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2,724,034

MULTITURN VARIABLE RESISTOR

Filed March 17, 1954

3 Sheets-Sheet 1

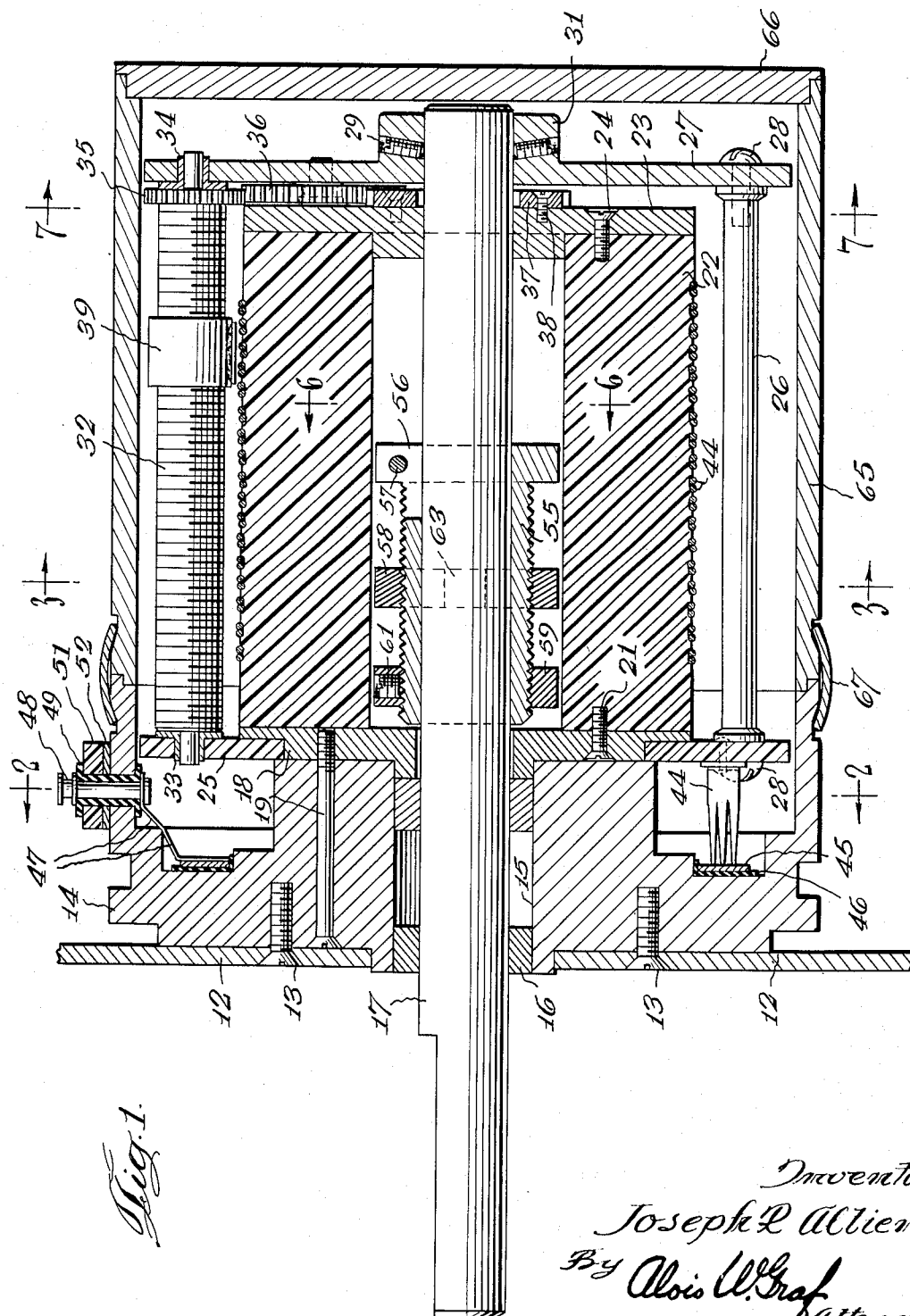


Fig. 1.

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Fig. 2.

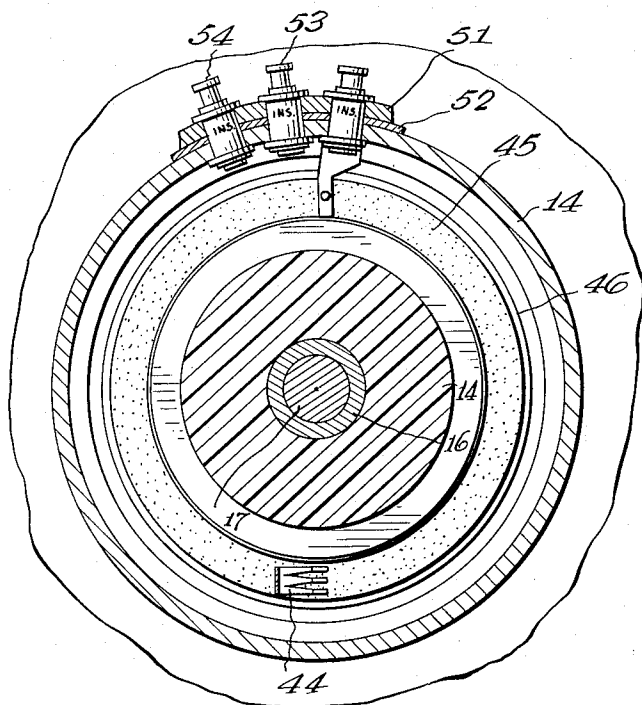


Fig. 4.

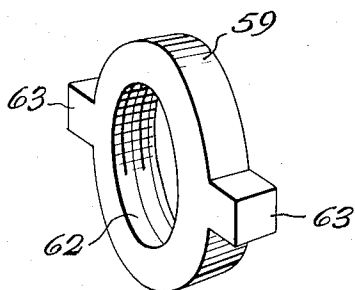


Fig. 8.

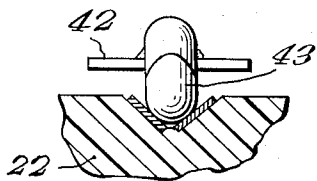
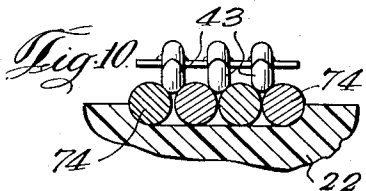
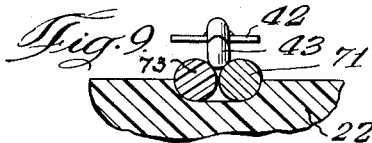
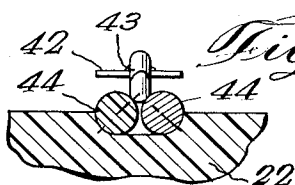
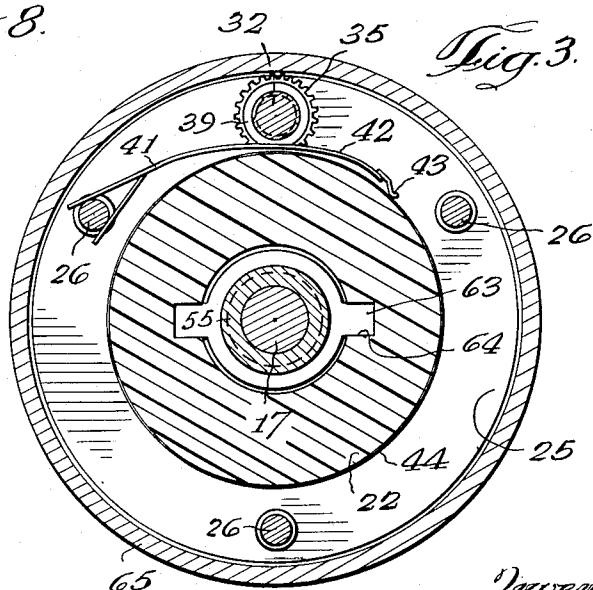


Fig. 11.

Fig. 3.



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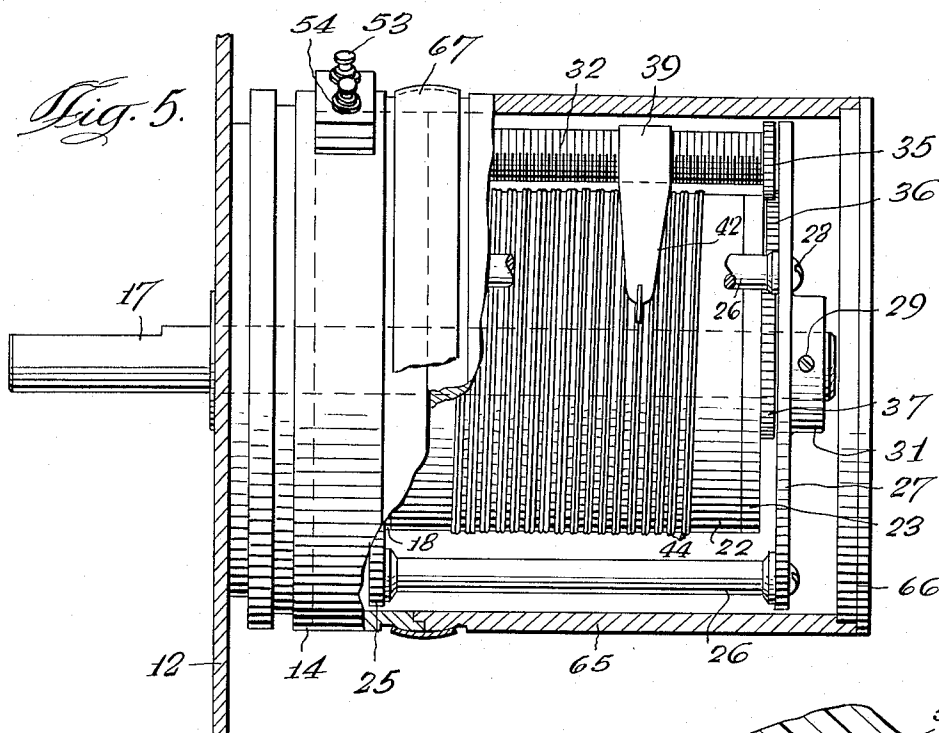


Fig. 6.

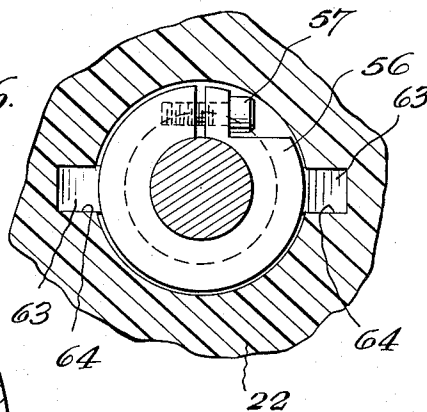
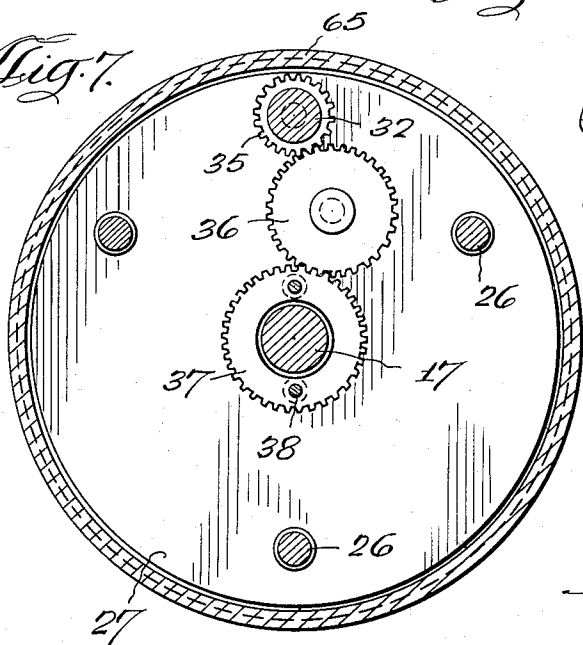


Fig. 7.



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MULTITURN VARIABLE RESISTOR

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6 Claims. (Cl. 201—56)

The present invention relates to a variable resistor or potentiometer, and more particularly to an improved multi-turn variable resistor or potentiometer.

Multi-turn potentiometers have heretofore been provided wherever it is desired to have a degree of resolution greater than that which can be provided in the type of potentiometer which has an angle of rotation of the movable contact somewhat less than 360°. In certain particular applications it would be desirable to provide the equivalent of a slide wire variable resistor or potentiometer in a comparatively small space, and hence a multi-turn potentiometer is employed. In such potentiometers, however, there are certain characteristics inherent in conventional constructions which it is desired to minimize or improve. One of the characteristics in particular is the inherent high contact resistance which occurs at times between the movable contact and the resistor wire. This at times may be occasioned by slight variations in the diameter of the wire, or more frequently the location of the wire in a groove on the supporting structure. At other times it has been found that there is a detrimental wear of the movable contact which gives a variation in the contact resistance. It, therefore, would be desirable to provide a different construction which would obviate some of the disadvantages heretofore encountered in multi-turn variable resistors or potentiometers.

In accordance with the present invention it is contemplated to provide a bifilar potentiometer, in one embodiment, with a variable contact which has a high lateral compliance so that a good contact is obtained at all times, irrespective of slight differences occurring in manufacturing, such as positioning of the wires in the groove. It is further contemplated in accordance with the improved construction to provide an arrangement whereby detrimental wear of the movable contact is minimized. These objectives are achieved by arranging the contact so that the forces exerted upon the contact in opposition to the normal downward bias of the contact toward the supporting structure on which the resistance wire is wound will be such that these forces lie in intersecting directions.

It is, therefore, an object of the invention to provide an improved multi-turn variable resistor or potentiometer having an improved lateral compliance of the movable contact.

Still another object of the invention is to provide an improved multi-turn variable resistor having low contact resistance at all times between the movable contact and the resistor wire.

Still another object of the invention is to provide an improved multi-turn variable resistor wherein detrimental wear of the movable contact is minimized.

A still further object of the invention is to provide in a multi-turn variable resistor a movable contact element construction which assures good conductivity of the resistor wire irrespective of any wear on the contact element.

A further object of the invention is to provide an improved multi-turn variable resistor wherein substantially constant contact of a movable contact element with the resistor wire is assured irrespective of variations in the position of the resistor wire or its support or other mechanical or manufacturing variations.

A still further object of the invention is to provide an improved multi-turn variable resistor having improved linearity characteristics.

A still further object of the invention is to provide an improved multi-turn variable resistor or potentiometer wherein contact noise between the movable contact and the resistor wire is minimized.

Other and further objects of the invention subsequently will become apparent by reference to the following description taken in conjunction with the accompanying drawings wherein:

Figure 1 is a longitudinal cross-section view of a variable resistor or potentiometer constructed in accordance with the present invention;

Figure 2 is a transverse cross-sectional view as seen in the direction of the arrows along the line 2—2 of Figure 1;

Figure 3 is a transverse cross-sectional view as seen in the direction of the arrows along the line 3—3 of Figure 1;

Figure 4 is a perspective view of one element of a resistor device;

Figure 5 is a longitudinal side view with portions of the outer casing broken away to expose the internal construction;

Figure 6 is a cross-sectional detailed view as seen in the direction of the arrows along the line 6—6 of Figure 1;

Figure 7 is a cross-sectional view as seen in the direction of the arrows along the line 7—7 of Figure 1;

Figure 8 is a cross-sectional detailed view showing bifilar conductors or resistor wires and a movable contact;

Figure 9 is a cross-sectional detailed view of an alternative resistor wire and contact arrangement;

Figure 10 is a cross-sectional view showing another wire and contact arrangement; and

Figure 11 is a cross-sectional view showing still another resistor wire and contact arrangement.

Referring to the drawing and more particularly to Figure 1, it will be noted that a variable resistor or potentiometer embodying the present invention is arranged to be mounted on a support panel 12 by means of a plurality of screws 13 passing into a support base 14. The support base 14, which has an annular configuration, has a central opening 15 which supports suitable bearing members 16 for a shaft 17. The shaft 17 passes through an inner support plate 18 which is secured to the support base 14 by suitable screws 19. The inner support plate 18 is secured by a plurality of screws 21 to a cylindrical support or drum 22 which in turn is secured to an outer support plate 23 by a plurality of screws 24. The outer support plate 23 has a central opening which serves as a bearing for the right end of the shaft 17 as seen in Figure 1.

The inner support plate 18 has a stepped configuration adjacent its outer periphery for receiving an annular member 25 which is connected by three rod spacers or pick-up members 26 to an outer cage plate 27. Suitable cap screws 28 pass through the annular cage ring 25 and the outer cage plate 27. The outer cage plate 27 is keyed to the end of the shaft 17 by suitable set screws 29 in an appropriate boss 31 formed about the opening in the outer cage plate 27.

A threaded lead screw 32 is supported by suitable bearing members 33 and 34 between the inner cage plate 25

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and the outer cage plate 27. One end of the lead screw 32 is provided with a gear 35 which meshes with an intermediate gear 36 rotatably mounted on one side of the outer cage plate 27. The intermediate gear 36 meshes with another gear 37 which is secured to the outer cylindrical support plate 23 by suitable screws 38. The shaft 17 upon rotation produces rotation of the cage comprising the inner plate 25, the outer plate 27, and the spacer rods 26. This rotation produces a rotation of the intermediate gear 36 since it is in engagement with the stationary gear 37. Rotation of the gear 36 in turn drives the gear 35 and the lead screw 32. The lead screw 32 is provided with a threaded follower 39 forming a part of the contact assembly.

From Figures 3 and 5 it will be noted that the follower 39 produces a resilient bifurcated collector member 41 which engages opposite sides of one of the rod spacers 26. The resilient member 41 extends to the other side of the follower member 39 in a tapered portion 42, and terminates in a contact element 43 which engages the resistor wire 44 carried by the cylindrical support or drum 22. It will be noted from Figure 5 that the drum 22 is provided with a helical groove, and that two wires 44 are positioned in the groove so that the contact element 43 is positioned between the wires 44 in a manner shown in greater detail in Figure 8. The tapered portion 42 exerts downward pressure on the contact element 43 so that the opposing forces on wires 44 are in the direction shown by the center lines in Figure 8. It is to be observed that these center lines intersect, and hence with the proper lateral compliance provided by the member 42 the contact 43 will always be in between the two wires 44 in the same relative position irrespective of minor variations in the position of the wires 44 and the helical groove of the wire 42. This construction will assure a substantially noise free contact at all times, and will avoid detrimental wear of the movable contact.

Where a flat contact element engages the top of the wire, the wire eventually wears the contact so as to produce an arcuate indentation therein. This arcuate indentation, however, is not semi-circular so that at times the actual area of contact between the wire and the contact element varies appreciably. In the present construction illustrated in detail in Figure 8, such variations are avoided since the same area of contact is provided under all conditions of operation.

Referring again in particular to Figure 1, it will be seen that the inner cage member 25 is provided with a contact brush 44 which engages a collector ring 45 carried on an insulated support 46 in an annular groove in the base support 14. The annular ring 45 is connected by a conductor 47 to a binding post 48 provided with an insulated bushing 49 extending through the cylindrical wall of the support base 14 and a plurality of insulating members 51 and 52.

From Figure 2 it will be noted that similar binding posts 53 and 54 are provided for making electrical connection to the ends of the resistor wire 44. In order to limit the relative rotation between the contact arm 42 and the wire 44 on the drum 22, there is provided on the shaft 17 a lock stop assembly comprising a threaded sleeve 55 terminating in a clamp portion 56 held in position by a cap screw 57. In Figure 6 the relation of the members 56 and 57 is shown with greater clarity. Mounted upon the threaded sleeve 55 is a traveler 58 which can travel from the member 56 to an adjustably positioned lock stop 59 which is held in position by a set screw 61. The traveler 58 is shown in perspective in Figure 4, and is provided with a threaded interior 62 and two projecting lugs 63. The projecting lugs 63, as may be seen from Figure 6, are contained within the longitudinal guides or recesses 64 provided on the inner surface of the drum 22. Thus the shaft 17 may only be rotated a certain number of turns and further rotation thereof is prevented. This will then permit the contact assembly 39 to move the proper dis-

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tance to cover the various turns of the resistor winding 44.

The assembly, as is apparent from Figures 1 and 5, is provided with a cover comprising a cylindrical portion 65 and an end plate 66 which is held in position on the support base 14 by a clamp ring 67.

In connection with Figures 1 to 8, the embodiment described has been one employing a bifilar winding consisting of two wires 44 in a helical groove in the support 22. Such an arrangement previously has been described as having certain advantages with respect to the lateral and vertical compliance of the contact 43. A similar advantage can be obtained by the use of a single resistor wire 71 laid parallel to an insulated wire 73 or a wire-like insulation member 73. The contact 43, as may be seen from Figure 9, still will be urged against the resistor wire 71 by the cooperation of the member 73 so as to minimize wear of the contact, and to assure that the area of contact between the contact element 43 and the wire 71 remains substantially constant irrespective of variations in the groove of the support 22, the position of the wire 71 in the groove, or other manufacturing variations.

Where exceptionally low resistance values and low contact resistances are desired, an arrangement such as that shown in Figure 10 may be employed wherein the groove in the support drum 22 is made sufficiently large to contain a greater number of parallel resistance wires 74, which might be four in number as shown. In such case a plurality of contacts 43, one less than the total number of parallel wires, would be employed on a movable fingered arm assembly so that each contact element 43 operates somewhat independently as it is urged in intimate contact with the adjacent resistor wires 74.

While the most convenient method of winding the drum 22 is to use grooves as shown, it is also possible to use V-shaped grooves such as illustrated in Figure 11 wherein two flat wires might be mounted in the groove for contact by a contact element 43. Here again, however, the forces exerted upon the contact 43 opposing the downward pressure of the resilient spring member 42 again are in directions which intersect. Thus vertical and lateral compliance of the contact is employed to assure substantially constant area of contact between the contact element and the resistance wire.

While for the purpose of illustrating and describing the present invention certain particular embodiments have been illustrated in the drawings, it is to be understood that such variations are contemplated as may be defined in the accompanying claims.

I claim as my invention:

1. In a multi-turn variable resistor, the combination comprising a cylindrical support having a helical groove, a pair of resistance wires wound parallel to each other within said groove, a movable contact having lateral compliance and engaging said wires so that both wires exert forces on said contact in intersecting directions, means for producing relative motion between said support and said contact, and means within said cylindrical support coaxial therewith for limiting said motion to a predetermined amount.

2. A multi-turn variable resistor comprising a cylindrical support having a helical groove, a plurality of wires wound parallel to each other within said groove, a cage surrounding said support and being mounted for relative rotation thereto, a movable contact having lateral and vertical compliance and being carried by said cage having a contact element positioned between said wires, means carried by said cage for moving said contact longitudinally, and gear means interconnecting said latter means and said cylindrical support.

3. A multi-turn variable resistor comprising a cylindrical support having a helical groove, a plurality of wires wound parallel to each other within said groove, a cage surrounding said support and being mounted for relative rotation thereto, a movable contact carried by

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said cage and positioned between adjacent wires, means carried by said cage for moving said contact helically relative to said support, gear means interconnecting said latter means and said support, and means for making electrical connections to said wires and to said movable contact.

4. A multi-turn variable resistor comprising a cylindrical support having a helical groove, a plurality of wires arranged parallel to each other within said groove, a cage surrounding said support and being mounted for rotation relative thereto, a movable contact having lateral and vertical compliance and being carried by said cage, said contact engaging said wires at the sides of said contact, means carried by said cage for moving said contact to follow said groove, gear means interconnecting said latter means and said cylindrical support, and means for limiting the relative rotation between said cage and said cylindrical support.

5. A multi-turn variable resistor comprising a cylindrical support having a helical groove, a plurality of wires arranged parallel to each other within said groove, a cage surrounding said support and being mounted for rotation relative thereto, said cage comprising two end plates interconnected by a plurality of spacer rods, a

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movable contact having lateral and vertical compliance carried by said cage for engaging two adjacent wires, means carried by said cage for moving said contact to follow said groove, and a sliding electric contact between said movable contact and one of said spacer bars.

6. A multi-turn variable resistor comprising a cylindrical support having a helical groove, a resistance wire wound on said groove, a cage surrounding said support and being mounted for rotation relative thereto, a movable contact having lateral and vertical compliance, and being carried by said cage having a contact element positioned to engage said wire on one side of said contact, and means engaging the other side of said contact to assure that the area of contact between said contact and said wire remains substantially constant.

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