Jan. 20, 1959 M. E. BOURNS ET AL 2,870,302

POTENTIOMETERS

Filed Nov. 7, 1955

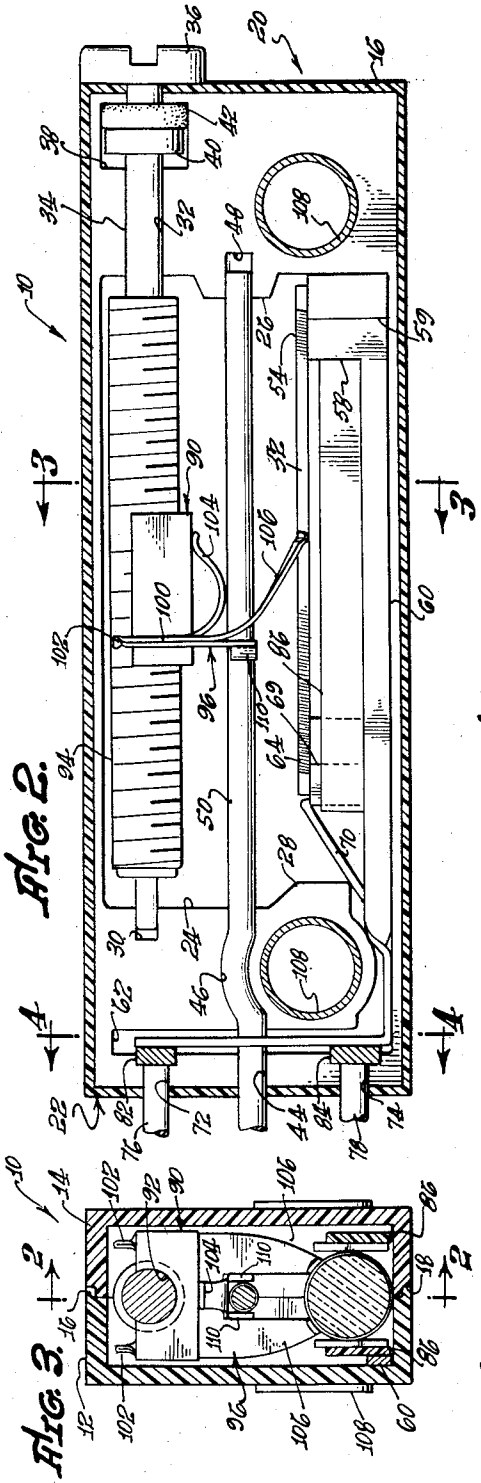

Fig. 2.

Fig. 3.

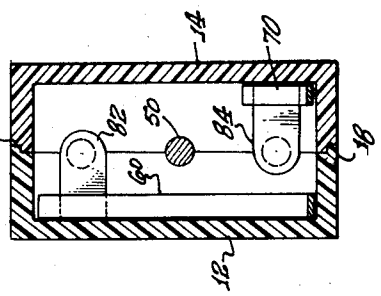

Fig. 4.

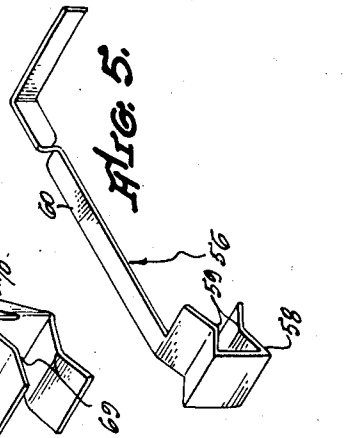

Fig. 5.

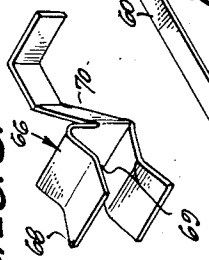

Fig. 6.

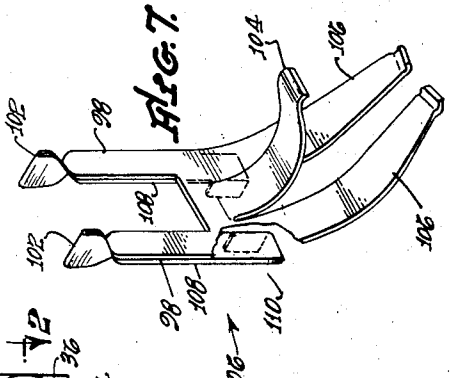

Fig. 7.

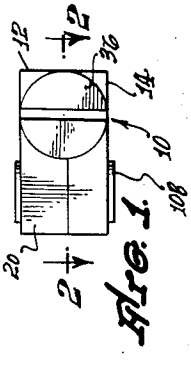

Fig. 8.

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POTENTIOMETERS

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Application November 7, 1955, Serial No. 545,232

14 Claims. (Cl. 201—62)

The present invention relates to new and improved potentiometers.

Because of size and weight limitations in guided missiles and various other types of equipment, there is a very strong demand at the present time for potentiometers which are exceedingly small and light in weight. Such potentiometers must be very rugged so as to be capable of withstanding a great deal of physical abuse. Further, they must be highly accurate, and they must be capable of being easily manufactured and assembled, if the manufacturer of them is to be placed at a competitive advantage in the present market.

An object of the present invention is to teach the construction of new and improved small, light weight potentiometers. Another object of this disclosure is to teach the construction of units of the class described which may be cheaply manufactured and which are very easy to assemble. A further object of this invention is to provide within potentiometers of this category including means which may be conveniently used for mounting these units.

Further objects of this invention, as well as many specific advantages of it will be apparent from the remainder of this description including the appended claims and the accompanying drawings, in which:

Fig. 1 is a front end view of a potentiometer of this invention;

Fig. 2 is a cross-sectional view taken at line 2—2 of Fig. 1 showing certain parts in elevation;

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. 2;

Figs. 5 and 6 are isometric views showing the construction of means used in a potentiometer shown in Fig. 1 for holding a resistance element; and

Fig. 7 is an isometric view of a contact member used in the potentiometer shown in Fig. 1.

In all figures of the drawings, like numerals are used to designate like parts whenever convenient for purposes of illustration and explanation. It is to be understood that this invention is not to be limited by the accompanying drawings, inasmuch as a number of different units may be manufactured embodying the essential features herein described.

In order to understand this invention, it is necessary to explain that it involves potentiometers formed of two essentially half shell housing sections which are held together by rivets; means are provided in each of these sections which are positioned opposite one another so as to hold in the final assembled unit various parts of the potentiometer such as, for example, a shaft, a wire serving as a shorting strip, a resistance element, end terminals and the like. Many of the individual features of the instant invention are considered to have separate utility apart from the complete structure herein defined. A complete summary of the invention and of the various individual aspects of it considered to have separate utility is

found in the form of the appended claims forming a part of this disclosure.

In Figs. 1, 2, 3 and 4 of the drawings it is seen that a complete potentiometer 10 of the invention is composed of two housing sections 12 and 14 which are essentially bilaterally symmetrical in configuration, except for the fact that upon the section 12 there is placed a small edge flange 16 which is adapted to fit within an edge groove 18 in the section 14 when these two sections are placed together during the assembly of the complete potentiometer. This flange and groove construction makes for a very tight unit which is relatively free from problems resulting from dust getting into the operative parts involved. The sections 12 and 14 may be conveniently formed by known plastic molding procedures out of any suitable resin such as, for example, compositions based upon phenolic resins.

From an examination of the drawings it will be seen that the potentiometer 10 has a front end 20 and a rear end 22. Further, the sections 12 and 14 when assembled together define an interior cavity 24 which is essentially elongated in shape, and which has a front end 26 and a rear end 28, these ends being positioned adjacent to but spaced from the front and rear ends 20 and 22 respectively.

In the two sections 12 and 14 there are formed matching grooves which, when the two sections 12 and 14 are assembled together, are adapted to define adjacent to the rear end 28 of the cavity 24 a passage 30 and between the front ends 20 and 26 another passage 32. These passages 30 and 32 are preferably aligned with one another so that a shaft 34 can be held by them in order to project from the rear end 28 of the cavity 24 out to the front end 20 of the potentiometer 10, where this shaft is provided with a common screw head 36 used in adjusting the potentiometer 10.

It is preferred to form within the two sections 12 and 14 midway along the passage 32 symmetrical means defining an enlarged cylindrical cavity 38 which is adapted to be occupied by the flange or collar 40 formed upon the shaft 34 and by a common elastomeric O-ring 42 of rubber or the like. With this construction, an O-ring serves to seal against the entrance of contaminants into the cavity 25, and to eliminate end play of the shaft 34. This latter function is accomplished by virtue of the pressure of the O-ring 42 again the collar 40 and the adjacent wall of the cavity 38.

Within the sections 12 and 14 there are formed grooves defining passages 44, 46, and 48, adjacent to rear end 22 of the potentiometer 10, adjacent to the rear end 28 of the cavity 24, and adjacent to the front end 26 of the cavity 24, respectively. It is noted that all three of these passages are roughly aligned with one another except for the fact that the passage 46 is slightly curved, as is best seen in Fig. 2 of the drawings. This curved section of the passage 46 serves to provide an offset, or bent section. A wire 50 which is held by the three grooves 44, 46, and 48 so as to pass from the front end 26 of the cavity 24 out through the rear end 22 of the potentiometer 10. The curved section in the passage 46 serves to secure the wire 50 against movement. This wire 50 is preferably of a comparatively strong material such as a copper alloy which is not easily deformed when moderate amounts of pressure are placed upon it. Within the potentiometer 10 the wire 50 serves as an electrical return.

A cylindrical resistance element 52 of conventional construction is held within the cavity 24 on the side of the wire 50 remote from the shaft 34 so as to be parallel to the wire 50 and the shaft 34 so as to extend generally between the front and rear ends 26 and 28 of this cavity. As is seen in Fig. 2 of the drawings, the resist-

ance element 52 is spaced from the wire 50. An end 54 of this resistance element is held in place by a first metal clip 56, the construction of which is best seen in Fig. 5 of the drawings. This clip includes a generally U-shaped end 58 having ridges 59 which are adapted to resiliently engage the sides of the end 54 of the resistance element 52. If desired, the clip 56 may be placed in electrical contact with the resistance element 52 through the use of a solder or other like means. Clip 56 also includes an elongated bar-like portion 60 which extends from the U-shaped end 58 along the side of the cavity 24 furthest removed from the section 14 so the rear end 28 of this cavity 24 where this bar is twisted and then bent so as to extend parallel to the rear end 22 of the potentiometer 10 within a slot-like cavity 62. It will be realized from a consideration of Fig. 4 of the drawings that half of this slot-like cavity is formed within each of the sections 12 and 14.

The other end 64 of the resistance element 52 is held by another metal clip 66, the construction of which is best seen in Fig. 6 of the drawings. This clip, like the clip 56, includes a generally U-shaped end 68 having ridges 69 which are adapted to engage the sides of the end 64 of the resistance element 52. This end 64 may be also attached to the resistance element 52 by solder or other like equivalent means. The clip 66 includes a bent bar-like portion 70 adapted to fit within a portion of the slot-like cavity 62 on the side of this cavity remote from the bar-like portion 60.

Within the rear end 60 of the potentiometer there are formed in the sections 12 and 14 matching grooves adapted to define passages 72 and 74 connecting the slot-like cavity 62 to the exterior of the potentiometer 10. Within these two passages 72 and 74 there are positioned terminals 76 and 78, which are provided with enlarged headed portions 82 or 84 respectively. As will be realized from an examination of Fig. 4 of the drawings, these two headed portions project toward opposite sides of the cavity 62 where they are respectively attached to the bar-like portions 60 and 70 of the clips 56 and 66. The actual attachment here may be through the use of solder or other equivalent means, although the clips 56 and 66 may be formed so as to establish electrical contact through the inherent resiliency of the material from which these clips are made. Movement of the clips so as to cause shorting within the cavity 62 is effectively prevented by the shape of these clips.

In order to prevent the resistance element 52 from being shorted out by the bar-like portion 60 extending past this resistance element, and in order to center the resistance element within the cavity 24 thin elongated sheets 86 of a dielectric material such as, for example, thin sheets of a phenolic composition, are preferably wedged in the position as shown in Fig. 3 of the drawings.

In order to complete the potentiometer 10, a generally box-shaped rectilineal movable member 90 formed of a phenolic or other non-conductive material is located within the cavity 24 so that a threaded partially cylindrical portion 92 formed on one side of this member 90 is held with the portion 92 engaging threads on a threaded portion 94 of the shaft 34. Preferably the portion 92 is larger than a half of a cylinder so it may be "snapped" into place. This movable member 90 is held in position by means of a spring metal contact member 96, the construction of which is best seen with reference to Fig. 7 of the drawings. This spring contact member includes upstanding projections 98 which are adapted to fit within slots 100 formed on the sides of the movable member 90 adjacent to an end of this member. The entire contact member 96 is held with respect to this movable member 90 by the ends 102 of the projections 98 being twisted slightly as seen in Figs. 2 and 3 of the drawings.

The contact member 96 includes a central resilient tongue 104 which is bent so that the center portion of this tongue bears against the wire 50 and so that the end of this tongue bears against the movable contact member 90 adjacent the end of this contact member remote from the slots 100. The contact member 96 also includes resilient arms 106 having curved ends which project on each side of the wire 50 so as to be in contact with different side portions of the resistance element 52. These arms 106 exert spring tension or pressure which tends to hold the movable member 90 in position against the shaft 34. The tongue 104 also tends to accomplish this same result and also serves to equalize the pressure upon the member 90 preventing this member 90 from moving to other than a desired position against the shaft 34 within the cavity 24. It is also noted that the ends of the arms 106 are curved so as to, in effect, bear against different sides of the resistance element 52 as shown in Fig. 3 of the drawings. This tends to prevent the contact member 96 or the movable member 70 from twisting within the cavity 24 when the shaft 34 is turned. Also, the "noise" characteristics of the potentiometer 10 is improved by using several different arms engaging the resistance element 52. The contact member 96 preferably is formed of a "bent over" sheet of metal as shown in Figs. 2 and 7 so as to include a back section 108 upon which there are located tongues 110 which resiliently bear against the sides of wire 50, establishing electrical contact with this wire and preventing lateral movement or twisting of the member 96 and the movable member 90.

The entire potentiometer 10 is held together by means of eyelets 108 passing through aligned openings 110 in the sections 12 and 14.

Those skilled in the art to which this invention pertains will realize that the potentiometer 10 is a highly compact unit capable of withstanding a great deal of physical abuse. Actual embodiments of the present invention have been manufactured to an incredibly small size. These units are very light in weight, are very easily mounted and are essentially immune from troubles resulting from contaminants entering the cavity 24. The entire potentiometer 10 may be readily assembled by positioning all of the various elements enumerated in an operative position in the section 12 or in the section 14 and then by placing the remaining section in place and securing the eyelets 108.

We claim:

1. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity; a movable member positioned against the side of said shaft adjacent to said wire, said movable member including threaded means engaging part of said shaft; resilient spring contact means attached to said movable member, said contact means being in electrical communication with said wire and said resistance element, said movable member being held

against said shaft by the action of said resilient contact means; and terminal means extending from said housing connected to the ends of said resistance member.

2. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact means formed of metal so as to include upstanding projections positioned within said cavity with said projections fitting within said slots on said movable member, said resilient contact means being resiliently biassed against said resistance element and said wire whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; and terminal means extending from said housing connected to the ends of said resistance element.

3. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact member formed of metal so as to include upstanding projections, a central resilient tongue and resilient arms, said contact member positioned within said cavity with said projections fitting within said slots on said movable member, said projections projecting through said slots on said movable member with the ends thereof twisted so as to secure said contact means to said movable member, said resilient tongue being resiliently biassed against said wire and said contact arms being resiliently biassed against different portions of said resistance element whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; and terminal means extending from said housing connected to the ends of said resistance element.

4. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact member formed of metal so as to include upstanding projections, a central resilient tongue and resilient arms, said contact member positioned within said cavity with said projections fitting within said slots on said movable member, said projections projecting through said slots on said movable member with the ends thereof twisted so as to secure said contact means to said movable member, the central portion of said resilient tongue bearing against said movable contact member at a point remote from said slots, and said contact arms engaging different portions of said resistance element whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; and terminal means extending from said housing connected to the ends of said resistance member.

5. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out

through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact member formed of metal so as to include upstanding projections, a central resilient tongue and resilient arms, said contact member positioned within said cavity with said projections fitting within said slots on said movable member, said projections projecting through said slots on said movable member with the ends thereof twisted so as to secure said contact means to said movable member, the central portion of said resilient tongue bearing against said movable contact member at a point remote from said slots, and said contact arms engaging different portions of said resistance element whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; means formed in said sections for defining a slot-like cavity within said potentiometer adjacent to the rear of said housing; a first metal clip engaging one end of said resistance element, said clip including a bar-like portion extending in one of said sections into said slot-like cavity; a second metal clip engaging the other end of said resistance element, said second clip including a bar-like section extending in the other of said sections into said slot-like cavity; means formed in said sections so as to define passages connecting said slot-like cavity to the exterior of said potentiometer; and electrical terminals positioned within said passages, each of said terminals including headed portions within said slot-like cavity extending toward opposite sides of said slot-like cavity, each of said headed portions being in electrical communication with one of said bar-like portions.

6. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact member formed of metal so as to include upstanding projections, a central resilient tongue and resilient arms, said contact member positioned within said cavity with said projections fitting within said slots on said movable member, said projections projecting through said slots on said movable member with the ends thereof twisted so as to secure said contact means to said movable member, the central portion of said resilient tongue bearing against said movable contact member at a point remote from said slots, and said contact arms engaging different portions of said resistance element whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; means formed in said sections for defining a slot-like cavity within said potentiometer adjacent to the rear of said housing; a first metal clip engaging one end of said resistance element, said clip including a bar-like portion extending in one of said sections into said slot-like cavity; a second metal clip engaging the other end of said resistance element, said second clip including a bar-like section extending in the other of said sections into said slot-like cavity; means formed in said sections so as to define passages connecting said slot-like cavity to the exterior of said potentiometer; electrical terminals positioned within said passages, each of said terminals including headed portions within said slot-like cavity extending toward opposite sides of said slot-like cavity, each of said headed portions being in electrical communication with one of said bar-like portions; and insulation means positioned in each of said sections beside said resistance element.

7. A potentiometer which comprises: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity having front and rear ends adjacent to said front and rear ends of said housing; means formed in said sections for holding a shaft between the front and rear ends of said elongated cavity, said means extending to the front end of said housing; a shaft held by said means for holding a shaft, said shaft extending from said front end of said housing to the rear end of said cavity, said shaft including a screw head formed thereon adjacent to said front end of said housing and a threaded portion within said cavity; means formed in said sections for holding a wire within the center portion of said cavity between said front and said rear ends of said cavity, said means for holding the wire extending to the rear end of said housing; a wire held by said means for holding a wire, said wire extending from said front end of said cavity past said rear end of said cavity out through the back end of said housing; a resistance element held within said cavity on the side of said wire remote from said shaft; a generally rectilineal movable member formed of a non-conductive material, said movable member including a threaded semi-cylindrical portion formed on one side thereof and including slots formed in said member adjacent to an end of said member, said movable member being positioned with said threads on said threaded semi-cylindrical portion engaging said threaded portion of said shaft; resilient spring contact member formed of metal so as to include upstanding projections, a central resilient tongue and resilient arms, said contact member positioned within said cavity with said projections fitting within said slots on said movable member, said projections projecting through said slots on said movable member with the ends thereof twisted so as to secure said contact means to said movable member, the central portion of said resilient tongue bearing against said movable contact member at a point remote from said slots, and said contact arms engaging different portions of said resistance element whereby said wire and said resistance element are placed in electrical communication with one another and whereby said movable member is held in engagement with said shaft; means formed in said sections for defining a slot-like cavity within said potentiometer adjacent to the rear of said housing; a first metal clip engaging one end of said resistance element, said clip including a bar-like portion extending in one of said sections into said slot-like cavity; a second metal clip engaging the other end of said re-

sistance element, said second clip including a bar-like section extending in the other of said sections into said slot-like cavity; means formed in said sections so as to define passages connecting said slot-like cavity to the exterior of said potentiometer; electrical terminals positioned within said passages, each of said terminals including headed portions within said slot-like cavity extending toward opposite sides of said slot-like cavity, each of said headed portions being in electrical communication with one of said bar-like portions; insulation means positioned in each of said sections beside said resistance element; and means for securing said sections to one another whereby said shaft, said wire, said resistance element, said movable member, said contact member, said clips, and said electrical terminals are held by said sections in position within said potentiometer.

8. A potentiometer which includes: two housing sections positioned together so as to define a complete housing having front and rear ends having an elongated cavity formed therein, said cavity; grooves formed in each of said housing sections so as to define passages, one of said passages leading from the outside of said housing into said cavity and the other of said passages leading from said cavity, one of said passages being curved; a wire positioned in said passages so as to project through said cavity, said wire being secured against movement by the shape of said curved passage; a resistance element positioned within said cavity; a movable contact member positioned within said cavity, said contact member being in electrical communication with said resistance element and said wire; and means for moving said movable contact member within said cavity.

9. A potentiometer which includes: a non-conductive housing having an internal cavity formed therein; a cylindrical resistance element positioned within said cavity; an electrical conductor positioned within said cavity parallel to said resistance element; a shaft positioned within said cavity parallel to said resistance element and said conductor; a movable member mounted upon said shaft; a contact member including resilient arm means engaging said resistance element and said electrical conductor; and metal clips each having a generally U-shaped end having ridges formed on the ends thereof positioned on the ends of said resistance element with said ridges engaging sides of said resistance element whereby electrical contact between said clips and said resistance element is established and whereby said resistance element is held in position within said cavity by said clips.

10. A potentiometer which includes: a housing having an internal cavity formed therein; means defining a passage leading from the outside of said housing into said internal cavity; means defining a cavity in said housing around said passage between said internal cavity and the outside of said housing; a shaft positioned within said passage so as to project into said internal cavity, said shaft leading from the outside of said housing; a head positioned on said shaft, said head being located on the outside of said housing against said housing; a collar positioned on said shaft within said cavity surrounding said passage; an O-ring formed of an elastomeric material positioned around said shaft within said cavity surrounding said passage, said O-ring pressing against said collar and the wall of said cavity surrounding said passage so as to eliminate end play of said shaft and so as to seal against the entrance of contaminants into said housing; a resistance element positioned within said internal cavity parallel to said shaft; an electrical conductor positioned within said internal cavity parallel to said resistance element and said shaft; and contact means carried by said shaft within said internal cavity engaging said resistance element and said electrical conductor.

11. A variable resistor comprising a housing consisting of two cooperating sections which coact to define an enclosed cavity, said housing sections having axially aligned, semi-cylindrical recesses formed in the end portions thereof, the recesses of one section registering with the corresponding recesses of the other section to form axially aligned, cylindrical bearings, a threaded shaft having journal portions rotatably supported within said bearings, a shoulder on said shaft, an opposing shoulder on said housing closely adjacent said shaft shoulder, an annular ring member of elastomeric material disposed between said opposed shoulders and compressed thereby, said ring member serving both to seal the clearances between said rotatable shaft and said housing, and to prevent endwise movement of said shaft with respect to said housing, a resistance element seated within said cavity, a member operatively engaged by said threaded shaft and movable thereby along the length of said resistance element, a contact on said member wiping on said resistance element, and electrical return means electrically connected to said contact.

12. A variable resistor comprising a housing consisting of cooperating sections which coact to define an enclosed cavity, said housing sections having axially aligned, semi-cylindrical recesses formed in the end portions thereof, the recesses of one section registering with the corresponding recesses of the other section to form axially aligned, cylindrical bearings, a threaded shaft having journal portions rotatably supported within said bearings, said housing sections having enlarged semi-cylindrical cavities in the bearing portions at one end of the housing which register with one another to form a cylindrical cavity of diameter greater than said bearing portion, a radial flange on said shaft disposed within said enlarged cylindrical cavity, an annular ring member of elastomeric material disposed between said radial flange and one end of said enlarged cavity, said ring member being compressed therebetween and serving both to seal the clearances between said rotatable shaft and said housing, and to prevent endwise movement of said shaft with respect to said housing, a resistance element seated within said cavity, a member operatively engaged by said threaded shaft and movable thereby along the length of said resistance element, a contact on said member wiping on said resistance element, and electrical return means electrically connected to said contact.

13. A variable resistor comprising a housing having an internal cavity provided therein, a resistance element seated within said cavity, a threaded shaft journaled in said housing and extending within said cavity, a resilient movable member having an open-sided, internally threaded, cylindrically curved slot formed in one side thereof to receive said threaded shaft, said cylindrically curved slot extending around said threaded shaft for an angular distance greater than 180°, whereby said movable member can be snapped onto said shaft one side thereof and then be retained thereon by the grip of the slot edges, a contact on said movable member wiping on said resistance element, and electrical return means electrically connected to said contact.

14. In a variable resistor having a body, an elongated resistance element of generally cylindrical cross section, and a movable contact wiping on said resistance element, means for mounting said resistance element within said body comprising a pair of spring clips seated within said body and holding said resistance element at both ends thereof, each of said clips having a pair of laterally spaced, opposed, V-shaped tabs which engage the rounded sides of said generally cylindrical element with substantially point contact, and terminal means connected to said spring clips.

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