June 8, 1948. M. J. ARVIN ET AL 2,443,018

VARIABLE RESISTANCE DEVICE

Filed Sept. 5, 1946

Fig. 1

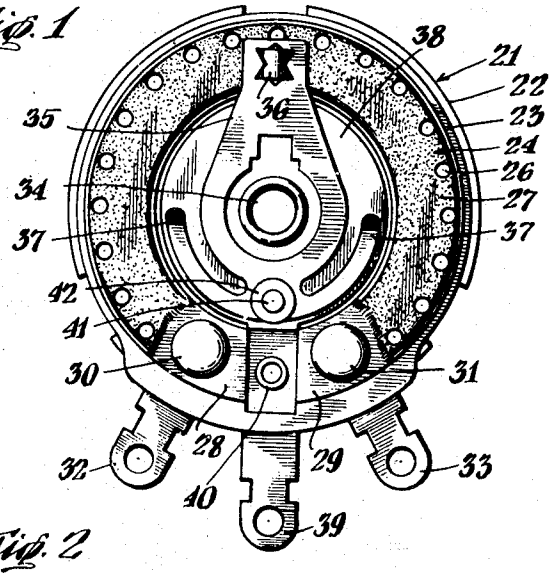


Fig. 2

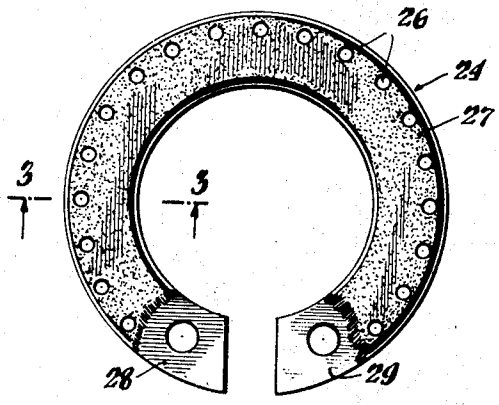


Fig. 3

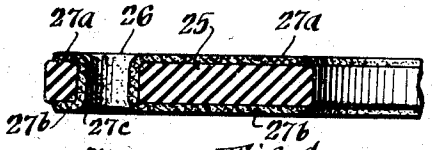


Fig. 4

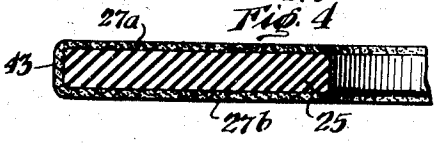
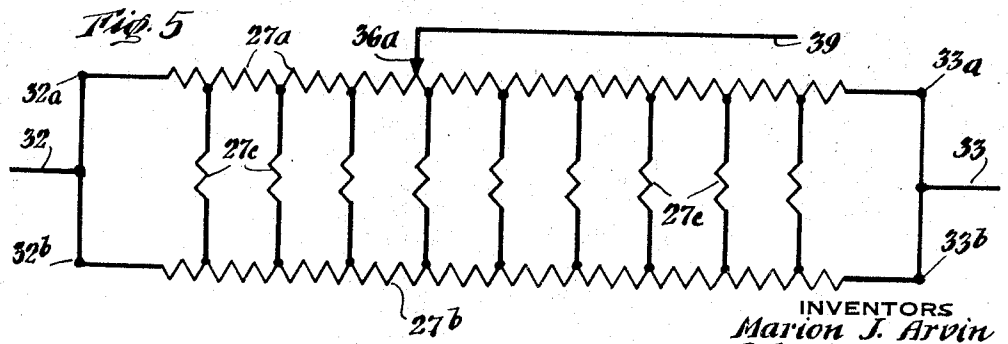


Fig. 5



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VARIABLE RESISTANCE DEVICE

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5 Claims. (Cl. 201—55)

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This invention relates to variable resistance devices and more particularly to variable resistance elements comprising layers of resistance material on a supporting base.

An object of the invention is to improve variable resistance devices.

Another object is to improve a resistance element for variable resistance devices and the arrangement of the resistance composition on such element.

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

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

In the drawing:

Figure 1 is a face view of a variable resistance device with the cover thereof removed;

Figure 2 is a face view of the resistance element for said variable resistance device;

Figure 3 is an enlarged sectional view of the resistance element taken on line 3—3 of Figure 2;

Figure 4 is an enlarged sectional view of an alternative form of resistance element; and

Figure 5 is a schematic representation of the equivalent electrical circuit of the resistance element shown in Figures 1 to 3.

Variable resistance devices have been made heretofore having a resistance element comprising a disk or ring of insulating material which is coated with a layer of resistance material such as carbon paint. Such a coating, which is usually made up of finely divided or comminuted carbon suspended in a suitable vehicle, has a high specific resistance which limits the effective range of rheostats, potentiometers, and the like, to high resistance values. Where lower resistance ranges are desired, the conventional coated or sprayed carbon paint resistance element has proven deficient. Various alternative expedients have been attempted whereby the carbon paint has been applied in varying strip widths upon the insulating base, or has been mixed with varying amounts of material of higher conductivity. These attempts have not been successful due to the lack of uniformity of the resistance elements. In addition, resistance elements of this type have been quite troublesome and expensive to produce.

The present invention provides a variable resistance device comprising a resistance element of novel and improved character which has low resistance characteristics and which is simple and inexpensive to produce. The essential feature of the invention is to provide a plurality of parallel-connected carbon deposits upon a suitable insulative base. In the preferred embodiment of the invention, this is accomplished by painting, spraying, or otherwise applying a coating of carbon-bearing resistance material to both faces of a disk or ring-shaped insulative base. A series of small apertures is arranged in the base, the inner surfaces of said apertures being likewise coated with the resistance material providing electrical connection between a plurality of points of the two resistive coatings, so that the said coatings are effectively connected in parallel. A sliding contact may be arranged for cooperation with one of the said resistive coatings, preferably in an imperforate region thereof.

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As a modification of the invention, the insulative base may be provided with a deposit of resistive material on both faces thereof, the said deposits being parallel-connected with each other by extending the deposits over the edge of the base.

Referring to the drawing, a variable resistance device is illustrated in Figure 1 embodying a resistance element made according to the present invention. The variable resistance 21 comprises a base formed of two superimposed disks 22 and 23 of insulation, such as fibre impregnated with a synthetic resin. Disks 22 and 23 each have suitable cut-out portions to accommodate other parts of the resistor structure.

The resistance element of the device, namely ring 24, is mounted against the face of disk 23. Figure 2 shows a face view of the resistance element which is preferably formed of an insulative base 25 through which there has been punched a series of holes 26, arranged in a circular line concentric with the periphery of said ring. Both sides of base 25 as well as the inside surfaces of holes 26 are coated with a layer of resistance paint 27, such as graphite, carbon particles or the like in a binder, such as shellac. The composition of the resistance paint and the thickness of the coating is so controlled as to provide the desired range of resistance characteristics. Figure 3 is an enlarged sectional view taken on line 3—3 of Figure 2 showing in detail the resistance paint coating 27 on both faces of insulative base 25 and on the inside surfaces of holes 26, the top coating being denoted by reference numeral 27a, the bottom

coating by reference numeral 27b, and the coating inside the holes by reference numeral 27c.

After the resistance elements are properly coated, they are assembled into resistance devices of the type illustrated in Figure 1. The element may also preferably be provided with a pair of conductive terminals 28 and 29 at the two ends of the resistance layer and in electrical contact with the same. Terminals 28 and 29 may be of conductive paint, such as silver particles in a shellac binder.

Terminal bolts 30 and 31 pass through ring 24 and base disk 23 and are in electrical contact with terminal coatings 28 and 29, respectively. Terminal lugs 32 and 33 are secured by bolts 30 and 31, respectively, underneath disk 23 and project out beyond the base to provide for external circuit connections to the two ends of the resistance element.

The variable contactor structure comprises a shaft 34, a contact arm 35 secured to and rotating about said shaft on the face side of the resistance device, a sliding contactor 36 mounted on the end of said arm and adapted to slide on the resistance surface 27 on ring 24, and sliding contact fingers 37 integral with said arm and adapted to slide on contact ring 38. Contact ring 38 has a terminal lug 39 integrally formed therewith and is held in place by a rivet or eyelet 40 which clamps disk 22 and lug 39 together. Sliding contactor 36 is positioned so that its arcuate path does not touch any part of the holes 26.

In operation, the terminal lugs 32, 33 and 39 are connected into an external circuit in any desired manner. By turning shaft 34 with a knob or other control means, sliding contactor 36 will slide on the exposed face of resistance surface 27 in a circular path. Thus, the length of the resistance path, and consequently the magnitude of the resistances on the resistance element 24 in parallel with terminal lugs 32 and 39 or 33 and 39 may be varied. Conductive coating 28 extends out a sufficient distance from terminal bolt 30 so that contactor 36 may ride up onto it as it approaches the terminal, thereby reducing the initial resistance to a negligible value. This enables the turning of arm 35 for a few degrees at the end of the stroke to allow for a switch to be operated by projection 41 on pin 42, if desired, without varying the resistance. The contact arm may be turned until it comes into direct contact with the bolt 30 connected to lug 32, thereby reducing the resistance to substantially zero.

The distinctive feature of the present invention involves providing a resistance element which may be made in relatively low resistance values but occupies no more space than the conventional resistance elements which have been coated only on one side. By coating both sides of the insulative base with a carbonaceous resistance paint and arranging for a series of parallel connections at regular intervals between the terminals of the resistance element, it is now possible to obtain low resistance values simply and inexpensively.

Figure 5 is a schematic representation of the equivalent electrical circuit of a variable resistance device embodying the principles of the present invention. Reference numeral 27a denotes the coating or deposit of resistance material on the top face of the resistance element, while numeral 27b denotes the restrictive deposit on the bottom face of said element. Resistive deposits 27a and 27b are electrically connected with each other at a plurality of closely spaced points by conductive paths 27c of relatively low resistance which represent the resistive material on the inner surface of holes 26. The ends of resistive deposits 27a, 32a and 33a, are respectively connected to the ends of deposit 27b, 32b and 33b, and to terminals 32 and 33, respectively, of the variable resistance device shown in Figure 1. Contact point 36a corresponds to contactor 36 of Figure 1 and is electrically connected to terminal 39. It will be readily understood that in accordance with well-known fundamental laws of electricity, the use of two equal parallel resistances 27a and 27b, in place of a single resistance, reduces the total resistance by substantialy one half. This is true with a fair degree of approximation in view of the relatively low resistance values of paths 27c with respect to the values of paths 27a and 27b. Thus, the principles of the present invention make it possible to provide heretofore unobtainable low resistance values in variable resistance devices of the carbon type.

Figure 4 illustrates an alternative form of construction of the resistance element of the invention. It will be noted that in this construction the two carbon deposits 27a and 27b on the top and bottom faces of base 25, respectively, are electrically connected in parallel by extending the said deposits over one of the circumferential edges of base 25, this connection being shown at 43. Of course, in this case, it is not necessary to provide spaced openings or holes in the base which are coated with the resistance material. In view of the similarity of construction, the operation of this modified construction will be readily understood without further description.

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. In a variable resistance device, a resistance element comprising an insulative base, a series of small holes spacedly arranged along a curved line on said insulative base, resistance material layers coating both sides of said insulative base, and resistance material on the inside surface of said holes providing parallel electrical connection between said resistance layers whereby low resistance values are obtained.

2. In a variable resistance device, a resistance element comprising an insulative base, a series of small holes spacedly arranged along a curved line on said insulative base, and carbonaceous resistance material layers coating both sides of said insulative base and the inner surface of said holes in such a manner as to provide electrical connection between the resistance material layers on both sides of said insulative base whereby low resistance values are obtained.

3. A resistance element for variable resistance devices of the type utilizing a moving contactor engaging the resistance surface, said element comprising an insulative base, a series of small holes spacedly arranged along an arcuate line outside the path of a moving contactor on said insulative base, carbonaceous resistance material layers coating both sides of said insulative base, and carbonaceous resistance material coating the inside surfaces of said holes in such a manner as to provide parallel electrical connection between said resistance layers whereby low resistance values are obtained.

4. A variable resistance device comprising an insulative base, a series of small holes spacedly

arranged in a curved line on said insulative base, carbonaceous resistance material layers coating both sides of said insulative base, carbonaceous resistance material coating the inside surface of said small holes providing parallel electrical connection between said resistance layers, and a moving contactor adapted to slidably engage one of said resistance layers.

5. A variable resistance device comprising an insulative base, a series of small holes spacedly arranged in a circular line on said insulative base, carbonaceous resistance material layers coating both sides of said insulative base, carbonaceous resistance material coating the inside surface of said holes providing parallel electrical connection between said resistance layers, and a

moving contactor adapted to slidably engage one of said resistance layers in an imperforate arcuate region thereof.

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