May 19, 1959 G. MARASON, JR 2,887,555

POTENTIOMETER

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FIG. 1.

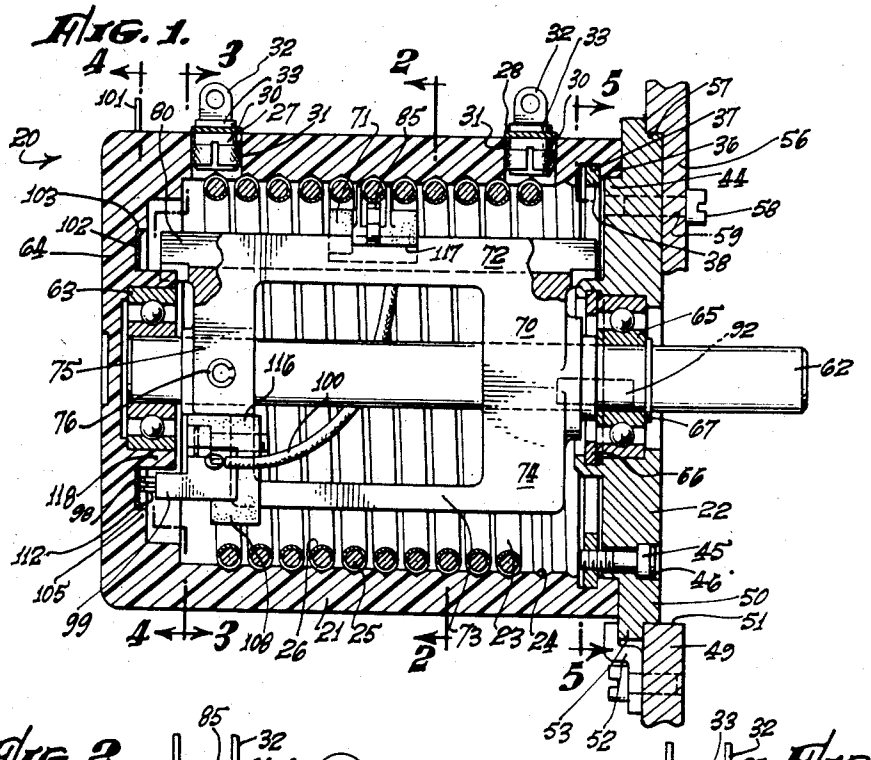

FIG. 2.

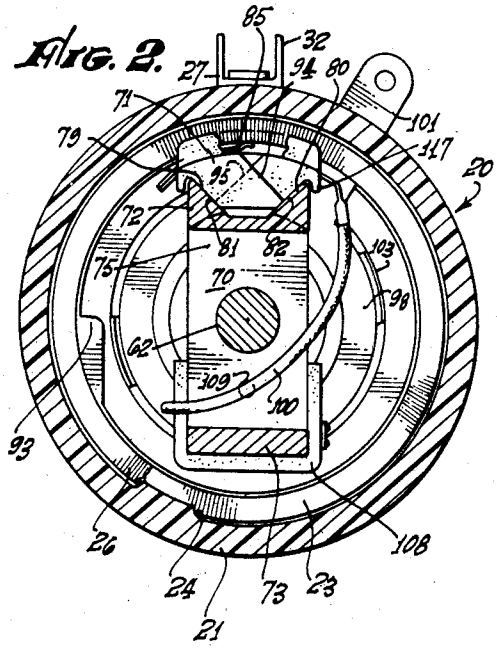

FIG. 3.

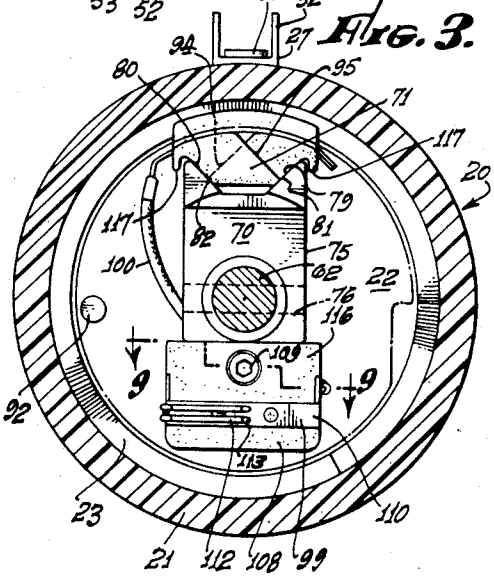

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Fig. 4.

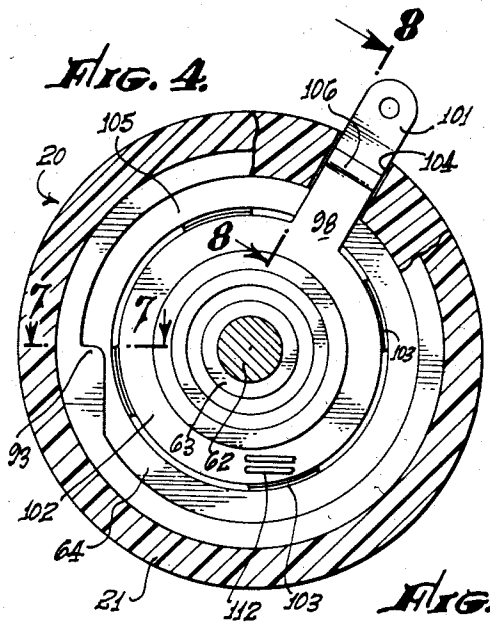


Fig. 5.

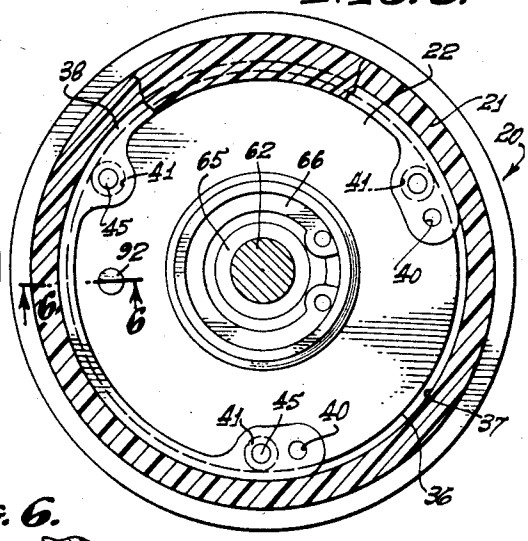


Fig. 6.

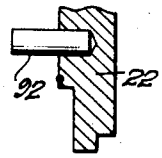


Fig. 10.

Fig. 8.

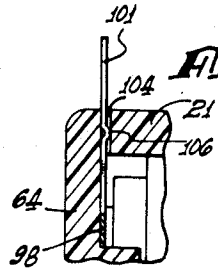


Fig. 11.

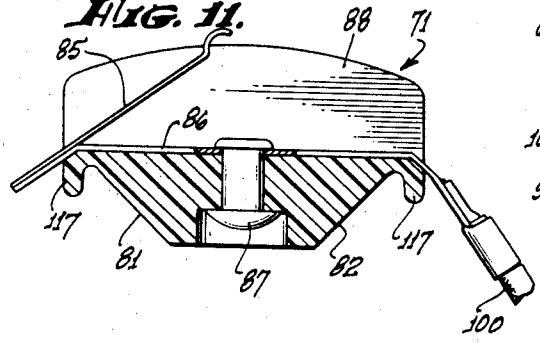


Fig. 7.

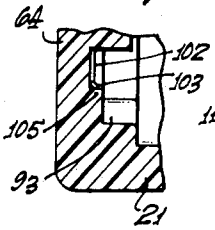
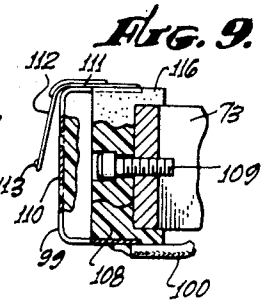


Fig. 9.



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2,887,555

POTENTIOMETER

Gabriel Marason, Jr., Garden Grove, Calif., assignor to Beckman Instruments, Inc., Fullerton, Calif., a corporation of California

Application September 9, 1957, Serial No. 682,879

12 Claims. (Cl. 201—56)

This invention relates to a potentiometer or the like and, in particular, to improvements in the design of such units which provide more accurate operation in combination with more rugged and durable construction and simpler and less expensive manufacture.

It is an object of the invention to provide a case for a potentiometer or the like in which an end cover is clamped to the body shell by externally adjustable means not requiring tapped holes or the like in the body shell. A further object of the invention is to provide such a clamping assembly in which the cover may carry a stop which may be rotated relative to the shell without disassembly of the components. Another object of the invention is to provide such a structure in which a snap ring is rotatably positioned within the shell and is mounted on the cover by screws or the like for clamping the end of the shell between the snap ring and the cover.

It is another object of the invention to provide a potentiometer or the like in which the rotating block which supports the contact carrier for advancement along the axis of the rotating shaft has a V-shaped groove or shoulder for engagement with mating surfaces of the contact carrier for substantially eliminating mechanical backlash in spite of dimensional errors, wear, temperature changes and the like. A further object of the invention is to provide such a structure in which the stop-engaging surfaces of the contact carrier are parallel to the mating surfaces of the rotor block and contact carrier.

It is a further object of the invention to provide a potentiometer or the like having a slip ring which can be formed of a single flat piece of material with a terminal lug extending radially outward from the case and with resilient, peripheral ears or tabs engaging the mounting shoulder in the end of the case. Another object of the invention is to provide a potentiometer or the like in which the rotor block carried on the shaft is of open rectangular construction permitting the pigtail lead from the slip ring contact to the coil contact to be restrained within the frame and protected from relatively moving parts. A still further object of the invention is to provide a potentiometer construction which permits provision of long electrical leakage paths between components at different electrical potentials.

While the invention will be described herein in conjunction with a helical potentiometer, it will be seen that certain features of the invention are equally applicable to other electrical components having rotating and fixed elements mounted within a case. The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. The drawings merely show and the description merely describes a preferred embodiment of the present invention which is given by way of illustration or example.

In the drawings:

Fig. 1 is a longitudinal sectional view of a preferred embodiment of the invention;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 1;

Fig. 6 is a partial sectional view taken along the line 6—6 of Fig. 5;

Fig. 7 is a partial sectional view taken along the line 7—7 of Fig. 4;

Fig. 8 is a partial sectional view taken along the line 8—8 of Fig. 4;

Fig. 9 is a partial sectional view taken along the line 9—9 of Fig. 3;

Fig. 10 is an enlarged plan view of the contact carrier of the embodiment of Fig. 1; and

Fig. 11 is a sectional view taken along the line 11—11 of Fig. 10.

The potentiometer illustrated herein has a case 20 comprising a shell 21 and a cover 22, the shell preferably being formed of an electrical insulating material. A helical coil 23 is fixed in a helical groove 24 in the internal surface of the shell 21, the coil preferably comprising a core 25 formed as a major helix with a resistance wire 26 wound on the core as a minor helix. Terminal assemblies 27, 28 are fixed in the shell 21 providing for external connections to the coil within the shell. Each of the terminal assemblies includes an insert 30 which is pressed into an opening 31 in the shell, a U-shaped lug 32, and a hollow screw 33 for clamping the lug to the insert. A wire may be passed from the coil within the shell through the hollow screw and soldered to one of the eyes of the lug.

An inwardly turned shoulder 36 at the open end of the shell 21 defines an annular groove 37 in which a ring 38 is rotatably positioned (Figs. 1 and 5). A preferred form for the ring 38 is shown in Fig. 5, the ring being a conventional internal snap ring having an opening 40 at each end thereof for engagement by a compressing tool to compress the ring for insertion into the internal groove 37. Three equally spaced threaded openings 41 are also provided in the ring 38.

The cover 22 is constructed to rotatably engage the open end of the shell 21, the cover preferably having a section 44 which projects into the zone enclosed by the shoulder 36 of the shell, means being provided for clamping the ring 38 to the cover with the shoulder 36 between the ring and cover. Screws 45 may be positioned in counterbored openings 46 in the cover for threading into the openings 41 in the ring, advancement of the screws drawing the ring and cover toward each other with the shoulder therebetween. Thus, after the case has been assembled, the relative positions of the shell and cover may be adjusted by slightly loosening the screws 45, rotating one element relative to the other, and then tightening the screws. Rapid and accurate phasing of shell and cover is thereby accomplished without the necessity of disassembling the unit or of providing threaded openings in the shell itself. Such cover-shell assembly may be used at either or both ends of the case if desired.

The case 20 of the invention may be mounted on a panel 49 by positioning a projecting portion 50 of the cover 22 in an opening 51 in the panel and clamping the cover to the panel with brackets 52 which engage a shoulder 53 of the cover. With this type of mounting, the angular position of the shell relative to the cover and panel can be adjusted without disturbing the mounting of the case to the panel.

Alternatively, the case may be mounted to a panel 56

by positioning the projecting portion 50 of the cover in a recessed section 57 of the panel and using screws 58 passing through openings 59 in the panel and the openings 46 in the cover for engaging the ring 38.

A shaft 62 is mounted in the case 20 for rotation about the axis of the helical coil 23 by a bearing 63 mounted in one end 64 of the case and a bearing 65 mounted in the cover 22, the bearing 65, the shaft and the cover being held together by an internal snap ring 66 and an external snap ring 67.

A rotor block 70 is mounted on the shaft 62 for rotation therewith and a contact carrier 71 rides on the rotor block for movement substantially parallel to the axis of rotation of the shaft, the contact carrier including means for engaging the turns of the helical coil to advance the carrier along the rotor block as the shaft is rotated. The rotor block is preferably formed as an open rectangle as seen in Fig. 1 with parallel members 72 and 73 spaced from the shaft 62 and parallel members 74 and 75 having aligned openings therein for receiving the shaft, the rotor block being fixed to the shaft by a roll pin 76 in aligned openings in the shaft and member 75.

The member 72 of the rotor block has flat walls 79, 80 which lie in planes that intersect at a line substantially parallel to the axis of the shaft 62. The contact carrier 71 has corresponding flat walls 81, 82 (Fig. 11) for surface engagement with the walls of the member 72. The walls 79 and 80 of the member 72 serve as a guide groove for the contact carrier and preferably converge toward the shaft which carries the rotor.

A flexible contact 85 for electrically engaging the turns of the helical coil is carried on the contact carrier 71 by suitable means, such as by spot-welding the contact to a conducting strip 86 which is fixed to the contact carrier 71 by a rivet 87 (Figs. 10 and 11). A preferred construction for the guiding engagement between the contact carrier and the turns of the helical coil includes parallel ribs 88, 89 of insulating material extending outward from the contact carrier for engaging the sides of the turn which is being electrically contacted by the contact 85. The ribs 88, 89 are preferably skewed to the helix angle of the major helix for better alignment with the turns of the coil (Fig. 10).

When the contact carrier is positioned in the guide groove of the rotor block with the flexible contact engaging a turn of the coil as seen in Fig. 1, the flexible contact urges the walls 81, 82 of the contact carrier and the walls 79, 80 of the guide groove into engagement. Since the planes of these walls converge at the same angles, the contact carrier will always engage the rotor block without mechanical backlash or lateral play along the axis of the minor helix and this desired fit will be maintained without binding even though the components are subjected to extreme operation and wear and extreme temperature ranges.

Stops are ordinarily provided in helical potentiometers and similar units for limiting the travel of the contact along the turns of the helical coil. In the structure shown herein, a pin 92 is mounted in and projects inward from the cover 22 to serve as one stop and a boss 93 is formed in the end 64 of the case to serve as the other stop. Stop-engaging surfaces 94 and 95 are provided on opposite sides of the contact carrier 71, the stop-engaging surface 94 being parallel to the wall 81 and the surface 95 being parallel to the wall 82. At one extreme of travel, the surface 95 will engage the boss 93 and at the other extreme of travel, the surface 94 will engage the pin 92. Because of the parallel relation of the surfaces of the contact carrier, the action of the stops is positive with no movement of the contact carrier relative to the rotor block or to the helical coil when a stop is engaged, thus eliminating another source of mechanical backlash. A stronger structure also results from this construction, since the forces exerted at stop-engagement are in compression rather than shear.

The angular adjustment of cover and shell previously described, permits the exact position of the stops to be set after the unit has been assembled, since the stop 92 is mounted in the cover.

External electrical connection is made to the sliding contact 85 through a slip ring 98, a slip ring wiper 99 and a flexible lead 100. The slip ring 98 includes an elongated tongue 101, an annular section 102 and four ears or tabs 103 extending outward from the periphery of the annular section 102. The slip ring is preferably made from a single flat piece of electrically conducting metal and is mounted in the base by passing the tongue 101 outward through a radial slot 104 in the shell 21 and then pressing the annular section 102 into the space enclosed by an annular shoulder 105 in the end 64 of the case, the ears 103 extending inwardly (Figs. 1 and 7) and engaging the inner surface of the shoulder 105 and fixing the slip ring in position. A channel 106 is preferably formed in the tongue 101 intermediate the ends thereof to make the tongue a push fit in the slot 104. The channel portion of the tongue effectively closes the slot and also raises the resonant frequency of the structure thereby reducing the sensitivity of the slip ring assembly to vibration.

The slip ring wiper 99 includes a block 108 of insulating material mounted on the rotor block 70 adjacent the member 73 with a screw 109, a conducting strip 110 molded in the block 108, and a spring contact 111 soldered to the conducting strip, the contact including a pair of fingers 112 having contact points 113 thereon for engaging a path on the slip ring 98 concentric with the shaft 62. One end of the flexible lead 100 is soldered to the conducting strip 110 of the slip ring wiper and the other end is soldered to the conducting strip 86 of the contact carrier, the flexible lead passing from one side of the rotor block at the slip ring wiper, through the open rotor block and around the shaft to the other side of the rotor block at the contact carrier, as seen in Figs. 1, 2 and 3. Thus, while the contact carrier moves from one end to the other of the rotor block, the flexible lead is maintained within the confines of the rotor block and is kept from coming into accidental contact with the coil or case.

By utilizing the construction disclosed herein, it is possible to obtain long current leakage paths between elements of the unit which are operated at different electrical potentials so that the leakage paths have high resistance and high breakdown potentials. For example, the slip ring wiper block 108, which is mounted at a corner of the rotor block by a single screw, may be provided with long skirts 116 of insulating material wrapping around the rotor block and providing a long path between the conductor strip 110 and the rotor block. Similarly, the contact carrier 71 may include flanges 117 extending over the edges of the guide groove in the rotor block providing a long electrical path between the conducting strip 86 on the contact carrier and the rotor block. For the same reason, the slip ring 98 may be positioned in an annular recess of the end 64 of the case with a long shoulder 118 separating the slip ring from the bearing 63 (Fig. 1).

Although an exemplary embodiment of the invention has been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiment disclosed may be subjected to various changes, modifications and substitutions without necessarily departing from the spirit of the invention.

I claim as my invention:

1. In a case for a potentiometer or the like, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell and a circular opening at one end thereof; a detachable cover rotatable in said circular opening about the axis of said shell; a ring positioned in said groove for rotation relative to said shell with said shoulder retaining said ring within said shell; and means for fixing

said cover to said ring to clamp said shoulder between said cover and ring.

2. In a case for a potentiometer or the like, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell and a circular opening at one end thereof; a cover for engaging said one end of said shell with a portion of said cover disposed within said opening for positioning said cover relative to said shell; a split ring positioned within said groove for rotation relative to said shell, said ring being temporarily compressible from its normal diameter to a smaller diameter to pass through said opening defined by said shoulder, with said shoulder retaining said ring within said shell when said ring attains its normal diameter; and means for fixing said cover to said ring to clamp said shoulder between said cover and ring.

3. In a case for a potentiometer or the like, having a rotating element disposed within the case, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell; a cover for positioning at one end of said shell in engagement with said shoulder, said cover being rotatable relative to said shell about the axis of said shell; a stop member carried on said cover and projecting into the interior of said shell for engagement with a portion of the rotating element; a ring positioned in said groove for rotation relative to said shell with said shoulder retaining said ring within said shell; and means for fixing said cover to said ring to clamp said shoulder between said cover and ring, said cover and ring being rotatable together relative to said shell when said last mentioned means are temporarily loosened.

4. In a case for a potentiometer or the like suitable for mounting to a plate, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell; a cover having a first surface for engaging said shoulder and a second surface for engaging the mounting plate, said cover being rotatable relative to said shell about the axis of said shell, said cover having a plurality of mounting openings therein substantially parallel to said axis; a ring positioned in said groove for rotation relative to said shell with said shoulder retaining said ring within said shell, said ring having a plurality of threaded openings in alignment with said mounting openings in said cover; and a plurality of screw means for passing through the mounting plate and said mounting openings in said cover and threadedly engaging said openings in said ring for clamping said cover and shoulder between the mounting plate and said ring.

5. In a potentiometer having a helical coil positioned within a case and a shaft mounted in the case for rotation about the axis of the helix, the combination of: a rotor carried on the shaft and including a carrier guide, said guide having a pair of flat walls disposed substantially parallel to the shaft with the planes of said walls intersecting at an angle along a line parallel to said guide; a contact carrier having a pair of flat walls lying in planes which intersect at an angle substantially equal to the angle of intersection of the planes of said walls of said guide, for engagement with said carrier guide and movement therealong; and a spring contact mounted on said carrier for engagement with a turn of the coil, said contact urging said carrier into engagement with said guide, inhibiting movement of said carrier except in a plane substantially parallel to the shaft, said carrier including means for engaging the sides of the turns for advancing said carrier along said guide as the shaft and rotor rotate.

6. In a potentiometer having a helical coil positioned within a case and a shaft mounted in the case for rotation about the axis of the helix, the combination of: a rotor carried on the shaft, said rotor having a guide groove therein disposed substantially parallel to the shaft, the opposing walls of said groove converging toward the shaft; a contact carrier for engagement with and movement along said rotor, said contact carrier including a portion mating with and resting on said converging walls of said guide groove; and a spring contact mounted on said carrier for engagement with a turn of the coil, said contact urging said portion of said carrier into engagement with said guide groove of said rotor, inhibiting movement of said carrier except in a plane substantially parallel to the shaft, said carrier including means for engaging the sides of the turns for advancing said carrier along said groove as the shaft and rotor rotate.

7. In a potentiometer having a helical coil positioned within a case and a shaft mounted in the case for rotation about the axis of the helix, the combination of: a rotor carried on the shaft and including a carrier guide, said guide having a pair of flat walls disposed substantially parallel to the shaft with the planes of said walls intersecting at an angle along a line parallel to said guide; first and second stops fixed to opposite ends of the case and projecting inward toward each other; a contact carrier having a pair of flat walls lying in planes which intersect at an angle substantially equal to the angle of intersection of the planes of said walls of said guide for engagement with said carrier guide and movement therealong; and a spring contact mounted on said carrier for engagement with a turn of the coil, said contact urging said carrier into engagement with said guide, inhibiting movement of said carrier except in a plane substantially parallel to the shaft, said carrier including means for engaging the sides of the turns for advancing said carrier along said guide as the shaft and rotor rotate, said carrier including a first stop-engaging surface on one side thereof disposed parallel to one of said flat walls for engaging one of said stops providing a limit on the travel of said carrier along said guide, and including a second stop-engaging surface on the opposing side disposed parallel to the other of said flat walls for engaging the other of said stops providing a second limit on the travel of said carrier along said guide.

8. In a potentiometer having a helical coil positioned within a case and a shaft mounted in the case for rotation about the axis of the helix, a combination of: a rotor comprising an open rectangular frame mounted on the shaft for rotation therewith, said frame including parallel members disposed on opposite sides of the shaft and spaced therefrom, one of said members having a guide groove therein disposed substantially parallel to the shaft with the opposing walls of said groove converging toward the shaft; a contact carrier for engagement with and movement along said one member, said contact carrier including a portion mating with and resting on said converging walls of said guide groove; a spring contact mounted on said carrier for engagement with a turn of the coil, said contact urging said carrier into engagement with said guide groove, inhibiting movement of said carrier except in a plane substantially parallel to the shaft, said carrier including means for engaging the sides of the turns for advancing said carrier along said groove as the shaft and rotor rotate; an electrical terminal insulatedly mounted on the other of said member; and a flexible electrical lead interconnecting said terminal and said contact, said lead passing from said terminal on one side of said other member, through said frame and around said shaft to said contact on the opposite side of said one member.

9. In a potentiometer or the like, the combination of: a case; a helical coil positioned within said case; a shaft mounted in said case for rotation about the axis of said helix, said case having an inwardly projecting shoulder in one end thereof concentric with said shaft and a radial slot in the side wall thereof adjacent one end; a rotor comprising an open, rectangular frame mounted on said shaft for rotation therewith, said frame including

parallel members disposed on opposite sides of said shaft and spaced therefrom, one of said members having a guide groove therein disposed substantially parallel to said shaft, the opposing walls of said groove converging toward said shaft; a contact carrier for engagement with and movement along said one member, said contact carrier including a portion mating with and resting on said converging walls of said guide groove; a spring contact mounted on said carrier for engagement with a turn of said coil, said contact urging said carrier into engagement with said guide groove, inhibiting movement of said carrier except in a plane substantially parallel to the shaft, said carrier including means for engaging the sides of the turns for advancing said carrier along said guide groove as said shaft and rotor rotate; an electrical terminal insulatedly mounted on the other of said members; a flexible electrical lead interconnecting said terminal and said contact, said lead passing from said terminal on one side of said other member, through said frame and around said shaft to said contact on the opposite side of said one member; and a slip ring comprising a unitary piece of electrical conducting metal, said slip ring including an elongated tongue section, an apertured flat section, and a plurality of resilient tabs extending outward from said flat section, said tongue section extending through said radial slot to the exterior of said case and said flat section being disposed within said shoulder around said shaft with said tabs urged outward into engagement with said shoulder, said terminal including a flexible contact for riding on said flat section as said shaft rotates.

10. In a potentiometer or the like having an electrical component arcuately disposed within a case with a rotating shaft carrying an electrical contact for engaging various portions of the electrical component as the shaft rotates, the combination of: a shoulder on one end of the case projecting into the interior of the case and including a concave zone concentric with the shaft; means defining a radial slot through the wall of the case and communicating with said zone; a slip ring comprising a unitary piece of electrical conducting metal, said slip ring including an elongated tongue section for positioning in said radial slot and a contacting section for positioning in said concave zone with at least a portion of the outer edge of said contacting section resiliently engaging said shoulder; and a wiper arm mounted on the shaft and electrically connected to the contact, said wiper arm slidingly engaging said contacting section of said slip ring as the shaft rotates.

11. In a case for a potentiometer or the like, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell and a circular opening at one end thereof; a detachable cover rotatable in said circular opening about the axis of said shell, said cover including a stop member integral therewith and extending into the interior of said shell for rotation about said axis; a ring positioned in said groove for rotation relative to said shell with the outside diameter of said ring greater than the diameter of said circular opening such that said shoulder retains said ring within said shell; and means for fixing said cover to said ring to clamp said shoulder between said cover and ring.

12. In a case for a potentiometer or the like suitable for mounting to a plate, the case having a rotating element disposed therein, the combination of: a cylindrical shell having an inwardly turned peripheral shoulder defining an inwardly opening annular groove in said shell; a cover having a first surface for engaging said shoulder and a second surface for engaging the mounting plate, said cover being rotatable relative to said shell about the axis of said shell, said cover having a plurality of mounting openings therein substantially parallel to said axis; a stop member fixed to said shell and rotatable therewith for engagement with a portion of the rotating element; a split ring positioned within said groove for rotation relative to said shell, said ring being temporarily compressible from its normal diameter to a smaller diameter to pass through said opening defined by said shoulder, with said shoulder retaining said ring within said shell when said ring attains its normal diameter, said ring having a plurality of threaded openings in alignment with said mounting openings in said cover; and a plurality of screws for passing through the mounting plate and said mounting openings in said cover and threadedly engaging said openings in said ring for clamping said cover and said shoulder between the mounting plate and said ring.

References Cited in the file of this patent

UNITED STATES PATENTS

2,473,048	Beckman	June 14, 1949
2,495,321	Gibbs et al.	Jan. 24, 1950
2,519,752	Fox	Aug. 22, 1950
2,558,326	Van Dyke	June 26, 1951
2,665,355	Van Alen et al.	Jan. 5, 1954
2,813,182	Van Alen	Nov. 12, 1957