June 11, 1968 G. W. WOOD 3,388,365

VARIABLE RESISTOR WITH VERNIER DRIVE

Filed July 25, 1967

FIG. 2

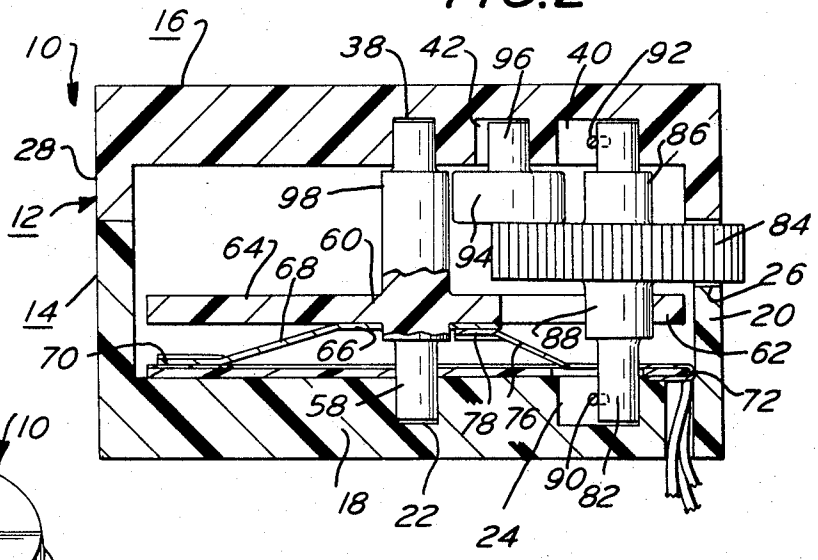
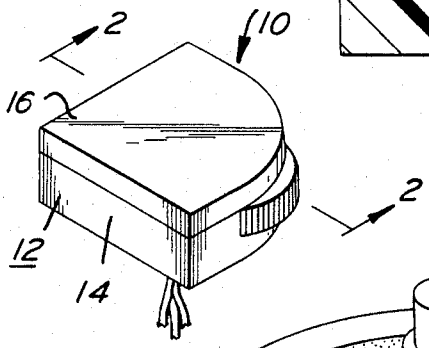


FIG. 1



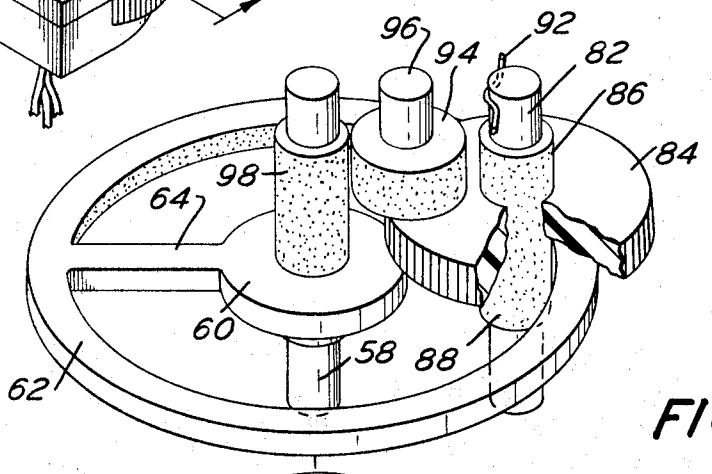
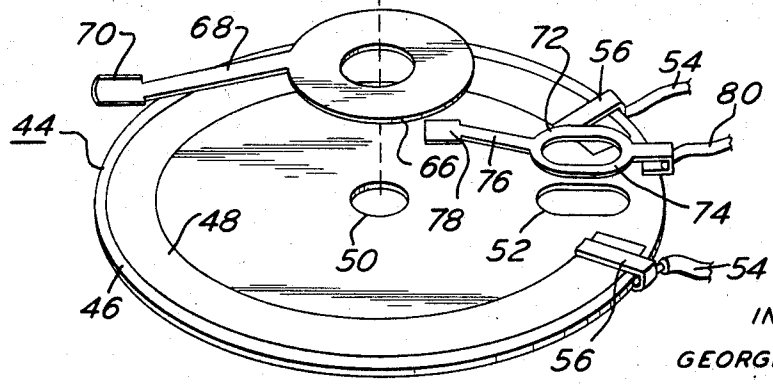


FIG. 3



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VARIABLE RESISTOR WITH VERNIER DRIVE

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ABSTRACT OF THE DISCLOSURE

A variable resistor comprising a flat, rectangular housing, having one rounded corner and an enclosed cavity. A resistance element having an annular resistance path is mounted within the housing. A shaft is rotatably supported within the cavity for rotation about the axis of the annular resistance path. A contact is carried by the shaft and slidably engages the resistance path. A drive wheel is rotatably supported in the housing and extends through an opening in the rounded corner of the housing to permit rotation of the drive wheel. A first drive connection is provided between the drive wheel and the shaft whereby rotation of the drive wheel rotates the shaft only a fraction of the amount that the drive wheel rotates. A second drive connection is provided between the drive wheel and the shaft whereby rotation of the drive wheel rotates the shaft substantially the same amount. The drive wheel is movable between a position in which the first drive connection is operable and a position in which the second drive connection is operable. This provides a vernier drive in which the second drive connection provides rough adjustments of the variable resistor and the first drive connection provides fine adjustments.

Background

With the trend to miniaturization of electrical components, there has been developed several types of miniature variable electrical resistors. One such miniature variable resistor is the type shown in United States Letters Patent No. 3,127,583, issued Mar. 31, 1964, to M. W. Hudson et al., entitled "Variable Resistor." This type of variable resistor in general comprises a flat, substantially rectangular, housing having an enclosed cylindrical cavity therein. An annular resistance element is mounted within the cavity for rotation about an axis which is on the axis of the annules of the resistance element. A contact is carried by the gear and slidably contacts the resistance element so that rotation of the gear moves the contact along the resistance element. A drive shaft is rotatably mounted in the housing and projects beyond a side edge of the housing so that it is exposed for rotation. The drive shaft has a worm gear thereon which meshes with the gear so that rotation of the shaft rotates the gear.

In this type of variable resistor, the purpose of the gear drive is to require a number of turns of the drive shaft to move the contact along the resistance element. Thus, the contact is moved along the resistance element in small increments so that an accurate setting of the contact on the resistance element can be easily obtained. This permits the achievement of accurate resistance values in a miniaturized variable resistor. However, one problem with this type of variable resistor is that to achieve a large change in the resistance value setting of the variable resistor is a time-consuming operation in that it requires a great number of turns of the drive shaft to achieve the change. Therefore, it would be desirable to have such a miniaturized, variable resistor which provides for ease of achieving large changes in the resistance setting of the variable resistor, as well as permitting small increments of change.

Summary of invention

It is an object of the present invention to provide a novel variable electrical resistor.

It is another object of the present invention to provide a variable electrical resistor having a vernier drive to the contact so as to permit rough and fine adjustments of the position of the contact along the resistance element.

It is a further object of the present invention to provide a variable resistor having a drive wheel for moving a contact along a resistance element, a first drive connection between the drive wheel and the contact which moves the contact by small increments along the resistance element and a second drive connection between the drive wheel and the contact which moves the contact by large increments along the resistance element.

Other objects will appear hereinafter.

Brief description of drawing

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a perspective view of the variable resistor of the present invention.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1.

FIGURE 3 is an exploded perspective view of the parts of the variable resistor which are within the housing.

Referring to the drawing, the variable resistor of the present invention is generally designated as **10**. Variable resistor **10** comprises a flat, substantial square housing **12** which has one rounded corner. Housing **12** includes a bottom section **14** and a cover **16** fitting on and secured to the bottom section. The bottom section **14** comprises a flat base **18** and an upright wall **20** around the edges of the bottom base **18**. The base **18** has a cylindrical bearing hole **22** in the center thereof and an elongated bearing hole **24** therein adjacent the rounded corner. The upright wall **20** has an opening **26** therethrough at the rounded corner of the housing **12**. Cover **16** has a downwardly extending rim **28** around its edges which is seated on the upright wall **20** of the bottom section. The cover **16** is secured to the bottom section **14** by a suitable cement. The inner surface of the cover **16** has a central cylindrical bearing hole **38** which is in alignment with the bearing hole **22** in the base **18**, an elongated bearing hole **40** which is of the same shape as and is in alignment with the hole **24** in the base, and a third bearing hole **42** between and in radial alignment with the bearing holes **38** and **40**.

A resistance element **44** is mounted on the base **18**. As shown, resistance element **44** comprises a flat, circular disk **46** of an electrical insulating material, such as a plastic or ceramic. A narrow strip **48** of an electrical resistance material, such as carbon or a metal, is coated on the top surface of the disk **46** and extends in an annular path around the edge of the disk. The resistance strip **48** does not extend completely around the disk **46** but has ends which are slightly spaced apart. The disk **46** has a central hole **50** therethrough and an elongated hole **52** therethrough between the ends of the resistance strip **48**. The central hole **50** is directly over the bearing hole **22** in the base **18**, and the elongated hole **52** is of the same size as and is directly over the elongated bearing hole **24** in the base. Terminal wires **54** are connected to the ends of the resistance strip **48** by metal clips **56**. The terminal wires **54** extend through an opening in the base **18** of the bottom section **14**. The resistance element **44** could also comprise an annular core of an electrical

insulating material having either a film of a resistance material coated thereon or a resistance wire helically wound therearound. Such a resistance element would be mounted on the base 18 and extend along the wall 20.

A main shaft 58 extends between the cover 16 and the base 18 of the bottom section 14. The ends of the shaft 58 are rotatably supported in the bearing holes 22 and 38. An annular flange 60 extends radially outwardly from the shaft 58 adjacent the base 18. An annular ring 62 circumscribes the flange 60 and is secured thereto by a radially extending rib 64. The outer diameter of the ring 62 is substantially equal to the outer diameter of the resistance element 44.

A flat, annular contact 66 of an electrically conductive metal extends around the shaft 58 beneath the flange 60 and is secured to the flange so as to rotate therewith. A contact arm 68 extends radially outwardly from the contact 66 and downwardly toward the resistance strip 48. A contact finger 70 on the end of the contact arm 68 slidably engages the resistance strip 48. A collector member 72 of an electrically conductive metal is mounted on the resistance element disk 46 between the ends of the resistance strip 48. The collector member 72 has an elongated opening 74 therethrough which corresponds to the elongated opening 52 in the resistance element disk 46. An arm 76 extends radially inwardly from the collector member 72 and upwardly toward contact 66. A finger 78 on the end of the arm slidably engages the bottom surface of the contact 66. A terminal wire 80 is secured to the collector 72 and extends through the opening in the base 18 along with the terminal wires 54.

A drive shaft 82 extends between the cover 16 and the base 18 and is rotatably supported in the elongated bearing holes 24 and 40. The drive shaft 82 extends along the inner periphery of the ring 62 and through the openings 52 and 74 in the resistance element disk 46 and collector 72 respectively. A drive wheel 84 extends around and is secured to the shaft 82. The drive wheel extends through the opening 26 in the housing wall 20 so that it is accessible from outside the housing 12 to permit rotation of the drive shaft 82. Drive shaft 82 has a pair of circumferential drive surfaces 86 and 88 above and below the drive wheel 84 respectively. The lower drive surface 88 extends within the ring 62 and is adapted to engage the inner periphery of the ring. A pair of springs 90 and 92 extend across the elongated bearing holes 24 and 40 respectively. The springs 90 and 92 engage the shaft 82 and press the shaft against the ends of the elongated bearing holes which are closest to the outer wall of the housing 12. This also holds the lower drive surface 88 of the shaft 82 against the inner periphery of the ring 62.

An idler wheel 94 is seated on the top surface of the drive wheel 84 between the drive shaft 82 and the main shaft 58. A stub shaft 96 extends upwardly from the idler wheel 94 and is rotatably supported in the third bearing hole 42 in the cover 16. The outer periphery of the idler wheel 94 is adapted to be engaged by the upper drive surface 86 of the drive shaft 82 and is adapted to engage a circumferential drive surface 98 on the main shaft 58. The drive surfaces 86 and 88 of the drive shaft 82, the inner periphery of the ring 62, the outer periphery of the idler wheel 94 and the drive surface 98 of the main shaft 58, are all of a construction which provides a driving connection between such mating drive surfaces when they are in mating relation. Such a driving connection can be either through frictional engagement of the mating surfaces or by providing such surfaces with suitable gear teeth.

In the operation of the variable resistor 10, the springs 90 and 92 normally urge the lower drive surface 88 into driving engagement with the inner periphery of the ring 62. Thus, when the drive wheel 84 is rotated to rotate the drive shaft 82, the ring 62 is rotated to rotate the main shaft 58. This rotates the contact 66 and moves the contact finger 70 along the resistance strip 48 to vary the resistance setting of the variable resistor 10. Since the diameter of the inner periphery of the ring 62 is much larger than the diameter of the drive surface 88 of the drive shaft 82, one rotation of the drive shaft 82 moves the contact finger 70 only a fraction of the total length of the resistance strip 48. Thus, a fine adjustment of the resistance setting of the variable resistor 10 can be obtained.

When the drive wheel 84 is pressed radially inwardly, the drive shaft 82 is moved along the elongated bearing holes 24 and 40 against the springs 90 and 92 until the upper drive surface 86 engages the periphery of the idler wheel 94 and the idler wheel also engages the drive surface 98 of the main shaft 58. This also moves the lower drive surface 88 out of engagement with the inner periphery of the ring 62. When the drive wheel 84 is rotated while holding it in its pressed-in position, the main shaft 58 is rotated by the drive shaft 82 through the idler wheel 94. Since the drive surfaces 86 and 98 of the drive shaft 82 and main shaft 58 are of substantially the same diameter, one rotation of the drive shaft will move the contact finger 70 along the entire length of the resistance strip 48. This provides a rough adjustment of the resistance setting of the variable resistor 10 which can be achieved quickly through a maximum of one turn of the drive wheel. Thus, by pressing in on the drive wheel 84 and rotating it, a large change in the resistance valve setting of the variable resistor 10 can be easily and quickly achieved, and by rotating the drive wheel 84 in its normal position, a fine adjustment of the resistance value setting can be achieved.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specifications as indicating the scope of the invention.

I claim:

1. A variable resistor comprising

a housing having an enclosed cavity therein;

resistance element having an annular resistance path mounted in the cavity in the housing;

a shaft mounted in the cavity in the housing for rotation about the center of the annular resistance path;

a contact carried by said shaft and slidably engaging said resistance path;

a drive wheel rotatably mounted within the cavity and extending through the housing so as to be accessible for rotation from outside the housing;

means providing a first drive connection between the drive wheel and the shaft whereby rotation of the drive wheel rotates the shaft a fraction of the circumferential distance that the drive wheel is rotated;

means providing a second drive connection between the drive wheel and the shaft whereby rotation of the drive wheel rotates the shaft substantially the same circumferential distance that the drive wheel is rotated; and

said drive wheel being movable between a first position in which it drivingly engages the first drive means and a second position in which it drivingly engages the second drive means.

2. A variable resistor in accordance with claim 1 in which the drive wheel is mounted on a second shaft which is rotatably mounted within the cavity parallel to but spaced from the first mentioned shaft.

3. A variable resistor in accordance with claim 2 in which the first drive means includes an annular ring within the cavity and connecting with said first shaft, said ring being connected to the first shaft so as to rotate therewith, and means on said second shaft drivingly engaging the inner periphery of said ring.

4. A variable resistor in accordance with claim 3 in which the second drive means includes an idler wheel mounted between said two shafts for rotation about an axis parellel to said shafts, said idler wheel drivingly engaging both of said shafts when the drive wheel is in its second position.

5. A variable resistor in accordance with claim 4 in which the housing includes a base, an outer wall extending from the edge of the base and a cover spaced from and extending across the base and mounted on the wall, the resistance element is mounted on the base, the shafts extend between and are rotatably supported in the base and the cover, and the drive wheel extends through the wall so as to be accessible for rotation.

6. A variable resistor in accordance with claim 5 in which the second shaft is supported in elongated bearing holes so as to permit the drive wheel to be moved between its two positions.

7. A variable resistor in accordance with claim 6 including spring means engaging said second shaft and normally urging the means on said second shaft into driving engagement with the inner periphery of said ring.

8. A variable resistor in accordance with claim 5 in which the base of the housing is rectangular and has one rounded corner and the drive wheel extends through the wall at the rounded corner.

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ROBERT K. SCHAEFER, *Primary Examiner.*

H. HOHAUSER, *Assistant Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

tent No. 3,388,365

June 11, 1968

George W. Wood

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, line 4, "IRC, Inc., ladelphia, Pa." should read -- TRW Inc., a corporation of Ohio --.

Signed and sealed this 3rd day of March 1970.

AL)
st:

ard M. Fletcher, Jr.
sting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents