Nov. 1, 1960 W. W. GARSTANG 2,958,841

VARIABLE RESISTOR

Filed April 13, 1959 2 Sheets-Sheet 1

Fig. 1

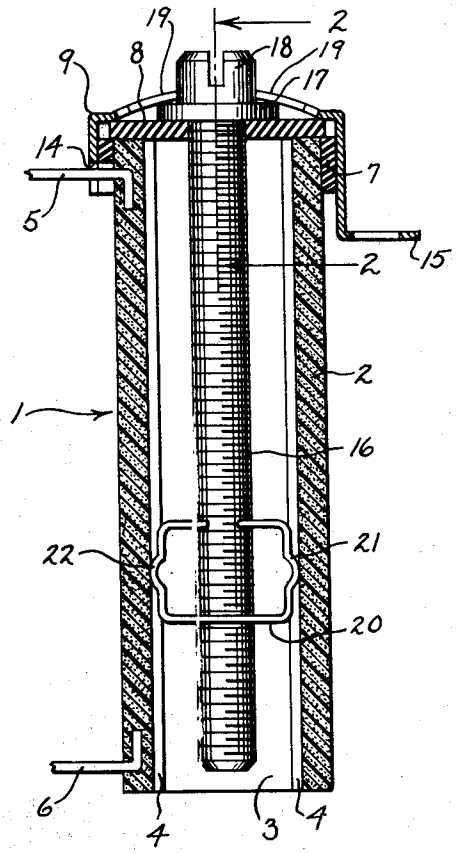


Fig. 2

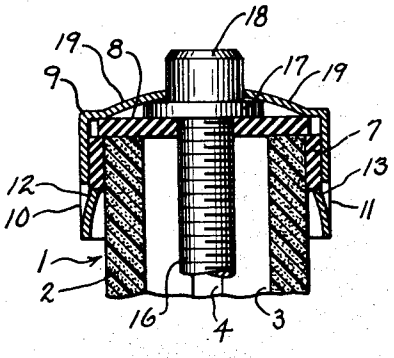


Fig. 3

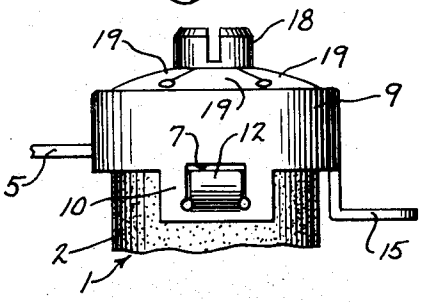


Fig. 4

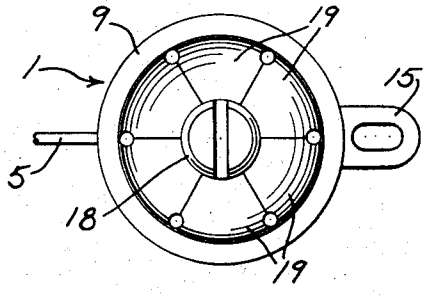
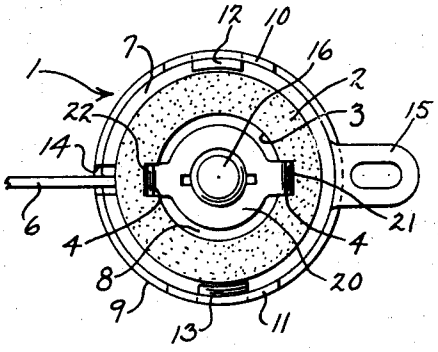


Fig. 5



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Fig. 6

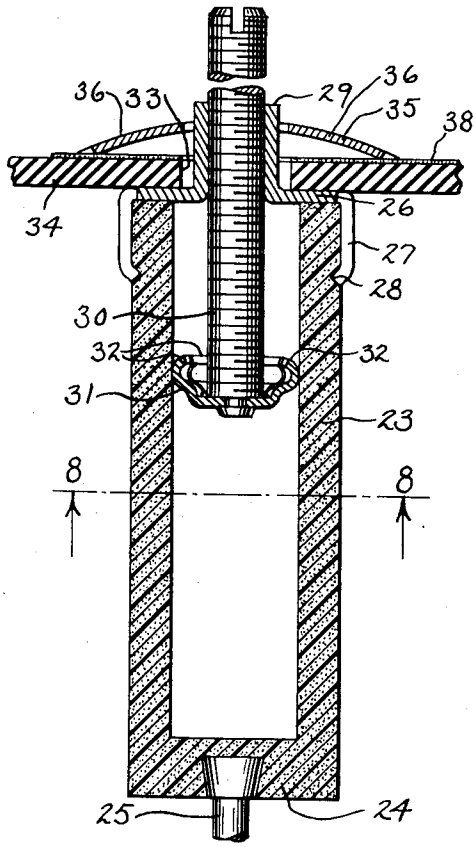


Fig. 7

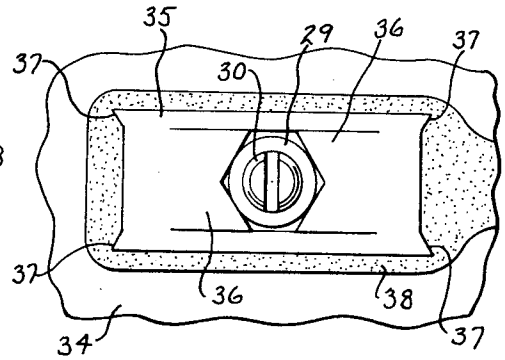


Fig. 8

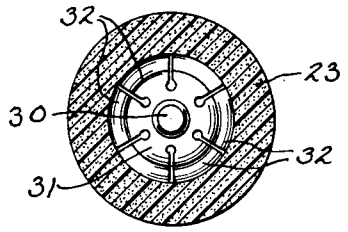


Fig. 9

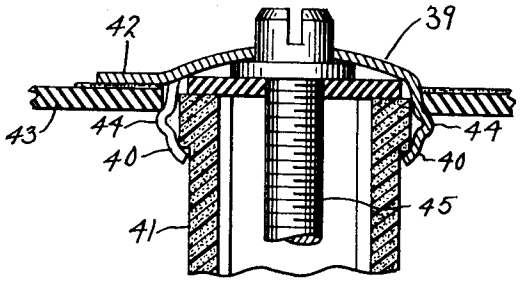
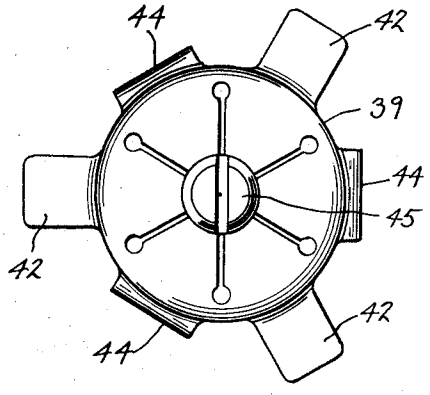


Fig. 10



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VARIABLE RESISTOR

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1 Claim. (Cl. 338—180)

This invention relates to linear variable resistors and it more specifically resides in a resistor having a self-sustaining body that is of molded composition material with conducting particles dispersed therein whereby the body itself constitutes the electrical resistance path of the resistor, and in combination with the body there is provided satisfactory terminals and a sliding contact which engages and moves along the length of the body.

In the assembly of electronic circuits substantial progress has been made in devising means of simplifying and standardizing circuit construction to achieve reduced costs and labor. Variable components in these circuits constitute some of the more intricate elements thereof, and therefore account for a considerable portion of the costs. This can be particularly objectionable where the circuits are intended for mass production and distribution, or for short life where expendability is dependent upon low initial costs. The present invention, while applicable to highly precise variable resistor components of precise workmanship, also lends itself to the provision of a variable resistor that may be economically manufactured to provide low unit cost. Also, a resistor is provided that is readily inserted in a chassis or printed circuit board, so that its assembly into a circuit network may be efficiently and rapidly carried out.

A feature of the invention comprises a self-sustaining body which itself is the resistance path of the resistor. The body is formed of a hot molded resin, which is an insulating material, and conductive particles are dispersed throughout the body proper to provide a conductive path of high resistance. The body is preferably formed in a tubular configuration, so that the interior may house an operating shaft with a movable contact thereon for adjustment of the resistance value. To mount the resistor, and provide a bearing for the shaft, a simple cap may be fastened on one end of the body. The cap not only presents mounting means, but also locates the shaft, thereby achieving a variable resistor with a minimum of parts. Compactness and simplicity of design results from the novel construction of a body that is not merely a housing for a separable resistance element, but in which the body itself constitutes the resistance element.

It is an object of this invention to provide a variable resistor of relatively few parts which may be economically manufactured.

It is another object of this invention to provide a variable resistor that is rugged so as to withstand mechanical abuse.

It is another object of this invention to provide a variable resistor that has excellent electrical characteristics such as stability of resistance value under varying load conditions and for a long life period.

It is another object of this invention to provide a variable resistor that is adapted to be readily inserted into a printed circuit network.

The foregoing and other objects and advantages of this invention will appear from the following description. In the description reference is made to the accompanying

drawings, which form a part hereof, and in which there is shown by way of illustration and not limitation specific form in which the invention may be embodied.

In the drawings:

Fig. 1 is a view in longitudinal cross section of a linear variable resistor embodying the invention which may be used either as a potentiometer or a rheostat,

Fig. 2 is a fragmentary view in longitudinal cross section of the resistor shown in Fig. 1 taken on the plane 2—2,

Fig. 3 is a fragmentary side view in elevation of the resistor shown in Fig. 1,

Fig. 4 is a top view of the resistor of Fig. 1,

Fig. 5 is a bottom view of the resistor of Fig. 1,

Fig. 6 is a view in longitudinal cross section of a second embodiment of the invention in which the resistor is mounted upon a thin board,

Fig. 7 is a top view of the resistor and boards shown in Fig. 6,

Fig. 8 is a view in transverse cross section of the resistor in Fig. 6 viewed through the plane 8—8,

Fig. 9 is a fragmentary view in longitudinal cross section of the upper portion of another form of resistor embodying the invention, and

Fig. 10 is a top view of the resistor shown in Fig. 9.

Referring now to the drawings, there is shown in Fig. 1 a linear variable resistor 1 having a circular cylindrical body 2 with an axially extending central bore 3 passing through the entire length of the body 2. A pair of diametrically opposed grooves 4 are recessed in the sides of the bore 3 and likewise extend for the entire axial length of the body 2. The body 2 is of a sufficient wall thickness to lend mechanical rigidity to the body, whereby it is a self-sustaining structural member of rugged characteristics to withstand abusive handling and mechanical shock to which electrical circuit components are frequently subject. The body 2 structurally comprises the main element of the resistor 1, and it functions to support the remaining structure of the resistor, as will be described herein.

It is a purpose of this invention to provide a body portion for a resistor that not only is the principal structural unit for the resistor, but which is also a conductive path forming the resistance element of the resistor. To this end, the body 2 is preferably formed of a hot molded composition resin such as a phenol-aldehyde condensation product together with appropriate filler, lubricant, and other ingredients if desired. A typical material of this nature is described in U.S. Letters Patent No. 2,269,-136 dated January 6, 1942 to B. F. Tellkamp. Intermixed with the resinous material of the body 2, so as to be dispersed throughout the same, are small electrically conducting particles and a material ideally suitable for this purpose is finely comminuted carbon black. The technique of intermixing the particles with the resin is discussed in said Letters Patent. The resulting body 2, then, is a single integral structure that is a self-sustaining resistance element without separate or separable resistance units individually attached thereto.

A pair of terminal leads 5 and 6 are inserted in the body 2 at the time of molding, and extend axially there from at opposite ends of the body 2 to provide for electrical connection with the resistance element presented by the body 2. A cylindrical ring 7 of insulating material tightly fits about the upper end of the outer surface of the body 2. The ring 7 may be adhesively secured in place, or if desired may be an integrally molded extension of the body 2. Covering the upper end of the body 2 is an insulating washer 8, which is held in place by a metallic cap 9 that is in clipped engagement with the ring 7. The manner of clipping the cap 9 in position is shown in Figs. 2 and 3, wherein it is seen that a pair of ears 10 and 11

project downwardly on opposite sides of the body 2 which have, respectively, upwardly extending spring fingers 12 and 13 that are bent inwardly so as to engage the lower edge of the insulating ring 7. The fit of the cap 9 is such as to tightly hold the washer 8 in position. The cap 9 has a slot 14 at the point where the terminal lead 5 emerges from the body 2, so as to be electrically separate therefrom, and on the side of the cap 9 opposite the slot 14 is a formed terminal 15 suitable for mounting the resistor 1 and for making electrical engagement with a sliding contact to be described.

A threaded adjustment screw 16 extends downwardly through the interior of the body 2 and has a collar 17 at its upper end that is held between the washer 8 and the top of the cap 9. In this manner the screw 16 is held captive to preclude axial movement, but it is free to rotate. A head 18 extends from the top of the screw 16, and projects above the cap 9 to provide means for rotating the screw 16. As is more clearly shown in Figs. 3 and 4, the upper surface of the cap 9 comprises a set of circumferentially arranged radially inwardly extending spring fingers 19. The fingers 19 bear downwardly upon the collar 17 of the screw 16, and the resilience of the fingers 19 insures a positive retention of the adjustment screw 16.

Mounted upon the adjustment screw 16 is a sliding contact 20 which has a pair of contact points 21, 22 that ride in the grooves 4 and bear against the inner wall of the body 2, so as to be in electrical engagement therewith. The contact 20 is held from rotation by reason of the grooves 4, and is engaged with the threads of the adjustment screw 16, whereby upon rotation of the screw 16 the contact 20 will be caused to slide axially along the resistance path presented by the body 2.

The resistor 1 may be placed in circuit either as a potentiometer or rheostat. For potentiometer connection the terminals 5 and 6 are joined to a source voltage, and the terminal 15 together with one of the other terminals 5, 6 serve to present an output. For functioning as a rheostat, the terminal 15 and one of the other terminals 5, 6 are connected in the circuit. The adjusting screw 16 and cap 9 consequently function as conducting elements of the resistor 1, as well as serving as structural portions. The resistor 1 has relatively few parts in its assembly, with all major constituents acting as current conducting members as well as serving some structural purpose. The resistor accordingly provides a construction of economical manufacture while at the same time providing a hard, rugged body that may withstand severe mechanical abuse. Phenolic products are commonly used in electrical apparatus as structural members because of recognized physical strength, and in this invention such mechanical strength is availed of while at the same time utilizing the principal body as the resistance element.

Turning now to Figs. 6–8, there is shown another embodiment of the invention, which is particularly adaptable for application as a rheostat. A tubular body 23 comprising a resistive element and formed similarly as the body 2 of Figs. 1–5 has a closed base 24 in which is embedded one end of a terminal lead 25. The base 24 is an integral continuation and is a part of the body 23 and therefor is also conductive. The terminal lead 25 is consequently in electrical connection with one end of the resistance path presented by the body 23. Fitted over the top of the body 23 is a cap 26 having a plurality of downwardly extending spring arms 27 that engage a groove 28 extending circumferentially about the outer surface of the body 23. The spring arms 27 thus grasp the upper end of the body 23 to hold the cap 26 in place, and at the center of the cap 26 is an axially extending neck 29 that is internally threaded to receive and hold an adjustment screw 30. By turning the screw 30 it is worked upwardly or downwardly in the neck 29. Riveted to the lower end of the screw 30 is a pick up contact 31 formed with a plurality of spring fingers 32, as more clearly shown in Fig. 8, which slide against and are in electrical engagement with the resistance track afforded by the body 23. In the form of the invention of Fig. 6, guiding grooves in the inner wall of the body are eliminated and the contact 31 is free to rotate with the adjustment screw 30. The connection of the screw 30 and contact 31 tightly presses these two elements together so that current may readily be conducted from the body 23 through the contact 31 to the adjustment screw 30.

As shown in Figs. 6 and 7 the resistor is mounted in an opening 33 of a printed circuit board 34. The neck 29 is extended through the opening 33 and the flat upper side of the cap 26 bears against the underside of the board 34. A spring clip 35 formed of sheet material fits over the neck 29 and engages the upper side of the board 34. The spring clip 35 has a pair of arms 36 that tightly engage the neck 29 to be in firm frictional connection therewith, and also to be in electrical contact therewith. The lower outer corners of the spring clip 35 are formed with pointed engagement toes 37 that press into the upper side of the board 34. The upper side of the board 34 has a conductive overlay 38 that is a part of the wiring of a printed circuit, and the toes 37 engage the overlay 38, whereby the resistor becomes a part of the circuit. Hence, the spring clip 35 serves to hold the resistor in place and also to complete an electrical connection.

In Figs. 9 and 10 an alternative form of cap 39 is shown which has downwardly extending spring arms 40 for engaging a resistor body 41 and a second set of radially extending spring arms 42 which are used in mounting the resistor. In mounting the resistor of Figs. 9 and 10, the resistor is inserted downwardly through an opening in the mounting board 43, and the board 43 is held between the spring arms 42 and a set of knuckles 44 on the spring arms 40. The cap 39 retains an adjustment screw 45 in similar fashion as the cap 9 of Figs. 1–5.

The snap type cap constructions shown in the drawings are held in assembly through spring pressures. They provide a means of easily mounting a complete resistor in a circuit by simple snap-in connection and such caps in combination with the conductive resistor bodies of the invention provide advantageous resistor constructions wherein a variable resistor has a minimal number of parts. The particular embodiments of the drawings are not intended as being definitive of the scope of the invention, but rather as a showing of representative forms which the invention may take. Reference is had to the following claim which is intended to more fully state and definie the scope, said claim being deemed inter alia as entitled to a range of equivalents.

I claim:

In a variable linear resistor the combination of a hollow cylindrical body open at one end and formed of molded material with conductive particles dispersed therein to provide a resistance path; a terminal joined to the body and extending therefrom; a bearing plate over the open end of the hollow body that has a central opening and forms a bearing support for an operating screw; an operating screw extending through the central opening of said bearing plate into the interior of said hollow body, with an enlarged collar resting upon said bearing plate and a head extending outwardly from the collar; a cap of thin spring material covering the bearing plate and operating screw collar having resilient fingers in clip engagement with the hollow body and having resilient portions bearing downwardly upon said operating screw collar that retain said operating screw in position; and an axially movable contact within said hollow body mounted upon said operating screw.

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