Aug. 4, 1959 E. W. DREWITZ ET AL 2,898,567

VARIABLE RESISTOR WITH SHORTED SECTION

Filed Dec. 31, 1957 2 Sheets-Sheet 1

FIG. 1

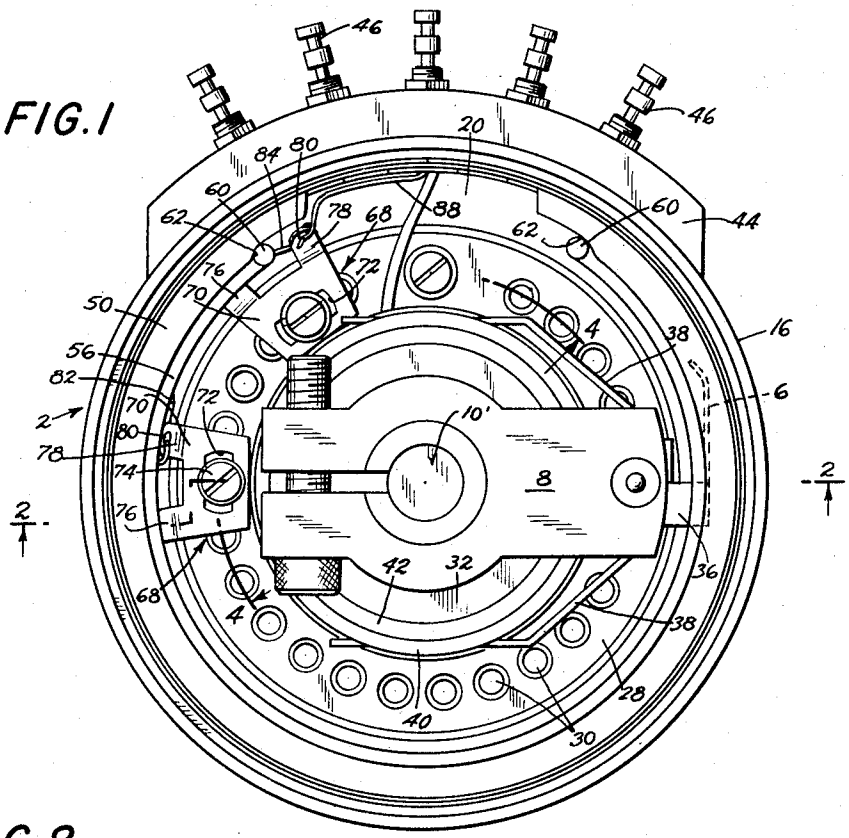
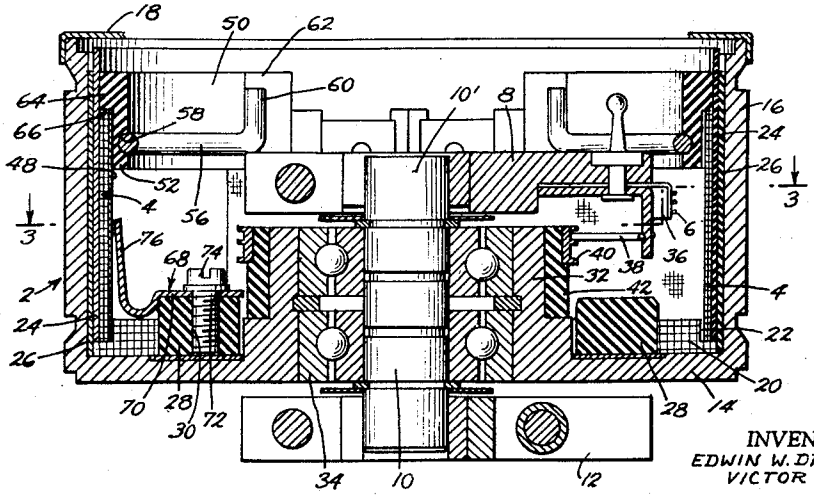


FIG. 2



INVENTORS
EDWIN W. DREWITZ
VICTOR STEIN

BY

James and Franklin

ATTORNEY

Aug. 4, 1959 E. W. DREWITZ ET AL 2,898,567

VARIABLE RESISTOR WITH SHORTED SECTION

Filed Dec. 31, 1957 2 Sheets-Sheet 2

FIG. 3

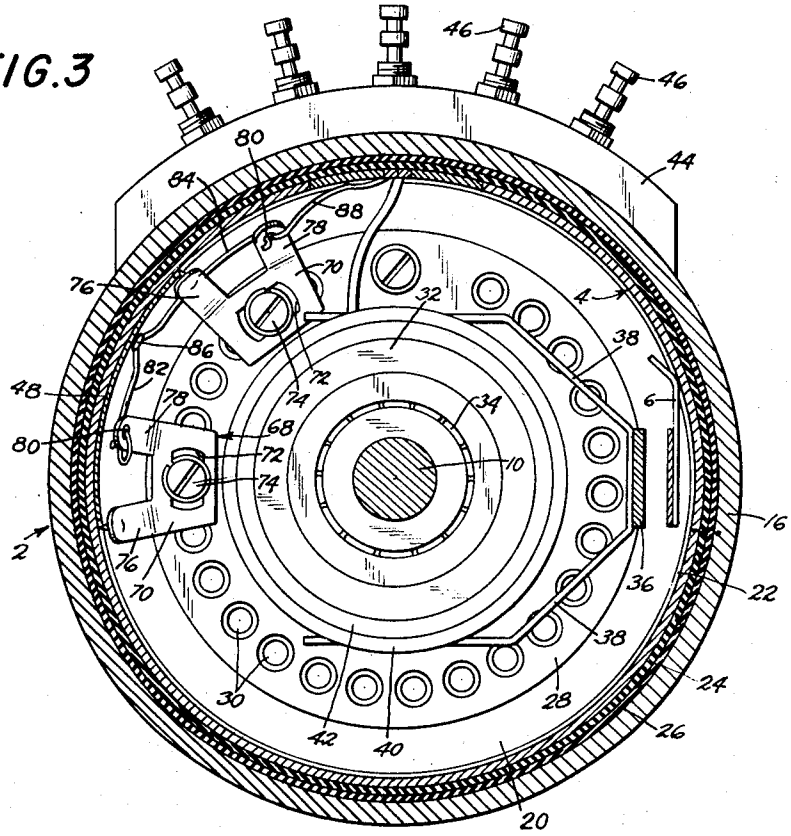
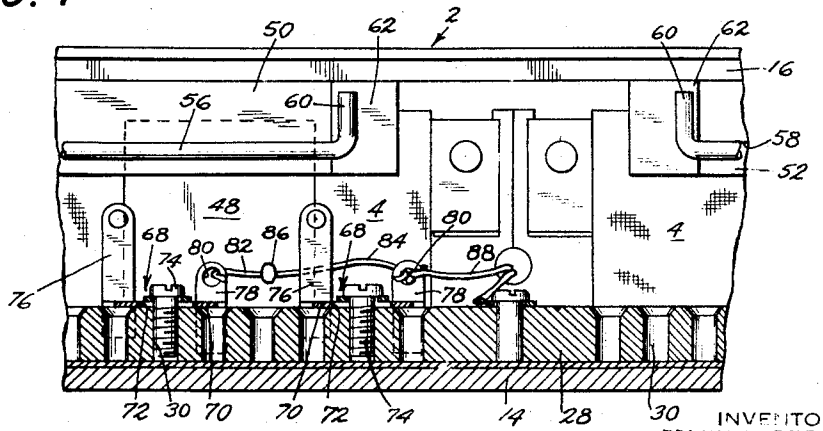


FIG. 4



INVENTORS
EDWIN J. DREWITZ
VICTOR STEIN

BY

James and Franklin

ATTORNEY

United States Patent Office 2,898,567 Patented Aug. 4, 1959

2,898,567

VARIABLE RESISTOR WITH SHORTED SECTION

Edwin W. Drewitz and Victor Stein, Flushing, N.Y., assignors to De Jur-Amsco Corporation, Long Island City, N.Y., a corporation of New York

Application December 31, 1957, Serial No. 706,334

16 Claims. (Cl. 338—92)

The present invention relates to a variable resistor, and in particular to one in which a preselected portion of the resistance member is adapted to be short circuited.

One of the most conventional types of variable resistor comprises an elongated resistance member, usually formed of resistance wire wound about a form, over a surface of which a movable contact slides. Appropriate electrical connections are made to the movable contact and to one or both ends of the resistance member, depending upon whether the device is to be used to vary resistance per se or to function as a potentiometer, and the particular position of the movable contact along the resistance member will determine the values of resistance or voltage made effective in the external circuit to which the resistor is electrically connected. Ordinarily, each time the movable contact changes its position along the resistance member the value of resistance or voltage will correspondingly change.

In many applications it is desired that the resistance or voltage should change with movement of the contact over a given range of movement and then should remain constant even though an additional movement is imparted to the contact. In other words, over a given portion or portions of the range of movement of the contact, no change in voltage or resistance is desired. The particular portions of the range of contact movement where constant resistance or voltage is desired will differ from installation to installation both as to length and as to location along the resistance member.

One way of providing for such portions of constant resistance is to wind the resistance wire on the form with gaps in the windings corresponding to the areas where no change is required, and then to provide built-in means for maintaining electrical connection with the contact when the contact is positioned within the gaps. This requires winding special resistance members for each individual installation or application. It also presents very difficult production problems where accuracy is required. After a particular resistance member is wound it must first be mounted in its housing and then electrically tested for function accuracy. If errors are detected the resistor must be disassembled and a completely new resistance member wound.

In accordance with the present invention means are provided for utilizing standard resistance members and for effecting short circuiting of predetermined areas thereof after they have been assembled in the resistor. The short circuiting can be accomplished in the assembled resistor, can be adjusted to achieve the desired degree of accuracy, the short circuited areas can be changed at will, and the arrangement is such that the normal functioning of the resistor is not impaired in any way. Variable resistors made according to the present invention can be used as standard unshorted units and may be converted to shorted units in the field and without requiring any special equipment. This is of particular importance to those, such as the Armed Forces, who use a large number of variable resistors in different applications. Such

customers can purchase standard units for all of their applications, which units can be used as such for conventional applications and can be converted to special applications involving short-circuited areas as and when desired.

To these ends the resistance member is mounted in a casing and the short circuiting of preselected areas of the resistance member is accomplished by means of a separate and readily insertable and removable thin flexible element of high conductivity, such as metal foil. The shorting element is placed over that area of the contact-engaged surface of the resistance member which is to be short circuited. Mechanical means are provided for causing the shorting element to conform to the contact-engaged surface of the resistance member, the contact therefore sliding over the metal foil when it is in the shorted area. The foil is easily assembled to the resistance member, and its position and length may be adjusted until the desired degree of accuracy is obtained. When short circuiting is no longer desired at a particular area, the metal foil may be removed or repositioned, and the resistor can then function in conventional manner or with short circuiting along a different area of the resistance member.

In order to facilitate extreme accuracy in locating the area to be short-circuited, adjustable taps of the type shown in Takats Patent 2,619,570 of November 25, 1952, assigned to the assignee of this application, may be employed, these taps being adjustably positioned on the resistor casing so that they accurately engage the resistance member at points at the beginning and the end of the area to be short circuited. A strip of metal foil of width corresponding to the length of the shorted section is inserted between the taps, serving as locating means for the foil. The taps and the foil are preferably externally electrically connected in order to ensure proper short circuiting of the designated areas.

In order to facilitate the mounting of the metal foil against the resistance member and to cause the metal foil to closely conform to the configuration of the contact-engaged surface of the resistance member, one end of the foil is adapted to be received in a groove in the casing closely adjacent to the resistance member and conforming to the configuration thereof, and releasable mechanical means such as a resiliently expandible split ring engages the other end of the foil so as to clamp it in position against the resistance member.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the construction of a variable resistor and the means for short circuiting preselected areas thereof as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

Fig. 1 is a top plan view of a variable resistor embodying the present invention; but with the top cover removed therefrom;

Fig. 2 is a cross sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a cross sectional view taken along the line 3—3 of Fig. 2; and

Fig. 4 is a cross sectional view taken along the line 4—4 of Fig. 1.

The resistor here illustrated comprises a casing generally designated **2** within which the arcuate resistance member **4** is mounted with its radially inner surface exposed for engagement by movable contact **6**, the latter being mounted at the end of an arm **8** which is fast on shaft **10** rotatably mounted in the casing **2** and connected to an actuating arm **12** on the exterior of the casing **2**. The casing comprises a bottom wall **14** and an upstanding side wall **16**, a cover **18**, shown fragmentarily in Fig.

2, being removably attachable to the upper end of the wall 16 so as to close the open top of the casing. On the bottom wall 14 is a ring 20 of insulating material provided with an outer groove 22 within which the lower end of the resistance member 4 is received, that resistance member comprising a form or card of insulating material around which resistance wire is coiled. One or more rings 24, 26 of insulating material are disposed radially outside the resistance member 4 and between it and the casing wall 16. The lower end of the resistance member 4 does not completely fill the groove 22, for reasons which will shortly become apparent.

Mounted on the bottom wall 14 radially inside the ring 20 is an insulating ring 28 provided on its upper surface with a plurality of recesses 30 equally spaced along its length.

The central portion of the casing is provided with an upstanding hub 32 within which ball bearings 34 are received, the shaft 10 being journaled in the bearings 34 and extending thereabove and above the hub 32, as at 10', the arm 8 being secured to the shaft portion 10' for rotation therewith.

The movable contact 6 is defined by a plurality of thin resiliently flexible brush wires mounted on conductive bracket 36, the latter having a pair of fingers 38 extending inwardly therefrom and engaging collector ring 40 mounted on an insulating bushing 42 carried by the hub 32. The exterior of the casing 2 is provided with a terminal block 44 from which terminals 46 extend, one of these terminals being electrically connected to the collector ring 40 and thus to the movable contact 6, others of the terminals 46 being connected to the ends of the resistance windings on the resistance member 4.

As thus far described the device is capable of use as a conventional variable resistor or potentiometer.

In order to provide for short circuiting of a desired area of the resistance member 4 a short circuiting element 48 is employed which is separable from and insertable into the resistor structure. The element 48 is thin and flexible and has a highly conductive surface. It is advantageously formed of metal foil, but it could also be constituted by a non-conductive sheet to which a coating of conductive material has been applied. The width of the element 48 corresponds to the desired length of the short circuited area of the resistance member 4. The height of the shorting element 48, as here disclosed, is closely the same as the height of the resistance member 4. The shorting element 48 is positioned in the casing 2 so as to engage that surface of the resistance member 4 over which the movable contact 6 slides at the area thereof to be short circuited, so that the contact 6, when it reaches the area in question, will engage and slide over the shorting element 48 instead of directly engaging the resistance winding on the resistance member 4. The flexible nature of the shorting element 48 permits it to conform accurately to the configuration of the contact-engaged surface of the resistance member 4, and the preferably foil-like thinness of the element 48 ensures that the movable contact 6, when it moves onto or off from the shorting member 48, will do so smoothly and without bounce, so that no discontinuity in electrical connection will result.

As here specifically disclosed the lower end of the element 48 is received within the groove 22 in the base ring 20 just inside the resistance member 4. It was for this reason that, as was set forth above, the resistance member 4 and the sheets 24 and 26 did not completely fill that groove 22. The reception of the lower end of the element 48 in the groove 22 will help to ensure that the shorting element 48 will closely conform to the configuration of the surface of the resistance member 4 to be shorted.

As here specifically disclosed a split fibre ring 50 of insulating material is inserted into the casing 2 via the open upper end thereof, that ring having a depending flange 52 which overlies the upper portion of the inner surface of the resistance member 4 and conforms to the configuration thereof, the upper end of the shorting element 48 being interposed between the ring flange 52 and the resistance member 4. A resiliently expandible metallic ring 56 is received within a groove 58 in the radially inner surface of the ring 50 and has its upbent ends 60 received within recesses 62 adjacent the ends of the insulating ring 50, the element 56 therefore expanding the ring 50 into engagement with the upper portion of the resistance member 4 and thus firmly clamping the upper end of the shorting element 48 in position. The upper portion of the ring 50 is provided with a radially outwardly projecting part 64 defining a shoulder 66 (see Fig. 2) which rests upon the upper edge of the resistance member 4 and thus limits the degree to which the ring 50 may be inserted into the casing 2. Since the lower edge of the ring 50 is positioned above the path of the movable contact 6, its presence does not interfere with the functioning of the resistor.

As is clear from the above description, the element 48 may be readily inserted into the casing 2 at any desired position, and since it may be removed or repositioned once the ring 50 has been removed, which may be accomplished merely by contracting it and lifting it out of the open top of the casing 2, it is apparent that the resistor of the present invention can be converted from conventional operation to operation with one or more shorted areas in a very facile manner. Moreover, the precise position of the shorting member 48 may be adjusted in order to ensure that it is properly located.

In order to facilitate the precise location of the shorted area, it is preferred to use, for each shorted area, in addition to the shorting element 48, a pair of taps generally designated 68, which may be of the form shown and claimed in Takats Patent 2,619,570, above referred to. These taps comprise a body portion 70 having an elongated aperture 72 therein, the length of the aperture 72 being at least equal to the distance between remote edges of adjacent recesses 30 in the ring 28. Hence no matter where the body portion 70 may be placed on top of the ring 28 along its entire length, at least one recess 30 will be completely exposed through the aperture 72. A screw or other fastening element 74 is adapted to pass through the aperture 72 and into an appropriate recess 30, engagement between the fastening element 74 and the recess 30 clamping the body portion 70 in place on the ring 28. The body portion 70 is provided with a finger 76 extending therefrom toward and into engagement with the exposed surface of the resistance member 4. The body 70 is provided with another finger 78, the tip thereof being provided with an aperture 80 for the reception of a suitable conductive wire for the making of electrical connection thereto. In practice a pair of taps 68 will be employed for each area of the resistance member 4 to be shorted, and they will be positioned and adjusted until the points at which they engage the resistance member 4 accurately correspond to the beginning and end of the area to be shorted. Once the taps 68 have been properly positioned, the linear distance between the points where they engage the resistance member 4 will have been determined and a shorting element 48 will be cut from a sheet of foil so that its width corresponds to that distance, and the foil sheet 48 will then be inserted between the taps 68, and more specifically between the points where those taps engage the resistance member 4, all as may best be seen in Figs. 3 and 4. Thus the accurately positioned taps 68 will serve as locating means for the foil sheet 48. In this regard it may be noted that the existence of some slight clearance between the side edges of the foil sheet 48 and the points where the taps 68 engage the resistance member 4 is ordinarily entirely permissible, particularly where, as is here specifically

disclosed, the taps **68** are electrically connected to one another as by the leads **82** and **84**. It is also preferred that the shorting element **48** be externally electrically connected to the taps **68**, and to this end, as may best be seen in Figs. 3 and 4, the leads **82** and **84** are themselves soldered or otherwise secured at **86** to the exposed surface of the shorting element **48**. If desired, another lead **88** may connect the taps **66** and the shorting element **48** to an appropriate terminal **46** on the exterior of the casing **2**.

From the above it will be clear that preselection of one or more shorted areas located over any desired portions of the resistance member **4** can be made at any time, that the actual physical accomplishment of the short circuiting can be carried out on a continually adjustable basis until the desired degree of accuracy and precision has been achieved without in any way disturbing or requiring modification of the basic resistor components, and that when short circuiting has been accomplished the movable contact **6** will cooperate therewith in an effective and satisfactory manner. Consequently standard resistor units can be purchased and stocked for all applications, whether shorted areas are desired or not, and can readily be converted to have shorted areas at whatever points are dictated by the particular system with which the individual resistor is to be used when and as such modifications are called for. The resultant saving in initial cost, the time required to produce the short circuited modifications, and the maintenance of adequate spare parts for all installations, are quite considerable. Moreover, the ready availability of spare parts for special installations is a factor which alone is of controlling significance in many situations.

While but a single embodiment of the present invention has been here disclosed, it will be apparent that many variations may be made in the specific structural details thereof without departing from the invention as defined in the following claims.

We claims:

1. In a variable resistor comprising a casing containing an elongated resistance member having an inner surface and a contact movable along said surface; the improvement which comprises a thin element of high conductivity and of predetermined width engageable with and covering a predetermined portion of said resistance member surface and conforming thereto, said contact engaging and moving along said element, and a pair of electrically connected taps mounted on said casing and engaging said resistance member at spaced points therealong, said element being positioned between said taps and having a width closely similar to the spacing between said points, said taps thereby constituting a locating means for said element.

2. The variable resistor of claim 1, in which said element is externally electrically connected to said taps.

3. In a variable resistor comprising a casing containing an elongated curved resistance member having an exposed surface and a contact movable along said surface, the improvement which comprises said resistance member being mounted on said casing with a groove in said casing adjacent and conforming to the curvature of said surface, a thin element of high conductivity and of predetermined width engageable with and covering a predetermined portion of said resistance member surface and conforming thereto in curvature, an end of said element being received within said groove, said contact engaging and moving along said element.

4. In the variable resistor of claim 3, a pair of electrically connected taps mounted on said casing and engaging said resistance member at spaced points therealong, said element being positioned between said taps and having a width closely similar to the spacing between said points, said taps thereby constituting a locating means for said element.

5. The variable resistor of claim 4, in which said element is externally electrically connected to said taps.

6. In a variable resistor comprising a casing containing an elongated resistance member having an exposed surface and a contact movable along a predetermined path on said surface, the improvement which comprises a thin element of high conductivity and of predetermined width separable from said resistance member, engageable with and covering a predetermined portion of said resistance member surface, including said path, and conforming thereto, and a resilient member releasably engaging an upper portion of said variable resistor and conforming to said resistance member, the upper end of said element outside said path being interposed and clamped between said resilient member and said upper portion of said resistor, said contact engaging and moving over said element along said path.

7. In the variable resistor of claim 6, a pair of electrically connected taps mounted on said casing and engaging said resistance member at spaced points therealong, said element being positioned between said taps and having a width closely similar to the spacing between said points, said taps thereby constituting a locating members for said element.

8. The variable resistor of claim 7, in which said element is externally electrically connected to said taps.

9. In a variable resistor comprising a casing containing a base and an elongated curved resistance member having an inner surface and a contact movable along a predetermined path on said surface, the improvement which comprises said resistance member being mounted on said base, said base having a groove adjacent and conforming to the curvature of said surface, a thin element of high conductivity and of predetermined width engageable with and covering a predetermined portion of said resistance member surface, including said path, and conforming thereto in curvature, the lower end of said element being received within said groove, and a resilient expansible member engaging an upper portion of said variable resistor and conforming to the curvature of said resistance member, the upper end of said element outside said path being interposed and clamped between said expansible member and said upper portion of said resistor, said contact engaging and moving over said element along said path.

10. In the variable resistor of claim 9, a pair of electrically connected taps mounted on said base and engaging said resistance member at spaced points therealong, said element being positioned between said taps and having a width closely similar to the spacing between said points, said taps thereby constituting a locating means for said element.

11. The variable resistor of claim 10, in which said element is externally electrically connected to said taps.

12. A variable resistor comprising a base, an elongated resistance member in said resistor and having an elongated surface adapted to be engaged by a movable contact, a series of spaced mounting parts on said base and extending along but spaced from said resistance member surface, said base having a groove immediately adjacent said resistance member surface and conforming thereto, said groove being located between said resistance member and said mounting parts, a pair of electrically connected taps mounted on selected mounting parts and engaging said resistance member at predetermined spaced points, a sheet of thin conductive material positioned against said resistance member surface between said tap points and having a width substantially equal to the distance between said points, the lower end of said sheet being received within said groove, and a contact movable along said resistance member and over said sheet.

13. A variable resistor comprising a base, an elongated resistance member in said resistor and having an

elongated surface adapted to be engaged by a movable contact, a series of spaced mounting parts on said base and extending along but spaced from said resistance member surface, said base having a groove immediately adjacent said resistance member surface and conforming thereto, said groove being located between said resistance member and said mounting parts, a pair of electrically connected taps mounted on selected mounting parts and engaging said resistance member at predetermined spaced points, a sheet of thin conductive material positioned against said resistance member surface between said tap points and having a width substantially equal to the distance between said points, the lower end of said sheet being received within said groove, means engaging the upper end of said sheet and causing said sheet to conform to and snugly engage said resistance member surface, and a contact movable along said resistance member and over said sheet.

14. The variable resistor of claim 13, in which said sheet engaging means comprises a resiliently expansible split ring movable into said resistor from the end thereof opposite said base and having an outer shoulder engageable with a coacting part of said resistor to limit the degree to which said ring may be moved into said resistor.

15. In a variable resistor comprising a casing containing an elongated resistance member having an exposed surface and a contact movable along a predetermined path on said surface, the improvement which

comprises a thin element of high conductivity and of predetermined width engageable with and covering a predetermined portion of said resistance member surface, including said path and conforming thereto, and a resilient member engaging an upper portion of said variable resistor and conforming to said resistance member, the upper end of said element, outside said path, being interposed and clamped between said resilient member and said upper portion of said resistor, said contact engaging and moving over said element along said path, and a pair of electrically connected taps mounted on said casing and engaging said resistance member at spaced points therealong, said element being positioned between said taps and having a width closely similar to the spacing between said points, said taps thereby constituting a locating means for said element.

16. The variable resistor of claim 15, in which said element is externally electrically connected to said taps.

References Cited in the file of this patent

UNITED STATES PATENTS

1,948,354	Lodge	Feb. 20, 1934
1,987,118	Lodge	Jan. 8, 1935
2,081,572	Bagno	May 25, 1937
2,448,783	De Giers et al.	Sept. 7, 1948
2,551,989	Wilson	May 8, 1951
2,573,122	Weber	Oct. 30, 1951
2.806.928	Woods et al.	Sept. 17, 1957