United States Patent

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[54] ROTOR AND SHAFT ASSEMBLY FOR VARIABLE RESISTOR

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[73] Assignee: **Beckman Instruments, Inc.**

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[52] **U.S. Cl.**.....**338/162,** 287/20.5 R, 287/103 A, 287/130

[51] **Int. Cl.**.....**H01c 9/02**

[58] **Field of Search**.....338/162, 166, 174; 287/20.5 R, 287/130, 103 A

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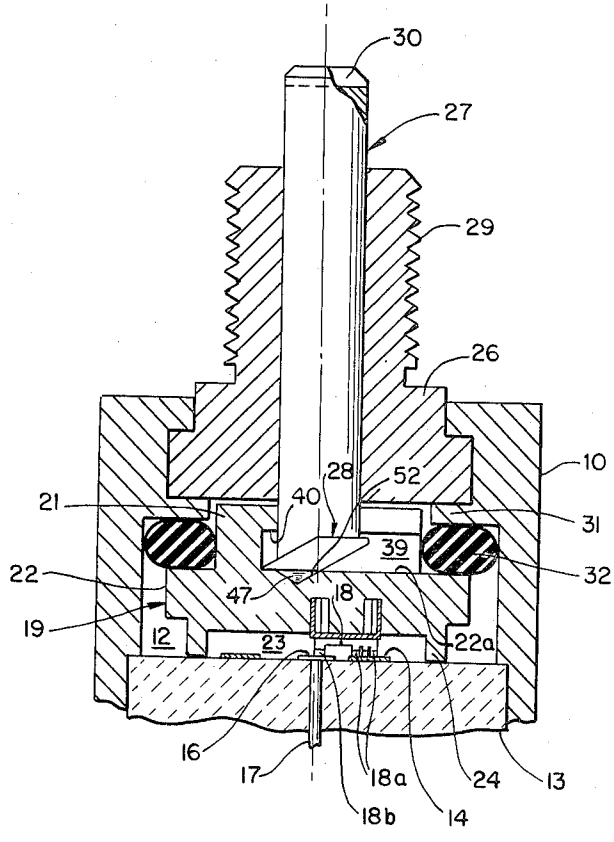
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[57] **ABSTRACT**

In a shaft and rotor assembly for a variable resistor device or the like the rotor member is provided with a slotted opening having an undercut lower portion of a width substantially greater than the upper portion of the opening. The shaft is provided with a driving head having substantially the shape of a parallelepiped in which a pair of upper and lower surfaces are arranged substantially normal to the axis of the shaft. The distance between the upper and lower parallel surfaces is slightly less than the depth of the lower portion of the slotted opening in the rotor and the sides of the head are arranged to mate substantially with the side walls of the slot in the rotor so that the shaft may be slid into the lower portion of the slot with the shank of the shaft extending through the upper portion of the slot. The upper surface of the head abuts against the upper surface of the undercut lower portion of the slot thereby preventing axial movement of the head and shaft with respect to the rotor. Lateral movement of the head with respect to the rotor is prevented by an extension from the lower surface of the head which fits into a mating opening formed on the lower surface of the slot.

8 Claims, 9 Drawing Figures



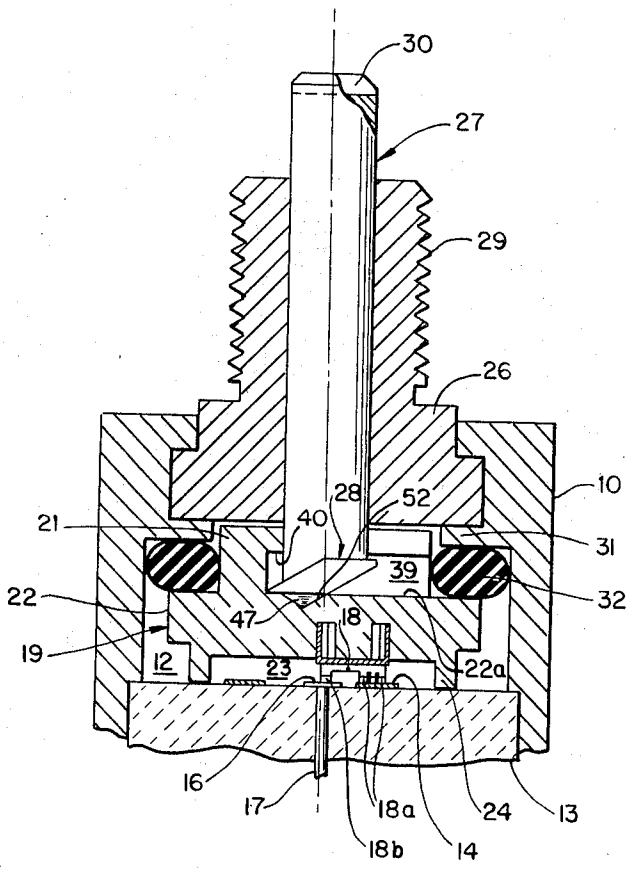


FIG. 1

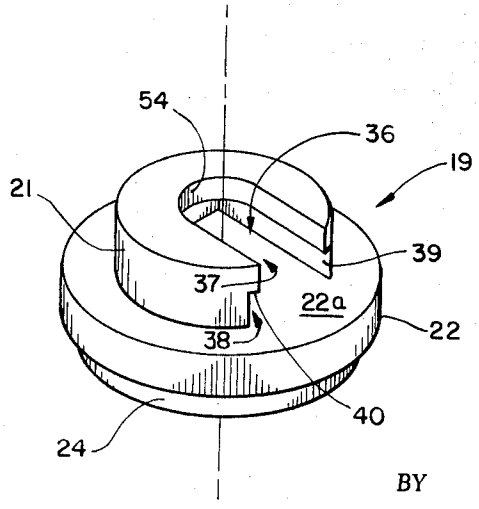


FIG. 2

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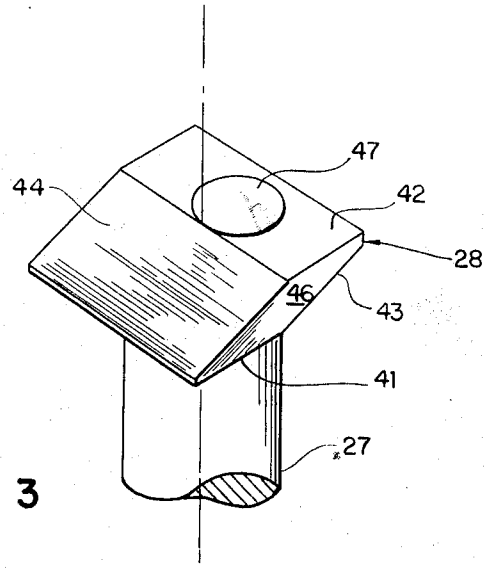


FIG. 3

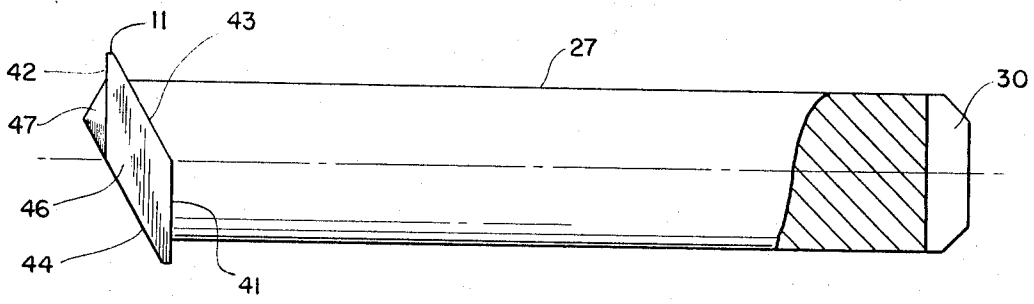


FIG. 4

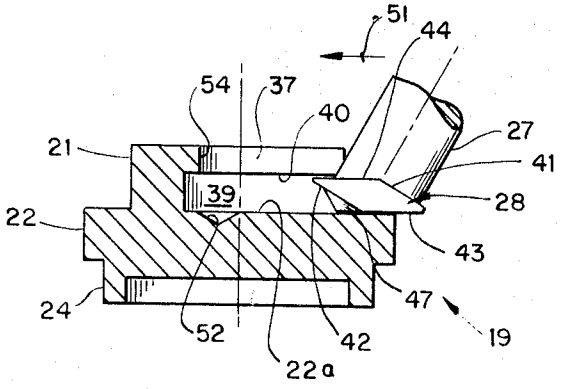


FIG. 5

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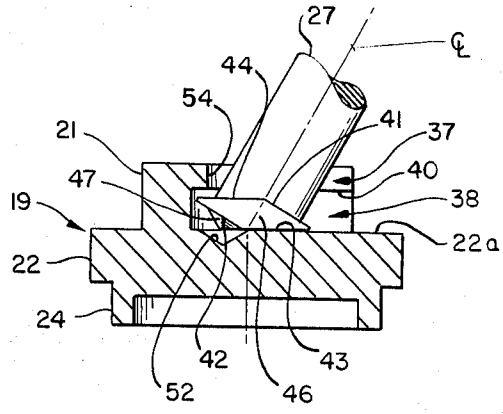


FIG. 6

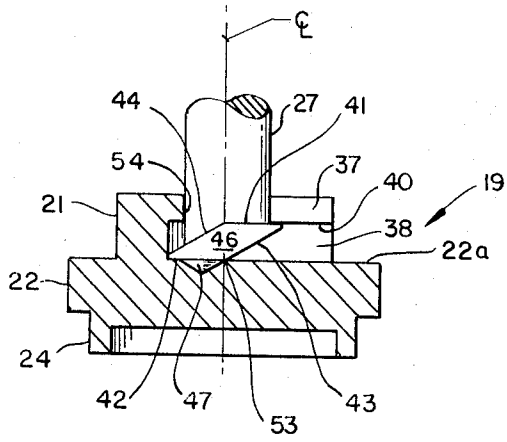


FIG. 7

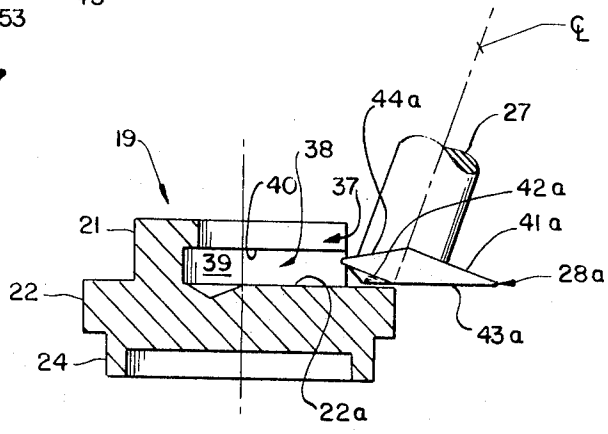


FIG. 8

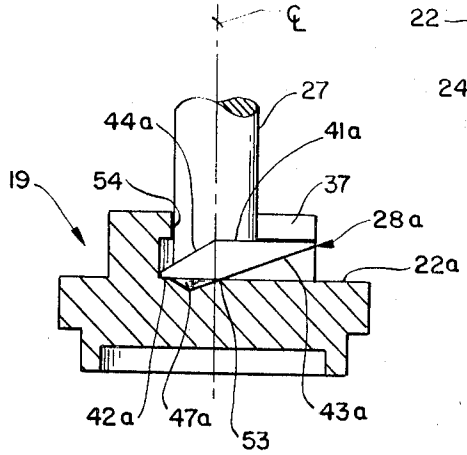


FIG. 9

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ROTOR AND SHAFT ASSEMBLY FOR VARIABLE RESISTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a simplified rotor and shaft assembly for a variable resistance device or the like and is more particularly directed to an improved arrangement for locking the shaft to the rotor member without additional attaching means.

2. Description of the Prior Art

While the invention is described and considered primarily in connection with its use in a variable resistance device, it is applicable to various types of devices in which a rotor, mounted within a housing, must be driven by a rotatable shaft accessible from outside the housing. There are numerous applications in which it is not practical for a rotor and shaft to be an integral piece. In electrical applications, it is sometimes essential that the rotor be of an insulative material while the shaft may be of a conductive metal. In such instances it becomes necessary to join the rotor and shaft. The rotor may be cemented to the shaft or may be held on the shaft by set screws or the like. Existing methods of attachment require machining operations on the rotor or the shaft and require expensive labor assembling operations, making the assembly of such members a costly and time-consuming operation.

SUMMARY OF THE INVENTION

Briefly the invention relates to the attachment of a rotor to a rotatable shaft by means of the structural relationship of the rotor and shaft. The rotor is provided with a slotted opening extending from one edge thereof in which the lower portion of the slot is undercut and wider than the upper portion of the slot. The upper portion of the slot is of a width adapted to receive the diameter of the shaft and the lower portion of the slot receives a driving head, which is in the general shape of a parallelopiped, having upper and lower surfaces arranged substantially normal to the axis of the shaft. The distance between the upper and lower surfaces is slightly less than the distance between the upper and lower surfaces of the lower portion of the slot so that when the shaft is in the upright position coinciding with the axis of the rotor, the overhanging portion of the slot prevents axial movement of the shaft with respect to the rotor. The sides of the lower portion of the slot are engaged by the sides of the driving head so that rotation of the shaft causes the rotor to rotate as well.

In the preferred embodiment, a lower surface of the driving head is provided with a protruding embossment adapted to fit into a depression or hole formed in the lower surface of the lower portion of the slot so that, when the shaft is in the upright position, the embossment prevents lateral movement of the driving head with respect to the slot in the rotor.

It is an object of the invention to provide a rotor and shaft assembly which may be simply and quickly assembled and disassembled without requiring additional attaching means for attaching the rotor to the shaft.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view in cross-section of a variable resistance device employing the rotor and shaft assembly;

FIG. 2 is a perspective view of the rotor showing the slot formed in a shank forming part of the rotor;

FIG. 3 is a perspective view of a portion of the shaft and the driving head formed thereon;

FIG. 4 is a side view of the shaft;

FIG. 5 is a cross-sectional view of the rotor illustrating the preferred method of assembling the shaft and driving head into the slot formed in the rotor;

FIG. 6 is a cross-sectional view of the rotor with the shaft tilted at an angle with respect to the axis of the rotor and the driving head inserted almost fully into the lower portion of the slot;

FIG. 7 is a cross-sectional view of the rotor showing the shaft and rotor axis coinciding;

FIG. 8 is a cross-sectional view of the rotor and shaft with a head having a slightly different configuration; and

FIG. 9 illustrates the components of FIG. 8 assembled with the shaft axis coinciding with that of the rotor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown in FIG. 1 a variable resistance device, which, in the illustrated embodiment, is a rotary potentiometer. This embodiment of the invention employs a generally cylindrical housing **10** enclosing a chamber **12**. The housing **10** may be formed of any suitable metallic material, such as stainless steel, nickel, silver or aluminum, which may be drawn or pressed into the shape shown, or may be formed of a suitable plastic material, molded into the desired shape. A base member or wafer **13** is mounted through an open end of the housing and supports an electrical resistance element **14** and collector member **16** thereon. In the described embodiment of the invention, the base member may comprise a non-conductive material, such as a plastic material or ceramic material, which is formed in a size and shape permitting it to be inserted into the open end of the housing **10**. The resistance element **14** is in the form of a thin arcuate strip and may comprise any suitable resistance material, such as the type commonly referred to as "cermet" material or conductive plastic material, or any suitable resistance material. Terminals such as the terminal **17** extend through the base member **13** and electrically connect the resistance element **14** and the collector **16** to an external electrical circuit in which the variable resistance device is to be employed.

An electrically conductive movable contact member **18** is supported in the chamber **12** above the resistance element **14** for movement in a predetermined arcuate path. In the embodiment illustrated in FIG. 1, the electrically conductive contact member or wiper **18** comprises a one piece metal stamping fabricated of a precious metal alloy or the like and staked securely into a rotor member or body, generally designated by the reference numeral **19**. The rotor body **19** may be fabricated of a non-conducting material, such as a molded epoxy resin, and includes an upper cylindrical shank or extension **21** projecting from the larger, lower cylindrical body or section **22**. The lower section of the rotor **19** is provided with a cylindrical shaped cavity **23** defined by a ring-like flange or spacer **24**. The cavity **23** is adapted to receive the electrical contact element **18** and insulates or shields this portion of the electrical device from the outer housing **10**.

In the embodiment shown, a plurality of resilient conductive arms or fingers **18***a* and **18***b* extend from the contact member **18** and make contact with the resistance element and collector member. The resilient fingers **18***a* and **18***b* are bent outwardly from the body of the contact and provide a spring bias directed toward the resistance element **14** and collector **16** on the base member **13**.

As may be seen in FIG. 1, in the upper end of the housing **10** there is mounted in the end wall **31** of the housing a bushing or support member **26** through which a shaft, generally designated by the reference numeral **27**, is supported for rotation. The upper portion of the shaft protrudes through the bushing **26** and may be turned by a suitable tool such as a screw driver which may be inserted into the slot **30** so formed in the end of the shaft. On the other or lower end of the shaft, a driving head **28** is attached in driving relationship to impart rotary motion to the rotor **19**. The bushing **26** is provided with an upper threaded portion **29** which permits the variable resistance device to be mounted through a hole formed in a panel or the like to be locked thereon by a nut (not shown) which may be assembled over the threaded portion **29**.

Mounted between the inner surface of the end wall 31, which supports the bearing member 26, and an upper surface 22*a* formed on the rotor 19 is a resilient O-ring 32. The O-ring 32 has the dual function of sealing the potentiometer interior from contamination and providing a downward or biasing force on the rotor so that the ring or space 24 is supported against the upper surface of the base member 13.

As will now be explained, the present invention deals with the structure of the rotor member 22 and the shaft 27 and their relationship with regard to assembly and the locking of the shaft driving head 28 in place with respect to the rotor. As may be seen in FIG. 2, the upper cylindrical portion or shank 21 of the rotor has formed therein a slot or cavity 36 molded or otherwise formed therein. The slot 36 comprises an upper portion 37 having a dimension only slightly larger than the diameter of the drive shaft 27 and a lower or undercut portion 38 of greater width than the diameter of the shaft and so adapted as to receive the driving head of the shaft. In the preferred embodiment of the invention the walls 39 of the lower portion of the slot are arranged perpendicular to the surface 22*a*. The walls 39 are, therefore, substantially parallel to the axis of the rotor. The under surface 40 of the overhanging edge of the upper portion of the slot is preferably arranged parallel to the lower surface 22*a* of the slot.

As will be seen in FIGS. 3 and 4, the driving head 28 attached to the end of the shaft 27 is formed by a process, such as cold-heading, into a shape resembling a parallelepiped. In the preferred embodiment, the top and bottom of sides 41 and 42 respectively are equal in length to the connecting sides 43 and 44 and the angle between sides 41 and 44 are equal to the angle between sides 42 and 43. The end walls 46 (only one shown) are preferably perpendicular to the side walls. A small cone-shaped protrusion 47 extends from the surface 42. Upper and lower surfaces 41 and 42 are preferably arranged parallel and perpendicular to the axis of the shaft. The distance between the upper and lower surfaces 41 and 42 is slightly less than the distance between the rotor surface 22*a* and the overhanging surface 41 of the upper portion of the slot.

In FIGS. 5–7 the assembly of the rotor and shaft is illustrated. In assembly, the shaft head 28 is positioned so that the surface 43 lies flat on the surface 22*a* of the rotor 19. The shaft 27 is arranged at an angle to the axis of the rotor and the surface 44 of the driving head 28 extends beneath the overhanging or undercut surface 41 of the slot. The head 28 is inserted into the enlarged lower section 38 of the slot and moved in the direction of the arrow 51 as shown in FIG. 5. Note that the cone-shaped protrusion 47 clears the lower surface 22a within the slot because the shaft and head are arranged at an angle with respect to the rotor. As the head 28 enters the undercut lower portion 38 of the slot, the outer edges of the upper surface 44 are captured or slide beneath the overhanging surface 41. The width of the head 28 is just sufficient so that the end walls 46 slide adjacent the walls 39 of the undercut portion of the slot.

When the shaft head 28 is almost completely inserted into the undercut portion 39 of the slot, or in the position illustrated in FIG. 6, the cone-shaped protuberance 47 is positioned over a similar shaped depression 52 or hole formed in the lower surface 22*a* of the slot. In this position, the shaft which fits into the upper portion 37 of the slot is then moved erect so that its axis coincides with the axis of the rotor. As the shaft is moved upright, the head pivots about the corner 53 and the cone-shaped protuberance 47 moves into the similar shaped depression within the rotor. Surface 41 moves upwardly parallel to the overhanging surface 40 and, in this position, the lower surface 42 rests on the lower surface 22*a* of the slot. Also, when the shaft 23 is in the upright position so that its axis coincides with the axis of the rotor, the forward portion of the shaft abuts against the rear edge 54 of the upper portion 37 of the slot. While not absolutely essential, it is preferable that rear edge 54 be rounded to conform to the shaft dimensions. When the shaft is positioned within the slot, the side walls 46 of the driving head abut the side walls 39 of the rotor so that rotation of the shaft causes similar rotation of the rotor.

When the shaft and rotor assembly are positioned in a device, such as a potentiometer of the type shown in FIG. 1, the shaft 27 is maintained in the upright or erect position with respect to the rotor by the bushing 29. On assembly, the shaft and rotor are inserted through the end of the housing before insertion of the base member 13. The shaft 27 is slid through the bushing 26 until it extends through the bushing and the surface 22*a* of the rotor is forced up against the O-ring 32. The base member 13 is then inserted into the end of the housing 10 to force the rotor securely against the O-ring. The base member 13 is then cemented in place. The provision of the cone-shaped protuberance 47 on the head 28 and the similar shaped opening 52 in the rotor, prevents lateral movement between these members when the shaft is in the upright position and when locked in place within the potentiometer bushing.

It is not absolutely essential that the sides 41, 42, 43 and 44 all be of the same length. However, it is desirable that the surfaces or sides 41 and 42 be parallel and perpendicular to the axis of the shaft. For example, referring to FIGS. 8 and 9, a shaft 27 is provided with a driving head 28*a* having sides which are not equal in length. For example, sides 41*a* and 43*a* are longer than sides 42*a* and 44*a*. However, sides 41*a* and 42*a* are parallel and, as shown in FIG. 9, the same relative relationships are present when the shaft 23 is moved into the slot and positioned in the upright position. The protuberance 47*a* is of slightly different shape than that of the previous embodiment of the invention (reference numeral 47) in order to permit it to clear the surface 22*a* when the head is moved into the slot. Note, however, when the head is positioned for insertion into the slot, the side 44*a* is not parallel to the surface 40. All that is necessary is that the angle formed between the side 42*a* and the surface 22*a* is similar to the angle formed between the surface 41*a* and the under surface 40 of the lower portion of the slot so that, when the shaft is moved into its upright position, both surfaces 42*a* and 41*a* move into abutting relationships with the associated surfaces 22*a* and 40 of the rotor and slot.

It will be understood that the reference to upper and lower portions of the slot and with respect to upper and lower surfaces on the head of the shaft is merely to provide orientation with respect to the drawings as illustrated. It will be understood that in operation the device itself may be oriented in other positions and the so-called upper and lower portions of the slot and surfaces may be in a different position than that shown in the drawings.

While in accordance with the patent statutes, there has been described what are considered to be the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is, therefore, the aim of the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A rotor and shaft assembly for a variable resistance device or the like comprising:

a rotor adapted to be rotated about its axis and to support an electrically conductive contact member for rotation about an arcuate path, said rotor including a shaft supporting shank having a slot therein, said slot including an upper portion and a lower undercut portion, said undercut portion being of a width greater than said upper portion so that there is an overhanging upper surface above at least a part of said lower portion of said slot, said lower portion of said slot having a hole formed in the lower surface thereof;

a shaft including a driving head on one end thereof, said shaft being of a width adapted to fit within said upper portion of said slot and said driving head being substantially in the shape of a parallelepiped with parallel upper and

lower surfaces arranged substantially normal to the axis of said shaft and extending beyond the circumference of said shaft and side surfaces connecting at an angle with said top and bottom surfaces, said driving head being positioned within said undercut portion of said slot, said driving head including an embossment protruding from the bottom surface thereof and extending into said hole formed in the bottom surface of said slot thereby preventing lateral movement of said shaft and said driving head when said shaft is positioned along the axis of rotation of said rotor.

2. The rotor and shaft assembly defined in claim 1 in which said embossment protruding from the bottom surface of said driving head is cone-shaped and said hole in the lower surface of said slot is similarly shaped.

3. The rotor and shaft assembly defined in claim 2 in which said cone-shaped embossment protruding from said lower surface is an extension of one of the connecting surfaces between said parallel upper and lower surfaces of said driving head.

4. The rotor and shaft assembly defined in claim 1 in which said driving head is in the shape of a parallelepiped having equilateral sides.

5. The rotor and shaft assembly defined in claim 3 in which the upper and lower surfaces of the driving head are parallel and the connecting surfaces to these surfaces are parallel and spaced apart a distance slightly less than the distance between said lower surface of the rotor slot and said overhanging upper surface of said slot.

6. A variable resistance device comprising:

a housing substantially open at one end and defining a cavity;

a base member supported across said open end of said housing, said base member having an annular resistance element and a collector element mounted thereon;

a rotor mounted within said cavity, said rotor including a shaft supporting shank having a slot therein, said slot including an upper portion and a lower undercut portion, said undercut portion being of a width greater than said upper portion so that there is an overhanging upper surface above at least a part of said lower portion of said slot, said lower portion of said slot having a hole formed in the lower surface thereof;

a drive shaft having one end extending through an end of said housing and including a driving head on the other end thereof, said shaft being of a width adapted to fit within said upper portion of said slot and said driving head being substantially in the shape of a parallelepiped with parallel top and bottom surfaces arranged substantially normal to the axis of said shaft and extending beyond the circumference of said shaft and side surfaces connecting at an angle with said top and bottom surfaces, said driving head being positioned within said undercut portion of said slot, said driving head including an embossment protruding from the bottom surface thereof and extending into said hole formed in the bottom of said slot thereby preventing lateral movement of said shaft and said driving head when said shaft is positioned along the axis of rotation of said rotor; and

an electrically conductive contact member attached to said rotor for rotation therewith, said contact member having a plurality of resilient wiper arms engaging said resistance and said collector elements on said base member for traversing these elements on rotation of said rotor.

7. The variable resistance device of claim 6 in which said driving head is in the shape of a parallelepiped having equal lateral sides.

8. The variable resistance device defined in claim 6 in which said embossment protruding from said bottom surface of said driving head is cone-shaped and said hole in the lower surface of said slot is similarly shaped.

* * * * *