Jan. 23, 1934. R. H. LANGLEY 1,944,329

POTENTIOMETER

Filed April 28, 1930

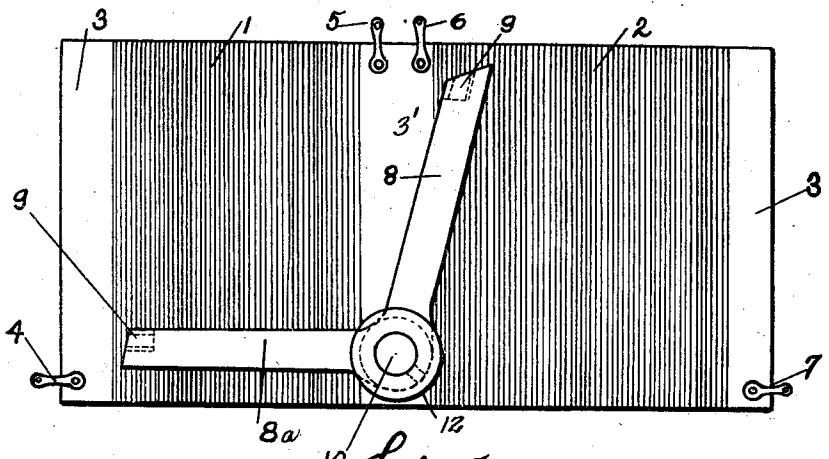


Fig. 1.

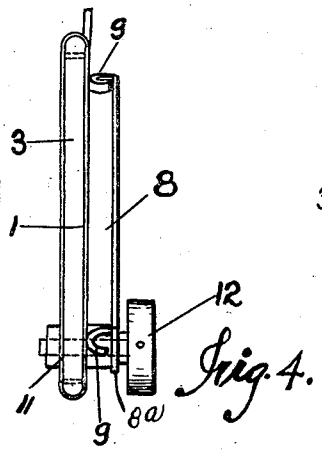


Fig. 4.

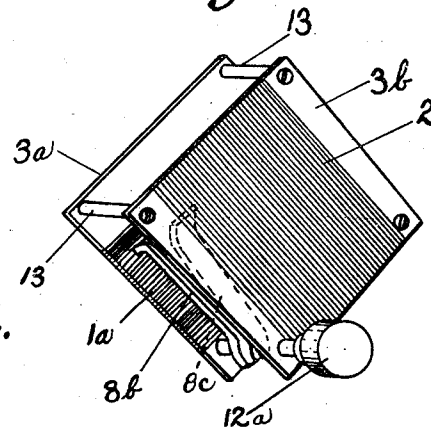


Fig. 2.

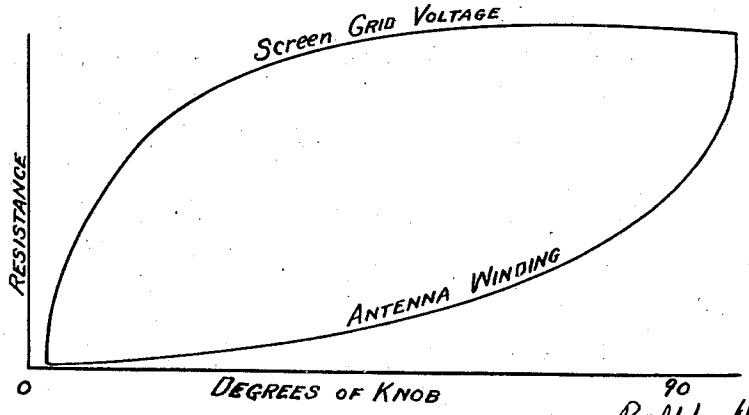


Fig. 3.

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UNITED STATES PATENT OFFICE

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POTENTIOMETER

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Application April 28, 1930. Serial No. 447,816

7 Claims. (Cl. 201—48)

My invention relates to potentiometers, particularly those characterized by a relatively high resistance of the order, say of 10,000 ohms, and in which it is desired that a tapered rather than a linear variation of resistance be produced. Potentiometers of this type are particularly useful for volume controls in radio broadcast receivers of the new screen grid type. It is frequently necessary in such receivers to use a compound potentiometer, for example in cases where it is desired to vary the signal voltage applied to the first tube, and also the potential of the screen grids. It is desirable to use a compound potentiometer having two resistance elements insulated from each other and with sliding contact members connected together and grounded, the resistances so arranged as to produce opposite tapered resistance variations in the two portions of the device. Potentiometers having resistance elements composed of paper coated with graphite or carbon in such a way as produces a non-linear resistance element have been extensively used in the art. They are, however, somewhat difficult to manufacture and, due to the nature of the resistance element itself, they vary considerably in temperature and are seriously affected by climatic conditions. Due to the very high resistance needed in these potentiometers, it has been a matter of great difficulty to make them with wire wound elements rather than with carbon coated elements, and particularly difficult in view of the requirement for non-linear resistance variation. It is an object of my invention to provide a compound potentiometer having resistance elements wound with wire. A second object of my invention is to produce such a compound potentiometer having non-linear resistance variations which may be made either equal or opposite. A further object of my invention is to produce a dependable compound tapered potentiometer which will be independent of climatic conditions and more positive in its action.

These and other objects of my invention which may be pointed out hereinafter or which will be apparent to one who is skilled in the art of reading these specifications, I accomplish by that certain construction and arrangement of parts of which I shall now describe two modifications, it being understood that a number of changes may be made in the exact construction thereof without departing from the spirit of my invention. Reference is made to the drawing which accompanies this specification.

In the drawing:

Figure 1 is an illustration of a compound volume control which comprises two complete potentiometers and in which the potentiometers are arranged side by side.

Figure 2 is another form of compound potentiometer in which the elements are placed one above the other.

Figure 3 is a graph showing the variation of the resistance in the two windings for a given rotation of the control shaft.

Figure 4 is a side elevation of the device of Figure 1.

I provide windings of high resistance wire designated as 1 and 2 upon a card or form of insulating material 3. Windings are separated by a central free space 31 on the form. The form may be as wide as necesasry to accommodate a length of winding sufficient to give the required resistance; but by reason of the type of contact which I use, it is advantageous to provide windings 7 occupying an area very nearly square in shape. The ends of the windings will be brought out to separate terminals 4—5—6—7. Thru the central free portion of the form I pass a shaft 10 which may be journaled in bearings on the form as shown at 11 or otherwise mounted as desired. Fixed on this shaft I provide a contact device comprising arms 8 and 8*a* which are resilient, and which are provided with contact members 9 adapted to slide over the wire in the windings. The shaft may be turned in any way desired as by a knob 12.

The manner in which my device operates as a non-linear resistance element will now be clear. In Figure 1 the arms 8 and 8*a* are shown as lying at an angle with each other somewhat greater than 90°, so that when the contact on the arm 8*a* is at the outer bottom of the resistance element 1 the contact on the arm 8 is at the inner top of the winding 2. As the shaft is rotated in a clock-wise direction, the contact arms will sweep across the windings in an arcuate path. As shown in Figure 1, the device is in the position of minimum resistance between the arm 8*a* and the terminal 4. As the shaft is rotated, the resistance will at first increase very slowly because the contact surface 9 will be moving more nearly parallel to the wire in the winding 1; but as rotation is continued, the contact surface 9 will tend to move more and more across the wires in the windings until in its final travel it is moving nearly at right angles thereto, under which conditions the variation in resistance will be at the maximum. Thus the resistance variation in the left-hand winding is indicated by the lower graph in Figure 3. Similarly during the

same rotation of the shaft the resistance between the arm 8 and the terminal 7 will vary linearly, but the variation will at first be of maximum rapidity and will then become less rapid.

Figure 2 shows how a compound potentiometer may be made with spaced windings 1*a* and 2*a* mounted upon cards 3*a* and 3*b*, held in spaced relation by posts 13. Here the shaft 10*a*, with a knob 12*a* passes thru both cards and is equipped with a contact device having parallel arms 8*b* and 8*c* contacting with windings 1*a* and 2*a*, respectively, which extend substantially at right angles to each other. Here also the characteristic arcuate sweep of the contact arm over the parallel turns in each winding will produce the desired tapered resistance variation. Thus I am able, in a very simple construction, to secure high resistance elements formed of wire which have non-linear variation characteristics.

Various modifications may be made in my invention without departing from the spirit thereof.

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

1. A compound resistance element comprising windings and a support therefor, and contact elements adapted to sweep over said windings in arcuate paths, part of each path being substantially parallel to a respective winding and part transverse to the winding, whereby the resistance is caused to vary non-linearly, said contact elements comprising arms pivoted on said support and connected together with such divergence that when one arm is moving substantially parallel with a winding the other arm will be moving transversely to a winding.

2. In a compound potentiometer, a plurality of substantially flat forms, windings on the respective forms, said forms held in spaced substantially parallel relationship, an operating shaft at a corner of said forms and a contact member mounted on said shaft and arranged to sweep a plurality of said windings at the same time in an arcuate path, one of said windings having its axis disposed at substantially a right angle to the axis of another, whereby in said elements the resistance variation is opposite.

3. A compound resistance device comprising a plurality of sets of elongated resistance elements, each set occupying a substantially rectangular area and elements in each set all extending in the same general direction, and contact elements operatively connected together and pivoted near a corner of each area and extending at an angle to each other and to the respective sets such that, contacting the resistance elements progressively as moved thereover, said contact elements are moved thereover in paths each progressively varying its angle to the lengthwise direction of the contacted resistance elements of the respective set and the variation of angle of each contact element is reverse to that of the other contact element, for the purpose set forth.

4. A compound resistance device comprising a plurality of sets of elongated resistance elements, elements in each set all extending in the same general direction and occupying a substantially rectangular area, the sets being arranged substantially in respective planes which are substantially parallel with a common plane, and contact members operatively connected together, and a single pivotal mounting for said elements near adjacent corners of said areas, said elements swinging on their pivotal mounting over and in contact with the elements of the respective sets in paths progressively varying their angles to the lengthwise direction of the contacted resistance elements of the respective sets, and the variation of angle of each contact element being reverse to that of each other contact element.

5. A compound tapered potentiometer comprising two spaced rectangular strips of insulating material having a resistance wire wound on each in a direction at right angles to the other, a shaft passing through one corner of each strip and perpendicular to the plane thereof, and unitary contact members to contact the respective wires, pivotally carried on said shaft.

6. A compound resistance device comprising at least two windings of resistance wire wound in substantially the form of a flat square, arm contact members pivoted at the corners of the windings and actuated unitarily and being at an angle to each other and to the respective windings such that the moving of one of the members across a respective winding will move another member across another winding and the contact members will define arcuate paths across the respective windings each progressively varying its angle to the respective winding inversely to the variation of angle of another member.

7. A compound resistance device comprising two windings of resistance wire each wound in the form of a flat square on insulative material, a shaft at adjacent corners of the square windings, and a contact member turning on said shaft and comprising two arms projecting over the respective windings and connected together at an angle to each other and to the respective windings such that the arcuate travel of the members will increase the effective resistance of one winding while decreasing the effective resistance of the other winding, for the purpose set forth.

RALPH H. LANGLEY.