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3,214,720

MULTI-TURN POTENTIOMETER

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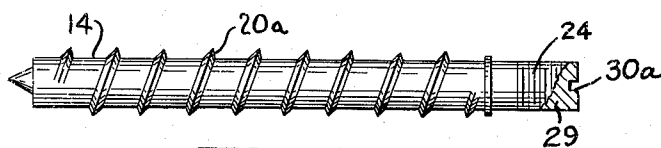
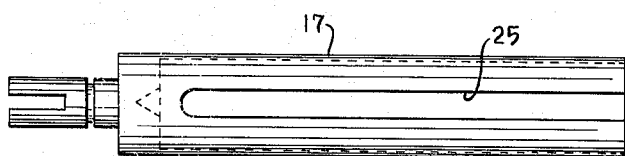
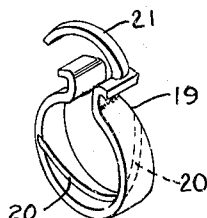
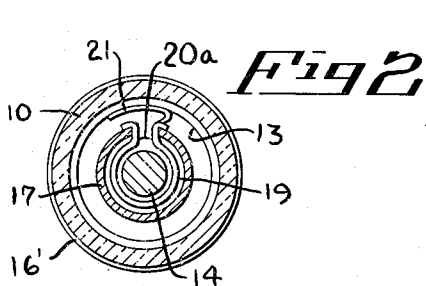
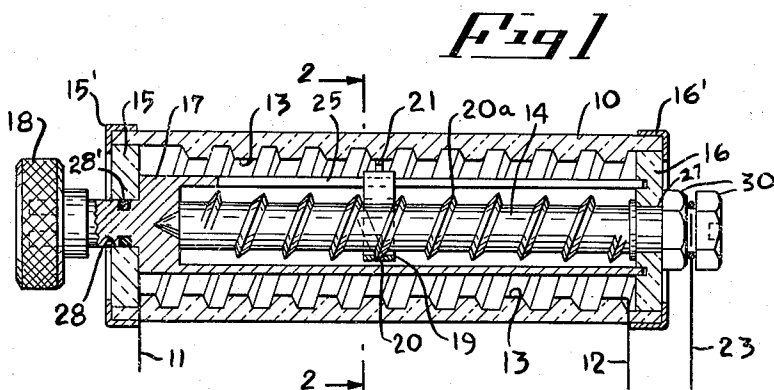


Fig 4

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MULTI-TURN POTENTIOMETER

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2 Claims. (Cl. 338-148)

This invention relates to a multi-turn potentiometer having an infinitely variable resistance change. More particularly, it relates to a variable resistor unit in which the value or resistance is readily adjusted and in which the resistance element is in the form of a continuous metallic film or strip.

The method of making of a potentiometer or rheostat having an infinitely variable resistance change by adding a third connection, is disclosed in my Patents 2,914,428 and 2,917,814. However, the present application is a continuation-in-part and improvement of my copending application, Ser. No. 827,936, filed July 17, 1959, now U.S. Patent No. 3,059,197, dated October 16, 1962. Also, the present application is an improvement of my copending application, Serial No. 827,935, now U.S. Patent No. 3,052,862, dated September 4, 1962.

It is an object of the present invention to provide a stable, simple, low cost resistor having infinite resolution and having a metallic film resistance element from which the resistance thereon can be readily adjusted depending upon the usage thereof.

Another object of the present invention is to provide a multi-turn potentiometer which can be easily adjusted along the entire resistance path and having a metallic film as the resistance element.

Another object of the present invention is to provide a simple, inexpensive method of adding a third terminal to a resistor, with a fixed metal film resistor so that the resistance can be varied by tracking said third terminal in the form of a slider along the path of the resistance material, from one end of the resistance material to the other, thereby obtaining an infinitely variable resistance change from one end to the other or from maximum resistance to minimum resistance.

A still further object of the present invention is to provide a miniature, non-wire wound, stable potentiometer having a lower temperature coefficient of resistance.

Still another object of the invention is to provide a resistor having an insulating tube whose interior is coated with a metalliferous surface and is provided with terminal conductors at the ends of same thereof; said terminal conductors being at least partly overlaid by said metalliferous surface.

A still further object of the present invention is to provide a potentiometer or rheostat having an infinitely variable resistance change by adding a moving third connection to a resistor made according to my Patent Nos. 2,917,814 and 2,914,428 but employing a thread cut into a ceramic tube after subliming the metal film on to it instead of before.

In my copending applications, it will be noted that there is provided a resistor having an infinitely variable resistance change in the resistance thereof which can be accomplished if the helix in the resistance unit is in the form of a film or thread in which a follower carrying the moving contact can be moved along the metallic film located in the apex portion of the helix, i.e., the inverse apex portion of the helix.

It is therefore another object of the present invention to show a definite improvement over the helically formed film in the aforesaid resistance unit to provide instead a plane, surfaced metallic helix which is in contact with a movable member and which can be regularly adjusted to obtain infinitely variable resistance change.

As was previously explained in my copending applica-

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tions, there are many forms of wire wound, multi-turn potentiometers presently in use, but in all these cases infinitely variable resolutions of resistance change are not possible because the resistance wire is first wound onto an insulated wire form and then the form is wound into a desired helix. There is thus obtained a helical potentiometer with many turns of wire from end to end and as the slider moves along the helix from end to end it jumps from one turn of resistance wire to the next. As a result, infinitely variable resistance change is not feasible for each turn represents a definite turn of resistance. For example, in a 500,000 ohm potentiometer having ten helical turns of form wire there may be 1,000 turns of fine resistance wire wound on the form wire before making it a helix. This means that each turn of fine resistance wire will have a resistance value of 500 ohms, thus as the slider jumps from one turn of resistance wire to the next along the helix form, it will change five hundred ohms per jump. This change can be reduced by using more turns of finer resistance wire but no matter how many are added, a definite jump between the wires will always occur. In my previous applications and in the present application it can be seen that because the slider moves longitudinally along the resistance film as it forms a helix from end to end, the change from one setting to another setting will be steady and smooth. This change will be gradual and without jump or as it is expressed will result in an infinite change in resolution.

In accordance with my present invention there is provided means by which an infinitely variable resistance change resolution potentiometer is obtained when a helix is formed on a smooth, walled tube after deposition of a helical film in accordance with my previously indicated patents hereinabove.

It will be noted that both types of resistor, namely, the one according to the copending application and the present application, have the same electrical characteristics and infinitely variable resistance change of resolutions. However, they differ in the mechanical means for achieving the results desired depending upon which tube is used.

If a very low resistance unit is required, the slider can move from one end to the other of the blank wherein no helix is formed. In other words, instead of cutting a helix, there may be employed an uncut blank, as will be later explained.

In order that there may be clarity of definition, the present application will be referred to as the preparation of a potentiometer since it is to be understood that a potentiometer is a rheostat having three connections, one at each end of the resistance element and one connection to the slider inside the tube member of the resisting unit. In order to use this as a rheostat, only one end terminal and the connection to the slider are used.

Other objects and features of my invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal axial sectional view of a preferred embodiment of my invention;

FIG. 2 is a detailed sectional view taken on line 2-2 of FIG. 1;

FIG. 3 is a longitudinal plan view of a portion of the embodiment shown in FIGS. 1 and 2;

FIG. 4 is a longitudinal plan view of another portion of the embodiment shown in FIG. 1, and

FIG. 5 is a perspective view of one of the elements shown in FIGS. 1 and 2.

Referring now to the drawings, wherein like parts refer to like numbers throughout, I provide an outer insulated tube member 10 having metallic terminals 11 and 12,

respectively, one affixed at each end of said tube, as shown. On the interior of the tube 10, there is provided a metallic film 13, deposited thereon in the manner according to the above noted patents.

In order to convert the fixed metal film resistor into a metal film potentiometer having an infinitely variable resistance change from maximum to minimum, I provide a fixed, threaded rod 14 running from end to end of the tube 10 and being insulated therein, by means of the end washers 15 and 16, respectively.

One end of said tube member 10 is provided with a longitudinally slotted tube 17 that rotates around the rod 14. At one end of the tube 17 there is provided a knob 18 or any other suitable means, on which is mounted a slidable and rotatable collar 19 concentric with the rod 14. Said collar 19 has a V groove or parallel walled slot 20 which rides on thread 20a of said fixed rod 14. It will be noted that said groove or slot 20 corresponds with the pitch or shape of the thread 20a as shown in FIG. 4 so as to permit ready sliding of said collar 19 in a longitudinal direction as tube 17 is rotated clockwise or counterclockwise. Attached to said collar is a slider 21 that makes sliding contact with helical metal film 13. It will be further noted that said rod 14 is provided with an insulated lead 23 or similar type of connection for further electrical connection. Fixed threaded rod 14 is mounted in end disc 16. It will be noted that said rod 14 has a continuous thread 20 which with metal film helix 13 have identical pitches so that the contact 21 and groove 20 are in synchronous operation when knob 18 is actuated to move collar 19. When tube 17 is rotated, it will be noted that thread 20a on said rod 14 and fitting in groove or slot 20 of collar 19 acts as a guide for the movement of collar 19 whereby slider 21 will contact film 13 and in either direction to the left or right to the end of the tube 10. Longitudinal slot 25 in tube 17 extends from one end thereof to a point short of the other end, and permits slider 21 extending from collar 19 to form smooth sliding contact with said smooth film 13. It is apparent that because of the shape of thread 20a and groove 20, that there is a mating thereof and also a sufficient space between tube 17 and thread 20a to permit the collar 19 to be moved in either direction of the longitudinal axis of the tube 10. This will cause collar 19 to move along tube 17 and move from one end to the other, causing slider 19 to move along helical resistor film 13.

Furthermore, one end of said resistor is sealed by outer end cap 15' while at the other end there is provided end cap 16'. Said caps 15' and 16' have insulated holes or openings 27 and 28 respectively to permit the insertion of tube 17 whereby it can be externally turned by means of knob 18. Said washers 15 and 16 are made of any suitable non-conductive material, preferably of the same type as member 10, namely, glazed ceramic, ceramic, glass or other material which will receive a metallic film. These discs provided with openings 28 and 27, respectively, form the closed ends of tube or member 10 and support the tube 17 therein. An "O" ring or similar device 28' can be used between the rod 17 and the end cap 15' to seal the interior of said tube 10.

It will be noted that said rod 14 has a thread 24 at one end 29, as shown in FIG. 4, to accommodate nut members 30. One of said nut members on rod 14 abuts end cap 16, and with the outer nut member 30 accommodates and retains lead 23. Furthermore, said end 29 of the rod is provided with a cross slot, kerf or groove 30a to permit tight engagement with outer nut 30 when the end of a screw driver is held in said kerf. Also, the slot or kerf 30a permits ready use of a screwdriver before the nuts 30 are tightened on the end 29 to line up thread 20 on rod 14 with the helical film 13 so that slider 21 on collar 19 properly "tracks" thus better obtaining the

infinitely variable change of resistance in the movement of said slider 21 on film 13.

In the case of low resistance units, the structure as above described is the same, but the metallic resistance film has no helical formation, whereby the slider 21 can be moved across the film from one end of said film to the other causing an infinite change of resistance between sliding contact 19 and either or both ends of film 13.

While a preferred embodiment of my invention has been illustrated and described, it is to be understood that modifications, as to form, arrangement of parts, uses of material may be made without departing from the spirit and scope of the invention as claimed.

What is claimed is:

1. A resistor having an infinitely variable resistance change comprising an insulated tube, a metallic resistance film deposited on the inner smooth cylindrical wall of said tube forming a helical resistance path, metallic terminals at the ends of said tube and in contact with the ends of said helical film, a slotted tube, a coaxial fixed threaded rod, a threaded collar comprising a circular section terminating in a section necked down intermediate its ends, said circular section embracing said threaded rod and said necked down section extending through and guidedly embracing the edges of the slot in said slotted tube and carrying a concentric movable slider in contact with said metallic resistance film, means for adjusting the resistance of said resistor by sliding said contact along said resistance path from one end to the other, to provide an infinitely variable change of resistance between the slider and said metallic terminals, when the slider is so moved, and capping means for each end of said tube.

2. A resistor having an infinitely variable resistance change comprising an insulated tube having a smooth inner wall, metallic terminals at each end of said tube, a helical metallic resistance film deposited on said smooth inner wall and contacting said terminals, means for providing said infinitely variable resistance change comprising a fixed threaded rod having the same pitch and number of turns as the helical film, said rod being co-axial with said tube, a rotatable slotted tube around said fixed rod, a threaded collar comprising a circular section terminating in a section necked down intermediate its ends, said circular section embracing said threaded rod and said necked down section extending through and guidedly embracing the edges of the slot in said slotted tube and carrying a slider making contact with said helical film so that when the slotted tube is rotated, said collar will carry said slider along the helical film resistance path from one end to the other, thereby causing an infinitely variable resistance change between the slider and terminals throughout the range of said resistor.

References Cited by the Examiner

UNITED STATES PATENTS

1,201,921	10/16	Beach	338—184 X
1,561,137	11/25	Burns	338—143
1,606,153	11/26	Douglas	338—148
1,739,256	12/29	Pender et al.	338—142
1,832,466	11/31	Means	338—143
2,495,321	1/50	Gibbs et al.	338—148 X
2,671,735	3/54	Grisdale et al.	338—300
2,761,945	9/56	Colbert et al.	338—308
2,798,140	7/57	Kohring	338—137
2,815,422	12/57	Lock	338—148 X
2,917,814	12/59	Ruckelshaus	338—143
3,059,197	10/62	Ruckelshaus	338—143

FOREIGN PATENTS

226,949 2/60 Australia.

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