March 10, 1964 W. D. HULBERT 3,124,780

RECTILINEARLY ADJUSTABLE VARIABLE RESISTOR

Filed July 3, 1962 2 Sheets-Sheet 1

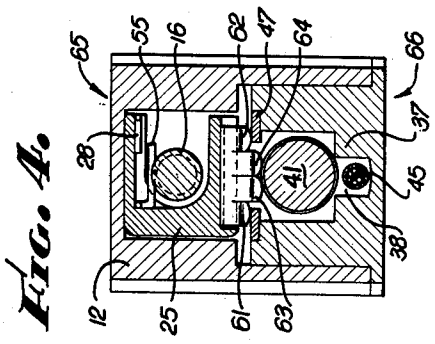


FIG. 4.

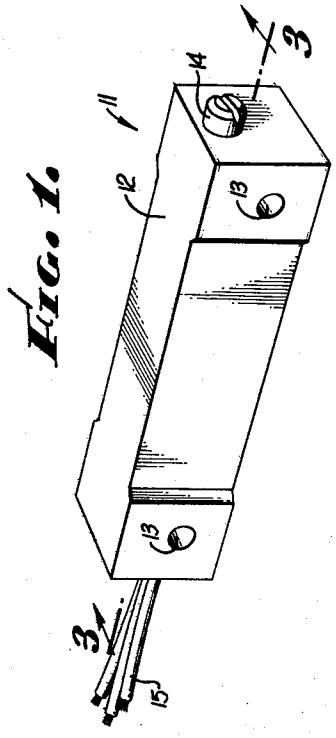


FIG. 1.

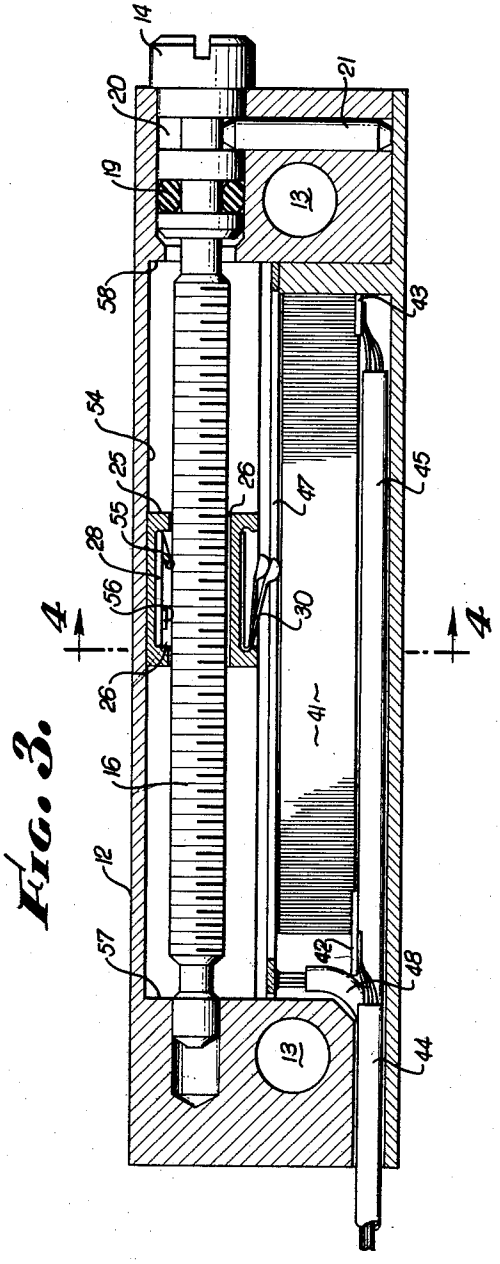


FIG. 3.

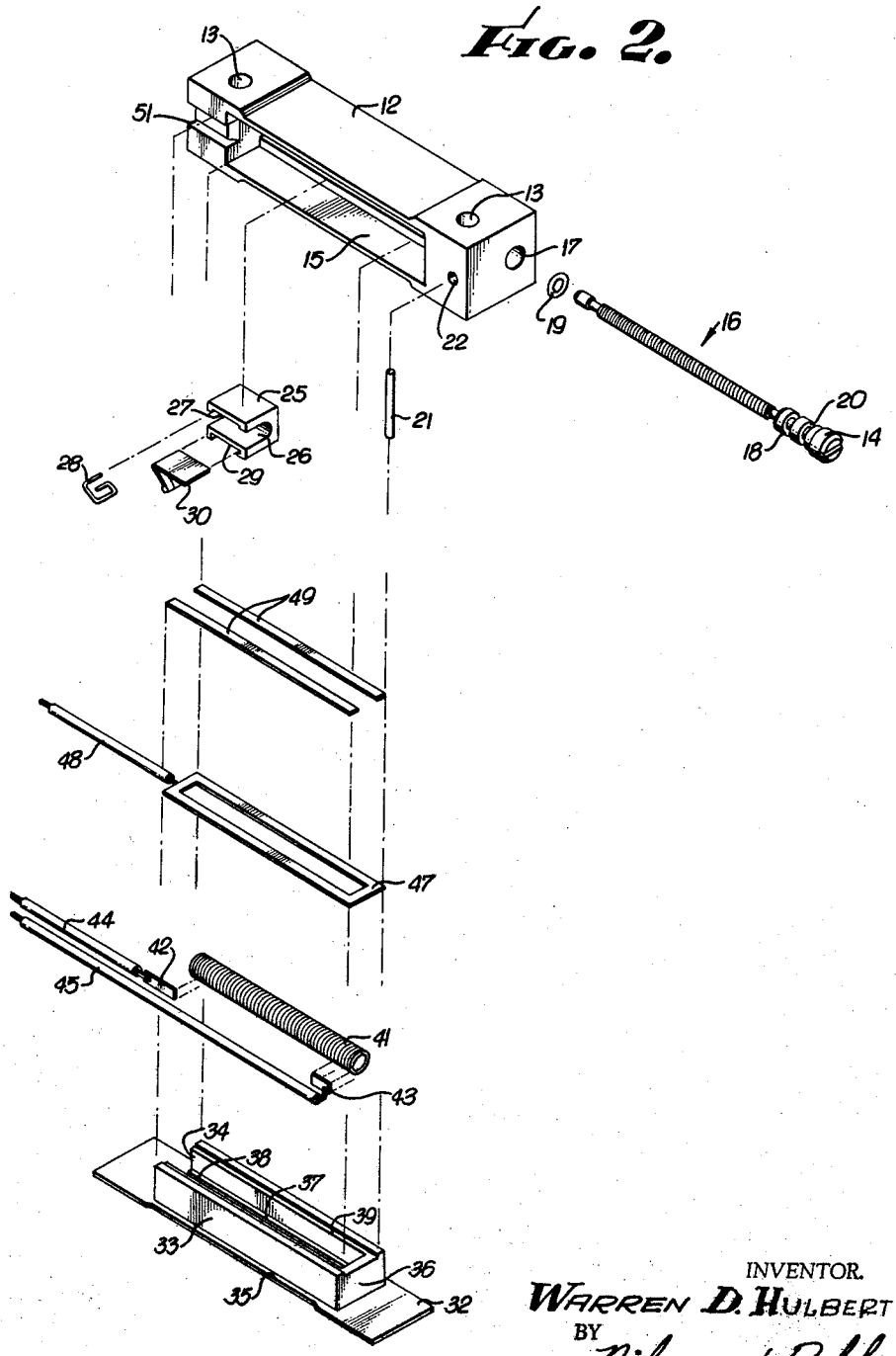
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FIG. 2.



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RECTILINEARLY ADJUSTABLE VARIABLE RESISTOR

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This invention relates generally to variable resistors, and more particularly to miniature trimmer potentiometers of the lead screw actuated type.

In the prior art, there have been a number of lead screw actuated type trimmer potentiometers having various internal operational configurations. The external appearance of these devices has been fairly well standardized to rectangular but with three different sizes as follows: .280 inch wide, 1¼ inches long and 5/16 inch high; .180 inch wide, 1¼ inches long and 5/16 inch high; and .180 inch wide, 1 inch long and 5/16 inch high. Since the length or width of these devices varies one to the other, one of the problems in the prior art has been the requirement of separate size internal operating parts for each size device. Such a requirement precluded interchangeability of parts between devices.

The slider block, which carries the electrical contact to the resistance element, has in the past been driven by engagement with the threads of the lead screw. Such a driving engagement has caused the slider block to have a tendency to rock during the time that it was being actuated by the lead screw. This rocking created two problems; a generation of undesired noises, and an indication of instability of the setting of the potentiometer. The latter problem is more acute after the potentiometer slider block has been moved to a desired position and is no longer actuated. As a result of the engagement with the lead screw the slider block would be slightly "cocked" and upon being subjected to vibration or other stresses the slider block would tend to right itself, thus causing the contacts on the resistance wire to shift from one turn to another and give the instability indication.

Furthermore, the threaded engagement between the slider block and the lead screw also had a tendency to reduce the life characteristics of the potentiometer. This resulted since the slider block contacts the end portions of the housing at the end of its travel and additional stress is placed upon the screw threads within the slider block by continued turning of the lead screw. These stresses have a tendency either to destroy or to weaken the threads formed in the slider block.

Still an additional difficulty with prior art trimmer potentiometers is that foreign matter will settle upon the internal parts during production. The movable electrical contacts engaging the resistance element and the collector element by riding over foreign matter during operation, interrupt the electrical continuity of the circuit, thus creating spurious noise signals.

Accordingly it is an object of the present invention to provide a miniature variable resistor which is rugged, inexpensive to manufacture, and meets the required tolerances for use in most circuit applications.

It is another object of the present invention to provide a miniature variable resistor in which the slider block is continuously urged into contact with a portion of the housing to prevent rocking thereof during actuation by a lead screw.

It is another object of the present invention to provide a miniature variable resistor having a slider block which is driven by an arrangement that will slip when movement of the slider block is opposed by reaching the end of travel along the lead screw.

It is another object of the present invention to provide a miniature variable resistor having sub-assemblies and detail parts which are readily interchangeable irrespective of the size of potentiometer which is being constructed, thus providing a greater versatility in mass production techniques of such variable resistors.

It is another object of the present invention to provide a miniature variable resistor in which electrical continuity between the resistor and the exterior portions of the circuit is never broken.

Other objects and advantages of the present invention will become apparent from a consideration of the following description taken in conjunction with the accompanying drawings which are presented by way of illustration only and are not intended as a limitation upon the scope of the present invention as defined in the appended claims, and in which:

FIG. 1 is a perspective view of a miniature variable resistor in accordance with the present invention;

FIG. 2 is an exploded view of a miniature variable resistor in accordance with the present invention;

FIG. 3 is a longitudinal view partly in cross-section taken about the lines 3—3 of FIG. 1; and

FIG. 4 is a transverse view partly in cross-section taken about the lines 4—4 of FIG. 3.

In accordance with one aspect of the present invention, there is provided a miniature potentiometer which is enclosed within a housing having a resistance element mounted therein and a rotatable lead screw mounted parallel to the resistance element. There is disposed about the lead screw a slider block which has an opening longitudinally through it and of such configuration as not to engage the lead screw. Disposed within the opening and contacting both the lead screw and the slider block is a resiliently deformable means which continuously urges the slider block into contact with an interior surface of the housing. The resiliently deformable means engages the threads on the lead screw and thereby imparts movement to the slider block upon rotation of the lead screw.

In accordance with another aspect of the present invention, the resistance element is mounted upon a substantially planar base member which has thereon a pair of spaced apart upstanding side walls which extend longitudinally of the base and are spaced inwardly from the end and the side edges of the base. The resistance element is disposed between these side walls. A collector bar is mounted upon the top edges of the side walls and a unitary box-like structure carrying the lead screw, slider block, and electrical contacts is united with the resistance element carrying base member in such a way as to provide a completely housed miniature variable resistor.

Referring now to the drawings, in which like parts are designated by the same reference numeral throughout, and more particularly to FIG. 1, there is illustrated generally at **11** the exterior configuration of a miniature variable resistor in accordance with the present invention. From the exterior view the miniature variable resistor in accordance with the present invention appears substantially the same as many such prior art miniature variable resistors and includes a housing **12** having mounting openings **13** therein with the head **14** of a lead screw extending from one end thereof and electrical leads **15** extending from the opposite end thereof. As can be seen the end portions of the housing are wider than the central portion thereof. This construction permits interchangeability of internal parts while meeting exterior mounting dimensions that may be required by some users.

The interior detail parts of the miniature variable resistor in accordance with the present invention are illustrated in the exploded view of FIG. 2 to which reference is hereby made. As is therein illustrated, the housing **12**

has the configuration generally of an elongated rectangular box like structure having one open side **15**. The housing can be constructed of any material which is desired, but preferably in accordance with the preferred embodiment of the present invention, is molded from a plastic material such as diallyl phthalate.

The lead screw **16** is inserted into an opening **17** provided in the housing **12** therefor. The lead screw **16** has a first continuous groove **18** upon the shank adjacent the head **14** thereof which is adapted to receive the end of a locking pin **21** which is inserted into an opening **22** provided in the under surface of the housing **12**. The end of the lock pin **21** fitting into the groove **20** of the shank of the lead screw **16** prevents undesired longitudinal movement of the lead screw internally of the housing during operation of the miniature variable resistor.

A substantially U-shaped slider block **25** is provided with a longitudinal opening **26** therethrough for receiving the lead screw **16** and particularly the threaded portion of the shaft thereof. The slider block **25** is disposed about the lead screw **16** in such a manner that the threads of the lead screw do not touch the internal portion of the slider block **25**. A recess **27** is provided within the opening **26** of the slider block **25** in such a manner as to present a substantially flat surface therein. A resiliently deformable member, such as a spring **28** substantially in the form of the number **6** is received within the recess **27** and contacts both the lead screw and the flat surface of the slider block as will be more fully described below.

An additional recess **29** is provided in the lower surface of the slider block **25** and receives an electrically conductive contact member **30** having four discrete arms. As will be more fully described below, the contact member makes electrical connection of a slidable nature with the resistance element and the collector bar. The housing **12** having the slider block and the lead screw contained therein forms the first sub-assembly of a miniature potentiometer or variable resistor in accordance with the present invention. The dimensions of the housing **12** may be varied depending upon the size requirements of the user so the slider block-lead screw combination is interchangeable for any external size variable resistor of the rectangular trimmer configuration which is presently utilized.

This being the case, it becomes clear that sub-assemblies for rectangular trimmer potentiometers can be manufactured in the same production line indiscriminately of size of external dimensions. These sub-assemblies can be stocked and then withdrawn at the time the final product is being manufactured in accordance with the customer's specifications.

The open side **15** of the housing **12** receives a base member carrying the resistance element and the collector bar. This sub-assembly closes the box-like structure and forms the housing and is illustrated in the exploded view of FIG. 2. This sub-assembly includes a substantially planar base member **32** having thereon a pair of spaced apart side walls **33** and **34** which are disposed longitudinally upon the base member **32** but are spaced inwardly from the sides and from the ends thereof, thereby providing a continuous space **35** around the periphery of the base member **32**. There may also be an end wall **36** interconnecting the spaced apart upstanding side walls **33** and **34**. The base **32** between the spaced apart side walls **33** and **34** is raised or thickened as shown at **37** and has formed therein a longitudinal groove **38** (more clearly seen in FIG. 4). The base member, side walls and end wall are preferably molded as a unitary member of electrically non-conductive material, such as plastic, and in accordance with the presently preferred embodiment of the present invention is constructed of diallyl phthalate.

A resistance element **41** is provided and is fitted into place upon the raised base **37** between the upstanding side walls **33**, and **34**. The end wall **36** is utilized during production to locate the resistance element **41** upon the base **32** in proper position for contact by the sliding contact member **30** disposed within the groove **29** provided on the slider block **25**. Any particular type of resistance element which is desired may be utilized without departing from the scope of the present invention. For purposes of illustration, there is shown one type of resistance element which is constructed by winding a fine resistance wire upon a mandrel. The resistance element is held in place within the side walls **33**, **34** by the use of a cement, such as epoxy resin. An electrically conductive tab **42**, **43** is affixed such as by soldering or welding to each end of the resistance element **41**. Electrical leads **44**, **45** are in turn affixed as by soldering or welding to the tabs **42**, **43** respectively. The lead **45** extending from one end of the resistance element **41** is at the time the resistance element is placed into the base **32** disposed within the groove **38** so that it may be brought externally throught the housing **12** at the same end as the lead **44**.

A collector bar **47** having a lead **48** affixed as by welding or soldering to one end thereof is placed upon the upper edge portion of the side walls **33**, **34** and the end wall **36** and is fitted into recess **39** provided therefor. The collector bar **47** is held in place by a cement, such as epoxy resin. If such is desired, the collector bar may be constructed of a hard-gold plated beryllium copper rectangularly frame shaped member as is illustrated. In some applications it has been found desirable to utilize an unplated beryllium copper collector bar having adhered or affixed as by welding or soldering to the upper surfaces thereof a pair of precious metal strips **49** which may be of any precious metal desired, but in accordance with the preferred embodiment of the present invention is a platinum alloy.

The base member **32** having the resistance element **41** and the collector bar **47** mounted thereon constitutes the second sub-assembly of a miniature variable resistor in accordance with the preferred embodiment of the present invention. As can also be seen, the only variable thing about the second sub-assembly is the value of the resistance element **41**. A plurality of such resistance elements may be constructed and stocked along with the various remaining parts of the sub-assembly. Therefore, one assembly line can construct the base sub-assembly by withdrawing the parts thereof from stock depending upon the magnitude of the resistance element and placed within the first sub-assembly to complete the potentiometer in accordance with the order of a customer. By such construction it is therefore seen that the cost of production can be substantially reduced for such miniature variable resistors. When the two sub-assemblies are brought together, it can be seen that a recess **51** provided within the lower edge portion of the housing **12** receives the lead wires **44**, **45** and **48** permitting them to pass through the housing and extend therefrom as is illustrated in FIG. 1.

Referring now more particularly to FIG. 3 there is illustrated partly in cross-section in a longitudinal assembly view of a miniature variable resistor in accordance with the present invention. As is therein seen, the "6-shaped" spring **28** is disposed within the opening **26** of the slider block **25**, and the end portions thereof contact the substantially flat surface provided by the recess **27** therein. Also the center portion of the "6-shaped" spring **28** contacts the threads upon the lead screw **16**. The spring member when inserted between the flat surface provided by the recess **27** and the slider block **25** and the threads of the lead screw **16** is placed in compression. Thereafter, as the spring **28** attempts to return to its non-deformed position the slider block is continuously urged puwardly and into contact with the upper inner surface **54** of the housing **12**. By so continuously urging the upper surface of the slider block **25** against the upper inner surface **54** of the housing **12**, the slider block is prevented from attempting to rotate or rock as the lead screw is actuated to move the slider block longitudinally

of the variable resistor. Motion longitudinally of the slider block is imparted thereto by the center portion of the "6-shaped" spring which has been offset and as viewed in FIG. 3 appears as a lower portion **55** of the spring **28**. The upper portion of the spring **28** is retained in position and restrained from longitudinal movement by the recess **27** and also by a land **56** extending outwardly from the surface of the recess **27**. As the lead screw is turned, the lower portion **55** of the spring **28** follows the configuration of the threads and since the upper portion of the spring **28** is held in place within the slider block **25**, the slider block is caused to move longitudinally of the resistance element.

When the slider block is prevented from further longitudinal movement as by abutting either end of the housing **12** as is illustrated at **57** and **58**, the resiliently deformable characteristics of the spring **28** causes the lower portion **55** thereof to ride over the threads on the lead screw **16**. That is, the lower portion **55** of the spring **28** is urged upwardly by the surface of the screw thread until the uppermost portion thereof is reached at which time the lower portion **55** of the spring **28** will snap back into the lowermost portion of the following threaded area. This snapping action will continue for so long as the lead screw is actuated. The snapping action creates a clicking-type noise which can readily be heard by an operator who is adjusting the lead screw, thus providing an audible positive signal that the end of travel of the slider block has been reached. Furthermore, no damage is imparted to the slider block or to the lead screw by this "slipping clutch" arrangement and thereby the life of the variable resistor is substantially increased.

As can clearly be seen in FIG. 3, there is no contact between the lead screw and the upper or lower surfaces defining the opening **26** longitudinally through the slider block **25**.

Referring now more particularly to FIG. 4, there is illustrated a transverse view in cross-section of the variable resistor in accordance with the present invention. Once more it can clearly be seen that there is no contact at any point between the lead screw and the slider block. The only inter-connection between the lead screw and the slider block is through the action of the spring **28** contacting the upper substantially flat surface provided within the opening **26** of the slider block and the lead screw by the spring **28**. As can particularly be seen in FIG. 4, the resistance element **41** is mounted upon the raised portion **37** of the base **32** and the lead wire **45** is clearly illustrated as being disposed within the groove **38**. As can be specifically and more clearly seen in FIG. 4, the outer two arms **61** and **62** of the contact member **30** are disposed on opposite sides of the resistance element and contact opposite longitudinal members of the collector bar **47**. Thus there is provided two distinct and separate electrical connections to the collector bar **47**. As can also be seen, the two inner arms **63** and **64** each contact the resistance element **41** thus providing two distinct and separate electrical connections to the resistance element. By providing two distinct and separate electrical connections to the resistance element and also two such connections to the collector bar, it can readily be appreciated that even though a particle of foreign matter such as dust or the like may inadvertently find its way to either the resistance element or the collector bar, electrical contact will not be broken although one of the electrical contacts on the collector bar or on the resistance element is caused to ride over such particle of foreign matter; thereby a more stable output electrical signal is provided when utilizing a variable resistor in accordance with the present invention.

When the two sub-assemblies as above described and designated in FIG. 4 by the numeral **65** for the upper sub-assembly and the numeral **66** for the lower sub-assembly are brought together as illustrated, they are sealed in position by a cement, such as epoxy resin thus providing an integrally formed housing for a variable miniature resistor having a cavity disposed internally thereof and within the cavity the various operational parts such as lead screw, slider block and resistance element that are required for such devices.

There has thus been disclosed one embodiment of a variable miniature resistor which is rugged, inexpensive to manufacture and which can be constructed in separate sub-assemblies capable of being brought together at such time as a specific value of resistance for such a variable resistor is desired Furthermore, a stable slider block and contacts to the resistance element and collector bar are provided.

Although only one specific embodiment of a variable resistor in accordance with the present invention has been illustrated and described above, it is to be expressly understood that various other configurations may be provided without departing from the scope or spirit of the present invention as defined by the following claims.

What is claimed is:

1. In a miniature potentiometer having an enclosed housing, a resistance element mounted within said housing and a rotatable lead screw mounted within said housing parallel to said resistance element, the improvement for making movable contact to said resistance element comprising: a slider block defining an opening longitudinally therethrough having at least one substantially flat surface, said slider block being disposed about said lead screw and spaced therefrom; a substantially "6-shaped" resiliently deformable metallic member disposed within said opening the center of said member contacting said lead screw and the ends of said member contacting the flat surface of said slider block and continuously urging said slider block into contact with the interior surface of said housing, said resiliently deformable means engaging the threads on said lead screw thereby to impart movement to said slider block upon rotation of said lead screw.

2. The improvement for miniature potentiometers as defined in claim 1 in which said "6-shaped" metallic member is restrained against longitudinal movement at all times.

3. In a miniature potentiometer having an enclosed housing, a resistance element mounted within said housing and a rotatable lead screw mounted within said housing parallel to said resistance element, the improvement for making movable contact to said resistance element comprising: a substantially U-shaped slider block having opposed substantially flat inner surfaces, a recess within one of said opposed inner surfaces, said slider block being disposed within said housing about said lead screw, the inner surfaces of said U-shaped slider block being spaced from said lead screw; a resiliently deformable substantially "6-shaped" metallic member disposed within said recess having the ends thereof in engagement with said slider block and the center thereof in engagement with at least one thread on said lead screw, whereby said slider block is moved upon rotation of said lead screw.

4. The improvement for miniature potentiometers defined in claim 3 in which includes a land disposed within said recess and said resiliently deformable "6-shaped" metallic member has one end thereof received between said land and edge of said slider block defining said recess thereby to prevent longitudinal movement of said "6-shaped" member.

5. A miniature variable resistor comprising: a substantially planar base member; a pair of spaced apart upstanding side walls longitudinally extending along said base member and spaced inwardly from the end and side edges thereof; a resistance element disposed between said side walls; a collector bar mounted upon the top edge of at least one of said side walls; a unitary box-like structure having one open side and carrying a lead screw therein; a slider block disposed about and spaced from said lead screw; resiliently deformable means engaging said slider block and said lead screw for moving said slider

block upon rotation of said lead screw; a contact member carried by said slider block; said open side of said box-like structure receiving said side walls on said base member, the edges of said open side contacting said base member whereby a closed housing is provided for said potentiometer, said contact member making sliding contact with said resistance element and said collector bar; and electrical leads connected to said resistance element and said collector bar and extending externally of said housing.

6. A miniature variable resistor in accordance with claim 5 in which said base member between said side walls is substantially increased in thickness and defines a longitudinal groove therein, one of said electrical leads being disposed within said groove and extending adjacent said resistance element for the length thereof.

7. A miniature variable resistor in accordance with claim 5 in which said slider block is a substantially U-shaped member of electrically non-conductive material defining an internal and an external recess, said internal recess receiving said resiliently deformable means, and said external recess receiving said contact member.

8. A miniature variable resistor in accordance with claim 5 in which said side walls are bridged at one end thereof by an end wall, said resistance element abutting said end wall and being retained in place thereby during assembly.

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