July 26, 1960 R. E. CADDOCK 2,946,975

VARIABLE RESISTOR

Filed Jan. 23, 1959

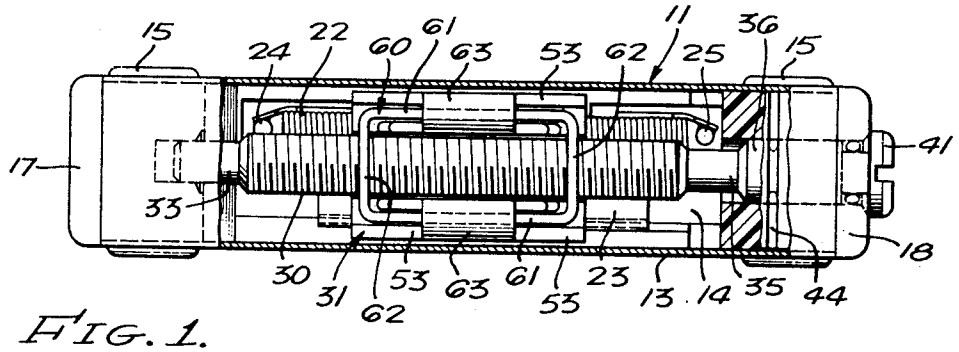


FIG. 1.

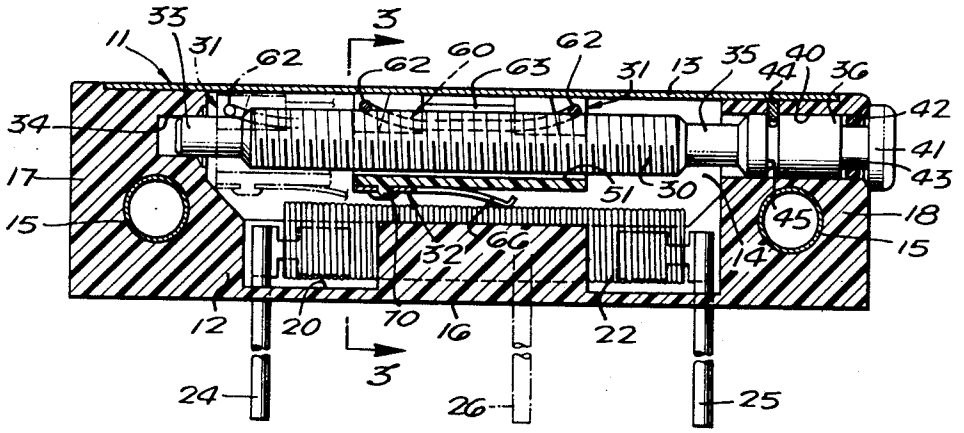


FIG. 2.

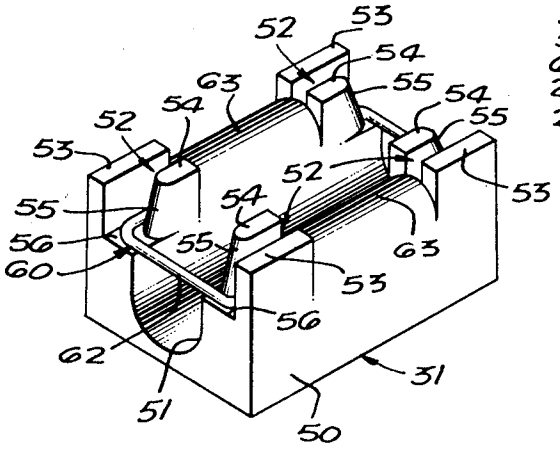


FIG. 4.

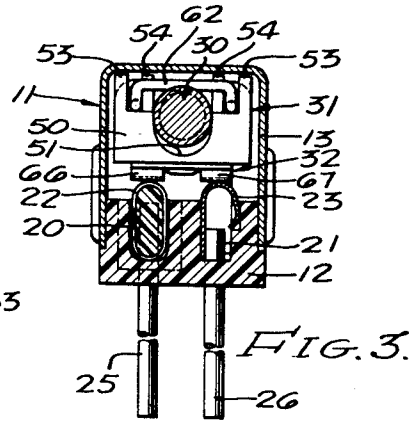


FIG. 3.

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VARIABLE RESISTOR

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4 Claims. (Cl. 338—183)

The present invention relates to variable resistors, and a general object of the invention is to provide a new and improved variable resistor of the type wherein a movable contact is shifted along the length of a resistance element by means of a rotatable leadscrew. More specifically, the primary object of the invention is to provide a new form of leadscrew follower which is provided with spring means yieldably engaging the leadscrew threads so that when the follower comes up against the end of the housing or is otherwise prevented from moving freely, the said spring means is allowed to slip up over the crests of the screw threads, thereby preventing the leadscrew from exerting an excessive driving force against the follower. This slip feature prevents the follower from being damaged by the leadscrew, or the body from being damaged by the follower due to excessive force being applied to the leadscrew when the follower is stopped.

Another object of the invention is to provide a follower of the class described, which is extremely stable with respect to maintaining parallelism to the leadscrew, and which is prevented from becoming cocked at an angle thereto.

A further object is to provide a follower having a releasable driving connection with the threads of the leadscrew, which is characterized by an extremely firm driving engagement with almost zero backlash throughout the normal operating range of the instrument, yet which slips readily over the crests of the screw threads without excessive torque on the leadscrew when the follower is at either end of its travel.

Still another object of the invention is to provide a leadscrew follower of the class described which is simple and inexpensive to manufacture and to assemble on the leadscrew.

These objects are attained by providing a follower having an open channel in one side thereof to receive the leadscrew, and spring means extending up over and operatively engaging the thread of the leadscrew at two longitudinally spaced points thereon so that the follower is moved along the length of the leadscrew as the latter is turned. The said spring means is yieldable to ride up over the crests of the thread when the follower comes up against the end of the housing or is otherwise prevented from moving freely. The advantages of having the spring means engage the thread of the leadscrew at two longitudinally spaced points thereon are: (1) a more positive driving engagement is obtained on the leadscrew thread than with only one spring means of the same dimension, (2) the two-point engagement of the leadscrew stabilizes the follower and prevents it from becoming cocked at an angle to the leadscrew, and (3) one of the said spring means is allowed to run off the leadscrew thread at the end of the follower's travel in either direction, leaving only the other spring means operatively engaging the threads, which greatly reduces the thrust exerted by the follower against the end of the housing, as well as the torque that must be applied to the leadscrew to cause the spring means to slip up over the crests of the threads when the follower is stopped.

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 a preferred embodiment thereof, reference being had to the accompanying drawings, wherein:

Figure 1 is a partially cutaway top plan view of a variable resistor embodying the principles of the invention;

Figure 2 is a longitudinal vertical section of the same;

Figure 3 is a transverse sectional view, taken at 3—3 in Figure 2; and

Figure 4 is a perspective view of the leadscrew follower.

In the drawings, the instrument will be seen to consist of an elongated, generally rectangular housing **11** comprising a body **12** having a channel-shaped sheet metal cover **13** wrapped around three sides thereof to enclose a cavity **14**. The cover **13** is secured to the body by two tubular rivets **15** which pass through aligned holes in the sides of the cover and the ends of the body. The body **12** is preferably formed of non-conductive plastic or the like, and is provided with a center section **16** having upstanding end portions **17** and **18** at opposite ends thereof.

The center section **16** is formed with two parallel grooves **20** and **21**, and seated side by side within these grooves are a resistance element **22** and a conductor strip **23**. The resistance element **22** may be a wire-wound element, as shown in the drawings, or it may take the form of a composition element, or a metal film element. The ends of the element **22** are electrically connected to terminal pins **24** and **25**, which project through suitable holes in the bottom of the body **12** to provide external electrical connections for the element. The conductor strip **23** is preferably, although not necessarily, in the form of an inverted U-shaped strip of sheet metal, having a terminal pin **26** electrically connected to one side thereof and projecting down through a hole in the bottom of the body **12**.

Rotatably mounted in the body **12** above the element **22** and conductor strip **23** and parallel thereto is a leadscrew **30**, which drives a follower **31** carrying a contact **32** that wipes on both the element and conductor strip. The leadscrew **30** has a smooth, unthreaded portion **33** at one end thereof, which is journaled in a bearing socket **34** in end portion **17**. A short length of the unthreaded portion **33** is exposed within the cavity **14**, for reasons which will be explained presently.

At the other end of the leadscrew is a smooth, unthreaded portion **35** of reduced diameter, which adjoins a smooth, unthreaded portion **36** of slightly larger diameter than the threaded portion of the leadscrew. The smooth portion **35** is exposed within the cavity **14**, for reasons which will be explained presently, while the smooth portion **36** serves as a bearing portion and is rotatably received within a smooth bore **40** in the end **18** of the body. The leadscrew **30** projects all the way through the bore and terminates in a slotted head **41**, which can be engaged and turned by a screwdriver or the like. An elastomeric O-ring **42** seated within a circumferential groove **43**, seals the leadscrew against the entrance of moisture and dirt. The leadscrew is restrained against endwise movement relative to the body **12** by means of a retainer **44** which is inserted in a slot in the top of the body **12**, and one edge of which engages a circumferential groove **45** in the bearing portion **36**.

The follower **31** is best shown in Figure 4, and is seen to comprise a block **50** of generally rectangular configuration, having an open-sided U-shaped channel or groove **51** formed in the top side thereof. The block

50 is preferably made of a thermoplastic, electrically non-conductive material which is initially molded with two narrow grooves 52 extending the full length of the block in the top surface of the side portions along both sides of the channel 51. The upstanding portions along both sides of each groove 52 form runners 53 and 54, which are adapted to slidably engage the underside of the cover 13, as shown in Figures 2 and 3. The inner runners 54 terminate slightly short of the ends of the block 50 in inclined, rounded ends 55, which rise from horizontal ledges 56 that constitute extensions of the bottom of the grooves 52.

A rectangularly formed wire 60 of spring material such as beryllium copper is assembled with the block 50 by placing the wire so that the long sides 61 lie in the grooves 52, while the shorter ends 62 bridge the channel 51 from one ledge 56 to the other. The intermediate portions of the runners 53, 54 are then engaged by a downwardly thrust heat-forming tool, which melts the plastic and closes the fused plastic around the center sections of the wire sides 61, as shown at 63, to fasten the wire spring 60 securely to the block.

The contact member 32 is secured to the bottom of the follower 31 and is preferably in the form of a bifurcated sheet metal part having two spring fingers 66 and 67, which wipe on the resistance element 22 and conductor strip 23, respectively. The contact 32 may be attached to the follower in any suitable manner, and is illustratively shown as being secured by a heat-formed button, or rivet 70, of the same plastic material as the block 50. The rivet 70 is initially molded as a simple stud, or pin, projecting from the bottom surface of the block 50. The contact member 32 is provided with a hole through which the said pin extends, and the projecting end of the pin is then melted and formed into a head, as shown in Figure 2, by means of a heat-forming tool (not shown).

To assemble the instrument, the leadscrew 30 is first inserted through the hole 40 in the body, and the follower 31 is then pushed onto the leadscrew. The ends 62 of the wire 60, being resiliently held by the free sections of the sides 61, yield upwardly under the camming effect of the threads, and therefore slip more or less freely over the crests of the leadscrew threads. The end portion 33 of the leadscrew is then inserted into the bearing cavity 34, and the retainer 44 is inserted into its groove to lock the leadscrew in place. When the cover 13 is placed on the body, the underside of the cover engages and presses against the runners 53, 54, pushing the follower 31 downwardly so that the bottom of the channel 51 is spaced downwardly from the bottom of the leadscrew. This provides an air gap between the bottom of the leadscrew and the bottom of the channel 51, which increases the resistance of the short path between the contact member 32 and the leadscrew, preventing any leakage of current from the contact to the leadscrew.

The operation of the device is believed to be self-evident from the foregoing description and the drawings. The end portions 62 of the wire spring 60 cross over the top of the leadscrew 30 and fit down between adjacent threads on the leadscrew, thereby providing a driving connection between the leadscrew and the follower. As the leadscrew is turned, the follower is caused to move lengthwise thereof, shifting the contact member 32 along the length of the resistance element and conductor strip. When the follower reaches the end of its travel, as shown in phantom lines in Figure 2, the end portion 62 of the wire spring runs off the thread of the leadscrew onto the smooth, unthreaded portion 33, leaving only the one end portion 62 at the opposite end of the follower in driving engagement with the leadscrew. With the follower 31 abutting against the end 17 of the body, the one operatively engaged end portion 62 of the wire spring yields under the endwise thrust of the threads when the leadscrew is forcibly turned, and slips more or less freely over the crests of the threads. This prevents any damage to the body 12 or follower 31, owing to the fact that only a limited amount of end thrust can be exerted against the follower by the leadscrew through the yieldable driving connection of the end spring portion 62. When the direction of rotation of the leadscrew is reversed, the follower is moved back along the leadscrew, causing the end portion 62 to re-engage the threads, so as to restore the two point driving connection shown in solid lines in Figure 2. The engagement of the leadscrew by the wire spring 60 at opposite ends of the follower has the effect of providing a uniform spring loading on the follower from one end thereof to the other, thereby stabilizing the follower with respect to the leadscrew and eliminating any tendency of the follower to be cocked at an angle to the leadscrew.

While I have shown in considerable detail what I believe to be the preferred form of the invention, it will be understood by those skilled in the art that various changes may be made in the shape and arrangement of the several parts without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a variable resistor having a housing, a leadscrew rotatably mounted on said housing, and a resistance element extending parallel to said leadscrew, the improvement comprising a follower having an open-sided channel in one side thereof to receive said leadscrew, a generally rectangular-shaped wire spring having end portions that extend over and yieldingly engage the thread of said leadscrew adjacent the ends of said follower, said wire spring having side portions extending substantially parallel to said leadscrew and secured at their midpoints to the sides of said follower, means preventing said follower from turning with said leadscrew, and a contact attached to the other side of said follower and wiping on said resistance element.

2. In a variable resistor having a housing, a leadscrew rotatably mounted on said housing, and a resistance element extending parallel to said leadscrew, the improvement comprising a follower in the form of a block having an open-sided channel provided in the top side thereof, said leadscrew being received within said channel and being freely movable therein, pairs of laterally spaced, parallel runners projecting upwardly from the sides of said block, a generally rectangular wire spring having side portions disposed between said pairs of runners on opposite sides of said leadscrew, the center sections of said side portions being fixedly secured to said block, said wire spring having end portions that cross over the top of said leadscrew and yieldingly engage the threads thereof adjacent the ends of said block, said runners slidably engaging the inside of said housing above said leadscrew to prevent the block from turning and to position it so that the bottom of said channel is spaced downwardly from the bottom of said leadscrew, and a contact attached to the bottom of said block and wiping on said resistance element.

3. The invention as defined in claim 2, wherein said leadscrew has exposed unthreaded portions adjacent its ends, one of said end portions of said wire spring running off the thread of said leadscrew onto said exposed unthreaded portion when said follower is at one end of its travel, the other of said end portions of said wire spring remaining in driving engagement with said leadscrew thread, said other end portion being yieldable upwardly to slip over the crest of said thread when said leadscrew is forcibly turned while said follower is stopped against the end of said housing.

4. In a variable resistor having a housing, a leadscrew rotatably mounted on said housing, and a resistance element extending parallel to said leadscrew, the improvement comprising a follower movable lengthwise of said leadscrew along one side thereof, a drive connection between said follower and said leadscrew, said drive connection being in the form of a wire spring having at least

one center portion extending parallel to said leadscrew and attached intermediate its ends to said follower, said wire spring being bent at each end to form transversely extending end portions that overlie the other side of said leadscrew and yieldingly engage the thread thereof adjacent the ends of said follower, and a contact attached to said follower and wiping on said resistance element.

References Cited in the file of this patent

UNITED STATES PATENTS

2,831,949	Bourns	Apr. 22, 1958
2,873,340	Bourns et al.	Feb. 10, 1959

FOREIGN PATENTS

588,558	Great Britain	May 28, 1947