March 10, 1959 M. E. HARRISON ET AL 2,877,325

VARIABLE RESISTOR CONSTRUCTIONS

Filed Dec. 13, 1954

FIG. 1.

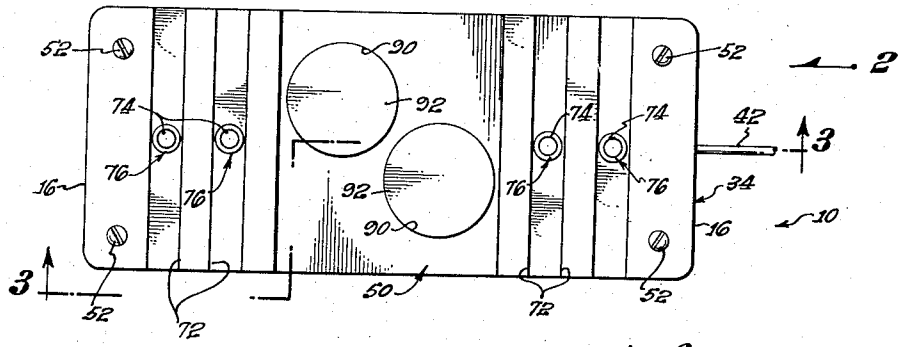


FIG. 3.

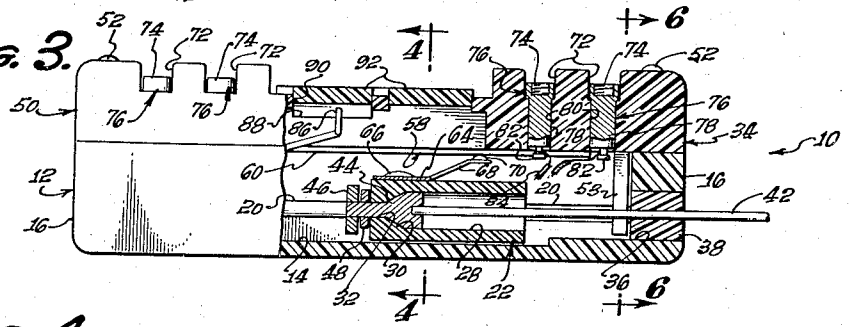


FIG. 4.

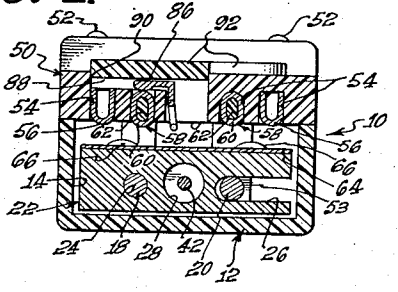


FIG. 2.

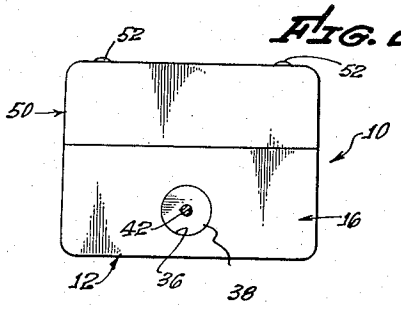


FIG. 5.

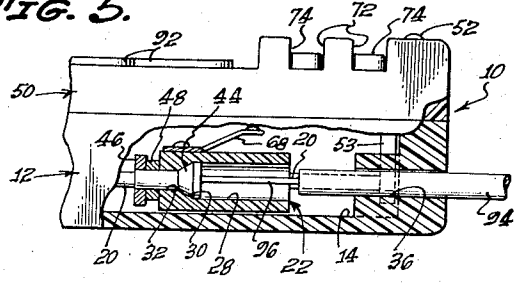
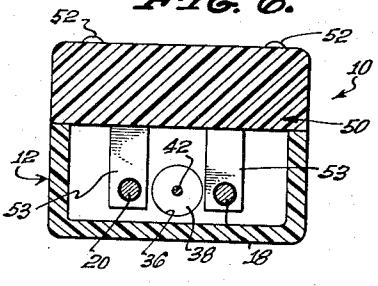


FIG. 6.



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VARIABLE RESISTOR CONSTRUCTIONS

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3 Claims. (Cl. 201—48)

The present invention relates primarily to new and improved variable resistor constructions. Many features of the present invention are, however, applicable to other related electrical devices.

The art of producing new and improved variable resistors has reached a very high state of development at the present time, and in order for a manufacturer to come out with a variable resistor which is satisfactory to a majority of customers, it is necessary to provide a structure which is comparatively cheap to manufacture, exceedingly rugged, and which is capable of functioning satisfactorily in spite of incorrect alignment and various attempts by users or others to tamper with the structures sold. It is a broad object of the present invention to provide variable resistors combining all of these qualities into a single, exceedingly small, resistor construction.

Another object of the present invention is to provide variable resistors in which means are provided for compensating for any misalignment of a movable member within the resistor, such misalignment being caused by incorrect mounting, and such compensation being effective even at the extremes of travel of a movable member within a unit. A further object of the invention is to provide varible resistors in which means are provided whereby the manufacturer of these units may adjust, at the time of assembly, contact elements after the complete variable resistor has been assembled, and then may seal these means so as to prevent tampering within the resistor by customers or service personnel. A still further object of the invention is to provide, in electrical devices of the class described, terminal means and surrounding insulating members which enable these devices to be easily and conveniently mounted in an assembled position with a minimum of difficulty.

Further objectives of the invention as well as the advantages of it will be more fully apparent from the remainder of this specification, including the accompanying claims and the accompanying drawings in which:

Fig. 1 is a top-view of a variable resistor of the present invention;

Fig. 2 is an end-view taken in the direction of the arrow 2 in Fig. 1;

Fig. 3 is a partial cross-sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is cross-sectional view taken at line 4—4 of Fig. 3;

Fig. 5 is a partial cross-sectional view, similar to Fig. 3, showing a modified construction which may be employed with the invention; and

Fig. 6 is a cross-sectional view taken at line 6—6 of Fig. 3.

For convenience of illustration and explanation the actual dimensions of the variable resistors shown in the drawings have been distorted in certain instances. Like numerals are used to designate like parts in all figures of the drawings.

The present invention may be summarized as required by the Rules of Practice of the Patent Office as being

concerned with a variable resistor including a base and cover assembled together so as to form a complete housing with an internal cavity located with this housing, a movable member or slider positioned within this cavity, guide means controlling the motion of this movable member or slider, means capable of compensating for any mal-positioning attached to the movable member so as to project therefrom through the housing, said means being employed to control the motion of the movable member or slider, electrically conductive means positioned in said housing parallel to said guide means, means defining openings in said housing and covers therefore, said means and covers being adapted to be used in locating contact elements upon parts of said electrically conductive means after the assembly of said variable resistor, and being adapted to be closed and sealed after this has been done so as to prevent tampering, means defining parallel slots including walls of an insulating material forming part of said housing, said slots being on the exterior of said housing, electrically conductive terminals positioned within said slots so as to project into the interior of said variable resistor, said electrically conductive terminals being insulated from one another by the walls of said slots.

The actual details of this invention are best explained by direct reference to the accompanying drawings. Here in Figs. 1 through 4 there is shown a complete variable resistor **10** composed of a base **12** having an internal elongated depression or cavity **14** formed therein, and having substantially parallel ends **16**. Between these parallel ends **16** there are mounted parallel guide rods **18** and **20**. These two guide rods are adapted to carry a movable member or slider **22** with the first of these guide rods **18** projecting through an opening **24** within the slider **22**, and with the second of these guide rods **20** fitting within a slot **26** which is located parallel to the opening **24**. By virtue of this construction the guide rods **18** and **20** serve as means controlling the motion of the movable member or slider, and the slot **26** specifically serves to allow for a slight amount of misalignment of either the guide rods **18** and **20** or the slider **22**.

Within the construction shown in detail in Figs. 3 and 4 of the drawings the slider **22** is provided with an elongated internal bore **28** terminating within the slider **22** at a shoulder **30** leading to a second bore **32** of smaller diameter than the first bore **28**. Within an end **34** of the complete resistor **10** there is provided an opening **36** which is aligned with the bores **28** and **32**. This opening **36** is designed to carry a bushing **38** which in turn includes an internal opening **40** designed to carry a wire **42** from the exterior of the variable resistor **10** into the cavity **14** so that this wire can project within this cavity **14** directly into the bore **28** of the slider **22**. Within this bore **28** it is attached to a retaining member **44** which fits against the shoulder **30** and projects through the second bore **32** to the exterior of the slider **22** where it is secured by means of a threaded nut **46**. Preferably a spring washer **48** is positioned around the retaining member **44** between this nut **46** and the adjacent portion of the slider **22**.

With this construction of the slider **22** and the attached wire **42** misalignment resulting from defective formation and mounting of the slider **22** or of the guide rods **18** and **20** is compensated for by virtue of the fact that when the slider **22** is moved so as to be immediately adjacent to or in contact with one of the ends **16** forming a part of the complete end **34** a substantial portion of the wire **42** is located within the bore **28** where this wire can bend to a substantial extent. Such bending within the slider **22** is quite desirable inasmuch as it prevents any breakage of the wire between the slider **22** and the end **34** when these two members are not cor-

rectly located with respect to one another. Such breakage has been a major problem with respect to prior related units in which a wire mounted so as to compensate for incorrect positioning has been secured to the base of the slider 22 immediately adjacent to an end of a variable resistor. It should be obvious from the aforegoing description that the wire 42 provides a very effective means by which the slider 22 may be moved along the guide rods 18 and 20.

Attached to the base 12 so as to close the cavity 14 is a cover 50. This cover is preferably secured in position so as to define a complete housing by means of small screws 52, and is formed of an insulating material, preferably a suitable resin. Small dependent lugs 53 formed integrally with the cover 50 are preferably employed with the invention to mount the guide rods 18 and 20 between the ends 16. The shape and location of these lugs 53 is best seen in Figs. 3 and 6 of the drawings. Because of this specific construction the slider 22 is normally held adjacent to the cover 50 by the guide rods 18 and 20. Further, the various items attached to or otherwise mounted on the cover 50 may be worked on as required before the cover 50 is secured to the base 12. Also the base 12 need not be formed to as specific tolerances as the cover 50. This latter feature is very important commercially in reducing cost. Within this cover there are formed grooves 54, two of which are adapted to hold generally U-shaped electrically conductive collector elements 56. The other two of these grooves 54 are adapted to hold resistance elements 58 which may, if desired, take the form of electrically conductive resistance layers 60 disposed upon non-conductive supporting rods 62. Such resistance layers may be continuous in character, or may be in the form of a spiral. If desired the resistance elements may consist of a composition including a resin, and may be co-molded along with the cover 50. Other equivalent resistance elements of types known to the art may also be employed with the invention. Further such resistance elements may, if desired, be substituted for the collector elements 56.

The grooves 54 and the elements 56 and 58 are all positioned within the cover 50 parallel to the guide rods 18 and 20 so that as the slider 22 is moved along these guide rods the elements 56 and 58 may be electrically connected with one another by means of a contact member 64 of conventional construction secured to the slider 22 by means of screws 66. The contact member 64 includes resilient arms having curved extremities 70 held by spring pressure against each of the collector and resistance elements 56 and 58.

Within the cover 50 there are provided slots 72 located on the side of this cover 50 remote from the base 12. Each of the slots 72 is parallel to the other of the slots 72; further within each of these slots there is located a head 74 of an electrically conductive terminal 76 having an elongated body portion 78 extending through openings 80 formed within the cover 50 so as to lead into the cavity 14. If desired the ends of these terminals 76 immediately adjacent to the cavity 14 may be provided with small heads 82 which enable the terminals 76 to be easily attached to wires 84 located within the cavity 14 connecting these terminals 76 with the extremities of the collector and resistance elements 56 and 58, and with center taps 86 as will be more fully described. For convenience of illustration portions of the wires 84 have been omitted from the drawings.

The center taps 86 referred to are secured to the center portions of the resistance elements 58 within flat slots 88 located in the cover 50 adjacent to the center section of this cover on the side thereof remote from the cavity 14. These slots 88 are designed so that they form part of openings 90 within the cover 50, which openings may be closed after the complete variable resistor 10 has been assembled, and after the center taps 86 have been secured in a desired location after testing of the unit in various operative positions of the slider 22, so as to prevent tampering. In general a suitable adhesive of thermo-setting characteristics is employed in securing covers 92 within these openings 90. Such covers 92 are frequently nick-named "man-hole covers" because of their configuration and function. The center taps 86 need not be located in the vicinity of the center of the resistance elements 58, but can be located anywhere along these resistance elements. Frequently it may be desired to use the structure of these center taps as the end terminals for the resistance elements.

In Fig. 5 of the drawings a modified construction of the means capable of compensating for any malpositioning of the slider 22 within the complete resistor 10 is shown. This structure differs from that shown in Fig. 3 of the drawings primarily in that the bushing 38 is omitted, and a rigid rod or shaft 94 is passed through an opening 36. If desired this opening 36 can be slightly larger than the rod 94. This rod is connected to a wire 96 corresponding to the wire 42 immediately adjacent to the slider 22. In the event the opening 36 is misaligned with the bore 28 the wire 96 will bend to compensate for any such misalignment. The rod 94 under these circumstances is less apt to break or buckle than the wire 42. The functioning of this structure is substantially identical to the functioning of the construction described above.

Those skilled in the art will realize that many details of the present invention constitute a substantial improvement over similar structures previously produced. As an example of how the structure herein described is particularly advantageous, reference is made to the fact that the complete variable resistor may be mounted so that the terminals 76 are in contact with other electrically conductive members (not shown) by sliding the variable resistor 10 into contact with members which mate with or engage the slots 72. Because of this type of construction shown shorting between the terminals 76 is substantially prevented. Normally the terminals 76 are provided with tapped openings as shown in the drawings so that electrical connection to these openings may be made in the obvious manner. With the type of construction shown shorting between these terminals is substantially prevented when they are employed in this manner.

The precise construction of the slider 22 incorporating the opening 24 and the slot 26 can be used where other means besides the precise means shown in the drawings are employed to actuate the slider. Thus the slider 22 may be moved along the guide rods 18 and 20 between the two pairs of lugs 53 supporting these guide rods by means of a lever projecting from the side of the slider 22, or by means of a fixed shaft attached to this slider. Further, with the construction of the slider 22, it is not necessary that the guide rods 18 and 20 passing through the opening 24 and the slot 26 be supported at their extremities by lugs 53 as indicated in Figs. 3, 4 and 6 of the drawings. Other equivalent means can be used, although, for the reasons indicated in the preceding discussion, the lugs 53 are preferred.

Obviously a number of modifications may be made which depart from the precise shape of the individual parts shown in the drawings. All such modifications are to be considered as being part of the inventive concept insofar as they are within the skill of the art and are defined by the appended claims.

We claim:

1. A new and improved variable resistor including a base, a non-conductive cover attached to said base so as to form a complete housing having an internal cavity located within said housing, a movable member positioned within said cavity, guide means positioned within said cavity for controlling the motion of said movable member, means capable of compensating for malpositioning of said guide means and said movable member

attached to said movable member so as to project therefrom, said means being employed to move said movable member; electrically conductive means positioned within said housing parallel to said guide means, means defining openings in said housing adjacent to said electrically conductive means, cover means positioned within said opening so as to seal said opening, means defining parallel slots including walls of insulating material within the exterior of said housing, electrically conductive terminals positioned within said slots, means electrically connecting said electrically conductive means with said terminals, and contact means mounted on said movable member, said contact means being in electrical communication with said electrically conductive means.

2. A variable resistor instrument comprising a housing, a resistance element mounted on said housing, guide means extending parallel to said resistance element, a movable member slidably supported on said guide means and having a contact wiping on said resistance element, means on said movable member limiting movement thereof toward one end of said housing, said means defining a cavity in the end of said movable member adjacent said one end of said housing, a flexible actuating wire projecting into said cavity, and means at the bottom of said cavity attaching said flexible actuating wire to said movable member, said flexible actuating wire being capable of bending within said cavity to prevent damage to the instrument when said movable member is immediately adjacent said one end of said housing.

3. A variable resistor instrument comprising a housing, a resistance element mounted on said housing, guide means extending parallel to said resistance element, a movable member slidably supported on said guide means

and having a contact wiping on said resistance element, means on said movable member limiting movement thereof toward one end of said housing, said means defining a cavity in the end of said movable member adjacent said one end of said housing, a slidably supported actuating rod projecting through an aperture in said one end of said housing, a short length of flexible wire attached at one end to said shaft and projecting into said cavity, and means at the bottom of said cavity securing the other end of said wire to said movable member, said length of flexible wire being capable of bending within said cavity to prevent damage to the instrument when said movable member is immediately adjacent said one end of said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

739,176	Heal	Sept. 15, 1903
1,621,233	Campbell	Mar. 15, 1927
1,630,213	Petry	May 24, 1927
1,710,488	Oliphant	Apr. 23, 1929
1,757,110	Chapman	May 6, 1930
1,882,326	Kennedy	Oct. 11, 1932
2,120,681	Ryder	June 14, 1938
2,339,721	Wilson	Jan. 18, 1944
2,668,218	Searle	Feb. 2, 1954
2,706,230	Bourns et al.	Apr. 12, 1955

FOREIGN PATENTS

471,563	Great Britain	Sept. 7, 1937
831,592	France	June 13, 1938
661,598	Great Britain	Nov. 21, 1951