

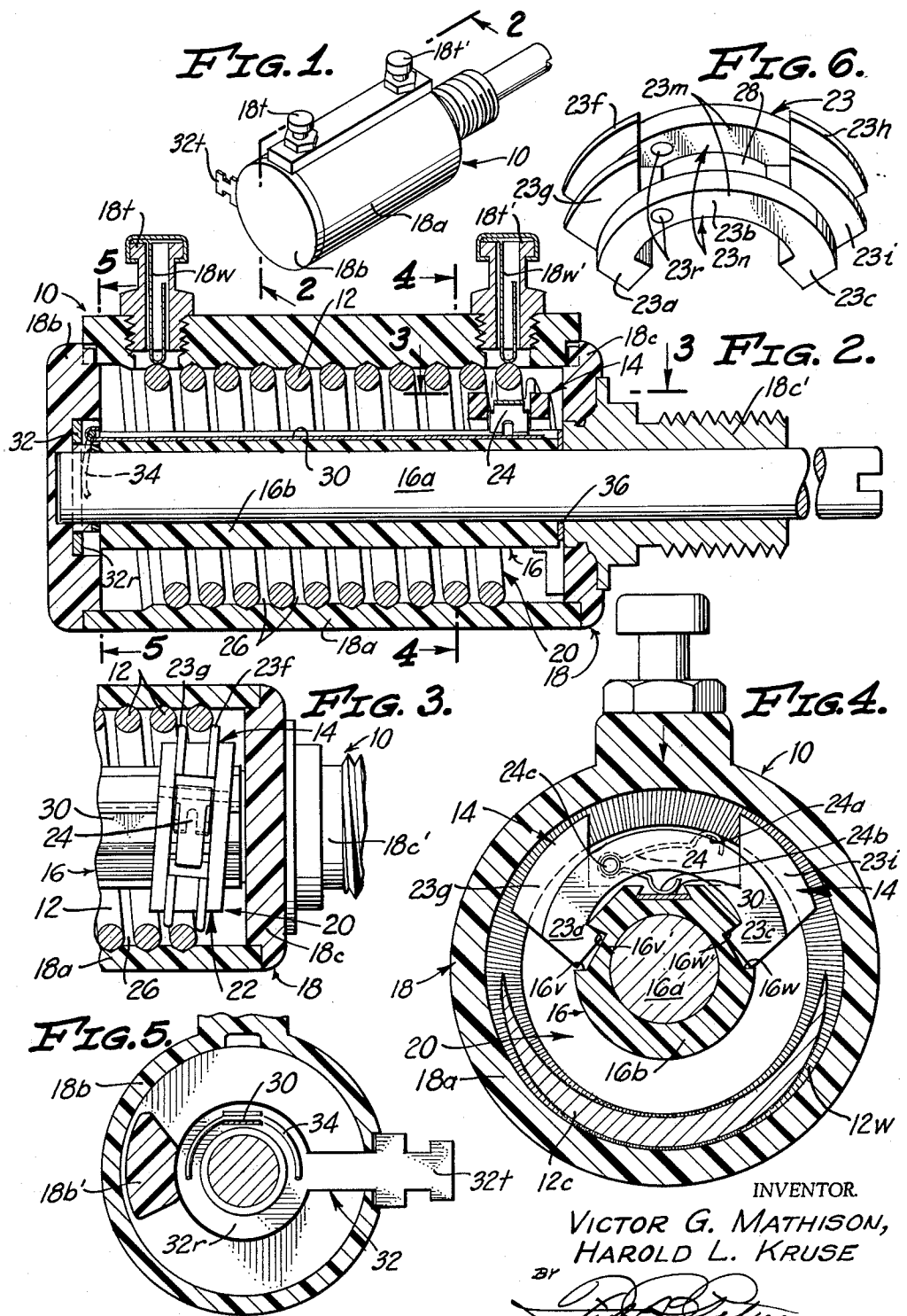
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V. G. MATHISON ET AL

3,099,809

MULTITURN ROTARY POTENTIOMETER

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3,099,809

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10 Claims. (Cl. 338-143)

The invention hereinafter disclosed relates to variable resistors of the type in which a multiturn helical resistance element is disposed with its convolutions encircling an axis about which axis a contact-carrying slider is moved along a length of the resistance element by rotation of a part such as a rotor.

Variable resistors of the type above noted are commonly constructed with the helical element affixed to the interior surface of a cylindrical housing member and with a rotor coaxial with the element and with a contact-carrier or slider encircling and slidably supported on the rotor and engaging the latter for rotation and translation along the helical element. In some instances the resistance element may be supported on the inner structure, which may be stationary, and the exterior shell rotated to move the slider. The contact carrier or slider may be guided by engagement with the helical element or with other helical means provided for the purpose. It carries a contact device that comprises a contact disposed to make wiping contact on the element, and the contact is maintained in electrical communications with a conductor or terminal means whereby division of electrical potential applied across the ends of the element may be variably effected. Various forms of driving connections between the rotor and the slider are known in the art, typical examples of which are illustrated in the following U.S. patents: Blanco, 2,856,493; MacLaren, 2,850,606; Paget, 2,883,501; Moore et al., 2,961,626; and Sorber, 2,813,956.

A substantially universal difficulty encountered in mechanisms in which two members are articulated for bi-directional transmission of motion from one to the other, is that caused by lost-motion and back lash. The former is caused by movement of one member without contemporaneous movement of the other, due to spatial clearance between the members, and the latter is caused by resilience of the structures and materials of the members. The mentioned difficulty is accentuated in multiturn rotary variable resistors, in which the slider is not only rotated by the rotor, but must also translate or slide along the rotor in the act of following along the helix of the resistance winding. When new, the rotor and slider may have been carefully matched so that looseness of the interconnection is at the minimum permissible in an operable instrument. However, as the sliding action in repeated and reversed in direction during operation of the variable resistor, wear occurs at the areas of mutual contact, with the result that looseness increases to the detriment of the accuracy and precision of adjustment of the potentiometer. It is evident, further, that slight differences in relative dimensions of rotors and sliders as manufactured are inevitable, with the result that looseness of fit between sliders and rotors as usually made may initially vary from very loose to very tight. As the size of the instruments is decreased as a consequence of efforts to produce smaller and yet smaller

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instruments, the difficulty and expense of manufacturing the mentioned parts within acceptable dimensional tolerances increase prohibitively.

The present invention provides a rotor and slider structure for a multiturn rotary potentiometer, the structural characteristics of which are such as to completely avoid or obviate the mentioned difficulty and such as to permit successful employment of rotor and slider components that do not require close manufacturing tolerances, whereby the cost of the instrument is considerably reduced and its efficiency and useful life are increased. Additionally in preferred forms of the invention, the configurations and interrelationships of the rotor and slider are such as to greatly facilitate application of the slider onto the rotor, whereby savings are effected in assembly operations. In the case of previously known rotor and slider constructions it was necessary to carefully position the slider at the end of the rotor and slide the slider onto the rotor, with exercise of care being required due to the close-fitting of the parts. Especially in the case of very small variable resistors of the class concerned, great care and dexterity were required. In the case of the present invention the slider may be applied to the guide surfaces of the rotor at any location along those surfaces, by a simple compressive action. The rotor is formed to provide two spaced-apart longitudinally-extending oppositely-facing parallel guideways or grooves, or other formations, to provide oppositely directed guideways, and the contact-carrier or slider is formed as a resilient arch-like structure whose feet or ends are, in the relaxed state of the structure, separated by a distance less than that between the guideways. Thus the ends of the slider must be spread apart prior to application of the slider to the rotor, irrespective of which mode of application is followed; and, due to the resilience of the arch (or of at least a portion thereof between the feet), the slider may be applied to the rotor transversely of the guideways by a simple application of force to the top of the arch whereby the feet are forced to spread or move apart and snap over a longitudinally extending part of the rotor between the guideways, and into place, each pressing inwardly at a respective guideway. The dimensions and other characteristics are such that the feet of the arch are caused to clasp or grip between them the portion of the rotor disposed between the two guideways; that clamping action being caused by the tensile stresses induced in the interior-most laminae of the arch and by the compressive stresses induced in the outermost laminae, incident, to the initial spreading-apart of the feet of the arch. The clamping or gripping action does not, however, prevent easy sliding of the slider structure along the guideways axially of the rotor.

In an exemplary device according to the invention the slider or contact-carrier structure comprises a means such as one or more fins, arranged to have guiding engagement with a helical structure such as the resistance element or a rib or groove structure adjacent to the element, whereby as the slider is driven around the axis of the rotor the slider is forced to slide axially along the rotor and thus follow a helical path of the same pitch as that of the resistance element. That path is traced in the generally cylindrical space between the rotatable structure (rotor) and the fixed or stationary structure.

Additionally, the invention provides a slider structure

adapted to come into contact with and be stopped by abutments disposed at respective ends of the helical path traversed by the slider during complete movements from end to end of the helical resistance element. The novel slider, of generally arcuate or arch-shaped configuration, has feet so formed as to be brought into direct collision with respective stops at respective ends of a housing in which the active components of the variable resistor are housed.

The preceding brief descriptive sketch of the invention makes it evident that it is a principal object of the invention to provide improvements in multiturn helical-element variable resistors.

Another object of the invention is to provide means for reducing to a minimum lost-motion between the wiping contact and the rotary means used to drive the contact, in multiturn rotary variable resistors.

An additional object of the invention is to provide improvements in contact-carrying slider structures for helical-element variable resistors.

Other objects of the invention will hereinafter be made evident in the following description of a preferred exemplary embodiment of the invention, or stated in the appended claims. The exemplary embodiment of the invention is illustrated in the accompanying drawings in which:

FIGURE 1 is a pictorial view of a variable resistor, in the form of a potentiometer, embodying components according to the invention, the drawing being on enlarged scale for the sake of clarity of illustration;

FIGURE 2 is a longitudinal sectional view, grossly magnified, of parts of the resistor depicted in FIG. 1, the section being taken as indicated by the broken line 2—2 in FIG. 1;

FIGURE 3 is a fragmentary view partly in section, taken as indicated by line 3—3 in FIG. 2;

FIGURE 4 is a transverse sectional view of part of the exemplary resistor, taken as indicated by broken line 4—4 in FIG. 2;

FIGURE 5 is a transverse sectional view taken as indicated by broken line 5—5 in FIG. 2; and

FIGURE 6 is a pictorial representation of a part of a generally arch-shaped slider structure according to the invention.

With reference to the drawings, it is noted that the exemplary variable resistor is a multiturn helical-element potentiometer indicated generally by the ordinal 10. The potentiometer comprises in addition to a helical resistance element 12 and a contact-carrying slider structure denoted generally by ordinal 14, two major elongate structures 16 and 18 which are rotatable one with respect to the other about a common longitudinal axis. As depicted in the exemplary instrument, one of the last-mentioned structures is a rotatable rotor structure comprising a rotatable shaft 16a and a specially-shaped sleeve or rotor 16b preferably formed of a suitable insulative compound such as diallyl phthalate, secured on shaft 16a to rotate therewith. The other of the elongate structures is in the form of a generally cylindrical housing comprising a hollow cylindrical shell 18a and first and second ends 18b, 18c. One end of the shaft 16a is journaled in a bore formed in end 18b, and the shaft is also journaled adjacent its other end in a bore formed in a bushing 18c' comprised in end 18c. As is evident the two elongate structures are rotatable, either relative to the other, about a common axis which is coincident with the axis of shaft 16a.

In the exemplary variable resistor structure depicted in the drawings, the helical resistance element is in the form of an insulated metal core 12c (FIG. 4) about which is wound a large number of turns of resistive wire 12w, the core having been formed into a helical configuration of a plurality of turns or convolutions. Further in the exemplary instrument illustrated, the resistance element is secured to the interior of shell 18a with next-adjacent

convolutions of the element spaced-apart (as depicted in FIG. 2) to provide a spiral formation or groove that is useful in performance of a guiding function presently to be described. As will be evident to those skilled in the art, a helical metallic-film resistance element may be substituted for the helical wire-wound element illustrated, a suitable guide rib or groove being in that case provided for performing the guiding function. Also, as will be evident, in certain instances the resistance element may be affixed to the rotor structure rather than to the shell as illustrated. As depicted, electrical connections to the electrical ends of the resistance element are provided, and for that purpose first and second terminal posts 18t, 18t' are mounted as shown in FIG. 2, each terminal having electrically connected thereto a respective terminal conductor or wire 18w, 18w' a portion of each of which wires is welded or otherwise connected to a respective end portion of the resistance element.

In accord with the invention there is disposed in the generally cylindrical space 20 (FIG. 4) between the shell 18a and the rotor, a slider structure comprising a contact device having a contact brushing on the resistance element, the slider structure being constructed and arranged to be driven along a path from end to end of the resistance element incident to suitable relative rotation between the two elongate structures. To those ends, one of the elongate structures is provided with elongate means providing a pair of longitudinally-extending guideways such as grooves that face in generally opposite directions transversely of the elongate structure, and the means is so constructed that bottom portions of the grooves are closer together transversely of the means than are adjacent side-walls of the grooves. By that construction, the part of the elongate means disposed between the guides or grooves may be used to drive in either rotational direction a specially devised generally arch-shaped slider structure having opposed ends and the arch of which operates under stress such that the ends continually grip or clasp the elongate means and thus eliminate transverse relative motion therebetween. Thus in the depicted exemplary structure, the rotor 16b (FIG. 4) is formed to provide first and second longitudinally-extending groove guideways 16v, 16w that face in generally opposite directions transversely of the rotor and the bottoms 16v' and 16w' of which are separated by a distance less than the distance separating adjacent sidewall portions of the grooves. The grooves or guideways and the sidewalls are parallel longitudinally of the rotor and preferably are such that the intervening portion between the grooves presents a longitudinally-extending edge formed by acutely related surfaces as shown; and the rotor is preferably made of material having a low coefficient of friction and excellent abrasion resistance. The previously mentioned diallyl phthalate is suitable in usual applications of the invention.

Further in accord with the invention the slider structure, depicted generally by numeral 14 (FIGS. 3 and 4), comprises a slider 23 (FIG. 6) which is preferably of insulative material and is of generally arch-shaped configuration. The slider structure also comprises a contact device 24 (FIG. 4), which includes first and second contacts 24a and 24b which are electrically interconnected and preferably are integral with a resilient interconnecting portion that embraces a contact pivot pin 24c which also may be part of the contact device carried by the slider 23. The slider, as is best indicated in FIGS. 4 and 6, is formed of arch-like shape with ends 23a and 23c forming feet or bases of the arch and an intermediate body portion 23b interconnecting the ends. The slider is made of stiff resilient material such as those sold under the trade names of "Nylatron," and "nylon," or such as diallyl phthalate synthetic resin, any of which may include fibrous glass as a reinforcing agent. Further, the arched body portion 23b is dimensioned to provide clearance space for that part of the elongate means spanned by the arch. Further, the arch is initially formed of different radius (sharper or

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shorter radius in the example illustrated), and with the ends closer together in the free state than will be the situation when the slider is disposed on the elongate structure with its ends engaged in the grooves or guideways. Thus the illustrated slider is produced, as by molding an elastic resin or the like, so that when its ends are forcibly spread apart and positioned in respective guideways or grooves, the outer laminae or portions 23m next-adjacent the outer face of the arch will be stressed in compression and the inner portions 23n adjacent the inner face will be stressed in tension. Such being the relationship of the "parts" of the slider, the ends will compressively clasp or grip the elongate member (as depicted, that longitudinally-extending part of rotor 16b that is disposed between grooves 16v and 16w), and, while being permitted to slide quite freely longitudinally along the elongate structure, will at any point therealong partake of transverse motion incident to rotation of the elongate structure or rotor about the axis of shaft 16a. As is evident such transverse motion may be in either direction, and the drive will be positive in either direction and will be free of lost-motion when the direction of the drive is reversed. While not necessary, in the presently preferred embodiment as illustrated, the intervening portion clasped by the end portions of the slider are formed to present respective edges of acute cross section as shown and herein termed sharp edges. The slider is then formed with complementary internal corners at each of which a respective sharp edge is engaged, as illustrated.

As depicted in the exemplary structure, the convolutions of the resistance element 12 (FIG. 2) are spaced apart to provide sufficient and proper electrical isolation, and thus there is a groove-like space 26 of helical configuration between the turns of the element. The actual shape of a cross section of the groove or space varies, depending upon the extent of separation of next-adjacent turns or convolutions of the element, and may vary also in dependence upon the cross-sectional shape of the resistance element, and whether or not adhesive is employed in securing the element in place. Thus the groove may be substantially a V-groove, a rectangular groove, etc. The groove is utilized as a path for guide means forming a part of the slider structure, to force the slider to move longitudinally of the elongate structures incident to the aforementioned relative rotation. Thus in the exemplary variable resistor the slider (FIG. 6) has guide means in the form of four projecting fins 23f, 23g, 23h and 23i, each disposed to ride in the aforementioned groove or space. While these guide means can take other forms, such as a single fin-like projection, as depicted in the preferred embodiment in FIG. 3 opposed fins of a pair are constructed and arranged to engage lightly opposite side portions of a turn or convolution of the resistance element and thus be constrained by the element to partake of longitudinal movement as relative rotation between the elongate structures occurs. As is evident to those skilled in the art, and depending upon details of construction, the element may be moved relative to the slider and hence progress between and past the fins, or the slider may be rotated about the longitudinal axis of the structures and thus be constrained to move along a helical path with the fins sliding along the guide formed, in the illustrated case, by the resistance element. The fins, and the principal mass of the slider, are preferably disposed at a degree of inclination to the direction of the guide surfaces of the slider-ends and of the rotor, the inclination being preferably the same as that of the helix of the resistance element relative to grooves 16v, 16w. That relationship is illustrated in FIG. 3.

The purpose of the slider is to support and guide the contact device for brushing engagement with the resistance element along the length of the latter, and other incidental functions. For those purposes the slider is provided with bore means 23r (FIG. 6) comprising a pair of aligned bores in which is seated and frictionally retained

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the contact pivot pin 24c (FIG. 4). In an open aperture or recess 28 (FIG. 6) provided in the slider, there is space for accommodation of the contact device 24. The contact structure is preferably formed from a flat strip of resilient metal, and is preferably of the shape indicated in FIGS. 3 and 4. With the slider disposed upon rotor 16 and with the slider guide fins disposed in guiding relationship to element 12, the contact device is somewhat compressed with contact 24a in conductive contact with the resistance element as depicted in FIG. 4. To provide a terminal connection to the contact device, there is provided on the appropriate one of the relatively rotatable elongate structures (in this case the rotor 16b), a conductive return bus bar or strip 30 (FIGS. 3 and 4), and means presently to be described, for completing connections to a terminal. The strip 30 may be suitably secured to the elongate structure, as by retention in a longitudinally extending dovetail slot into which it may be pressed and cemented, as indicated in FIG. 4. The second contact 24b of the contact device is constructed and arranged to engage and brush along strip 30. While illustrated with the pivot pin 24c at the left end of recess 28 and the contacts thus adjacent the right end, it is evident that those positions may in practice be reversed by providing pivot pin bores at the other end of the recess. Selection of the location used may be governed by the mode of assembly of the instrument.

To electrically connect return conductor strip 30 to an externally accessible terminal, there is provided in a recess in the inner face of end member 18b of the casing, as depicted in FIGS. 2 and 5, a specially-shaped terminal device 32 having an externally exposed terminal 32t (see also FIG. 1) and an annular contact ring 32r which encircles, but is spaced away from, the adjacent end of shaft 16a. The annular ring is brushed at spaced-apart locations by respective ends of an arcuate resilient conductive brush 34 the middle portion of which is conductively secured (as by welding) to the adjacent end of strip 30. The brush 34 is biased into contact with ring 32 and the rotor and strip 30 are held against outward displacement by a washer 36 (FIG. 2) which bears against an end of rotor 16b and oppositely against the inner end face of bushing 18c'. Thus, incident to rotation of one of the elongate structures 16 and 18 relative to the other, contact 24a contacts different areas or points along the extent of the resistance element 12, and as a consequence the electrical resistance exhibited between terminal 32t and either of terminals 18t, 18t' is varied. And when the relative rotation has been in one sense or direction and is changed to the opposite sense of direction the response of slider 23 and contact 24a is instantaneous and precise, there being no slack or lost-motion in the mechanical connection between the contact and slider and rotor. In instances wherein very close control of brush-to-ring pressure is desired, thin shim washers may be inserted below ring 32r in the recess in end 18b.

As is evident from consideration of the preceding description and the drawings, the precision of adjustments of the instrument in practical use is greatly enhanced by the described construction. Further assembly of the slider structure onto the elongate slider-guiding structure is easily accomplished by merely placing the slider above the longitudinal guideways and pressing downwardly (in the direction of the downwardly directed arrow in FIG. 4) with enough force to cause spreading apart of ends 23a, 23c sufficiently for them to snap into respective ones of grooves 16v, 16w. That subassembly operation is performed (in the illustrated embodiment) prior to introduction of the rotor and shaft into shell 18a. As the assembled slider structure is thus assembled onto the rotor, contact 24b engages strip 30 and the contact device is rotated about pin 24c. Introduction of the rotor and slider into the interior of the helical element is performed with a twisting motion akin to threading a screw into a nut, which operation brings contact 24a into engagement with

an end of element 12 and causes that contact to ride up onto the element and thus bring the contact device to the desired degree of compression.

End stop abutments, such as that shown as 18b' in FIG. 5, are preferably formed integral with ends 18b and 18c, and are disposed to be struck by respective ones of the end faces of the slider when the latter has been driven to an end of the element. Collision of an end face of the slider with a stop abutment results in cessation of relative rotation of the elongated structures being arrested without harm to any part of the variable resistor, the shapes of the abutments and the end faces of the slider being such that the arresting force is transmitted in compression from the rotor through an end portion of the slider to an abutment. Thus danger of stripping or other damage to parts is avoided. The ends 18b and 18c of the housing are formed to fit partly within shell 18a, as depicted; and they are maintained rigidly in place by means of a suitable adhesive such as an epoxy resin.

From the preceding description it is evident that in those instances wherein the resistance element is mounted on the inner one of the two elongate structures (herein shown as the rotor) the longitudinal guide means will be formed along the interior of the encircling cylindrical shell, and the slider may have its feet arranged to point outwardly of the shell and arranged with surfaces complementary to the cross-sectional shape of the guide means, the stressing of the arch depending upon its shape but such that the longitudinally extending means between the two guideways is clasped or gripped between the feet or bases of the slider so that lost motion is obviated.

From consideration of the preceding description of a preferred exemplary embodiment of the invention it is evident that the aforementioned objects have been attained. In the light of the foregoing disclosure it is evident that changes within the spirit and scope of the invention, such as changes of shape or proportion, may occur to those skilled in the art; and accordingly it is not desired to restrict the invention to the details of the illustrated embodiment, but what we claim is:

1. A variable resistor comprising:

first means, including rotary means comprising an elongate rotor rotatable about a longitudinal axis, said rotor having first and second longitudinally-extending groove guideways therein and said grooves being spaced apart by a longitudinally extending intervening portion; said first means comprising a longitudinally-extending electrical return conductor mounted on said intervening portion of said rotor between said grooves, and terminating in a brush means at one end of the rotor;

second means, including a helical resistance element the axis of the helix of which is coincident with said longitudinal axis and the next-adjacent convolutions of which are longitudinally spaced apart, and including means supporting said resistance element and said rotor in coaxial relationship;

third means, comprising electrical terminal means for said resistance element and terminal means including a conductive ring around said axis and disposed for contact by said brush means during rotation of said rotor; and

fourth means, comprising a resilient generally arch-shaped slider device disposed between said resistance element and said rotor and having an arch-forming body portion having at least one guide portion extending between adjacent convolutions of said element and formed complementary thereto and said slider having at least one portion straddling an arcuate portion of said resistance element and said slider device further having first and second generally inwardly directed opposed end portions riding in respective ones of said groove guideways and in the relaxed state of the slider device being closer together than when disposed in said groove guideways, where-

by said end portions are caused to compressively press against and embrace said intervening portion of said rotor to eliminate lost motion therebetween, said slider device carrying a contact means thereon having portions disposed to brush on said return conductor and on said resistance element.

2. A variable resistor according to claim 1, said longitudinally-extending intervening portion of said rotor having first and second outwardly and oppositely directed longitudinally-extending projections presenting respective longitudinally-extending sharp edges, and said slider device having at each juncture of a said foot portion with the body portion a notch complementary to and receiving a respective one of said projections, whereby said slider may be reversibly driven along said element and traversed along said rotor without lost-motion effects.

3. A variable resistor comprising:

a helical resistance element disposed along and concentric about a straight axis and having successive convolutions thereof spaced apart to provide a guide-receiving space therebetween;

means, including housing means, enclosing said element; a shaft supported by said housing means and disposed in coaxial relationship with the helix of said resistance element, and an elongate rotor arranged for rotation about said axis, said rotor having first and second longitudinally-extending guides generally parallel to but spaced away from said axis and angularly spaced apart an equal extent in any plane there-through perpendicular to said axis by an intervening portion;

an arch-shaped slider device disposed transversely of said rotor and comprising a slider having first and second end portions and said slider including a middle portion transversely spanning said guides on said rotor and said middle portion having inner and outer faces, one face of said middle portion being stressed in tension and the other face thereof being stressed in compression whereby the end portions of said slider clasp said intervening portion of said rotor to be guided and bidirectionally rotated thereby without lost motion, and said slider device including a guide fin disposed between next-adjacent convolutions of said element to be guided along said element incident to rotation of the device by rotation of said rotor, and said device having a contact brushing on said element; and

termination means electrically connected to respective ones of the ends of said element and said contact.

4. A variable resistor according to claim 3, the inner face of the arch of said slider clearing the said intervening portion of said rotor sufficiently to permit physical separation of the end portions of the slider to an extent sufficient to permit direct application of the slider device to said rotor in a direction transverse to said axis.

5. For a multiturn rotary potentiometer, an elongate rotor having a longitudinal axis of rotation and having first and second generally oppositely-outwardly-opening and inwardly-directed longitudinally-extending substantially-parallel grooves separated by an intervening longitudinally-extending ridge portion, whereby to provide longitudinally-extending parallel guideways spaced apart as viewed on a plane transverse of said axis; and

an arch-shaped slider device having complementary guides each engaging a respective one of said guideways and longitudinally slidable thereon, said guides being spaced apart by an arch-shaped body portion of said slider device and the inner portions of said arch-shaped body portion being under tensile stress and the outer portions thereof being under compressive stress, whereby the rotor between said guideways is compressively clasped by said slider device to substantially avoid lost-motion effects incident to reversal of direction of rotation of said rotor in driving said slider device.

6. In a variable resistor having a plural-turn helical resistance the helix of which is disposed around and along a straight-line axis and the convolutions of which element are formed to provide a helical groove thereadjacent, the combination therewith comprising:

first and second elongate structures, the first one bearing and supporting said element and the second having a longitudinal axis coincident with said straight line-axis, one of said first and second elongate structures being rotatable about said axis and the other being relatively stationary, one of said structures being hollow and dimensioned to encircle a part at least of the other structure and a generally cylindrical space in which space is situated said helical resistance elements, said second elongate structure having an elongate intermediate portion between and providing a set of oppositely-facing longitudinally extending substantially parallel guide surfaces spaced apart transversely of said axis;

a generally arch-shaped slider structure disposed in said cylindrical space between said first and second elongate structures and having first and second end portions spaced-apart by an intermediate arcuate portion and arranged to engage respective ones of said guide surfaces, one arcuate face of said arcuate portion being stressed in compression and an opposite arcuate face thereof being stressed in tension whereby said end portions press against respective ones of said guide surfaces, said slider structure being movable longitudinally along a path of motion through an extent of said space at a fixed distance from said axis and arranged to be driven along said path by engagement with said intermediate portion of said second elongate structure incident to relative rotation between said first and second structures;

a return-conductor;

a contact device mounted upon and carried by said slider structure and having a conductive contact to brush along said resistance element incident to said relative rotation, and having conductive electrical connection to said return conductor;

and electrical termination means, including terminals and respective connections therefrom to end portions of said resistance element and said return-conductor, whereby there is no lost motion between said slider and said guide surfaces incident to reversal of said relative rotation, to render accurate the movement of said first conductive contact on said resistance element.

7. In a variable resistor having a resistance element of helical form the convolutions of which are disposed around and along a straight-line axis and next-adjacent convolutions of which are formed to provide a helical groove therebetween, the combination therewith comprising:

first and second elongate structures, the first one bearing and supporting said resistance element and the second one having a longitudinal axis coincident with said straightline axis, one of said elongate structures being rotatable about said axis and the other being relatively fixed, one of said elongate structures being hollow to provide a cylindrical space therein and encircling said resistance element and a part at least of the other elongate structure, said second one of said elongate structures having a longitudinally-extending portion forming a set of oppositely-facing longitudinally-extending substantially parallel guide surfaces spaced apart transversely of said axis;

a generally arch-shaped slider structure disposed in said cylindrical space between said first and second elongate structures and spanning said portion of said second elongate structure and having first and second end portions spaced apart by an intermediate arcuate

portion and said end portions arranged to engage respective ones of said guide surfaces, one arcuate face of said arcuate portion being stressed in compression and an opposite arcuate face thereof being stressed in tension whereby said longitudinally-extending portion of said second elongate structure is gripped between said end portions of said slider structure, said slider structure having engagement with said resistance element for movement along the helical extent thereof and further having a contact brushing on said element; and

electrical connections to said contact and the electrical ends of said element;

whereby said slider is reversibly moved along said element without lost motion incident to reversals of relative rotation between said first and second elongate structures during adjustment of said contact to vary the resistance exhibited between said contact and an end of said element.

8. In a variable resistor having a resistance element of helical form the convolutions of which are disposed around and along a straight-line axis and next-adjacent convolutions of which are formed to provide a helical groove, the combination therewith comprising:

a rotor structure comprising a shaft rotatable about its longitudinal axis, the rotor structure comprising elongate guide means forming first and second longitudinally-extending oppositely facing spaced-apart grooves the bottoms of which grooves are closer together transversely of said axis than are sides thereof; resistance-element means comprising a helical resistance element the convolutions of which extend around and along said axis to be generally coaxial with said shaft and spaced outwardly from said rotor to provide a space therebetween, said resistance-element means providing a helical guideway between next-adjacent convolutions of the resistance element; means supporting said resistance element and said shaft in coaxial relationship;

an arch-shaped contact-carrier disposed in said space and having a portion disposed in said helical guideway and having first and second end-portions constructed and arranged to be disposed in respective ones of said grooves for longitudinal sliding traverse therealong, said first and second end-portions being interconnected by a generally arcuate intermediate body having an inner and an outer face, that portion of the body adjacent to the inner face being under tensile strain and that portion of the body adjacent to the outer face being under compressive strain whereby said guide means is gripped between said end portions of said contact-carrier, said contact-carrier comprising a conductive contact device arranged with a contact thereof in brushing contact with said resistance element;

and electrical connections to said contact and to end portions of said element.

9. The structure defined in claim 8, said rotor structure comprising, between said grooves, a longitudinally-extending conductive member forming part of said electrical connections; and said contact device comprising a second contact disposed in brushing contact with said conductive member.

10. For a variable resistor having an elongate rotor having oppositely-facing guide grooves generally parallel with the axis of the rotor, and a helical resistance element disposed with the convolutions thereof generally coaxial with the rotor and spaced therefrom transversely of the rotor axis to provide a generally-cylindrical intervening space;

a generally arch-shaped contact carrier having end portions interconnected by an intermediate body portion of arcuate shape and having an outer face and an inner face, said end portions being shaped and

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disposed to repose in respective ones of the grooves of the rotor, and that part of said intermediate body portion adjacent to and forming said inner face being in tension when said end portions are disposed in such grooves, whereby said contact-carrier grips the rotor to prevent lost motion therebetween; and a contact device carried on the contact-carrier and disposed for brushing engagement with such helical resistance element.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,099,809

July 30, 1963

Victor G. Mathison et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 49, strike out the comma, second occurrence; column 4, line 27, for "in" read -- is --; column 6, line 50, for "of", first occurrence, read -- or --; column 11, line 3, for "poriton" read -- portion --.

Signed and sealed this 21st day of January 1964.

(SEAL)

Attest:

EDWIN L. REYNOLDS

ERNEST W. SWIDER

Attesting Officer

Acting Commissioner of Patents