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H. B. CASEY ET AL

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VARIABLE RESISTOR

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FIG. 1

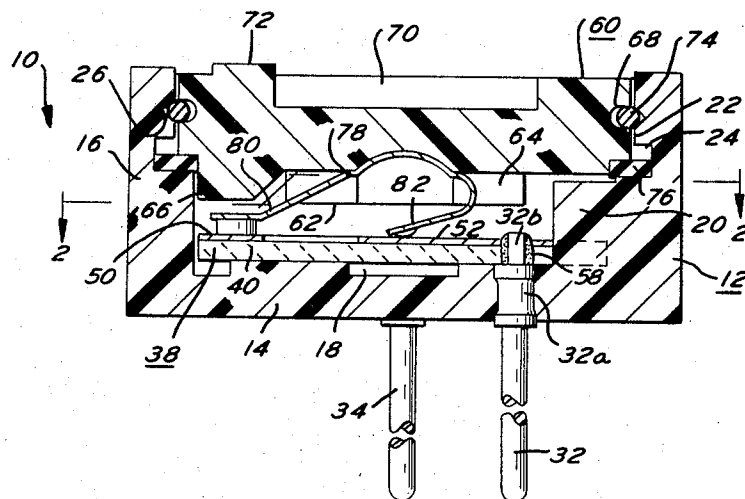


FIG. 2

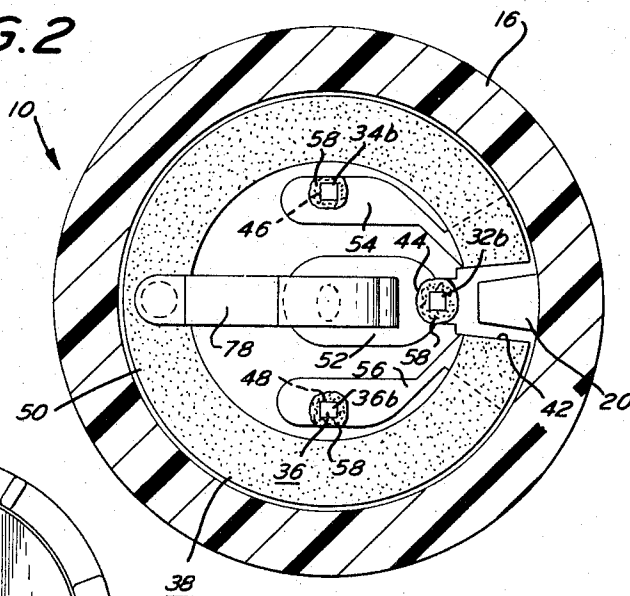
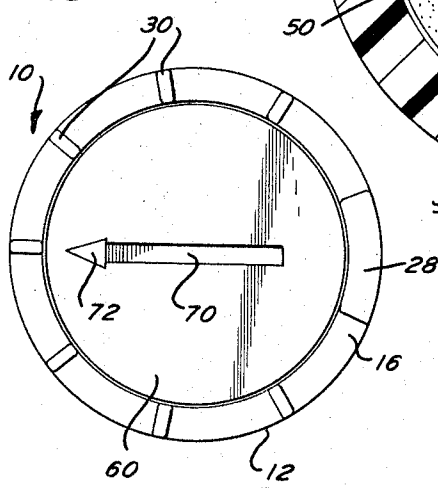


FIG. 3



INVENTORS.
HARRY B. CASEY
JOHN G. WOODS

BY *Donald S. Cohen*
ATTORNEY

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VARIABLE RESISTOR

Harry B. Casey, Willow Grove, and John G. Woods, Philadelphia, Pa., assignors to IRC, Inc., a corporation of Delaware

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7 Claims. (Cl. 338—174)

The present invention relates to a variable resistor, and more particularly to a subminiature variable resistor having a film type resistance element.

With the trend in the electronics industry to making electronic equipment smaller and more compact, there has developed a demand for miniaturized and subminiaturized electrical components. In the electrical resistor field a major problem in meeting this demand has been with regard to variable resistors, such as rheostats and potentiometers. In developing subminiature variable resistors, i.e. variable resistors no greater than one-half inch in diameter, it has been found that merely reducing the size of previously used variable resistors is not satisfactory because of the number of parts used in such variable resistors. If the parts of such previously used variable resistors are merely reduced in size, even by only one-half, the parts become so small that they are extremely difficult to handle and to assemble. In designing a subminiature variable resistor having a film type resistance element, another major problem which arises is in the manner of attaching the terminals of the variable resistor to the resistance path. Because of these problems in making a subminiature variable resistor, it has been found necessary to redesign the variable resistor and to minimize the number of parts making up the variable resistor so that the variable resistor can be easily and quickly assembled.

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

It is another object of the present invention to provide a novel subminiature variable resistor.

It is still another object of the present invention to provide a subminiature variable resistor having a film type resistance element.

It is a further object of the present invention to provide a subminiature variable resistor having a film type resistance element which can be easily and quickly assembled.

Other objects will appear hereinafter.

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 transverse sectional view of the variable resistor of the present invention.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1 with the cover of the variable resistor completely removed.

FIGURE 3 is an elevational view of the front side of the variable resistor of the present invention.

Referring initially to FIGURE 1, the variable resistor of the present invention is generally designated as 10.

Variable resistor 10 comprises a housing 12 of an electrical insulating material, such as a plastic. Housing 12 has a circular base 14, and a cylindrical wall 16 integral with and projecting from the edge of the base 14. In the subminiature variable resistor 10 of the present invention, the base 14 of the housing 12 can be as small as one-half inch in diameter, and the cylindrical wall 16 approximately one-quarter inch in length.

The base 14 of the house 12 has grooves 18 extending across its inner surface for reasons which will be explained later. A lug 20 is integral with the base 14 and projects

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upwardly from the inner surface of the base along the inner surface of the cylindrical wall 16. As shown in FIGURE 2, the opposite side walls of the lug 20 are tapered toward each other from the inner surface of the cylindrical wall 16. A cylindrical groove 22 is provided in the inner surface of the cylindrical wall 16. The cylindrical groove 22 extends from the free end of the cylindrical wall 16 to a point adjacent the lug 20. The cylindrical surface of the cylindrical groove 22 is provided with an annular groove 24 therein at the radial end surface of the groove 22. The cylindrical surface of the groove 22 also provided with a V-shaped groove 26 therearound intermediate its ends.

As shown in FIGURE 3, the free end surface of the cylindrical wall 16 of the housing 12 has a wide projection 28 integral therewith and projecting therefrom at the position of the lug 20. The projection 28 has a circumferential width of approximately 40 degrees and extends equal distances beyond each side of the lug 22. Seven additional narrow projections 30 are provided on the end surface of the cylindrical wall 16, and are uniformly spaced around the cylindrical wall. Thus, there is provided a 40 degree spacing between the projections 28 and 30.

Three relatively rigid terminals 32, 34 and 36 are secured to the base 14 of the housing 12, and project from the outer surface of the base. As shown in FIGURE 1, terminal 32 has an enlarged head 32a at one end thereof. The head 32a of the terminal 32 extends through and is secured in the base 14 of the housing 12. A pin 32b projects into the housing 12 from the top surface of the head 32a. The pin 32b has a transverse area smaller than that of the head 32a and the terminal 32. Each of the terminals 34 and 36 has a head, not shown, on one end similar to the head 32a of the terminal 32. Also, pins 34b and 36b, similar to the pin 32b project into the housing 12 from the heads of the terminals 34 and 36. Terminal 32 is positioned adjacent the inner end of the lug 20 and in radial alignment with the lug. Terminals 34 and 36 are positioned at opposite sides of the terminal 32 and are circumferentially spaced approximately 90 degrees from the terminal 32 so as to be in diametrical alignment.

A resistance element, generally designated as 38, is mounted on the inner surface of the housing base 14. Resistance element 38 comprises a relatively thin, flat, circular disk 40 of an electrical insulating material, such as a glass, ceramic or plastic. Disk 40 is of a diameter slightly less than the inner diameter of the housing cylindrical wall 16. A substantially rectangular notch 42 is provided in the edge of the disk 40 which is slightly larger than the lug 20 on the housing 12 (see FIGURE 2). A substantially U-shaped notch 44 is provided in the disk 40 at the bottom surface of the notch 42. The U-shaped notch 44 is narrow than the bottom end of the notch 42. A pair of holes 46 and 48 are provided through the disk 40. The holes 46 and 48 are positioned at opposite sides of the notch 44 and are circumferentially spaced 90 degrees from the notch 44 so as to be in diametrical alignment.

A substantially annular resistance path 50 is provided on the top surface of the disk 40. The resistance path 50 extends around the edge of the top surface of the disk 40 from one side of the notch 42 to the other side of the notch, and is of a width slightly less than the depth of the notch 42. The resistance path 50 comprises a film of any well known resistance material, such as carbon or a metal either with or without a suitable binder, coated on the surface of the disk. A contact termination 52 is provided on the top surface of the disk 40 and extends from along the sides of the U-shaped notch 44 to across the center of the disk 40. The contact termination 52 comprises a film of an electrically conductive material, such as a metal, coated on the surface of the disk 40. Although

there are many well known conductive materials which can be used for the contact termination 52, a preferred material is a mixture of conductive metal particles and a glass frit which is applied to and fired on the disk 40. Resistor terminations 54 and 56 are provided on the top surface of the disk 40, and extend from under opposite ends of the resistance path 50 along the sides of the notch 42 to areas around the holes 46 and 48 respectively in the disk 40. The resistor terminations 54 and 56 are thin films of an electrically conductive material, preferably the same material as that of the contact termination 52, coated on the disk 40.

The resistance element 38 is seated on the inner surface of the housing base 14 with the lug 20 fitting in the notch 42 and the terminal pins 32b, 34b and 36b extending through the notch 44 and the holes 46 and 48 respectively. The resistance element 38 is secured to the housing base 14 by a suitable cement. The terminal pins 32b, 34b and 36b are of a length to project to approximately the top surface of the resistance element 38, and are electrically connected to their respective terminations 52, 54 and 56 on the resistance element by an electrically conductive cement or solder 58. Thus, the terminal 32 is electrically connected to the contact termination 52, and the terminals 34 and 36 are electrically connected to opposite ends of the resistance path 50 through the resistor terminations 54 and 56.

A circular cover 60 of an electrically insulating material is mounted in the open end of the housing 12. Cover 60 is of a diameter substantially equal to the diameter of the cylindrical wall of the groove 22 in the housing wall 16. Thus, the cover 60 extends completely across the open end of the housing 12 with the edge of the cover rotatably fitting in the groove 22 in the housing wall 16. A cylindrical hub 62 is provided on the center of the inner surface of the cover 60. The hub 62 has a slot 64 extending diametrically thereacross. A stop lug 66 projects from the inner surface of the cover 60 adjacent one end of the slot 64 in the hub 62. The peripheral surface of the cover 60 has an annular groove 68 therein which is directly opposed to the V-shaped groove 26 in the housing wall 16. The outer surface of the cover 60 has a narrow slot 70 extending diametrically across the center portion thereof. As shown in FIGURE 3, a triangular shaped projection 72 is provided on the outer surface of the cover 60 adjacent one end of the slot 70. The projection 72 is positioned with its base being adjacent the end of the slot 70, and its apex being adjacent the edge of the cover 60 and in alignment with the longitudinal axis of the slot 70. Thus, the slot 70 and the projection 72 provide the appearance of an arrow.

The cover 60 is secured in the housing 12 by an annular snap ring 74. The snap ring 74 fits partially into the V-shaped groove 26 in the housing wall 16 and partially into the annular groove 68 in the periphery of the cover 60. Thus, the snap ring 74 secures the cover 60 to the housing 12, but permits rotation of the cover with respect to the housing. An annular washer 76 is provided between the edge portion of the inner surface of the cover 60 and the radial surface of the groove 22 in the housing wall 16. The outer peripheral portion of the washer 76 extends into the groove 24 in the housing wall 16 to secure the washer to the housing.

A contact 78 of a strip of an electrically conductive metal is carried by the cover 52 in the slot 64 in the hub 62. The contact 78 is provided at one end with a resistor contact arm 80 which extends into slidable engagement with the resistance path 50 of the resistance element 38. The other end of the contact 78 has an arm 82 which extends back across the contact 70 and slidably engages the contact termination 52 at substantially the center of the resistance element disk 40. Each of the arms 80 and 82 of the contact 78 are spring arms which are bent back slightly toward the cover 60 so that the resiliency of the

arms holds them tightly against the resistance path 50 and contact termination 52 respectively. Thus, the resistance path 50 is electrically connected to the terminal 32 through the contact 78 and the contact termination 52.

In the manufacture of the variable resistor 10 of the present invention, the housing 12 and cover 60 are individually molded parts. When molding the housing 12, the terminals 32, 34 and 36 are molded in the housing. The resistance element 38 is formed by first simultaneously coating the terminations 52, 54 and 56 on the surface of the disk 40. The shape of the terminations 52, 54 and 56 can be obtained by applying the conductive material through a suitable mask. The resistance path 50 is then coated on the disk 40 so that the ends of the resistance path extend over and contact the terminations 54 and 56. After the inner surface of the housing base 14 is coated with a cement, the resistance element 38 is inserted in the housing 12 and pressed down against the base. Any excess cement will flow into the grooves 18 in the base 14 so that the cement will not flow around the edge of the resistance element. When the resistance element is inserted in the housing 12, the resistance element is properly positioned by the lug 20 fitting into the notch 42 so that the terminal pins 32b, 34b and 36b will extend through the notch 44 and holes 46 and 48 in the disk 40. The terminal pins 32b, 34b and 36b are then electrically connected to the terminations 52, 54 and 56 by placing a small amount of a conductive cement 58 onto each of the terminal pins which flows onto the terminations. The cover 60 with the contact 78 and snap ring 74 thereon is then inserted into the housing 12 until the snap ring snaps into the groove 26 in the housing wall 16 so as to complete the assembling of the variable resistor 10. Thus, it can be seen that because of the limited number of parts constituting the variable resistor 10 and the construction of the resistance element 38, the variable resistor of the present invention can be easily and quickly assembled even though the variable resistor is very small in size.

In the use of the variable resistor 10 of the present invention, the cover 60 can be rotated by means of a screw driver or similar tool which is inserted into the slot 70 in the outer surface of the cover. As the cover 60 is rotated, the end of the resistance path contact arm 82 is moved along the resistance path 50. Since the resistance path 50 is electrically connected between the terminals 34 and 36, a desired resistance value can be obtained between the terminal 32 and either of the terminals 34 and 36 by rotating the cover 60. Rotation of the cover 60 is limited in either direction by the cover stop lug 66 engaging the lug 20 on the housing 12. Since, as shown in FIGURE 1, the end of the resistance path contact arm 82 is directly beneath the cover stop lug 66, the end of the resistance path contact arm will be at an end of the resistance path 50 when the cover stop lug 66 engages the housing lug 20. Thus, the housing lug 20 serves not only to properly position the resistance element 38 as it is inserted in the housing 12, but also serves to limit rotation of the cover 60 so that the resistance path contact arm 82 does not leave the ends of the resistance path 50.

As shown in FIGURE 1, the triangular projection 72 on the outer surface of the cover 60 is directly over the stop lug 66. Thus, when the cover 60 is rotated to a position where the cover stop lug 66 engages the housing lug 20, the apex of the triangular projection will point to an end of the wide projection 28 on the end surface of the housing wall 16. As the cover 60 is rotated, the arrow formed by the slot 70 and the triangular projection 72 will point to the narrower projections 30 on the end surface of the housing wall 16. Thus, the arrow formed by the slot 70 and triangular projection 72 on the cover 60 along with the projections 28 and 30 on the end surface of the housing wall 16 provide an indication of the position of the resistance path contact arm 82 along the resistance path 50, with the wider projection 28 indicating the ends of the resistance path. By knowing the maximum

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resistance value provided by the resistance path 50, the approximate resistance value provided by any setting of the cover 60 can be easily and quickly determined.

Thus, the variable resistor 10 of the present invention provides a small, compact unit which is composed of a minimum number of parts which can be easily and quickly assembled even though the variable resistor is small in size. Although the variable resistor 10 is shown as having three terminals, if it is to be used as a rheostat, it can be provided with only two terminals, i.e., the terminal 32 which is connected to the contact termination 52 and either of the resistor path terminals 34 and 36.

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 specification as indicating the scope of the invention.

We claim:

1. A variable resistor comprising:

- a housing of an electrical insulating material having a circular base and a cylindrical wall extending from the edge of the base;
- a pair of relatively rigid terminals extending through and secured to the base of the housing, each of said terminals having a pin projecting into the housing;
- a flat circular disk of an electrical insulating material seated on the inner surface of the base of said housing, said disk having two openings therethrough through which the terminal pins extend;
- a film of an electrical resistance material coated on the upper surface of said disk and extending in an arcuate path around the periphery of said surface of the disk with the path having a pair of spaced ends;
- a contact termination film of an electrically conductive material coated on said surface of the disk and extending from one of said openings in the disk to the center of said disk;
- a resistance path termination film of an electrically conductive material coated on said surface of the disk and extending from under one end of the resistance path to around the other opening in the disk; means electrically connecting each of the terminal pins to its adjacent termination film;
- a circular cover extending across the open end of the cylindrical housing wall;
- means securing said cover to the housing but permitting rotation of said cover with respect to the housing; and
- a contact of an electrically conductive metal carried on the inner surface of said cover, said contact having a pair of contact arms extending therefrom, one of said contact arms slidably engaging said resistance path and the other contact arm slidably engaging said contact termination film.

2. A variable resistor in accordance with claim 1 in which the disk has a notch in its peripheral edge, the resistance film path extends around the surface of the disk from one side of the notch to the other side of the notch, and the terminal pin opening through said disk to which the contact termination film extends is a second notch in the disk at the end of said first notch.

3. A variable resistor in accordance with claim 2 including a lug extending from the inner surface of the base of the housing along the inner surface of the cylindrical wall of the housing, said lug extending through the first said notch in the disk.

4. A variable resistor in accordance with claim 3 including a stop lug projecting from the inner surface of the cover over the end of the contact arm which engages the resistance path, said stop lug being engageable with the lug on the housing to limit rotation of the cover.

5. A variable resistor in accordance with claim 4 including a third terminal extending through and secured to the base of the housing and having a pin projecting into the housing, the disk having a third opening therethrough which the pin of said third terminal extends, a second resistance path termination film of an electrically conductive material coated on the surface of the disk and extending from under the other end of the resistance path to around the third opening in the disk, and means electrically connecting said third terminal pin to said second resistance path termination film.

6. A variable resistor in accordance with claim 5 in which the means electrically connecting each of the terminal pins to its respective termination film comprises an electrically conductive cement coated over the terminal pin and the adjacent area of the termination film.

7. A variable resistor in accordance with claim 5 in which the openings through the disk to which the resistance path termination films extend are positioned at opposite sides of and 90 degrees circumferentially from the second notch in the disk, one of the terminal pins is adjacent to and in radial alignment with the housing lug so as to extend through the second notch in the disk, and the other two terminal pins are positioned at opposite sides of and 90 degrees circumferentially from said one terminal pin so as to extend through the other openings in said disk.

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RICHARD M. WOOD, *Primary Examiner*.

J. G. SMITH, *Assistant Examiner*.