May 24, 1938. W. DEUTSCHMANN 2,118,072

POTENTIOMETER

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Fig. 1

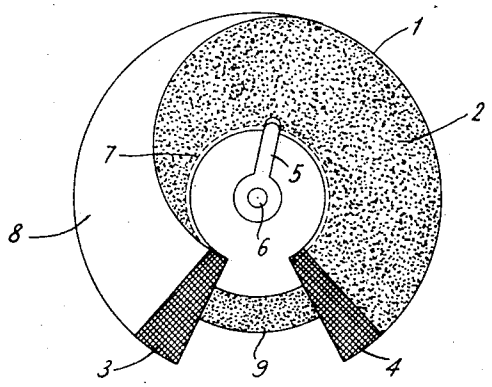
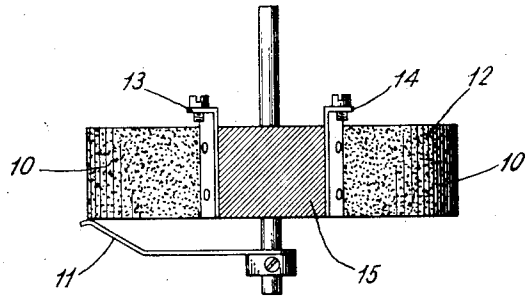


Fig. 2



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POTENTIOMETER

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3 Claims. (Cl. 201—55)

Potentiometers are in extensive use in broadcast receiver apparatus and other means used in intelligence transmission and in other fields of the electrotechnical engineering arts. These potentiometers are either furnished with a resistance wire winding or else they are furnished with a poorly conducting layer or coating on an insulating support acting as a resistance. The said layer or coating may consist of varnish to which, by the incorporation therein of soot or graphite, is imparted a certain amount of conductivity. In the majority of cases such coats involve a certain surface or area, and they may be applied upon the insulating support either by means of cathode disintegration or by some other process. The supports consist often of circular disks or cylindrical pieces which are unilaterally coated with the layer of resistor material. These circular or annular disks are not closed completely, in fact, they have a cone-shaped recess or slot (gap). At the two ends of the incomplete annular dish are fitted the terminals or electrodes for the resistance coating. These terminals may be made, for instance, by the provision of narrow strips consisting of highly conducting material fixed upon the support.

In making potentiometers with a layer of resistance material having low conductivity difficulties arise whenever a comparatively low aggregate resistance is to be obtained. In this case, as will be understood, the thickness or depth of the layer must be made comparatively heavy, and this frequently involves the risk of scaling or breaking off of the layer from the support. On the other hand, the conducting power of the varnish solution may be improved by raising the soot or graphite content of the same. Varnishes containing high proportions of soot, however, exhibit also this drawback that in burning-in upon the insulating supporter body, fissures and scaling off may be caused.

Another shortcoming of potentiometers comprising a poorly conducting resistance coat or layer resides in the fact that the desired resistance value is obtainable only with coarse approximation seeing that both the thickness of the layer as well as the conductivity of the layer vary within wide limits. A remedy consists in that the terminals or connecting electrodes are made more or less wide so that the resistance layer is touched at the ends over lengths of varying size. This, however, involves the disadvantage that in individual potentiometers of a production series the resistance characteristics may vary very widely. As a matter of fact, the said remedial step is not useful at all whenever a definite resistance shape differing greatly from linearity, say, a roughly logarithmic characteristic is required. Such a form is obtained by applying pieces of increased conducting power upon the insulating support whereby the resistance layer is partly limited in size, and which, for instance, are of conical shape, or else by varying the thickness or the breadth of the layer. In the case of potentiometers presenting a resistance curve adjusted in a way as hereinbefore indicated, the resistance characteristic was considerably altered whenever for the adjustment of the aggregate resistance, the width or area of the contact between the terminals or connecting electrodes and the resistor layer was to be varied.

Now, according to the present invention the said difficulties in potentiometers with a poor-conductor layer applied upon an insulating support are avoided in that a supporter body consisting of a solid (full) ring is employed which in addition to the resistance layer in contact with the terminal contact, has a further more or less poorly conducting layer between the terminals thereof; in other words, upon the part of the support which heretofore was left uncovered, the said supplementary layer or coating is formed constituting a shunt to the other and serving for balancing or adjusting the potentiometer resistance.

For instance, if a high-ohm potentiometer is to be balanced or adjusted so that it will possess a certain high value, then, in order that the aggregate resistance may not be essentially reduced by such adjustment, the resistance of the shunt will have to be several times higher than that of the layer contacted by the tap or slide. A potentiometer of this kind may be made in this manner that the annular supporter body is completely covered with a resistor layer of uniform thickness and composition. Upon the same the terminals are applied and secured, whereupon adjustment of the potentiometer is effected in this manner that the resistance of the layer between the terminals on the support and which in the past was absent in potentiometers, is increased by scratching or partial removal of the supporting body at this place, or is diminished by covering with a highly conducting substance. It is also possible prior to the application of the low-conductor coat upon the annular supporting body at the place which is later to be covered by the shunt to effect a reduction in cross-section of the support in order to thus make conditions so that the cross-section of the poorly conducting layer which constitutes the shunt will turn out to be essentially less than the layer covered by the slider or tap. The resistance value of the shunt is thus raised several times compared with the potentiometer resistance properly so-called. In case it has not yet reached the requisite value it may be still further altered on balancing or adjusting the potentiometer by scraping or scratching as previously pointed out.

In potentiometers which are to have a low

aggregate resistance, the resistance layer over which the contactor moves may be made thin so as to have a high resistance which corresponds to that of high-ohm potentiometers. When burning-in scaling will thus be avoided. The low ohmic resistance of the potentiometer is obtained by giving the shunt a resistance value which amounts to only a fraction of that of the area or layer engaged by the contact arm. With this end in view, on the portion of the resistance layer which is provided upon the annular support for the shunt there is applied a coating consisting of a substance having a higher conductivity. On the other hand, also at this place the conductivity of the resistance layer may be essentially different, in other words, in the present instance, be higher than in the portions which are engaged by the contact.

The present invention will be explained in more detail in connection with the accompanying drawing in which,

Fig. 1 is a rear view of a rheostat embodying the invention and,

Fig. 2 is a front view of a rheostat embodying a modified form of the invention. In the case of the potentiometer as shown in Fig. 1, an annular disk 1 made of press-spahn or fuller's board, bakelized hard paper or the like serves as a support for the low-conducting resistance layer 2. The connections or terminals therefor consist of highly conducting coats 3 and 4 whereas the contact or slide consists, for instance, of a slide spring 5 which is secured on a spindle 6 and which contacts the resistance layer along the broken line 7. However, it is also possible to use any other contact arrangement. 8 designates a highly conducting layer, which is also applied upon the insulating support and which is in contact with the poor-conductor resistance layer, as shown in Fig. 1, along a considerable area. By this auxiliary means it is possible to change at will the resistance characteristic according to the shape of the contact line between the layer 2 possessing poor conducting power and the one having high conductivity. The shunt provided between terminals 3 and 4 for balancing or adjusting the potentiometer resistance is indicated at 9, and the same consists of a layer having just as low a conductivity as that of the potentiometer proper and which is designated in Fig. 1 by 2. Whenever high-ohm potentiometers are involved, the resistance of the same is substantially higher than that of the layer 2, a fact which follows alone from the circumstance, shown in Fig. 1, that the area covered thereby upon the supporting body is very narrow. On the other hand, the resistance thereof is made very low whenever the potentiometer is to have a low-ohm rating. In this instance upon the portion of the insulating support intended for the shunt 9 a layer having a higher conductivity than layer 2 is provided.

As previously pointed out above, the narrow strip covered by the shunt 9 may be made at the time when making the insulating support whereupon the support is completely covered with the poor-conductor layer which already has the thickness it is to have eventually. To equalize or adjust the potentiometer resistance properly so-called, all that is then necessary is that the composition or the thickness of the layer upon the portion 9 should be somewhat altered, say, by scratching or scraping away part of it. On the other hand, it would also be feasible to first furnish a supporting body in the shape of a solid ring with a poor-conductor layer, while subsequently, by punching, stamping or cutting, the narrow strip 9 is worked out of the solid at the place intended for the shunt. In the case of low-ohm potentiometers, as previously mentioned, a coating possessing a higher conductivity is applied upon the said narrow strip 9. If the potentiometer resistance is to be very low, it would also be possible to make a winding consisting of thin resistance wire upon the strip 9 instead of a layer of resistance material.

Fig. 2 shows another embodiment of the potentiometer made according to this invention. The resistance layer 10 which is contacted by the arm or slide 11 is made upon the shell of a cylinder piece 12 made of press-spahn or the like insulation. 13 and 14 form the terminals for the potentiometer. By the shaded area 15 is indicated the part of the cylindrical shell which is intended for the layer which is to form the shunt. In this embodiment of the improved potentiometer of this invention the surface of the support for reduction of the resistance of the shunt has not been diminished, in fact, balancing or adjustment to the rated value is accomplished only in this manner that the resistance layer at this particular point has been made considerably thinner than the layer 10 by scraping away parts of the material. Of course, as in the embodiment of Fig. 1, it would also be feasible to reduce the surface of the support at the place intended for the shunt in order to make the resistance of the shunt greater than that of the layer covered by the contact slider. In low-ohm potentiometers in accordance with the exemplified embodiment first described, a layer having a conductivity higher than that of the layer 10 would be applied upon the surface 15 of the cylinder.

Having described my invention, what I claim as novel and desire to secure by Letters Patent is:

1. A potentiometer comprising the combination of a disc, a coating of low conductivity on one surface of said disc and having the ends thereof separated and a coating on said disc surface having substantially the same unit conductivity as said first coating but of a lesser area connected across said separated ends and a contact arm engaging said first named coating.

2. A potentiometer comprising the combination of a disc, a coating of low unit conductivity on one surface of said disc and having the ends thereof separated, a terminal connected to each end of said coating, and a coating on said disc surface connecting said terminals, said second coating having a specific conductivity substantially higher than that of said first named coating.

3. A potentiometer unit comprising the combination of an annular shaped insulating support, a thin coating of conducting material formed into a curved band extending through an angle of substantially 270 degrees and secured to the surface of said support, a terminal of good conducting material secured to each end of said coating and means for adjusting the resistance between said terminals to a predetermined value comprising a coating of material having low conductivity secured to the surface of said support and connecting said terminals, a recess being formed in said support in the region between said terminals whereby the width of said last named coating is substantially less than the average width of said first named coating.

WALTER DEUTSCHMANN.