United States Patent [19]

Koch et al.

[11] **3,872,420**

[45] **Mar. 18, 1975**

[54] **ROTARY POTENTIOMETER**

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[22] Filed: **Jan. 24, 1974**

[21] Appl. No.: **436,209**

[30] **Foreign Application Priority Data**

Feb. 16, 1973 Germany 2307680

[52] **U.S. Cl.** **338/162,** 338/163, 338/174, 338/196, 338/202, 338/DIG. 1

[51] **Int. Cl.** **H01l 9/02**

[58] **Field of Search** ..... 338/162, 174, 196, 202, 338/118, 160, DIG. 1, 334, 166, 168, 175, 176, 163, 184

[56] **References Cited**

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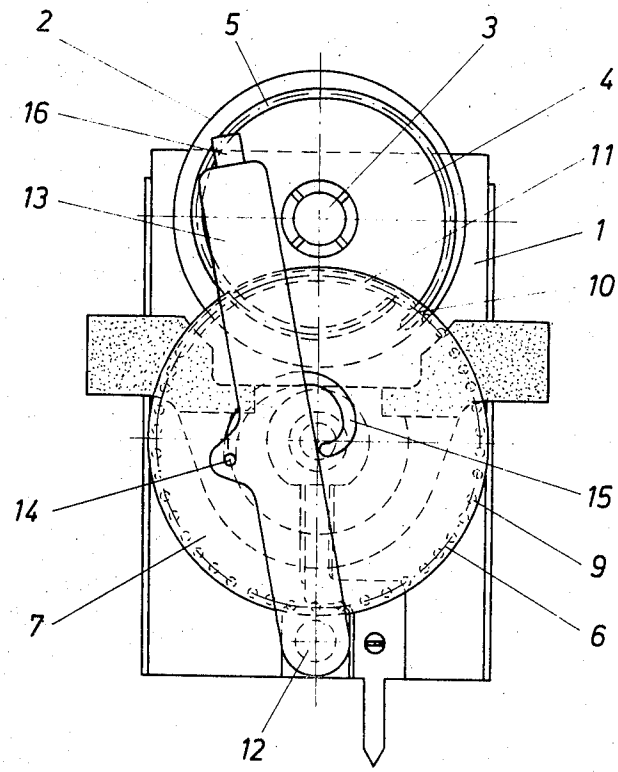
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Primary Examiner—Bruce A. Reynolds
Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**

The resistance element of a potentiometer is a flat semicircular strip with ends having outward extensions providing jutting contact tabs that may be slipped into spring clips and inward extensions fitting into notches in a centering boss of the carrier plate of the device so that the resistance element can be accurately positioned without affixation. The rotating wiper is mounted on the inside surface of a drive wheel that has one contact that slides along the resistance element and a pair of spring contacts that engage an annular surface of a contact lug that passes under the resistance element in a channel in the carrier plate. The outer surface of the drive wheel has a spiral groove that guides a pointer. The axis of the drive wheel and of the potentiometer is skewed relative to the position of the thumb wheel by which the drive wheel is propelled, so that the spiral ridge on the thumb wheel will engage the crown teeth of the drive wheel at only one location. If the thumb wheel is made to project through a slot in a panel, the pointer will move essentially across the slot along or near the thumb wheel.

4 Claims, 5 Drawing Figures



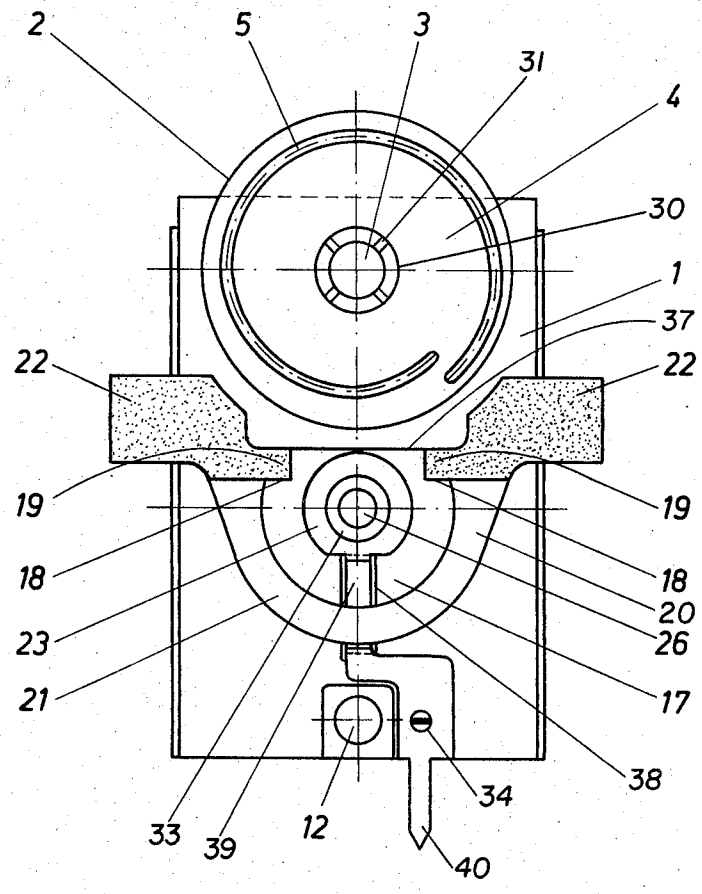


Fig. 1

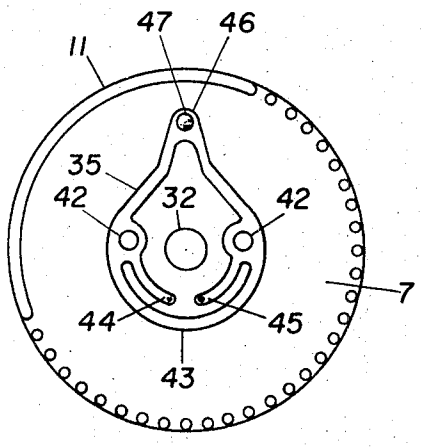


Fig.4

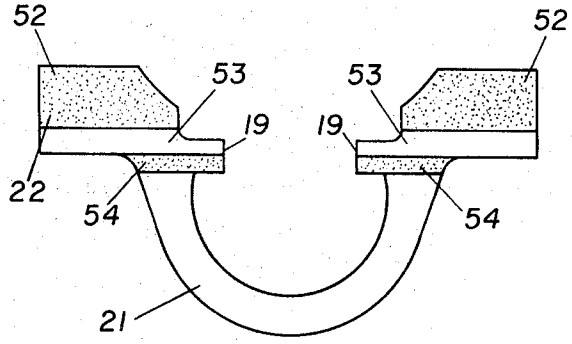


Fig.5

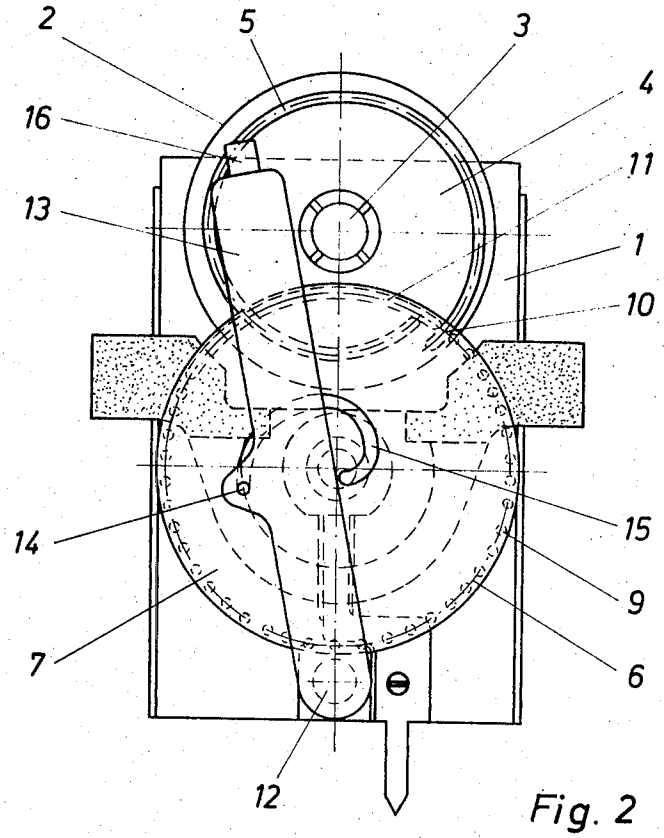


Fig. 2

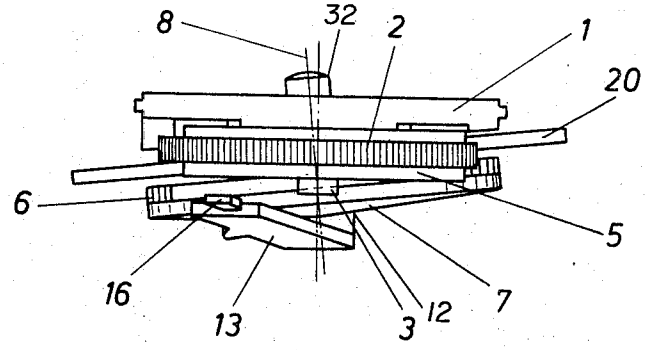


Fig. 3

ROTARY POTENTIOMETER

The invention relates to a rotary potentiometer, particularly of the kind that is used for making adjustments on a television set, in which a control wheel is in the form of a knurled disc of which only a little of the periphery projects through the front of the set and in which a rough indication of the adjustment is provided by a pointer which, like the control wheel, moves in a plane perpendicular to the panel of the set through which the control wheel protrudes. This invention relates to the electrical elements of such a potentiometer.

The type of mechanical control drive for a potentiometer just mentioned is described in the published German Patent application (Offenlegungsschrift) No. 1,951,972. In this type of device one entire revolution of the control wheel advances a crown toothed drive wheel affixed to the potentiometer shaft by only one tooth. This mechanical drive system is further described below so that the cooperation of these mechanical elements and of the electrical elements constituted according to this invention may be fully appreciated. In a known form of potentiometer driven by a mechanical drive of the type just mentioned, the resistance element along which the contact of the wiper arm moves when the potentiometer is adjusted is riveted at its connections with connection lugs, the rivets holding the resistance element and its lugs to the carrier plate of the device. This way of providing for connection to the resistance element is produced with considerable variation in the resistance of the connection, which is dependent upon the stability of the resistance carrier material, the surface of the material and the clamping force of the riveting. Furthermore, the riveting can produce cracks in the carrier material and in the layers applied to it. When connections are soldered to the lugs, furthermore, there is also the risk that an insulating layer will be deposited between the resistance layer of the resistance element and the slider of the potentiometer, as the result of condensation of soldering vapors.

It is an object of the invention to reconstitute the electrical elements of this type of potentiometer so as to overcome the above mentioned disadvantages.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, the resistance element is made in the form of a semicircular flat piece with extended lengths having outwardly extending portions providing connection tabs with metallized surfaces extending beyond the edges of the carrier plate. A centering boss on the carrier plate fits against the interior edge of the resistance element and provides notches into which inward projections provided on the resistance element nest. The resistance element is seated on the carrier plate in a plane parallel to the disc of its drive wheel, which is skewed at a small angle with reference to the plane of the disc of the control wheel.

The advantages of this arrangement are that the connection tabs of the potentiometer are readily and conveniently insertable in spring contact devices and it is relatively simple as well as reliable to mount one or more such potentiometers in spring clips.

The invention will be further described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a plan view of a partly assembled potentiometer;

FIG. 2 is a plan view of a completely assembled potentiometer;

FIG. 3 is an elevation view from the front side of the potentiometer of FIG. 2, which is at the top in FIG. 2;

FIG. 4 is a plan view of the drive wheel of the potentiometer of FIG. 2, shown from the side carrying the contact wiper or slider of the potentiometer, and

FIG. 5 is a plan view of a modified form of resistance element for use in the potentiometer of FIGS. 1, 2 and 3.

FIG. 1 shows a carrier plate 1 on which have been mounted the control wheel 2, the resistance element 21 and the central connection lug 23. The control wheel 2 is mounted on the carrier plate 1 by means of a hub 30 surrounding the cylindrical post 3 which is molded integral with the carrier plate. Either or both of the ends of the hub 30 may be split, as shown for example at 31, to assure a good rotating fit.

FIG. 2 shows the potentiometer of FIG. 1 after the drive wheel 7 and the pointer 13 have been put into place. FIG. 3 is an edge view of the assembly of FIG. 2 from the front edge of the device, which is at the top in FIG. 2.

As may be seen from FIG. 3, whereas the control wheel 2 and a portion of the carrier plate 1 immediately above it are disposed horizontally, the drive wheel 7 is set askew on an axis 8 tilted laterally from the vertical by a small angle. As a matter of practical construction, the portion of the carrier plate to the rear of the control wheel 2 (below the control wheel 2 in FIG. 2) have surfaces that are slightly oblique instead of horizontal, being parallel to the plane of the disc of the drive wheel 7 and perpendicular to the axis 8. In this manner the resistance element 20, as is clear from FIG. 3, is mounted in an oblique plane parallel to the disc of the drive wheel 7. The drive wheel 7 is provided with an axle 32 molded integrally therewith, held in a hub 33, and is preferably provided with a spring washer, not shown, to prevent the drive wheel from being removed by an axial pull after it is fully assembled.

The drive wheel 7, as shown more particularly in FIG. 4, is provided with a crown of peg-like teeth 9 on the side on which the potentiometer wiper 35 is carried. The teeth 9 do not go all the way around the periphery, being replaced with a continuous ridge 11 for part of the periphery. The other side of the drive wheel 7 is slightly domed and has a groove 15 which guides an actuating boss 14 of the pointer 13 that has a pivot stud at its fulcrum that fits into the bearing 12 of the carrier plate.

The device operates as follows. The control wheel is rotated by the user's thumb acting on the projecting front edge. As it rotates the ridge 5, in the form of a single turn spiral near its outer edge, slides through the gap 6 between adjacent teeth 9 of the drive wheel. Because the axis of the drive wheel 7 is skewed with respect to the control wheel 2, the spiral ridge 5 engages the teeth of the drive wheel at only one place of its periphery. A complete revolution of the control wheel 2 rotates the drive wheel by the angle between successive teeth 9 and this rotation may be performed in either direction. The ridge 11 acts as a stop to limit the range of rotation of the drive wheel to the desired amount of travel of the wiper 35 on the semicircular portion 21 of the resistance element 20. As the drive wheel rotates,

the boss 14 of the pointer 13 moves in the spiral groove 15, swinging the pointer 13 across a portion of the disc of the drive wheel 7. The position of the nose 16 of the pointer 13 is visible from the front of the device where the front edge of the control wheel extends forward of the carrier plate 1 and therefore provides an indication of the adjustment of the potentiometer. The control wheel 2 is knurled so that it may easily be manipulated.

The electrical components of the potentiometer of this invention are more particularly shown in FIGS. 1, 4 and 5. The resistance element 20 is a semicircular strip of flat material with extended legs having outwardly jutting tabs 22. The resistance element 20 may consist entirely of a resistive composition of the desired characteristics or it may be composed of a strip of insulation with a film on its upper surface having the desired resistance characteristics. The tabs 22 are provided with a metallized contact surface as indicated by the dashed shading. This metal surface is preferably of a kind used for contact elements designed for insertion into spring contacts rather than of the kind designed to accept solder. The resistance element 20 is seated on a surface of the carrier plate 1 which is perpendicular to the axis of the hub 23 and its bore 26 in which the shaft 32 of the drive wheel 7 revolves. It is not necessary, however, that this slightly oblique seating surface should extend under the entire lower surface of the tabs 22. The line 37, for example, may be the boundary between the oblique surfaces and the horizontal surfaces of the carrier plate 1. The carrier plate 1 has a raised centering boss 17 the outer edge of which fits the inner edge of the resistance element 20 and provides notches 18 into which the inward projections 19 of the resistance element may nest, thus accurately positioning the resistance element 20 and making it quite unnecessary to affix the resistance element 20 to the carrier plate 1. The centering boss 17 is interrupted by a channel 38 that provides a deep cavity in the carrier plate through which the lug strip 39 may pass under the resistance element 20 in a position spaced somewhat from the resistance element 20.

The lug 39 has a strip of metal that also has an annular portion 23 providing an inner contact surface for the potentiometer wiper 35. The annular portion 23 of the lug 39 fits around the hub 33. At its other end the lug 39 is riveted to the carrier plate 1 either by means of a metal rivet 34 or by deforming a boss of the carrier plate projecting through the hole in the strip 39. The lug strip 39 continues past the rivet 34 to form a projecting end 40 to which a wire may be soldered or crimped. If desired this lug may also be provided in a form that will make contact with other circuit elements by being slipped into a spring clip.

If desired, the carrier plate 1 may also be provided with a contour to fit the outer edge of the resistance element 20, or with one or more bosses to engage the outer edge of the resistance element 20.

Construction of the slider or wiper element 35 (in a rotary potentiometer a potentiometer slider is frequently called a wiper) is shown in FIG. 4. It is made of resilient metal and is held in bosses 42 formed integral with the drive wheel 7 which may, if desired, be riveted over. The semicircular portion 43 rests against the disc of the drive wheel 7. Inner contact springs 44 and 45 extend away from the drive wheel disc for engagement with the annular portion 23 of the lug 39. The remainder of the structure forms the cusp 46 that, like the spring portions 44 and 45, extends somewhat away from the disc of the drive wheel 7, in this case for making contact with the semicircular portion 21 of the resistance element 20. A contact stud 47 is mounted near the apex of the cusp and this may be a metal or a graphite material chosen for making good contact with relatively little wear on the resistance element 20. Depending on the size of the contact stud 47 it may be desirable to provide a hole (not shown) in the disc of the drive wheel 7 immediately in back of the contact stud 47.

The metal coatings on the tabs 22 may be provided by electroplating, vapor deposition, dipping in molten metal, or by other metallizing processes. Preferably a hard silver plating is provided on these tabs.

FIG. 5 shows a modified form of resistance element for the potentiometer of the present invention. In this case the metallizing of the tabs 22 is confined to an end portion 52 and there are intermediate parts 53 of the resistance element that add resistance to the circuit but are inaccessible to the contact 47 of the wiper 35, an arrangement which may be desired on account of electrical requirements of the particular circuit into which the potentiometer is placed. At or near the ends of the travel of the wiper contact 47 additional metallized portions 54 are provided, effectively short circuiting small lengths of the resistor element, so that variations from one device to another in the extent and centering of the range of travel of the wiper contact 47 will not be accompanied by any variation in the circuit values for the extreme positions of the wiper.

Although the invention has been described with respect to a particular embodiment, it will be understood that variation and modification are possible within the inventive concept.

In the preferred construction of the resistance element 20 a carbon film is vacuum-deposited on a substrate made of cured phenolic resin or some other hard insulating sheet material.

The carbon film is applied before the base resistance element is stamped from the insulating material. The hard silvering of the tabs 22 is preferably accomplished by printing.

The wiper 35 is preferably made of suitably plated brass or phosphor bronze, for example silver or tin plated, and the wiper contact 47 is preferably made of carbon.

The central connection lug is preferably of tinned copper and is preferably (for simplicity) riveted in place by peening over a stud formed integrally with the carrier plate, which is made of glass fiber fortified poly carbonate.

We claim:

1. In a rotary potentiometer having a drive wheel of the peg-toothed crown gear type, engaged with an approximately one-turn spiral ridge provided on a control wheel in the outer part of a disc surface thereof, said drive wheel and the potentiometer arm being rotatably mounted slightly askew to the control wheel on a carrier plate on which said control wheel is also rotatably mounted, so that by the engagement of said control wheel and said drive wheel one revolution of said control wheel will rotate said drive wheel by one tooth, said teeth of said drive wheel being in the form of evenly spaced pegs over part of the periphery of said drive wheel, the improvement which is that the electrical portion of the rotary potentiometer comprises:

a resistance element consisting essentially of a substantially semicircular segment of an annular disc, including an exposed layer of resistance material, with the legs thereof extended to form outwardly extended contact tabs provided with a metallized contact surface, said resistance element being seated on said carrier plate approximately parallel to the disc of said drive wheel with its tabs extending respectively beyond opposite edges of said carrier plate;

central connection lug means seated on said carrier plate and having an annular disc portion concentric with and within the semicircular segment of said resistance element and providing an annular contact surface and having also a strip portion extending away from said annular portion and at least for part of its length seated in a channel in said carrier plate so as to pass under said semicircular portion of said resistance element without contact therewith and providing a connection lug in the neighborhood of its extremity, and

wiper means affixed to said drive wheel for making contact with said annular contact surface of said central connection lug means and with said resistance element.

2. Improvement in a rotary potentiometer as defined in claim **1** in which said carrier plate has a raised centering boss on which said annular contact surface of said central lug means is seated, said centering boss being shaped not only to provide part of the channel in which the strip portion of said central connection lug means is seated but also being shaped to fit the inner edge of said resistance element and being provided with positioning notches near the location of the said tabs of said resistance element and in which, further, said resistance element has projections fitting into said notches, whereby the resistance element is accurately positioned without necessity of affixation.

3. Improvement in a rotary potentiometer as defined in claim **2** in which fixed resistance portions are provided respectively in series with both ends of the potentiometer by the presence, between the portion of said tabs having metallized contact surfaces and the ends of said semicircular portion of said resistance element, of an extension of said semicircular portion not provided with a metallized surface and located beyond the range of movement of the outer contact of said wiper means.

4. Improvement in a rotary potentiometer as defined in claim **3** in which said resistance element has additional metallized surfaces in the respective regions of the ends of the path of travel of said outer contact of said wiper means.

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