as would be produced by sand-blasting or other mechanical roughening means over which the carbonaceous material has been applied. The craters 28 are adapted to catch the fine particles of carbon to prevent their being brushed over onto the other sections of the resistance element. The same effect can be produced by spraying or otherwise coating the supporting base 13 with a high resistance or insulating material so as to form droplets thereon. Then the droplets could be designated by 28 and the depressions or crevices between droplets would be adapted to catch the carbon particles practically as efficiently as the craters 28.

The resistance element 23 may comprise carbonaceous material applied to a suitable strip of insulating material 14 as disclosed with reference to Fig. 1 or it may comprise the same applied directly to the supporting base 13 as shown in Fig. 3 and in which the supporting base is provided with cuts or grooves 27 so as to make a more positive and uniform contact with the terminal ears 16.

The supporting strip may be provided with cuts or grooves instead of small crater-like depressions 28 (see Fig. 4). These cuts or grooves may have the form of straight cuts 28a, curved cuts 28b or undulated cuts 28c. These cuts are shown as being made at an angle to radii of the supporting base but may be made to coincide with the radii if they are of sufficiently small size to prevent interference with the movement of the contactor on the resistance element.

The contact terminals 15 may be secured to the resistance element 23 by means of rivets 29 or other similar fastening means. The rivet head in such construction is preferably countersunk into the base to present an even surface with the

resistance element. The countersunk portion is provided with grooves or cuts 27b in the same manner as above described with reference to the terminal ears 16 in order to form a more positive uniform contact with the rivet heads.

It is to be understood the specific method and construction of the invention illustrated and specifically described may be varied and modified in many details of its construction and variations in the steps of the method without departing from the spirit of the invention, and that the invention is to be limited only as set forth by the terms of the appended claims.

I claim:

1. In a variable resistance device, a resistance element comprising a supporting base having indentations therein and a layer of hard carbonaceous material on said supporting base, said carbonaceous material substantially filling some of said indentations and covering the surface in between said indentations, and current conducting elements connected to said layer at said filled indentations.

2. In a variable resistance device, a supporting base, the surface of said supporting base having a plurality of grooved depressions therein extending transversely thereof, a layer of carbonaceous resistance material having high and low resistance sections on the grooved surface of said supporting base, said resistance material covering both the grooves and surfaces intermediate the grooves, and a contactor slidably engageable with said layer of carbonaceous material to vary the effective resistance thereof.

3. In a variable resistance device, a supporting base, the surface of said supporting base having a plurality of crater-like depressions therein, a thin layer of carbonaceous resistance material on said surface, and a contactor slidably engageable with said layer of carbonaceous material to vary the effective resistance thereof.

4. A resistance element comprising a supporting base, a rough uneven layer of high resistance material on said supporting base, and a layer of substantially uniform thickness of carbonaceous resistance material on said rough uneven layer.

5. The method of making a resistance element which comprises the steps of applying a rough uneven coating of high resistance material on a substantially planar supporting base, and applying a coating of substantially uniform thickness of carbonaceous resistance material on said rough uneven coating.

6. The method of making a resistance element which comprises the steps of forming a plurality of indentations in the surface of supporting base, and applying a layer of substantially uniform thickness of hard carbonaceous resistance material on said indented surface covering the indentations and the intermediate surface.

7. The method of making a resistance element for variable resistances which comprises the steps of sand-blasting the surface of a supporting base, and applying a layer of substantially uniform thickness of carbonaceous resistance material on said sand-blasted surface to produce a roughened resistance surface.

8. The method of making a resistance element for variable resistances which comprises the steps of forming a rough uneven surface on a supporting base, and applying layers of substantially uniform thickness of hard carbonaceous resistance material in high and low resistance sec-

tions on said rough uneven surface to produce a roughened resistance surface.

9. The method of making a resistance element for variable resistances which comprises the steps of spraying a supporting base with a high resistance material to form a rough uneven surface

thereon, and spraying said uneven surface with a carbonaceous resistance material to form a coating of such material of substantially uniform thickness thereon.

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