VARIABLE RESISTOR CONTACT DEVICE

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INVENTOR

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BY

Signature
VARIOUS RESISTOR CONTACT DEVICE
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3 Claims

ABSTRACT OF THE DISCLOSURE

A variable resistor or potentiometer contact device adapted to furnish optimum surface engagement with resistance element and conductor element or return in variable resistor constructions by being of close-wound helical resistive winding form allowing each convolution of the coil across the width of the element to conform to surface irregularities of the element.

CROSS-REFERENCES TO OTHER APPLICATIONS

This invention is related in certain respects to that disclosed in application Ser. No. 807,698 filed contemporaneously with this application.

BACKGROUND OF THE INVENTION

In the production of variable resistors such as potentiometers in which an electrical wiper or brush or contact is traversable along an extent of resistive material comprised in a resistance element whereby potential-division is variably effected between the electrical ends of the resistance element, continuing efforts are made to reduce the physical size and mass of the resistors with concurrent attempts to improve or at least avoid lowering the electrical and mechanical qualities and characteristics of the instruments. Difficulties are encountered, however, in making parts smaller and smaller, in that mechanical rigidity, strength and durability decrease much faster than in direct proportion to decrease in size; so that the point is quickly reached at which further size reduction results in a weak and useless product. Further, as size decreases, difficulty is experienced in producing parts that are inexpensive and also accurate and uniform. Since in such resistors a resistance element has first and second ends or terminals between which a movable contact or wiper is arranged to brush, the physical length of the element also decreases with decrease in size of the resistor; and that increases the difficulty of providing uniformity of change of resistance with movement of the wiper, and increases the intensity of the problem of rapid wearing out of the element and/or wiper. Intensifying the problem of obtaining uniformity of change of resistance with wiper movement, especially in the case of circular or arcuate elements used in single-turn rotary potentiometers, is the decrease in lateral width of the element and the inability to produce wipers or contacts that are at once compact and inexpensive and yet capable of effectively brushing a very large proportion of the width of the element. To provide a maximum of effectiveness in brushing an extensive proportion of the width of the element, it has been proposed to make the contact of thin sheet-like metal and to slit or otherwise divide the sheet to form a plurality of resilient fingers each of which, theoretically at least, could flex and follow minute undulations or irregularities in the surface of the element. As wiper size were decreased in size, the cost of producing uniformly accurate contacts increased exorbitantly, and a point was reached at which the contact width was too small to be slit to produce self-sustaining fingers. Thus, with seriously increased production costs, and serious mechanical and electrical problems attending, a practical limit was reached in production of plural-finger wipers or contacts which were satisfactorily uniform from specimen to specimen and which were characterized by satisfactory operating longevity and practical precision cost. Those factors, all related to the wiper or contact, dictated a minimum practical size for adjustment (single-turn) potentiometers.

SUMMARY OF THE INVENTION

The invention herein disclosed permits a maximum of surface-conforming contact engagement with a transverse zone across the widthwise extent of an elongate resistance element, whether the latter be of arcuate shape or of rectangular form, while greatly increasing longevity of contact and/or element; and further results in reduction of contact cost and permits reduction of overall minimum size of potentiometer, relating to the prior art devices. These advantages and meritorious unobvious advances in the art from flow of use of a wiper or contact device very inexpensively produced as a section of helically coiled resilient wire. The helical spring thus produced is adapted to be held loosely captive with its axis transverse of the longitudinal axis of the resistance element, as in a pocket or recess of a slider or rotor, and with as many of its individual convolutions or turns as are accommodated by the width of the element each in individual contact with the latter along a straight transverse contact zone, and further with additional turns of the spring in brushing contact with a return conductor or collector which is disposed alongside the resistance element. Since the material of which the coil is composed may be an alloy selected to provide desired optimum wear resistance and electrical characteristics for the most desirable spring diameter and wire diameter, and since each turn or convolution may be made to act as an individual contact or finger, and since the spring may be so held captive that it partakes of a desired amount of rolling in combination with a desired amount of sliding, relative to the element being brushed, extremely efficient electrical contact is effected while concurrently greatly extending the art working life of the contact and the element. The rolling permits a relatively large area (the entire periphery of each of the element-brushing turns or convolutions) to be used as a wear area of the contact, and the sliding causes a desirable amount of wearing (which in effect cleans the contact). The ability of each turn to independently flex and move toward and away from the element surface permits the turns to very effectively brush the entire width of the element. Thus contact-resistance variation (CRV) is reduced to an extremely low minimum value, and since coil springs of even very small diametrical dimensions are extremely easy to form, the contact is very inexpensive relative to prior art element-brushing contacts. The relation between the degree of rolling contact and sliding contact, with the resistance element, can readily be regulated by use of a frictional pressure pad and/or by other applied constraints.

DESCRIPTION OF THE DRAWINGS

The accompanying drawings depict to grossly enlarged scale the invention as embodied in a miniature single-turn adjustment potentiometer. Therein:

FIG. 1 is a pictorial view of the exemplary selected potentiometer embodying the invention, to no measured scale;

FIG. 2 is a transverse sectional view of the structure depicted in FIG. 1, the section being as indicated by directors 2—2 in FIG. 1;

FIG. 3 is a sectional view, partially offset, showing internal details of structure depicted generally in FIG. 1; the section being as indicated by offset directors 3—3 in FIG. 2;
FIG. 4 is a fragmentary view in elevation, with parts in section, illustrating a helical spring contact according to the invention as it partakes of combined rolling and sliding brushing contact with a resistance element and associated conductor, and

FIG. 5 is a plan view illustrating the geometrical arrangement of collector, resistance element, terminals and base of the illustrative potentiometer.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention is illustrated as embodied by way of examples in a miniature single-turn rotary adjustment potentiometer all parts of which with the exception of the rotor and contact device are conventional except as to physical dimensions. The potentiometer generally is denoted by number 10. It comprises an insulative base 12 which preferably is of ceramic material, and a cap 14 of spun sheet metal and which is attached to the base by depending legs or lugs such as 14a which are received in complementary recessed slots such as 12a formed in the base, the legs 14a being crimped inwardly as indicated at the lower left in FIG. 2. Thus the cap is secured to the base to form or provide an open-top chamber in which a rotor 16 of insulation is held captive.

The rotor is of circular plan form, and has a rotor or stub 16o, which extends through and is journaled in, a generally disposed opening 14o produced in the cap 14. The rotor is provided with a circular foot 16f which is arranged to limit approach of the bottom face of the rotor toward the base 12, as indicated in FIGS. 2 and 3. The lower outside periphery of the rotor is cut away or formed to provide a space for reception of a resilient ring-seal 15 which seal is thus pressed into sealing contact with base 12, cap 14 and rotor 16, whereby undesired material (e.g., dust or grease) is prevented from passing inwardly toward the center of the upper face of base 12.

Base 12 has formed on the upper face thereof an elongate arcuate flat film-like adherent resistive element 20 which in this instance is arranged with the center of the strip along a circle whose axis is coincident or on the axis of the potentiometer about which the rotor 16 is constrained to rotate. The element 20 or may be of the type and material well known in the art as an arcuate cermet element. An example of the upper face of base 12 is a return conductor or collector 22 of adherent conductive material such as silver. The collector is formed as a circular disc-shaped film the center of which is coincident with that of element 20. Terminal means are provided for the two electrical ends of element 20 and for collector 22, in any of several well-known ways; for example, as somewhat diagrammatically depicted on a reduced scale in FIG. 5. Therein, base 12 is formed with molded-in wire pin inserts T1, T2 and T3, the latter being a straight length of wire and the former two having offsets embedded in the base. The lower ends of the terminal pins protrude from the base, whereas the upper ends are flush with, and exposed at, the upper face of base 12. The geometrical array of the protruding lower ends of the pins may be as desired, for example, such that the three pins occupy respective corners of a square whereby they may variously fit in a circuit board having square-arrayed perforations. The upper, exposed ends of the pins are so disposed that the collector 22 overlies and contacts pin insert T3, 65 and respective ends of pin inserts T1 and T2 are overlaid and in contact with respective conductive films F1 and F2 which may be similar to the collector 22 as regards material, and which films F1 and F2 underlie and connect with respect ends of the resistive element 20. The terminations, collector and element per se are known in the art and are exemplary only and are not hereinafter described.

The rotor 16 is formed or provided at its lower face with a shallow circular recess 16r (FIG. 2), and a rectangular deeper pocket or recess 16s the length of which is such that the recess extends laterally across the width of element 20 and across collector 22, as shown in FIG. 3. Disposed inside recess 16s and secured to the inner surface thereof is a resilient pad 24, of synthetic rubber foam or the like. Further disposed in the recess 16s and held captive therein by the walls bounding the recess, and by element 20 and collectors 22, is the contact device according to this invention. The contact device, denoted by number 26, is a helical spring formed from resilient conductive material such as phosphor bronze or other alloy. It may, if desired, be plated with precious metal, such as gold; or it may be made of precious metal alloy. The helical spring is, as indicated in the drawing, made of fine gauge wire, and is of diameter and length such as to have very slight clearance with the end and side walls of recess 16s. The recess is so dimensioned in depth, and pad 24 so dimensioned in thickness, that turns of the spring are pressed lightly into firm contact with the resistance element and with the collector. Since the wire is of circular or curved cross-section, each convolution or turn may easily shift upwardly or downwardly relative to its neighbors, and each turn is individually pressed downwardly by a respective portion of pad 24.

As the rotor 16 is rotated, as by rotation of a screwdriver engaged in the slot 16d in the upper end of the rotor, to effect adjustment of the division of potential between the terminals, the turns of the multiple-turn helical contact device 26 are forced to move along respective arcuate paths about the axis of the potentiometer. Due to the disposition of a majority of the turns along one radius of the rotor, there is a tendency for the spring to roll. That tendency is opposed by a measure of frictional drag imposed on the turns by pad 24, with the consequence that motion of device 26 as the rotor is rotated is, relative to element 20 and collector 22, partly a sliding motion and partly a rolling motion. The relative proportions of the two types of motion can be controlled to a considerable extent by choice of the material of pad 24 and by choice of the thickness and spring constant of the pad. Thus, a desirable slight rubbing or sliding of the contact device on the flat surface of the element is insured, whereby the contacting surface of the element and contact device turns are kept clean or oiled for electrical contact with low individual-turn contact resistance and low total contact resistance. Concurrently, by virtue of the reduction of the sliding or rubbing contact action due to the rolling portion of the spring motion, wearing of the contact is greatly reduced; and by virtue of the rolling action bringing different segments of the turns of the spring into contact with the element and thus gradually distributing contact-wear around the entire periphery of the contacting turns, the ability of the potentiometer to endure and attain very long operating life is greatly augmented.

I claim:
1. A variable resistor comprising:
first means, including an elongate flat-surfaced resistance element and a conductive collector therewith adjacent;
second means, including supporting means, supporting said resistance element and collector;
third means, including a single-turn conductive helical spring contact device disposed transversely of the length of said element and having a plurality of the turns thereof in contact with said element and a portion in contact with said collector; and
fourth means, including means for pressing turns of said contact device against said element and for moving said contact device along said element with a motion partly rolling and partly sliding.
2. A variable resistor according to claim 1, in which said supporting means is a base on which said element is an arcuate film-like adherent deposit arranged around an axis and in which said fourth means is a rotor rotatable.
about said axis and having a recess containing said contact device whereby incident upon rotation of said rotor said contact device is moved along said element with rolling and sliding motion.

3. A variable resistor according to claim 1, said fourth means comprising a rotor carrying said contact device, and said resistor further comprising a cap disposed about said rotor and defining an axis of rotation for said rotor, and said resistance element being arcuate and disposed along a circular course encircling said collector.

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