

Sept. 2, 1958

M. E. BOURNS ET AL

2,850,607

VARIABLE RESISTOR CONSTRUCTIONS

Filed Dec. 13, 1954

FIG. 2.

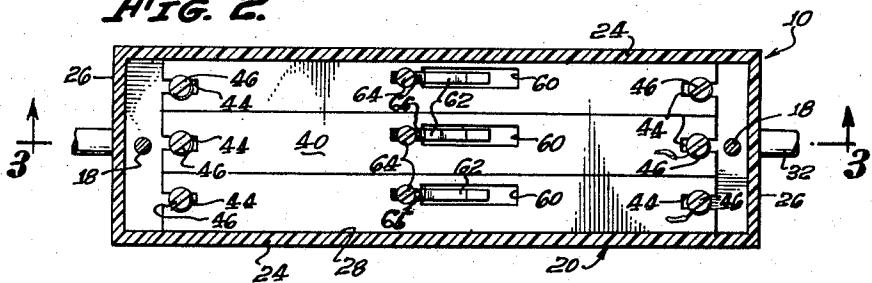


FIG. 3

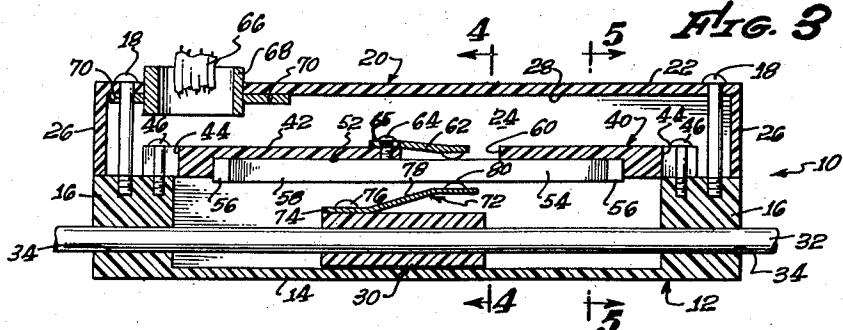


FIG. 4.

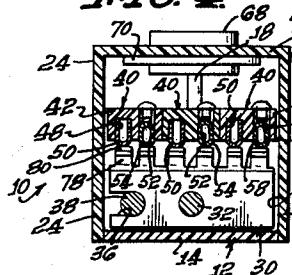


FIG. 5.

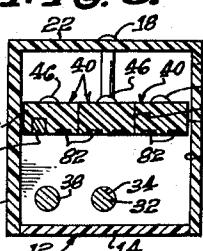


FIG. 6.

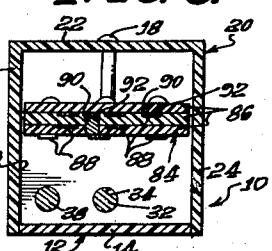
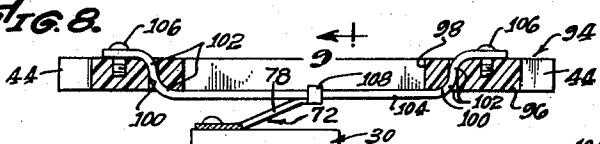


FIG. 8.



87 FIG. 9.

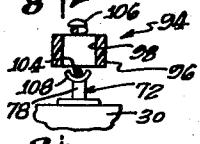


FIG. 10.

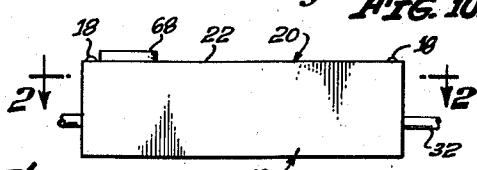
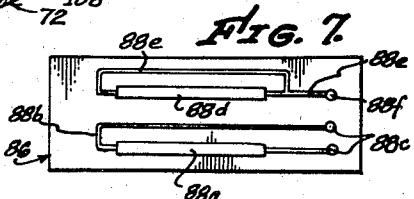


FIG. 1.



United States Patent Office

2,850,607

Patented Sept. 2, 1958

1

2,850,607

VARIABLE RESISTOR CONSTRUCTIONS

Marlan E. Bourns, Marvin E. Harrison, and Wilbur T. Hardison, Riverside, and Alfred W. Stewart, Yucaipa, Calif.; said Harrison, said Hardison, and said Stewart assigns to Bourns Laboratories, Inc.

Application December 13, 1954, Serial No. 474,846

2 Claims. (Cl. 201—62)

The present invention relates primarily to new and improved variable resistor constructions, although, as will be subsequently indicated it is capable of other applications.

This invention is best summarized as being concerned with variable resistor constructions which include a base, a cover attached to said base so as to define a cavity between this base and the cover, a movable member positioned within this cavity, means attached to this movable member for moving the movable member, at least one electrically conductive member positioned within this cavity, and means for mounting this electrically conductive member in such a manner that the position of the electrically conductive member may be adjusted with respect to the movable member and the base as desired so as to achieve proper operation of the complete variable resistor.

Unfortunately a brief summary of this category does not describe the actual details of the invention to a sufficient extent to appraise those familiar with the usual variable resistors commercially produced at the present time with the actual purpose of the present invention. An object of the present invention is to provide variable resistors as indicated in the above brief summary in which the position of the electrically conductive members employed can be adjusted relative to the location of the movable member used, once this movable member has been assembled in an operative position. This feature is particularly advantageous when a plurality of separate electrically conductive members are employed in a single variable resistor, and when it is desired to have all of these conductive members be touched in synchronism by contact members attached to the movable member.

Another object of the invention is to provide variable resistors of the class described in which electrical connections can be made to the electrically conductive members at a number of different locations after the movable and electrically conductive members indicated above have been secured in an operative relation to one another, and after the positions of these members have been adjusted with respect to one another. Such electrical connections are usually what may be termed "center taps," and serve to adapt electrical resistors of the class described for use in specialized circuit applications. Such taps need not be in any definite location. They may also be used as end connections or terminals. With this invention such center taps can be adjusted after assembly.

The term "electrically conductive member" employed in the foregoing discussion and the remainder of this specification is not to be considered as being restricted to a single element which is electrically conductive. This term, as employed herein, is intended to include single electrically conductive elements which are not employed with any mounting or supporting structure, and to include electrically conductive elements formed upon, held by, or otherwise secured to mounting or supporting structures. Thus, the term "electrically conductive member" as used in this specification includes conductive wires, metal strips, conductive composition

2

layers, wound resistance elements, printed circuit type conductive areas, and the like, regardless of whether such conductive means are self-supporting or not.

It is considered obvious from the above definition that 5 a further object of the invention is to provide variable resistors in which a variety of different types of electrically conductive members may be employed. A related object is to provide variable resistors of the type indicated in which the individual electrically conductive 10 members employed can be easily and conveniently adjusted to correct operating positions with a minimum of difficulty. Another related object is to provide constructions of this category in which the individual electrically conductive members can also be replaced with a minimum of difficulty.

It will be obvious from the remainder of this description that a number of individual features of the variable resistor constructions described are not limited in their application to variable resistors as described in the brief 20 summary of the invention given above, but can obviously be used in other resistor constructions.

Further objectives of the invention and the actual details of the invention are best explained with reference to the accompanying drawings in which:

25 Fig. 1 is a side view of a variable resistor of this invention;

Fig. 2 is a cross-sectional view taken at line 2—2 of Fig. 1;

30 Fig. 3 is a cross-sectional view taken at line 3—3 of Fig. 2;

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

35 Fig. 5 is a cross-sectional view of a modified variable resistor of the invention taken in the direction of line 5—5 in Fig. 3;

Fig. 6 is a cross-sectional view which is similar to Fig. 5 of a second modified variable resistor of the invention;

Fig. 7 is a view showing a type of electrically conductive member which may be employed with the invention;

40 Fig. 8 is a side cross-sectional view of an electrically conductive member which can be employed with the invention taken at line 8—8 of Fig. 9;

Fig. 9 is a cross-sectional view taken at line 9—9 of Fig. 8; and

45 Fig. 10 is a detail view of part of the structure shown in Figs. 8 and 9.

For convenience, like numerals in the various figures of the drawings have been used to designate like parts. Also the actual dimensions of the various parts shown have in many cases been distorted from the actual commercial dimensions of these parts in order that the invention may be more easily explained and illustrated.

In Figs. 1, 2, 3, and 4 of the drawings a variable resistor 10 is shown which includes a base 12 having an elongated flat bottom or center section 14 and upstanding ends 16. Attached to these ends 16 by means of screws 18 is a cover 20 having a top 22, side walls 24, and end walls 26. When the cover 20 is secured to the base 12 as shown this cover defines, in conjunction with the base 12, a cavity 28.

Within the cavity 28 there is located a slider 30 which is secured around an elongated shaft 32 in such a manner that the ends of this shaft 32 project out through the ends 16 of the base 12 through openings 34 formed within the ends 16. Thus, as the shaft 32 is reciprocated axially, the slider 30 is moved along the bottom 14 of the base 12 between the ends 16. Rotation of the slider 30 within the cavity 28 is prevented by means of a notch 36 on the slider 30 engaging a shaft 38 secured in a fixed position parallel to the bottom 14 between the ends 16 of the base 12. This shaft 38 is held within appropriate openings (not shown) in the ends 16.

Positioned immediately above the shaft 32 so as to be located parallel to this shaft are a plurality of electrically conductive members 40. Each of these members 40 includes a supporting carrier 42 of a non-conductive material, which carriers 42 are formed with end slots 44 in such a manner that these end slots are adapted to overlie the ends 16 of the base 12. Conventional screws 46 are employed to secure the carriers 42 to the ends 16 by projecting through the slots 44 in the manner indicated in Figs. 2 and 3 of the drawings. With this type of construction the locations of the electrically conductive members 40 can be readily adjusted by merely loosening the screws 46, moving the members 40, and then tightening the screws 46.

Each of the electrically conductive members 40 includes an elongated slot 48 within a carrier 42 which is designed to hold a conductive U-shaped collecting element 50. Each of the electrically conductive members 40 also includes another slot 52 within a carrier 42 which is designed to carry a resistance element 54. All of the slots 48 and 52 are positioned parallel to the shaft 32. The elements 50 and 54 are adapted to be secured in their respective slots by conventional means such as, for example, an adhesive. Each of the resistance elements 54 employed with the invention preferably include an inert base 56 of a non-conductive material around which there is an actual resistance means 58. Such resistance means can comprise a wire coil, a spiral composition layer, or, as indicated in the drawings a single composition layer which is uniformly spaced around the base 56.

Within each of the carriers 42 immediately above the slots 52 there are provided elongated openings 60 in the essential form of slots which are in communication with the slots 52. These openings 60 are designed to be used in enabling a center connection to be made to the resistance elements 54 through the use of metallic contact members 62. The contact members 62 are of essentially conventional design, and are secured to the carriers 42 by means of screws 64 projecting through slots 65 within these members. With this construction the position of these contact members 62 may be easily adjusted after assembly. If desired, soldered or spot welded or other connections to the resistance elements 54 may be made directly through the openings 60, thus avoiding the use of these contact members 62. It is to be understood that any number of openings 60 may be provided within the carrier 42, and that the location of these openings may be varied in each of the carriers 42 illustrated. Further such openings may be provided in back of the slots 48 in order to make contact with the collecting elements 50.

During the assembly of the variable resistor 10 wires 66 are secured to the extremities of the collecting elements 50 and the resistance elements 54, and to the contact members 62 for the obvious purpose by conventional means. These wires are collected together and passed out of the resistor 10 through a bushing 68 secured by means of flanges 70 to the top 22 of the cover 20. If desired other conventional terminal means can be provided.

In order that the variable resistor 10 may be made operative it is necessary to provide upon the slider 30 a contact element 72 having a base 74 attached to the slider 30 by means of screws 76. The contact 72 is electrically conductive, and includes a plurality of resilient arms 78 which are designed to hold curved extremities 80 against the collecting elements 50 and the resistance elements 54. If desired the contact 72 may be broken up into a plurality of separate parts each of which is designed to engage one or more of the electrically conductive members 40.

One major advantage of the present invention lies in the fact that the cover 20 can be removed from the base 12 exposing the electrically conductive members 40 so that the position of these electrically conductive members and the contact members 62 can be adjusted in any

manner deemed desirable with the slider 30 and the contact 72 in any desired operative position. Normally the slider 30 employed with the variable resistor 10 is formed of an insulating material. If desired, however, this member may be formed of a conductive material so as to in effect establish electrical communication from the contact 72 through the slider 30 to either the shaft 32 or the shaft 38. If this is done one of the wires 66 is preferably connected to the shaft 38, or an appropriate electrical connection is made to the shaft 32 on the exterior of the variable resistor 10. Usually when the slider 30 is made conductive it is preferred to form the shaft 32 of a non-conductive material.

In Fig. 5 of the drawings a modified construction is shown in which the electrically conductive members 40 are also formed so as to include carriers 42. Each of these carriers 42 is provided with at least one conductive element 82 which may be placed upon the carrier 42 by any of the established printed circuit techniques. If desired resistance elements 82a consisting of a mixture of resistance particles and a resinous binder may be formed as indicated within one or more of the carriers 42. This is conveniently done when the carrier holding the resistance element 82a is formed of a synthetic resin or plastic by co-molding the carrier and the resistance element together. In Fig. 6 of the drawings a second modified construction is shown in which a single electrically conductive member 84 is employed. This member is composed of a plurality of generally flat non-conductive sheets 86 upon the surfaces of which there are disposed a plurality of conductive elements 88, some of which may be connected together by means of solder terminals 90 projecting through openings 92 within these sheets 86 or other equivalent means. These conductive elements 88 may also be created by printed circuit techniques. With the construction shown in Fig. 6 some of the conductive elements 88 are disposed upon the portion of the conductive member 84 immediately adjacent to the bottom 14 of the base 12 so as to be contacted by the contact 72 during movement of the slider 30.

Both of the constructions shown in Figs. 5 and 6 of the drawings may be employed with the variable resistor 10 in order to add a high degree of versatility to this resistor, and the constructions shown in either of these figures can be employed together with the electrically conductive members 40 as indicated in the initial figures of the drawings. The type of construction shown in Fig. 6 is particularly advantageous since certain of the conductive elements 88 may be located and formed so as to constitute capacitors and resistors coupled together as complete circuit components. These sheets 86 shown in Fig. 6 of the drawings may be readily adjusted with respect to one another as indicated in the preceding discussion when located on the base 12.

One manner in which one of the sheets 86 intended to be positioned immediately adjacent to the slider 30 may be provided with conductive elements 88 is shown in Fig. 7. Here a sheet 86 is illustrated as being coated by printed circuit techniques with coatings 88a and 88d designed to be engaged by the contact member 72. The coating 88a is preferably of a resistance type, and is connected by conductive strips 88b connecting the ends of the coating 88a to contact points 88c designed to be connected to wires 66. The coating 88d is preferably of a highly conductive tape and is similarly connected by conductive strips 88e to a contact point 88f which is also designed to be connected to a wire 66. The broad type of configuration illustrated in Fig. 7 is not restricted to use as the construction illustrated in Fig. 8, but can be employed on each of the carriers 42 illustrated in Fig. 5.

Also, considerable variation may be made in the configurations and number of the conductive coatings upon the sheet 86.

In Figs. 8, 9, and 10 of the drawings a modified electrically conductive member 94 is indicated as including a carrier 96 having an elongated centrally located slot 98

adjacent to the ends of which there are formed openings 100 having curved shoulders 102. With this construction a single conductive wire 104 which may have appreciable resistance is held as indicated in Fig. 8 by means of screws 106. This wire 104 is adapted to be engaged by a curved extremity 108 upon an arm 78 of the contact 72 substantially as indicated in Figs. 9 and 10 of the drawings. The term "curved extremity" employed here is intended to designate the curvature shown in Fig. 9 of the drawings for the extremity 108 which may be described as being in a plane perpendicular to the axis of the wire 104. The extremity may also be curved in a direction longitudinally of the wire 104 in order to provide for essentially point contact between the contact member 72 and the wire 104. By virtue of this construction the extremity 108 is not apt to be knocked off of the wire 104 due to the normal jolts received in handling and use.

When the wire 104 is of extremely small diameter it is frequently desirable to mount the wire 104 directly upon a rigid member extending the length of this wire 104 using a suitable adhesive. When this is done the wire 104 is preferably mounted directly in a small groove so as to project from the supporting member a short distance. With the type of construction employed in this embodiment of the invention the terminal means may be on the same side of the supporting member as the principle portion of the wire 104.

Those skilled in the art will realize that a comparatively large number of modifications may be made within the scope of the present disclosure without departing from the essential teachings of this specification. As an example of such modifications any number of electrically conductive members may be employed within a single variable resistor, and further the electrically conductive members employed together may be of completely different constructions, such as any of the constructions specifically indicated herein. The shaft 34 need not project from both ends of the complete unit shown. If it only projects from one end of a variable resistor the non-projecting end is preferably carried within an opening in a suitable bushing-like construction formed as part of the base 12, this opening being aligned with an opening in the other end of the base. All such modifications of this category are to be considered as part of the inventive concept insofar as they are defined by the appended claims.

It is thought that those skilled in the art will realize from this description the extreme flexibility of variable resistor constructions of the invention. With these constructions both the positions of the electrically conductive members employed and of the contacts made to various portions of electrical elements carried by these electrically conductive members may be easily and conveniently adjusted with all of the parts of the units in an operative position. It is possible to use the openings 60 and contact members such as the contact members 62 normally employed with these openings not only as

centrally located connections as indicated in Figs. 2 and 3 of the drawings, but also as end terminals.

We claim:

1. A variable resistor comprising a body, a slider movable linearly with respect to said body, a plurality of laterally spaced contacts mounted on said slider, a plurality of element support members arranged side by side on said body, each of said support members having a resistance element mounted on one side thereof and wiped by one of said contacts, each of said support members having an aperture in the other side thereof exposing a portion of its respective resistance element, tap means on said other side of said support member making electrical contact with said resistance element through said aperture, and means securing each of said support members to said body for individual adjustment with respect thereto along the line of travel of said slider.
2. A variable resistor comprising a body member having a cavity provided therein, a linearly movable shaft disposed within said cavity, a slider mounted on said shaft and having a contact attached thereto, an element support member mounted on said body member to bridge said cavity, a resistance element mounted on the under side of said element support member in a position to be wiped by said contact, said support member having an aperture in the top side thereof exposing a portion of said resistance element, a tap adjustably mounted on the top side of said support and making electrical contact with said resistance element through said aperture, said tap being shiftable along the length of said resistance element, and means securing said element support member to said body and permitting adjustment thereof along the line of travel of said slider, said means including at least one screw threaded into one of said members and having a head engaging the other member so as to clamp said element support member tightly to said body member.

References Cited in the file of this patent

UNITED STATES PATENTS

753,716	Leonard	Mar. 1, 1904
966,555	Jesse	Aug. 9, 1910
1,660,979	Thayer	Feb. 28, 1928
1,724,538	Weichelt et al.	Aug. 13, 1929
1,901,233	Glowacki	Mar. 14, 1933
2,197,312	Nelson	Apr. 16, 1940
2,339,721	Wilson	Jan. 18, 1944
2,551,989	Wilson	May 8, 1951
2,592,392	Canziani et al.	Apr. 8, 1952
2,617,912	Colvin	Nov. 11, 1952
2,657,295	Barclay	Oct. 27, 1953
2,668,218	Searle	Feb. 2, 1954
2,706,230	Bourns et al.	Apr. 12, 1955

OTHER REFERENCES

Brunetti et al.: "National Bureau of Standard Circular" #468, Nov. 15, 1947.