March 1, 1960 M. E. BOURNS 2,927,294

VARIABLE RESISTOR

Original Filed Jan. 12, 1953

Fig. 1

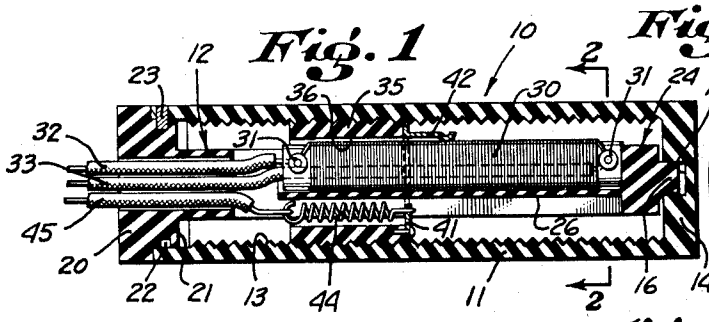


Fig. 2

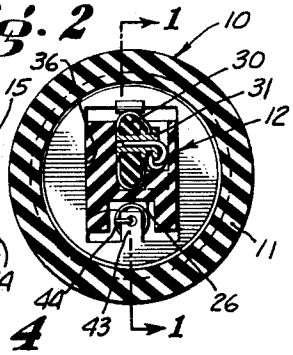


Fig. 3

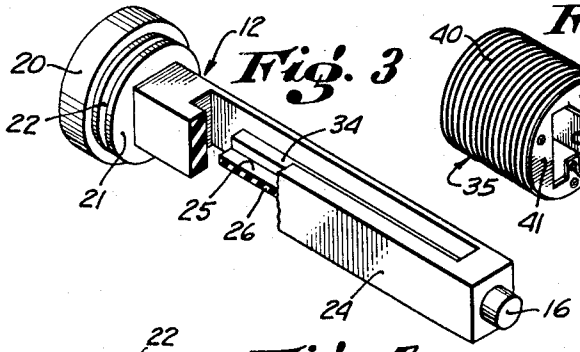


Fig. 4

Fig. 7

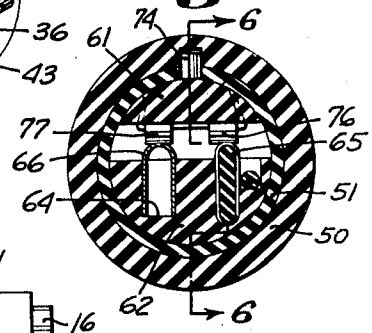


Fig. 5

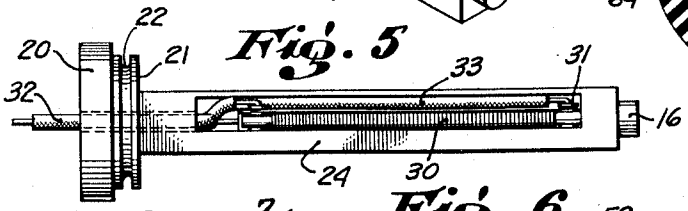


Fig. 6

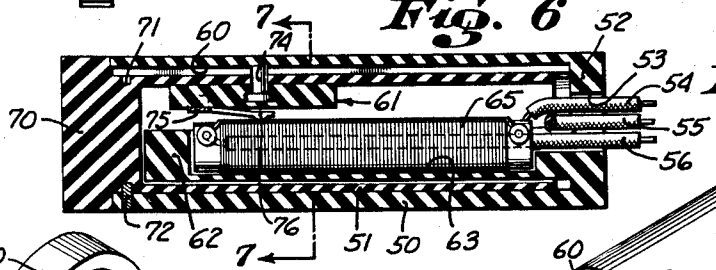


Fig. 9

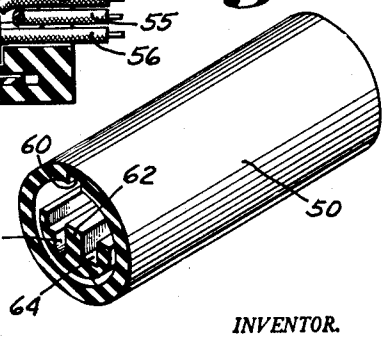
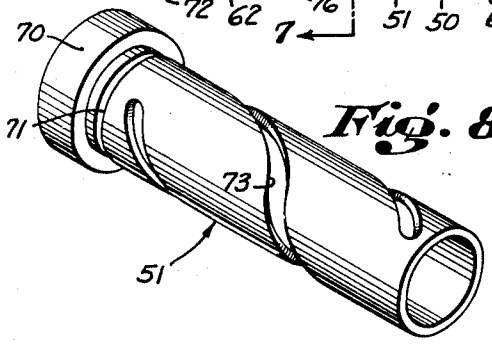


Fig. 8



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VARIABLE RESISTOR

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Original application January 12, 1953, Serial No. 330,642. Divided and this application December 7, 1956, Serial No. 626,847

10 Claims. (Cl. 338—180)

The present invention relates to variable resistors or potentiometers, and is a division of my pending application, Serial No. 330,642, filed January 12, 1953, now Patent No. 2,777,926, entitled Variable Resistor. This invention is primarily concerned with high precision instruments of the type used in guided missiles, aircraft, and other complex electronic equipment, and the primary object of the invention is to provide a variable resistor or potentiometer which is extremely compact, yet designed for extremely precise adjustment, and capable of giving accurately reproducible results.

Another object of the invention is to provide a variable resistor which will withstand acceleration, vibration, and extreme ranges of temperature such as an instrument of this type may be exposed to in aircraft or in guided missile use.

These and other objects and advantages of the invention will become apparent to those skilled in the art upon consideration of the following detailed description of the preferred forms thereof, reference being had to the accompanying drawings, wherein:

Figure 1 is a longitudinal section through one embodiment of the invention taken at the plane indicated by the line 1—1 of Figure 2;

Figure 2 is a transverse section through the same, taken at 2—2 in Figure 1;

Figure 3 is a perspective elevation of the mandrel member employed in this embodiment;

Figure 4 is a perspective view of the contact member employed with this embodiment;

Figure 5 is a plan view of the device shown in Figure 3, with the resistance and conductor elements in place;

Figure 6 is a longitudinal section through another embodiment of the invention, taken along the line 6—6 of Figure 7;

Figure 7 is a transverse section, taken at 7—7 of Figure 6;

Figure 8 is a perspective view of the screw element of this embodiment; and

Figure 9 is a partially sectioned perspective view of the outer case employed with this last embodiment.

Attention is directed first to Figures 1 to 5, inclusive, wherein an instrument embodying the invention is designated in its entirety by the reference numeral 10, and is seen to comprise a tubular case 11, which may be of plastic, as shown, having a mandrel 12 rotatably connected therewith. The case 11 is internally threaded at 13 to form a helix, and is closed at one end by an end wall 14, having a central socket 15 that receives a journal 16 on the end of the mandrel.

The mandrel 12 comprises an end plate 20, having a portion 21 of reduced diameter, which projects into the open end of the case 11. An annular groove 22 is provided in the reduced diameter portion 21, and seating in the groove 22 to prevent endwise movement of the mandrel with respect to the case is a pin 23, which is rigidly held within a hole in the case 11. A main body

portion 24, of rectangular cross section, projects lengthwise through the center of the tubular case 11 from the portion 21, and is provided on its inner end with the journal 16 that is seated in the bearing socket 15 in the end wall 14.

The main body portion 24 of the mandrel has longitudinally extending channels 25 and 26 formed in the top and bottom surfaces thereof, and seated within the top channel 25 is a wire wound resistance element 30. The ends of the wire windings are attached to rivets 31, and joined to these rivets are terminal wires 32 and 33. It will be noted that terminal wire 33 returns from the outer end of the element 30 to the end plate 20 alongside the element on a shelf 34.

Slidably mounted upon the mandrel 12 is a slider, or carrier 35 having a rectangular opening 36 extending there through to receive the main body portion 24 of the mandrel. The outer portion of the carrier 35 is generally cylindrical, and is provided with a male thread 40 which is adapted to engage the threads 13 on the inside of the case 11. An end plate 41 is attached to one end of the carrier 35, and projecting axially therefrom is a spring contact arm 42, the outer end of which wipes on the top edge of the resistance element 30.

Also projecting upwardly from the bottom portion of the end plate 41 into the bottom channel 26 of the mandrel is a tab 43, which is connected to one end of a flexible, extensible coil spring 44, which serves as an electrical return means from the contact arm 42 to an external terminal. The other end of the spring 44 is attached to a third terminal wire 45 extending through a hole in the end plate 20.

Thus, when the case 11 is turned with respect to the mandrel, the carrier 35 is caused to move lengthwise along the resistance element 30 by the threads 13, 40; the said carrier being held against turning by the sliding engagement of the flat sides of the opening 36 with the flat sides of the body portion 24 of the mandrel. One of the advantageous features of the arrangement just described is the extremely accurate adjustment that can be obtained in a very small, miniature instrument.

Figures 6 through 9 show another embodiment of the invention comprising a cylindrical case 50 and a companionate tubular screw element 51, which is rotatable with respect thereto. The cylindrical case 50 is closed at one end by a wall portion 52 having an opening 53 therein, through which terminal wires 54, 55 and 56 pass. Formed in the inside surface of the cylindrical case is a longitudinally extending groove 60, which serves to guide the slider, or carrier 61 and prevent the same from rotating.

Projecting from the inner side of the end wall 52 concentric with the inside surface of the cylindrical case 50 is a semi-cylindrical supporting member 62 having two parallel, longitudinally extending grooves 63 and 64 formed in the flat top surface thereof. Seated within groove 63 is a wire-wound resistance element 65; while groove 64 has a U-shaped conductor strip 66 seated therein, which serves as an electrical return means. Terminal wires 54 and 56 are connected to the windings of the resistance element 65 at opposite ends thereof, while wire 55 is connected to the conductor strip 66.

The tubular screw element 51 is inserted into the open end of the cylindrical case 50, and is sized to fit loosely within the space between the inner wall of the case and the cylindrical outer surface of the supporting member 62. The outer end of the screw element 51 projects beyond the end of the case 50, and this projecting portion is enlarged in diameter to provide a knob 70. Closely adjacent the knob 70, the tubular element 51 is provided with an annular groove 71, which receives the end of a

pin 72 projecting inwardly from the case 50, so as to hold the members 50, 51 against endwise separation, while permitting free rotation relative to one another.

The tubular element 51 has a helical groove or slot 73 formed therein, which extends for the greater part of the length of the element. A pin 74 projecting upwardly from the top of the carrier 61, passes through the helical slot 73 of the tubular element 51, and its end is slidably received within the longitudinally extending groove 60 in the cylindrical case 50.

The slider, or carrier 61 may have the form shown in Figure 7, wherein its cross sectional shape is the segment of a circle, with the cylindrical top surface thereof fitted to the inside surface of the tubular element 51. Attached to the flat bottom surface of the carrier is a U-shaped spring contact 75, one arm 76 of which wipes on the resistance element 65, while the other arm 77 wipes on the conductor strip 66.

From the foregoing description, it will be understood by those skilled in the art that rotation of the tubular screw element 51 relative to the cylindrical case 50 causes the carrier 61 to be shifted lengthwise of the resistance element 65 and conductor strip 66, owing to camming effect of the helical slot 73 on the pin 74. The carrier 61 is, of course, kept from turning with the screw element 50 by the sliding engagement of the pin 74 in the groove 60.

While I have shown and described in considerable detail two selected embodiments of the invention, it will be understood by those skilled in the art that these are merely illustrative of the principles of the invention, and various changes may be made in the shape and arrangement or disposition of the several parts without departing from the broad scope of the invention, as defined in the following claims.

I claim:

1. A variable resistor comprising: a tubular case; a female thread in said case; a slider having a male thread engaging said female thread; a non-round opening in said slider; a mounting member in said case and having a matching non-round cross section; said slider being slidably mounted on said mounting; a resistance element secured on said mounting on one side thereof; contact means carried by said slider having a contact arm engaging said resistance element and means carried by said case and said mounting preventing relative longitudinal movement thereof but permitting relative rotation thereof whereby said spring contact arm is carried to travel over said element.

2. A variable resistor, comprising a body made up of two relatively rotatable parts, one of said parts being hollow and having a helical thread formed thereon, and the other part having a projecting portion extending into the hollow center of said one part, parallel to the longitudinal axis thereof, a resistance element mounted on said projecting portion, and a slider movable along the length of said projecting portion and having a contact wiping on said resistance element, said slider being engaged by said helical thread and being movable thereby when said body parts are rotated with respect to one another.

3. A variable resistor comprising a body made up of a stationary member and a rotatable sleeve member having an internal thread formed thereon, a projection on said stationary member extending parallel to the axis of said rotatable sleeve member, said projection having a non-round cross section, a resistance element mounted on said projection, a slider slidably mounted on said projection and restrained thereby against rotation, said slider having an external thread coacting with said internal thread on said sleeve member, whereby the slider is moved lengthwise of said projection when said sleeve member is rotated, and a contact on said slider engaging said resistance element.

4. A variable resistor comprising a generally cylindrical member having a helix formed thereon, a resistance element mounted within said cylindrical member generally parallel to the axis thereof, a carrier mounted within said cylindrical member and having a contact wiping on said resistance element, means on said carrier engaging said helix whereby rotation of said cylindrical member with respect to said resistance element causes said carrier to be moved lengthwise along said element, said carrier being restrained against rotation with said cylindrical member, and electrical return means from said contact to an external terminal means.

5. A variable resistor comprising a body made up of two relatively rotatable members, one of said members having a helix formed thereon, a resistance element mounted on the other of said members generally parallel to the longitudinal axis thereof, a carrier movable lengthwise of said resistance element and having a contact wiping thereon, means restraining said carrier against rotation while permitting free movement thereof along the length of said resistance element, means on said carrier engaging said helix whereby rotation of said one member with respect to said other member causes said carrier to move along said element, and electrical return means from said contact to an external terminal means.

6. A variable resistor comprising a body made up of two relatively rotatable members, one of said members having a helix formed thereon, a resistance element mounted on the other of said members generally parallel to the longitudinal axis thereof, a carrier movable lengthwise of said resistance element and having a contact wiping thereon, said carrier having a part slidably engaging said other member so as to restrain it from turning while permitting free movement thereof along the length of said resistance element, said carrier being operatively engaged by said helix whereby rotation of said one member with respect to said other member causes said carrier to move along said element, and electrical return means from said contact to an external terminal means.

7. A variable resistor comprising, in combination, a body member having a resistance element mounted thereon, a slidable carrier having a contact wiping on said resistance element, a tubular member rotatably mounted on said body member and enclosing said carrier and said resistance element, said carrier being restrained against rotation relative to said body member while permitted free sliding movement with respect thereto, and means operatively connecting said carrier with said rotatable tubular member to shift the carrier lengthwise along said resistance element as said tubular member is rotated with respect to said body member.

8. A variable resistor as recited in claim 5 wherein said one member comprises a hollow cylinder, the helix formed on said one of said members comprises a helical slot through the walls of said hollow cylinder, said means on said carrier engaging said helix comprises a pin extending through said helical slot, said other of said relatively rotatable members comprises a hollow cylinder having an end wall, a projecting portion extending from said end wall into the cavity of said cylinder and being spaced sufficiently from the sides thereof to enable said one member to be inserted therein, said resistance winding being mounted on said projection, said means restraining said carrier against rotation while permitting free movement thereof along the length of said resistance element comprises a longitudinal groove in said other of said relatively rotatable members into which said pin extends, and said electrical return means from said contact to an external terminal means includes an elongated conductor mounted parallel to said resistance winding on said projection, and a second contact carried by said carrier and wiping on said conductor, said second contact being electrically connected to said contact wiping on said resistance.

9. A variable resistor as recited in claim 6 wherein said one of said members having a helix formed thereon comprises a hollow cylinder with said helix being in the form of a slot, said other of said two relatively rotatable mem-

bers also comprises a hollow cylinder within which said first hollow member fits, said other of said two relatively rotatable members including means for supporting said resistance element within said one of said members, said other of said two relatively rotatable members including a slot extending parallel to its longitudinal axis, and said part of said carrier slidably engaging said other member so as to restrain it from turning while permitting free movement thereof along the length of said resistance element comprises a post on said carrier extending through said helical slot into said groove.

10. A variable resistor as recited in claim 6 wherein said electrical return means includes an elongated conductor means for mounting said elongated conductor on the other of said members parallel to said resistance element, a second contact carrier by said carrier for wiping on said conductor, said second contact being electrically connected to said contact wiping on said resistance.

References Cited in the file of this patent

UNITED STATES PATENTS

2,523,896	Bartolomei	Sept. 26, 1950
2,704,800	Graybeal et al.	May 22, 1955
2,714,147	Reid	July 26, 1955
2,769,073	Gintovt	Oct. 30, 1956