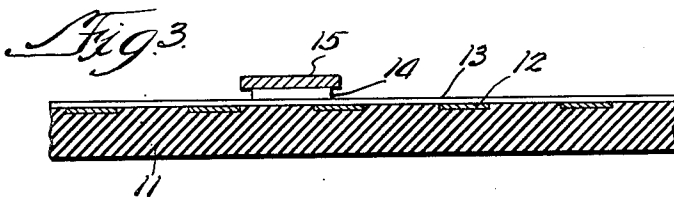
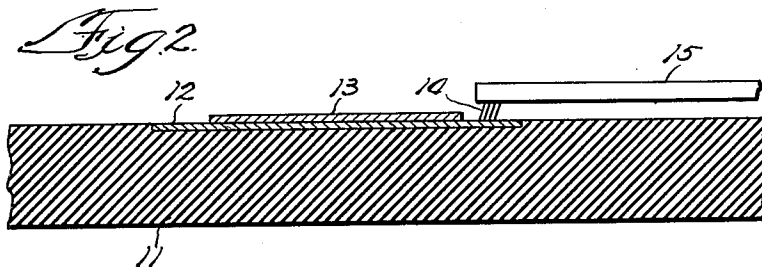
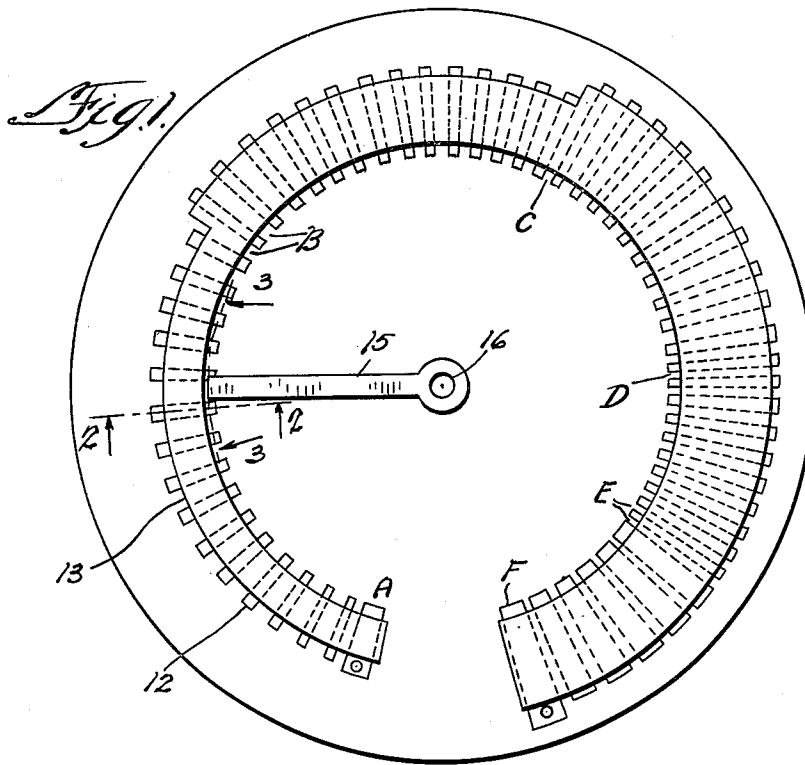


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N. PRITIKIN ET AL
VARIABLE RESISTANCE ELEMENT

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VARIABLE RESISTANCE ELEMENT

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8 Claims. (Cl. 201—48)

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This invention relates to a variable resistance element and in particular to a variable resistance element for use as a rheostat or as a potentiometer. It is an object of the invention to provide an improved resistance element of that character.

According to one embodiment of the invention a substantially circular resistance path and a pivoted movable contact are employed. A sheet of insulating material serves as a base and a plurality of spaced conductors traverse the resistance path. These conductors are embedded in the insulating sheet and are flush with one surface of the sheet. The resistance element itself comprises a thin layer or film of carbon or other resistance material laid in an arcuate path over the major portion of the length of each conductor. One end of each conductor, preferably the radially inner end, is left bare for cooperating with the movable contact.

Various advantages arise from this construction. Since the conductors are flush with the surface of the base sheet, a smooth even surface is available upon which the resistance element may be deposited or laid. This is particularly advantageous where graphite or other forms of carbon in combination with a suitable binder are employed as the resistance element since a carbon film laid over a smooth surface is much more durable than one which is made to bridge over an irregular surface. Also, since the end portions of the conductors which are used as stationary contacts are flush with the surface of the base, a continuous smooth surface is available over which the movable contact may ride. Physical resistance to movement of the movable contact is thereby minimized. The conductors carry the current across the width of the resistance strip with practically negligible resistance, whereby the entire width of the resistance strip is employed for carrying current over the entire selected length thereof. This results in a stable and readily predetermined resistance per unit length of the resistance path. Also, erosion of the resistance material and a source of noise are eliminated by the avoidance of direct contact between the movable contact and the resistance strip.

Still another advantage lies in the fact that the resistance path can readily be made non-linear, in accordance with some predetermined plan, by varying the width of the resistor strip, by varying the spacing of the transversely extending conductors, and by varying the width of the conductors.

Accordingly, it is another object of the inven-

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tion to provide an improved variable resistor in which mechanical resistance to movement of the movable contact is minimized.

It is another object of the invention to provide an improved variable resistor in which the entire width of the resistance element is employed for carrying current over the entire selected length thereof.

It is another object of the invention to provide an improved variable resistor whose construction is well adapted to provide preselected non-linear resistance characteristics.

It is another object of the invention to provide an improved rheostat or potentiometer having the desirable characteristics mentioned above while being simple, reliable, durable, and economical to manufacture.

This invention, together with further objects and advantages thereof, will best be understood by reference to the following description taken in combination with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing in which like parts are designated by like reference numerals,

Fig. 1 is a plan view of a rheostat or potentiometer constructed in accordance with the invention;

Fig. 2 is an enlarged cross-sectional view of the same apparatus taken along the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged developed cross-sectional view of the same apparatus taken along the line 3—3 of Fig. 1.

The variable resistance shown in the drawing includes a base 11 of suitable insulating material such as a thermosetting plastic. A plurality of conductors 12 are embedded in the base in spaced relationship to define a path, with each conductor being substantially parallel to adjacent conductors as is clearly seen in Fig. 1. The conductors 12 are set into the base 11 in such manner that the upper surfaces of the conductors and the base are flush, as seen in Figs. 2 and 3.

The conductors may be inset in the base by any suitable method and accordingly such method will not be described in detail herein. Preferably, the method employed is that disclosed and claimed in another application by the same inventors, Serial No. 189,850, filed October 12, 1950, and entitled Metallic Element Embedding Process and Product. The conductors may be bars of metal or other conducting material and may be of substantial thickness or may be formed of very thin metal foil, for example.

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In the preferred embodiment a resistance strip 13 of carbon is provided, the carbon being applied by spraying or by other suitable means in the form of carbon particles mixed with a suitable binder such as ethyl cellulose and a compatible solvent such as lacquer thinner. The resistance strip or film may, however, be of other suitable resistance material such as metal foil or metallic salts. The resistance strip is laid over a portion of each conductor 12 and makes electrical contact therewith, the smooth flush surface provided by the inseting of the conductors in the base 11 permitting a uniform application of the film or strip. This is advantageous since the film tends to bridge over any irregularities on the surface to which it is applied with the result that the film is unsupported and hence easily broken at such points, especially where the carbon film is used. The smooth surface provided in the preferred embodiment shown in the drawing simplifies the application of the resistance film and results in a film of maximum strength and durability.

At each end of the resistance strip there is an enlarged conductor electrically connected to terminals A and E. These terminals may, for example, be in the form of binding posts, secured to the base 11 by any suitable means, not shown in the drawing.

In the particular embodiment of the invention shown the resistance film is varied in width at two points B and C along its length. It will be apparent that by such means a resistance may be obtained having any reasonable form and degree of non-linearity.

The inner ends of the conductors 12 extend beyond the inner edge of the resistance film whereby they are exposed and may serve as stationary contacts. A movable contact 14 is carried by a rotatable arm 15 pivoted near the center of the rheostat or potentiometer on a shaft 16. A bearing and some form of control are provided, but these are not shown in the drawing since they may be of any suitable form, many of which are well known in the art.

The movable contact 14 may be of any desired form and is shown in the drawing as being made up of a series of copper sheets, this form of contact being well known in the art. As the pivoted arm 15 rotates about the shaft 16, the contact 14 successively engages the inner ends of the conductors 12 and is successively connected thereby to corresponding points along the length of the resistance film 13.

In the particular embodiment disclosed, the conductors 12 are of equal width and evenly spaced from the terminal A to the point D. Over this length of the resistance path the resistance is linear with the exception of the non-linear characteristic introduced by the variation in the width of the carbon path at the points B and C, previously mentioned. However, between the points D and E on the resistance path the conductors, while they continue to be of the same width, are more closely spaced. The conductors contact and hence substantially short-circuit the resistance film over the width of each conductor, and, accordingly, it is apparent that the resistance per unit length of the resistance path is less between the points D and E, where the conductors are closely spaced, than it is between the points C and D, where relatively wide conductor spacing is employed.

A still lower value of resistance per unit length is obtained between the point E and the termi-

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nal F by virtue of the fact that the conductors between these points are made wider while the close spacing of the conductors, employed between the points D and E, is also employed between E and F.

A rheostat or potentiometer constructed in accordance with the invention permits the use of a thin film of resistance material of uniform thickness, this film being readily applied and of maximum strength since it is laid upon a smooth surface. The width of the resistance film or strip may readily be varied to produce any reasonable non-linear characteristic. A smooth even path is provided for the movable contact with the result that minimum mechanical resistance to the movement thereof is obtained. Also, a very substantial cause of noise and of erosion of the resistance material are eliminated by virtue of the fact that the movable contact does not slide over the resistance element itself but, instead, engages the ends of the conductors.

A non-linear characteristic of the resistance path is readily obtained also by varying the relative spacing or width of the conductors. Finally, the entire width of the resistance film is employed to carry current over the entire selected length of the path whereby the resistance between each pair of conductors may readily be predetermined.

The resistance path need not be circular as in the embodiment shown but may be of any desired form. It may, for example, be arranged in a straight line, a sliding rather than a rotating contact being provided. Similarly, the base need not be flat but may be cylindrical or of any other desired contour. Preferably, however, the surface is smooth and even in order that the resistance material may be applied easily and may be of uniform thickness and solidly supported.

In the preferred embodiment of the invention the conductors 12 are narrow strips of a thin metal foil. It is to be understood, however, that other forms may be suitable and the scope of the invention is not limited to any particular nature of the conductors or method of arranging them flush with the surface of the base.

While a particular embodiment of the invention has been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made, and it is, therefore, contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

The invention having thus been described, what is claimed and desired to be secured by Letters Patent is:

1. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base and flush with one surface thereof, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element extending along said path and overlying and contacting a portion of each of said conductors, and a contact, movable with respect to said base, for successively engaging other portions of each of said conductors.

2. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base and flush with one surface thereof, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element comprising carbon particles and a binder extending

along said path and overlying and adhering to said base and to a portion of each of said conductors, and a contact, movable with respect to said base, for successively engaging other portions of each of said conductors.

3. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base and flush with one surface thereof, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element overlying and contacting a portion of each of said conductors, and a contact movable with respect to said base for successively engaging an exposed portion of each of said conductors.

4. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base, each of said conductors having a flat surface flush with one surface of said base, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element overlying and contacting a portion of each of said conductors, and a movable contact for successively engaging an exposed portion of each of said conductors.

5. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base, each of said conductors having a flat surface flush with one surface of said base, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element comprising carbon particles and a binder overlying and adhering to said base and to a portion of each of said conductors, and a movable contact for successively engaging an exposed portion of each of said conductors.

6. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base, each of said conductors having a flat surface flush with one surface of said base, said conductors being spaced apart and arranged to define a path extending substantially transversely of said conductors, a resistance element overlying a portion of each of said conductors and contacting said

conductors over the entire width of said resistance element, and a movable contact for successively engaging an exposed portion of each of said conductors.

7. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base, each of said conductors having a flat surface flush with one surface of said base, said conductors being spaced apart and arranged to form a path extending substantially transversely of said conductors, a resistance element overlying and contacting a portion of each of said conductors, and a movable contact for successively engaging an exposed portion of each of said conductors, said conductors being unequally spaced in accordance with a predetermined schedule whereby said resistor is made non-linear.

8. A variable resistor comprising an insulating base, a plurality of conductors embedded in said base, each of said conductors having a flat surface flush with one surface of said base, said conductors being spaced apart and arranged to form a path extending substantially transversely of said conductors, a resistance element overlying and contacting a portion of each of said conductors, and a movable contact for successively engaging an exposed portion of each of said conductors, said conductors being of unequal width and arranged in accordance with a predetermined schedule whereby said resistor is made non-linear.

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HAROLD WEINSTEIN.

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