Dec. 3, 1968 L. GINSBERG 3,414,862

VARIABLE RESISTOR

Filed March 24, 1967

FIG. 5

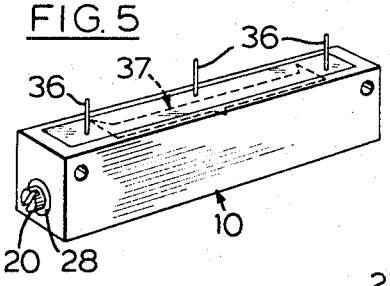


FIG. 1

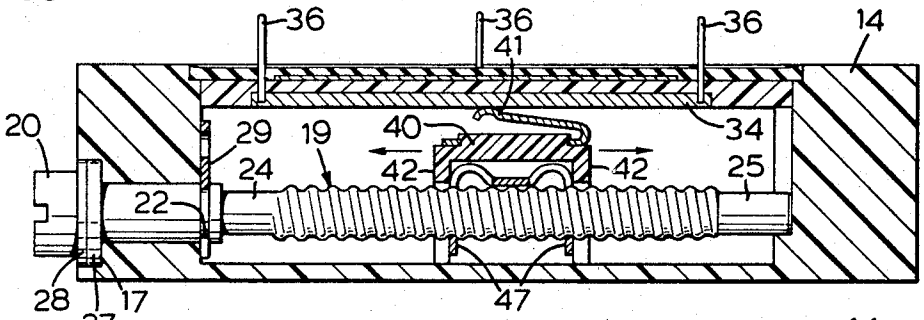


FIG. 2

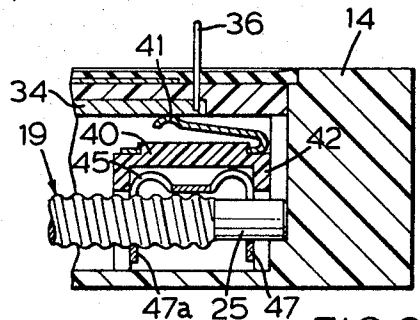
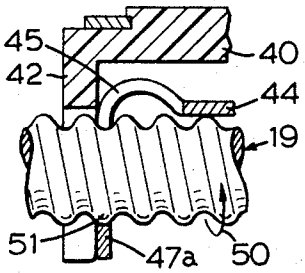


FIG. 3

FIG. 4



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VARIABLE RESISTOR

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ABSTRACT OF THE DISCLOSURE

A miniature, hermetically sealed, variable resistor or potentiometer is provided with a lead screw drive to a contact carrier, the contact carrier being hollow and provided with an internally positioned resilient member engaging the lead screw. The resilient member engages the lead screw on opposite sides and is provided with spaced members (47) which, when the carrier is in the limit of its travel, can "ratchet" over the threads of the lead screw if it is further rotated in a direction tending to move the carrier beyond its limit of travel.

This invention relates to variable resistors and potentiometers and, in particular, to a drive arrangement by means of which a lead screw may be conveniently employed to adjust the position of a movable contact in association with a resistance element.

BACKGROUND OF THE INVENTION

Lead screw operated variable resistors and potentiometers are not broadly new. Indeed, devices of this kind in various sizes and of varying constructions have been well known in the art for a considerable length of time. Miniature lead screw operated variable resistors and potentiometers, with which this invention is particularly concerned, embody, for the most part, certain common features of construction and present certain common problems and difficulties. Among these difficulties is the requirement that the complete variable resistor or potentiometer be hermetically sealed and enclosed with the result that it is impossible, from the outside of the device, to determine the position of the movable contact which is adjusted by rotation of the lead screw. Accordingly means must be provided to ensure that continued rotation of the lead screw in one direction will not cause damage to the internal components of the device when the contact moved by this rotation has reached one limit or the other of its travel axially of the lead screw. Numerous constructions have been proposed to overcome this difficulty with varying degrees of success.

SUMMARY OF THE INVENTION

The present invention proposes to overcome the difficulty referred to by providing a novel and particularly effective arrangement by means of which a movable contact can be caused to axially traverse the length of a lead screw within a variable resistor or potentiometer housing and which will ensure that continued rotation of the lead screw in one direction will not cause damage to the movable components after these components have reached their limit of travel in one direction or the other.

Further, the arrangement which is provided according to the present invention provides for a drive system connecting the lead screw and the movable components which is virtually backlash-free and which is believed to be less subject to deterioration as a result of prolonged use.

Further advantages of the present invention will become apparent as the following description proceeds with reference to the accompanying drawings in which like reference numerals denote like parts in the various views in which:

Brief description of the drawings

FIGURE 1 is a perspective view, partly cutaway and exploded, of a variable resistor or potentiometer constructed according to the present invention;

FIGURE 2 is a longitudinal section view of the assembled device of FIGURE 1;

FIGURE 3 is a partial longitudinal section view of the device showing the movable contact carrier in one extreme position;

FIGURE 4 is an enlarged view of a portion of FIGURE 3 illustrating the action of the device under continued rotation of the lead screw after the movable elements have reached the limit of travel, and

FIGURE 5 is an overall perspective view of the completed and assembled device.

Referring now to the drawings and, in particular, to FIGURE 1, the variable resistor or potentiometer of the present invention will be seen to comprise a housing which is generally indicated by reference character **10**. The housing is conveniently a plastic moulding and embodies an internal cavity **11** which is defined by a bottom wall **12**, two side walls **13**, two end walls **14** and which is open along the remaining side of the housing **10**. One end wall **14** is provided with an aperture **15** which is counterbored at **16** to provide a shoulder or seat **17**. The opposite end wall **14** is internally provided with an upwardly opening recess **18**.

A lead screw **19** is provided having an enlarged and slotted head **20** which is carried by one end of a shank **21** of slightly smaller diameter than the head **20**. A groove **22** is formed in the shank adjacent the head **20** and the major portion of the remainder of the length of the lead screw is provided with screw threads as indicated at **23**. An unthreaded portion **24** extends between the groove **22** and the beginning of the threads **23** and another unthreaded portion **25** lies adjacent the free end **26** of the lead screw **19**.

The lead screw **19** is adapted to be inserted within the housing **10** through the aperture **15** so as to lie within the cavity **11** and to be rotatable therein. One end of the lead screw will be supported by the bore **15** and the other end will be supported by the bight of the U-shaped recess **18** in the opposite end wall **14**. A resilient sealing member such as O-ring **27** is adapted to lie within the counterbore **16** and to bear upon the seat **17** and a metallic washer **28** bears against that side of the O-ring **27** remote from the seat **17** and also bears against the enlarged head **20** of the lead screw **19** when it is in the position shown in FIGURE 2. A retaining clip **29** is provided with a resilient aperture **30** which, when the lead screw **19** has been inserted within the housing **10**, can be moved so that the resilient aperture **30** will enter the groove **22** and embrace the lead screw so as to retain it in position. The position of the groove **22** along the length of the lead screw is such that when the element **29** is engaged therewith, the O-ring **27** will be under compression so as to provide for a hermetic seal about the lead screw and around the bore **15**.

A hole **31** is provided in the element **29** by means of which it may be engaged by a hooked tool to facilitate its removal.

The upper edges of the side walls **13** and end walls **14** which define the cavity **11** are provided with an inwardly extending shoulder **32** which constitutes a seat for a planar cover **33** which is adapted to fit within the open side of the cavity **11** and rest upon the shoulder **32**. The cover **33** may be of ceramic or plastic material and will carry, upon that face which is presented to the interior of the cavity when the cover is in position, a resistance element **34** and a collector track **35**. Terminal elements **36** are provided, in a well known manner to provide electrical connection between the resistance element **34**, the collector track **35**,

and the outer face of the cover **33**. This arrangement can be clearly seen in FIGURE 2.

The thickness of the cover **33** is less than the distance between the shoulder **32** and the upper edge of the side and end walls **13** and **14** respectively. Thus, when the cover is seated upon the shoulder **32**, a recess remains above it and into this recess is forced a resilient locking piece illustrated generally at **37** in FIGURE 1. The locking piece **37** is a resilient metallic member of generally rectangular configuration and provided, on one of its longitudinal edges, with a single sharp projection **38** and, on its opposite longitudinal edge, with a pair of spaced sharp projections **39**. The projections **38** and **39** are so dimensioned that the locking piece is an interference fit within the open side of the cavity **11**. Thus, the locking piece **37** may be forced into the recess above the cover **33** so that the sharp projections **38** and **39** will "bite" into the plastic material of which the housing has been moulded and provide for a relatively firm mechanical fixing of the cover in position. Once the cover has been thus positioned and locked with the locking piece **37**, an adhesive sealant or potting compound may be applied (see FIGURE 5) to seal the cover in position, to hermetically enclose the cavity **11** and to provide additional mechanical support for the terminal wires **36** which project from the cover.

Within the cavity **11** and at least partly embracing the lead screw **19** is a movable contact carrier **40** supporting a contact member **41** which, in the assembled condition of the device (see FIGURE 2) is in a position to electrically engage both the resistance element **34** and the collector track **35** to provide for the adjustable electrical connection between the resistance element **34** and the collector track **35** in a manner which is well understood and which is common to a number of devices of this general type.

The contact carrier **40** is a small, rectangular, plastic moulding adapted to fit snugly within the cavity between the parallel side walls **13**. The fit of the carrier **40** within the cavity, however, is sufficiently loose to enable it to move freely in a direction axially of the lead screw. The carrier **40** is adapted to slide along wall **12** of the housing **10** and is urged into abutment with wall **12** by the resiliency of the contact fingers **41**. Thus, as seen in FIGURE 2, the constant engagement between contacts **41** and the cover at the top and the carrier **40** and wall **12** at the bottom hold the carrier firmly, prevent any tendency for it to rotate with the lead screw **19** and provide for a smooth functioning of the movable components.

In order that the carrier **40** may at least in part embrace the lead screw, it is provided with a pair of spaced, parallel walls **42** each of which is provided with an aperture **43** to enable the lead screw to pass through both walls **42** of the carrier **40** as can be clearly seen from FIGURES 2 to 4 inclusive.

Within the contact carrier **40** is a resilient member lying between the spaced, parallel walls **42**, the resilient member being in engagement with the lead screw **19** and constituting the drive mechanism by means of which the contact carrier and, hence the contact **41** can be moved axially of the lead screw within the cavity **11** of the housing **10**.

The nature and construction of this resilient member can best be seen from FIGURE 1 in which it is shown to comprise a central portion **44** which is integrally joined by means of curved resilient portions **45** to a pair of spaced, parallel and opposed end members **46** which are adapted to lie against the adjacent faces of the spaced, parallel walls **42** of the contact carrier **40**. The end members of the resilient element each have, integral therewith, a transverse bar **47** and the arrangement shown in FIGURE 1 is such as to enable the resilient member to embrace the lead screw (see FIGURE 2) with the central member **44** bearing against the lead screw on one side and the transverse bars **47** engaging the lead screw on the diametrically opposite side.

The function of the central portion **44** bearing against the lead screw on one side is to maintain the transfer bars **47** in engagement with the screw threaded portion of the lead screw on its diametrically opposite side as can be seen in FIGURE 2. This engagement of the transverse bars **47** with the screw threads of the lead screw enables them to transform the rotary motion of the lead screw into axial motion in the resilient member which, in turn, being snugly received within the carrier **40**, causes the axial translation of the carrier **40** relative to the lead screw upon rotation thereof within the cavity **11**.

The function of the apparatus as shown in FIGURE 2 is believed to be obvious and apparent from the drawings during that portion of the movement of carrier **40** which takes place with both of the transverse bars in engagement with the screw threads upon the lead screw **19**. Continued rotation of the lead screw in one direction, however, will cause the movement of the carrier axially of the lead screw until one wall **42** abuts one end wall **14** defining the cavity **11** in the housing **10**. In FIGURE 3, the device is illustrated in such a position. The carrier **40** has moved to the right (in FIGURE 2) until one wall **42** of the carrier **40** is in engagement with the internal surface of end wall **14**. It is to be observed that the unthreaded portion **25** of the lead screw **19** is now engaged by one of the bars **47** and rotation of the lead screw **19** is, accordingly, as far as this bar **47** is concerned, ineffective to move the carrier **40** axially of the lead screw in either direction. The other transverse bar, however, identified in FIGURE 3 as **47*a*** is still in engagement with the threaded portion of the lead screw **19** and continued rotation thereof will produce the effect shown sequentially in FIGURES 3 and 4.

Turning now to FIGURE 4, rotation of the lead screw **19** in the direction of the arrow **50** after engagement of the carrier **40** with the end wall **14** has caused the curved portion **45** connecting bar **47*a*** with the central portion **44** to flex and permit transverse bar **47*a*** to be moved in a direction parallel to a diameter of the lead screw **19** and away from the central portion **44** so that it may "climb up" the incline of the screw thread **51** as shown in FIGURE 4.

The effect of further continued rotation of the lead screw **19** in the direction of the arrow **50** will be to allow bar **47*a*** to ride down the side of thread **51** into the trough again. This movement of bar **47*a*** is made easier by the component of force acting upon it in a direction axially of the lead screw which tends to reduce the frictional engagement between bar **47*a*** and the adjacent end wall **42** of carrier **40**. The sequence of events which has been illustrated in FIGURES 3 and 4 will repetitively continue so long as the lead screw **19** is rotated in the direction of the arrow **50** and this continued rotation will result in nothing more than the resilient travel of the transverse bar **47*a*** from trough to crest of the thread **51** (as shown in FIGURE 4) back to the position shown in FIGURE 3. It is apparent that these sequence of events will cause no damage to the internal mechanism of the device.

In the event that the direction of rotation of the lead screw **19** is reversed, the tendency of the transverse bar **47*a*** to climb up upon the thread **51** will be resisted by the frictional engagement of the bar **47*a*** and the end members **46** with the internal face of the adjacent wall **42** of the carrier **40**. This frictional engagement is assisted by the resilient action of the curved portions **45** which tend to urge the bars **47** and the end members **46** into abutment with the adjacent faces of the walls **42** within the carrier **40**. This resilient engagement precludes and eliminates any backlash which might otherwise exist between the lead screw **19** and the mechanism constituting the movable carrier **40** and the resilient member carried within it. Thus, reverse rotation of the lead screw **19** will immediately produce movement to the left (as seen in FIGURE 2) of the carrier **40** by virtue of the en-

gagement between the transverse bar **47***a* and the threads on the lead screw **19**. The other transverse bar **47** (see FIGURE 3) which is in engagement with the unthreaded portion **25** of the lead screw **19** is, during this initial movement, ineffective to either assist in or detract from the movement of the carrier **40**. A few turns of the lead screw **19**, however, will bring the right-hand bar **47** into engagement with the threaded portion of the lead screw and, thereafter, both bars **47** will be in engagement with the threaded portion although the movement of the carrier **40** will rely solely upon the engagement between bar **47***a* and the threads since this is the bar which the rotation of the lead screw will urge to engagement with the wall **42** and which will, therefore, transmit the axially directed force to the carrier **40**.

It will, of course, be apparent that continued rotation of the lead screw in a direction such as to move the carrier to the left in FIGURE 2 will utimately bring the carrier into contact with the opposite end wall **14** adjacent which the lead screw **19** is provided with an unthreaded portion **24** equivalent to the unthreaded portion **25** at the opposite end. Here, the sequence of events illustrated in FIGURES 3 and 4 will be repeated in exactly the same manner as before except that, in this event, it will be the opposite bar **47** which will climb up upon the thread **51** in a manner similar but opposite to the manner which has already been described.

It will be apparent that in order for the device illustrated to be operative, the axial extent of the unthreaded portions **24** and **25** must be less than the separation between the internal surfaces of the walls **42** of the carrier **40** so that, at all times, one bar **47** will remain in engagement with the threaded portion of the lead screw.

The advantages to be derived from the construction disclosed herein will be apparent to those skilled in the art. The freedom from backlash which the resilient member provides is an important advantage and, further, another important advantage derives from the fact that the resilient member may be considered as "floating" within the carrier **40** and that it does not transmit to the carrier **40** any of the flexing which takes place when the carrier **40** is at a limit of its travel and the lead screw is further rotated.

While a preferred embodiment of the invention has been described in detail with reference to the accompanying drawings it is to be appreciated that minor modifications in construction and arrangement are contemplated within the spirit of the invention and the scope of the appended claims.

What I claim as my invention is:

1. In a variable resistor comprising a housing, the housing having an internal cavity open along one side of the housing, a threaded lead screw passing through the housing and rotatable in the cavity, the lead screw being screw threaded over a major portion of its length within the cavity and unthreaded adjacent each end of the cavity, a cover adapted to close the housing, a resistance element parallel to the lead screw and presented to the inside of the cavity, a contact carrier at least partly embracing the lead screw and carrying a contact to engage the resistance element, the contact carrier comprising a rectangular element having a rectangular cavity therein defined by at least two spaced, parallel end walls normal to the lead screw, through which the lead screw passes, a resilient element within the rectangular cavity and having a first central portion bearing on the lead screw on one side thereof and having a pair of spaced, parallel opposed end members, integrally joined thereto by means of curved, resilient portions, the end members engaging the lead screw on the side thereof remote from the first central portion, the end members also resiliently bearing against the said two spaced, parallel end walls of the cavity in the contact carrier to cause rotation of the lead screw to be transformed into axial movement of at least one of the spaced, parallel end members which, being in direct contact with the adjacent end wall of the contact carrier thus causes movement of the contact carrier axially of the lead screw.

2. In a variable resistor, the arrangement as claimed in claim **1**, wherein the length of each unthreaded portion of the lead screw within the cavity is less than the separation between the spaced, parallel end walls of the contact carrier.

3. In a variable resistor, the arrangement of claim **2**, wherein the central portion of the resilient member is joined to the end members by curved portions integral both with the end members and the central portion, the curved portions providing resiliency to enable the bars transverse to the lead screw to move away from the central portion by a distance at least equal to the height of a screw thread on the lead screw.

4. In a variable resistor, the arrangement of claim **1**, wherein the cavity has a shoulder surrounding the open side upon which the cover may be seated.

5. In a variable resistor, the arrangement of claim **4**, wherein the shoulder is spaced from the edge of the open side by a distance greater than the thickness of the cover so that, when the cover is inserted, a recess is defined to receive a locking piece, the locking piece comprising a flat member of resilient material having two spaced pointed projections on one side and a single pointed projection on the other side and located between the first two, the pointed projections being dimensioned so as to enable the locking piece to be forced into the open side of the cavity after the cover, and to secure the cover therein.

References Cited

UNITED STATES PATENTS

1,669,447	5/1928	Boyton et al.	174—66
3,107,336	10/1963	Caddock et al.	338—180
3,175,723	3/1965	Schmidt et al.	174—50 X
3,187,289	6/1965	Rolwes	338—180

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