Aug. 4, 1959 D. F. ROYCE 2,898,569

POTENTIOMETERS

Filed Jan. 27, 1958

FIG. 1.

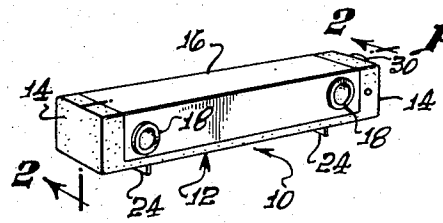


FIG. 2.

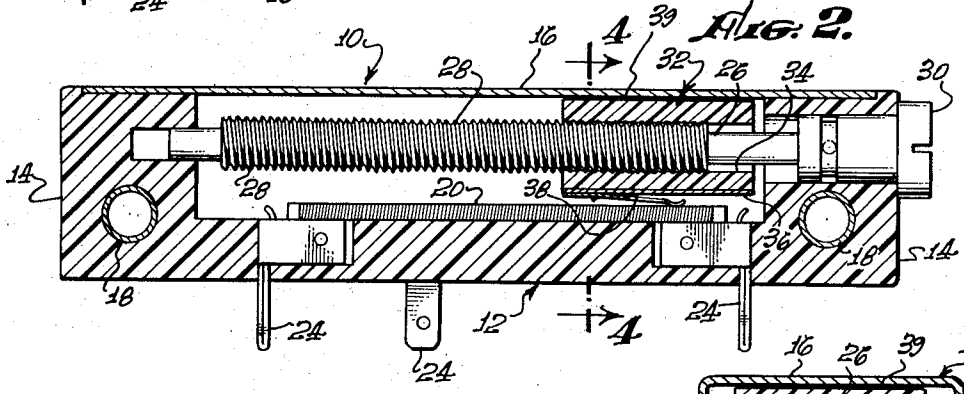


FIG. 3.

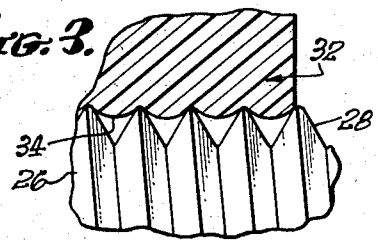


FIG. 4.

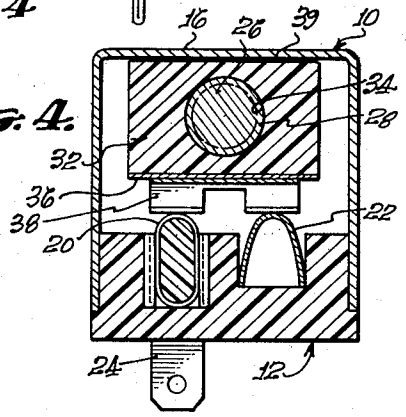


FIG. 6.

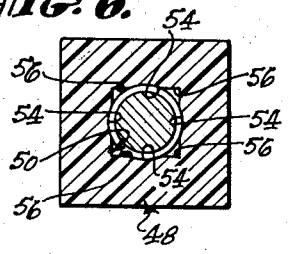


FIG. 7.

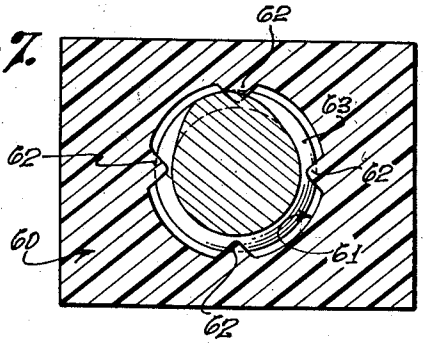
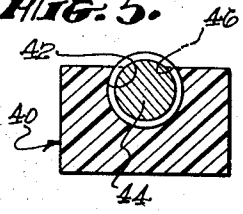


FIG. 5.



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POTENTIOMETERS

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5 Claims. (Cl. 338—180)

This invention relates to variable resistors of the leadscrew actuated type, which category includes potentiometers. Such instruments are extensively used in electronic circuits for fine adjustment of resistance or voltage values, owing to the precise adjustment that is obtainable with a leadscrew. A further advantage of this type of instrument is that it is self-locking, and therefore not readily disturbed by vibration, shock or acceleration.

Variable resistors of the type referred to, usually comprise a housing or body, within which is mounted a resistance element. A rotatable leadscrew extends through the housing parallel to the resistance element, and an internally threaded movable member is located upon or engageable by the shaft. This movable member carries a contact which resiliently engages the resistance element to establish electrical connection between it and some part of the instrument serving as an electrical return. With this type of construction, as the threaded shaft employed is turned, the movable member and the contact element carried by it are moved along the length of the resistance element.

In the never-ending search for ways of reducing manufacturing costs, it has long been recognized that forming the thread in the movable member is one of the more costly operations, and that elimination of this operation would substantially reduce manufacturing costs, making it possible to sell the instrument at a lower price. However, the internally threaded bore in the movable member has been thought to be indispensable to the leadscrew type of actuation. The present invention provides a novel and unique arrangement, whereby the leadscrew type of actuation is obtained without the necessity of forming threads of any kind in the movable member. Thus, the costly thread-forming operation is completely eliminated without sacrifice of any of the desirable characteristics of leadscrew actuation.

One operational disadvantage of the conventional leadscrew actuated potentiometer is that it is possible to damage the instrument by forcibly turning the leadscrew after the movable member has run up against the end of the body. Such damage may be in the form of stripped threads on the movable member, or breakage of the instrument body itself. In the latter case, the leadscrew and threaded movable member act as an expanding screw jack, exerting a very considerable outward pressure against the opposite ends of the body.

In order to remedy this type of problem, a number of different types of constructions have been proposed to prevent the threads within a screw actuated potentiometer from being stripped. At the present time none of the prior expedients is considered to be completely satisfactory, and one of the primary objects of the present invention is to provide a leadscrew actuated variable resistor having all of the characteristic advantages of conventional instruments, but without the above-mentioned disadvantages.

Another object of the present invention is to provide a new and improved type of movable member or post

for use in potentiometers. A closely related object of this invention is to provide a movable member for such use in which there are no threads, as the term is ordinarily used, which may be stripped due to maloperation of such an instrument. Another more specific object of this invention is to provide in a potentiometer of the type described a movable member formed out of a nonconductive, elastically deformable material, which is capable of forming its own threads during use.

Because of the nature of this invention it is not considered necessary to set forth in this specification a further long list of various specific objects and advantages of it. Those skilled in the art to which this invention pertains will realize various objects and advantages of this invention from a detailed consideration of the remainder of this specification, including the appended claims and the accompanying drawing, in which:

Figure 1 is a perspective view of a new and improved potentiometer of this invention;

Figure 2 is a cross-sectional view taken at line 2—2 of Figure 1;

Figure 3 is an enlarged partial cross-sectional view, taken along the same plane as the view illustrated in Figure 2;

Figure 4 is a cross-sectional view taken at line 4—4 of Figure 2; and

Figures 5, 6 and 7 are cross-sectional views, illustrating three modified forms of the movable member, falling within the scope of this invention.

Wherever convenient for purposes of illustration and explanation like numerals have been used to designate like parts in the accompanying drawing. It is to be understood that this drawing is primarily intended so as to clearly illustrate certain presently preferred forms or embodiments of this invention. Those skilled in the art to which this invention pertains will realize the basic features or principles set forth in this specification may be applied to a number of differently appearing potentiometers, and that the movable members shown can obviously be modified in a number of ways without altering the manner in which they operate in a potentiometer.

As an aid to understanding the invention, it may be stated in essentially summary form that it involves variable resistors, each of which is manufactured so as to include a resistance element and a threaded shaft mounted adjacent to this resistance element so as to extend parallel to it. With this invention a movable member of nonconductive, elastically deformable material is formed to provide a portion that is engageable by the leadscrew with sufficient pressure to cause the crests of the leadscrew thread to press into the material, so that the latter takes a transient impression of the thread which functions in the same manner as if the thread were cut into the material in the conventional manner. Thus, when the leadscrew is turned, the movable member is caused to move lengthwise thereof. However, if the member is prevented from moving freely, as by running up against one end of the instrument body, the deformable material of the movable member is capable of yielding under the endwise sliding movement of the leadscrew thread, and thus prevents damage to the instrument.

In the drawings, the reference numeral 10 designates a potentiometer having a housing 12 including ends 14. This housing is adapted to be closed by means of a cover 16 held in place by small rivets 18. Within the housing 12 there is mounted a resistance element 20 and an electrical return 22. Appropriate terminals 24 are attached to the ends of this resistance element 20 and the return 22 so that the potentiometer 10 may be connected in an established manner into an electrical circuit. The ends 14 of the housing 12 rotatably support a leadscrew 26 having threads 28 formed thereon, and having a slotted

head 30 located on the outside of this housing 12. This head 30 may be engaged by a screwdriver or other like instrument in order to turn the leadscrew 26. It is noted that the leadscrew 26 extends through the housing 12 parallel to the resistance element 20, and it is spaced from this resistance element.

With the present invention a movable member 32 of a generally rectangular block-like type shape is mounted so that the leadscrew 26 extends completely through a cylindrical opening 34 formed in the movable member 32. This opening 34 is formed so as to have a uniform cross-sectional configuration. The movable member 32 is formed out of a nonconductive material, and serves to insulate the leadscrew 26 from a metal contact element 36 carried by the movable member 32. This contact element 36 includes a brush means 38 which resiliently engage the resistance element 20 and the electrical return 22. The contact element 36 may be attached to the movable member 32 by any convenient means, such as, for example, an adhesive, by the use of interlocking projections or flanges or the like.

The material out of which the movable member 32 is formed is considered to be important with the present invention. Preferably this movable member 32 is manufactured so that the portion of it defining the wall of the opening 34 possesses sufficient resilience so as to be capable of undergoing temporary deformation. Preferably the portion of the movable member 32 defining the wall of the opening 34 is also formed out of a material having sufficient resistance to abrasion so that the threads 28 will not cut or otherwise mar this material. With the present invention suitable movable members such as the member 32 may be conveniently formed by appropriate injection molding or other similar techniques out of various resinous materials such as, for example, polytetrafluoroethylene, nylon, vinyl, polyethylene, and the like. The molding material may be pure resin, suitably plasticized if necessary, or it may contain substantial amounts of filler for various reasons. The primary physical characteristics required in the material of the movable member are: (1) sufficient softness and resilience to yield under the pressure of the leadscrew threads and thereby take a transient impression of the threads, (2) elastic recovery, (3) resistance to abrasion or gouging, and (4) reasonably good frictional properties.

The diameter of the opening 34 is somewhat less than the major diameter of the threads 28 on the leadscrew 26 but greater than the minor diameter of these threads, so that the leadscrew is an interference fit in the opening. The wall of the opening 34 is normally smooth. When assembled on the leadscrew 26 the portion of the movable member 32 defining the opening 34 will be deformed, or plastically displaced, as indicated in Figure 3 of the drawing, so that portions of the movable member 32 extend between the crests and the valleys or bottoms of the threads 28 on the leadscrew 26 a short distance which approximately corresponds to the distance to the pitch diameter of the threads 28. The member 32 is restrained against turning with the leadscrew by any suitable means, such as by sliding engagement of the top surface 39 with the under side of the cover 16.

When the movable member 32 is formed as indicated and the leadscrew 26 is turned, the movable member 32 will move upon the threads 28 as if the opening 34 was threaded in an established manner. When the movable member 32 abuts against either of the ends 14 of the housing, the portion of the movable member 32 defining the cylindrical opening 34 will yield with the sliding, forward movement of the threads, permitting the leadscrew 26 to be turned without causing the walls of the opening 34 to become marred or the like. When the direction of the rotation of the leadscrew 26 is reversed, the movable member 32 will again function in its established manner and move toward the other end of the housing.

It is not to be assumed from the above that this invention is limited to movable members such as the member 32 which extend completely around a leadscrew. If desired, a movable member 40 as shown in Figure 5 of the drawing may be formed which is identical with the movable member 32 except for the fact that the opening 42 in this movable member 40 extends more than 180° and less than 360° around a threaded shaft 44. The opening 42 is of a uniform cross-sectional configuration and includes what may be termed a slot 46 on one side of this movable member 40 leading to the outside of the movable member.

It is also possible to utilize the principles of this invention with various types of nonround openings. In Figure 6 of the drawing there is shown another modified movable member 48 having a nonround opening 50 formed therein. As indicated in this figure of the drawing the nonround opening 50 extends completely around the threaded shaft 52 and includes various portions 54 on different sides of the shaft 52 which engage the shaft 52 in the manner indicated in Figure 3 of the drawing. These portions 54 are preferably spaced around the shaft 52 in symmetrical manner and they are separated by portions 56 which are spaced from the shaft 52 itself. Preferably the nonround opening 50 shown in Figure 6 of the drawing is of a uniform cross-sectional configuration and has a "smooth" or unthreaded interior.

Another form of the invention is illustrated in Figure 7, which shows a block 60 of plastic material, having a generally cylindrical bore 61 extending through from one end to the other, and a plurality of relatively narrow ribs, or "lands" 62 projecting inwardly from the sides at regularly spaced intervals. The diameter of the bore 61 is slightly greater than the major diameter of the leadscrew thread, so that the latter clears the inner surface of the bore between the lands 62. The lands 62 extend lengthwise of the bore 61, and their height is such that the crests of the lands are engaged and elastically deformed by the thread 63 of the leadscrew 64, but do not reach in quite to the thread roots. The lands 62 may take any desired cross-sectional shape, such as the prismatic form illustrated in Figure 7, or they may be half-round in form. The chief advantage of the lands 62 is that they allow the screw thread 63 to obtain a deep "bite" into the material, with only a minimum contact area of the plastic engaged by the screw thread. This reduces frictional drag on the screw and provides an excellent driving connection between the screw and member 60, owing to the greater depth of penetration of the screw thread into the plastic material. While there are four lands shown, it will be understood that any number of lands may be used with equally effective results.

Those skilled in the art to which this invention pertains will realize that various modified constructions such as are illustrated in Figures 5 and 6 of the drawing function in substantially the same way as the movable member 32 described earlier in this specification. They will further realize that all such movable members formed in accordance with the broad teachings of this invention are effective for the purpose intended and that such members may be economically produced. Because of the fact that a variety of different types of constructions using the basic features of this invention may be designed and employed, this invention is to be considered as being limited only by the appended claims.

I claim:

1. In a potentiometer having a housing, a resistance element mounted within said housing, and a leadscrew rotatably mounted so as to extend through said housing parallel to said resistance element, the improvement which comprises: a movable member positioned within said housing, said movable member being provided with an open-sided groove to receive said leadscrew, at least a portion of the surface of said open-sided groove being formed of an elastically deformable material, said leadscrew bearing against said portion of elastically deform-

able material with sufficient pressure to cause said material to take a transient impression of the leadscrew thread, whereby rotation of said leadscrew causes said member to be moved lengthwise thereof, and contact means carried by said movable member and resiliently engaging said resistance element.

2. In a construction including a movable member positioned upon a threaded shaft so that as said shaft is turned, said movable member is caused to move along the length thereof by the threads of the shaft, the improvement which comprises: a movable member of non-conductive material having sufficient resilience so as to undergo temporary deformation when in pressure contact with the threads of said shaft, said movable member being formed with an elongated opening of uniform cross-sectional configuration to receive said shaft, said opening being formed so as to extend more than 180° of a circle around said shaft and less than 360° of a circle around said shaft, said opening being formed so that at least a part of said movable member is engaged by said shaft and deformed thereby, the resilient material of said member being displaced between the threads of said shaft down into the space between the crests and valleys of said threads.

3. In a construction including a movable member positioned upon a threaded shaft so that as said shaft is turned, said movable member is caused to move along the length thereof by the threads of the shaft, the improvement which comprises: a movable member of non-conductive material having sufficient resilience so as to undergo temporary deformation when in pressure contact with the threads of said shaft, said movable member being formed with an elongated opening of uniform cross-sectional configuration to receive said shaft, said opening being formed so as to extend entirely around said shaft,

said opening being formed so that at least a part of said movable member is engaged by said shaft and deformed thereby, the resilient material of said member being displaced between the threads of said shaft down into the space between the crests and valleys of said threads.

4. In a construction including a movable member positioned upon a threaded shaft so that as said shaft is turned, said movable member is caused to move along the length thereof by the threads of the shaft, the improvement which comprises: a movable member of non-conductive material having sufficient resilience so as to undergo temporary deformation when in pressure contact with the threads of said shaft, said movable member being formed with an elongated opening of uniform cross-sectional configuration to receive said shaft, said opening being formed so that portions thereof spaced angularly from one another engage said threaded shaft, other parts of said opening between said portions being not engaged by said threaded shaft, the resilient material of said engaged portions being displaced between the threads of said shaft down into the space between the crests and valleys of said threads.

5. A construction as defined in claim 1 wherein said open sided groove is of a cylindrical configuration and extends more than 180° and less than 360° around said threaded shaft, wherein the diameter of said groove is less than the major diameter of said threaded shaft and is greater than the minor diameter of said threaded shaft.

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