

Jan. 8, 1963

W. F. O'SHEA
ROTARY POTENTIOMETER

3,072,872

Filed Feb. 15, 1961

2 Sheets-Sheet 1

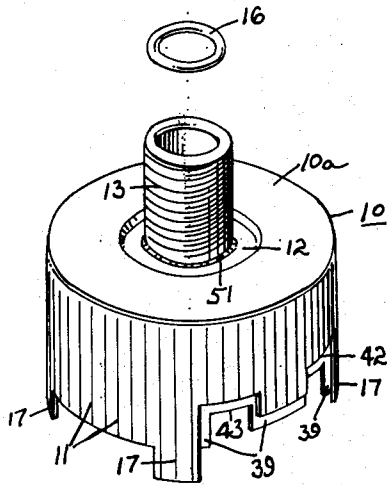


Fig. 2.

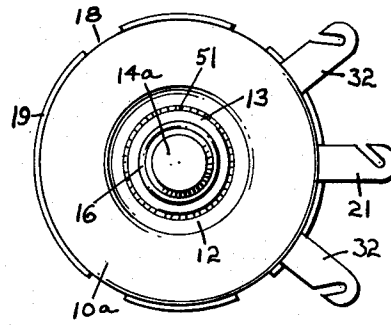


Fig. 3.

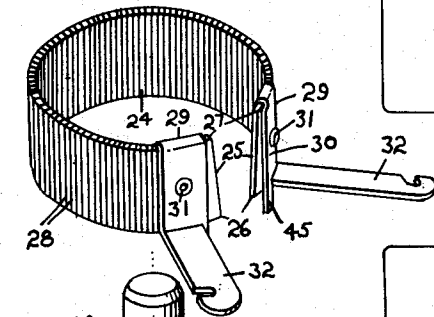
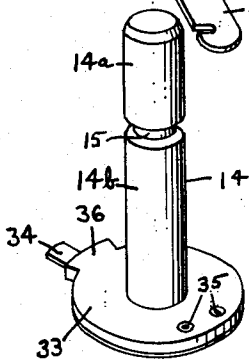
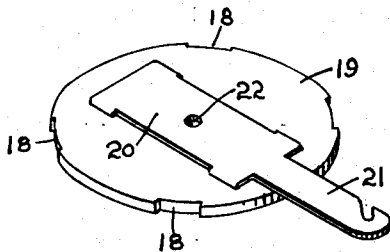
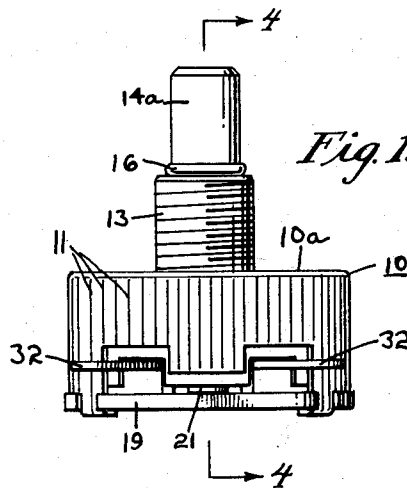


Fig. 1.

INVENTOR.
WILLIAM F. O'SHEA
BY *Lev Edelson*
ATTORNEY.

Jan. 8, 1963

W. F. O'SHEA

3,072,872

ROTARY POTENTIOMETER

Filed Feb. 15, 1961

2 Sheets-Sheet 2

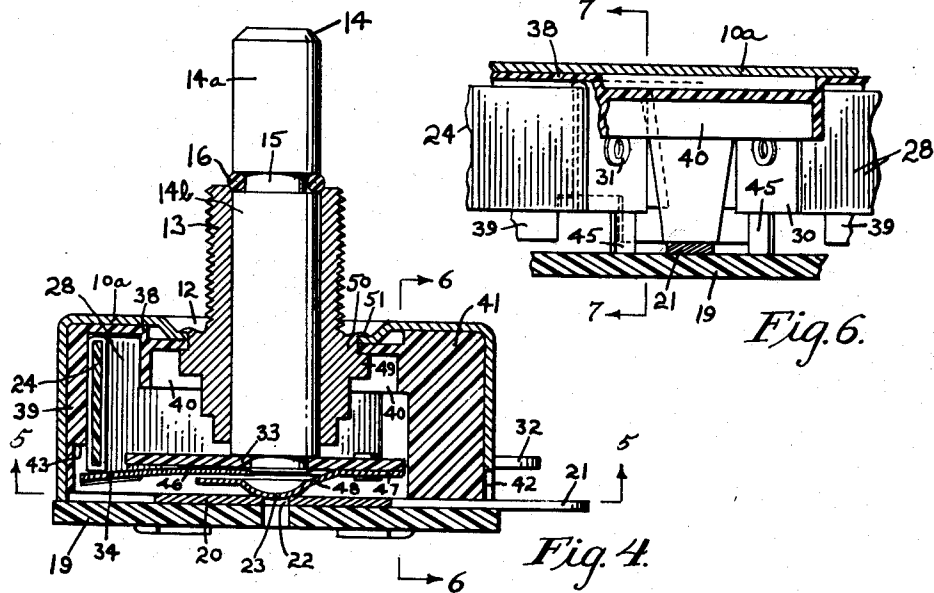
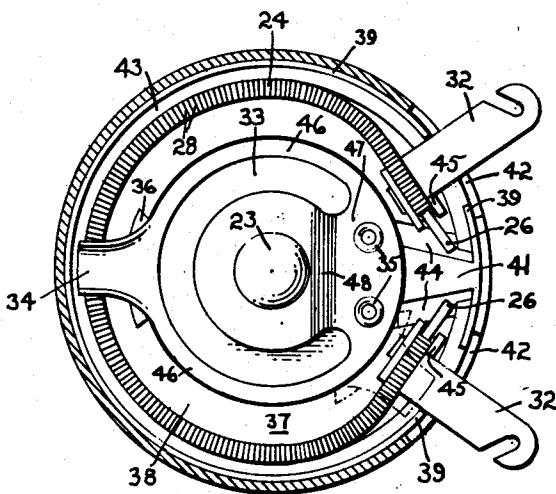
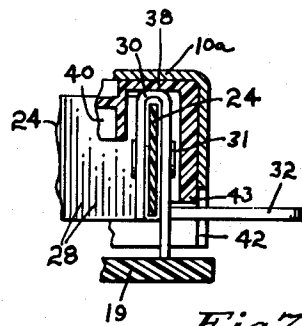


Fig. 5.

Fig. 7.

INVENTOR.

BY WILLIAM F. O'SHEA

Leander
ATTORNEY.

ATTORNEY.

1

3,072,872

ROTARY POTENTIOMETER

William F. O'Shea, Hathboro, Pa., assignor to Continental-Wirt Electronics Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Filed Feb. 15, 1961, Ser. No. 89,541

12 Claims. (Cl. 338—174)

This invention relates to electrical resistance devices, and more particularly relates to devices of the variable resistance type known generally as potentiometers.

The potentiometer according to the invention embodies a number of novel features which cooperate to provide an electrically reliable, mechanically rugged unit of relatively low cost which may be easily and quickly assembled by comparatively unskilled personnel. One novel aspect of the potentiometer according to the invention resides in a resistance element which is disposed within the potentiometer housing and held in mechanically stabilized position by a novel interlocking arrangement which does not require rivets, cementing or other permanent type securement. One advantage of this construction resides in the great simplification of assembly, and also optionally permits the simple and rapid replacement of the resistance element in the field. Indeed, under emergency conditions, temporary emergency repairs may even be effected in the field by virtue of the potentiometer construction which permits easy removal of the resistance element from the composite unit without physical demounting of the potentiometer casework. Additional features of the novel potentiometer construction include a potentiometer case-forming treatment which effectively increases the heat dissipation rating of the unit, a novel rotor structure and electrical connection of the movable rotor arm to an external terminal, and a composite assembly comprising a minimum number of parts. Accordingly, it is a primary object of this invention to provide a novel potentiometer incorporating the aforescribed features.

Another object of this invention is to provide a novel potentiometer which incorporates a one-piece molded plastic liner disposed within and secured to the potentiometer cover shell.

Still another object of this invention is to provide a novel potentiometer structure including a quickly demountable resistance element carried by a plastic former of a resilient nature which mechanically interfits with the plastic cover shell liner.

Yet another object of this invention is to provide a novel potentiometer wherein the movable arm of the potentiometer is electrically coupled to an external terminal which is carried by the cover shell backplate, and wherein securement of the backplate to the cover shell further mechanically stabilizes the electrical resistance element.

The foregoing and other objects of the invention will become apparent from a reading of the following specification in conjunction with an examination of the appended drawings, wherein:

FIGURE 1 is a side elevational view of the novel potentiometer according to the invention as would be seen when facing the three contact terminals projecting externally of the unit;

FIGURE 2 is a top plan view of the potentiometer shown in side elevation in FIGURE 1;

FIGURE 3 is a perspective exploded view of the potentiometer with the backplate, rotor and shaft, and resistance element assembly all physically separated from the potentiometer cover shell and separated one from another;

FIGURE 4 is a vertical sectional view through the assembled potentiometer as would be seen when viewed along the lines 4—4 of FIGURE 1;

FIGURE 5 is an inverted plan view of the interior of the assembled potentiometer as would be seen when viewed

2

along the lines 5—5 of FIGURE 4, the rotor assembly being also illustrated in phantom in one extreme position of rotation;

FIGURE 6 is a fragmentary vertical section as would be seen when viewed along the lines 6—6 of FIGURE 4; and

FIGURE 7 is a fragmented view as would be seen when viewed along the lines 7—7 of FIGURE 6 and showing a terminal affixed to one end of the resistance element with the resistance element disposed within a channel portion of the plastic shell liner.

In the several figures, like elements are denoted by like reference characters.

Referring first to FIGURES 1, 2 and 3, the gross aspects of the potentiometer according to the invention as disclosed therein comprise a cylindrical metal cover shell 10 closed at one end 10a, the closed end 10a being provided with a central depression or well 12 through which axially projects an externally threaded hollow bushing 13 adapted to have passed axially therethrough and partially disposed therewithin the segmented rotor shaft 14. The rotor shaft 14 is divided into a shorter upper segment 14a and a longer lower segment 14b by an annular groove 15 within which is disposed an O-ring 16. When the shaft 14 has been slid through the bushing 13, the O ring 16, when in place, prevents retraction of the shaft backward through the bushing 13, as best seen in the showing of FIGURE 4. The cylindrical side wall portion of the cover shell 10 is deep-scored or grooved as at 11 to provide a greatly increased surface area to the cover shell by means of which more rapid and effective cooling thereof may be obtained.

The open end of the cover shell 10 is provided with a plurality of locking tabs 17 which extend in axial continuation of the annular side wall of the cylindrical cover shell 10, and which in the assembled units are disposed within the correspondingly located notches 18 cut into the periphery of the cover shell insulating material backplate 19, being thereafter turned radially inward into close overlying engagement with the outer surface of the backplate to secure the latter in place. Tab-locked or otherwise secured to the backplate 19 is a metallic rotor contact plate 20 having an external terminal plate 21 integrally formed therewith and extending therefrom radially outward beyond the edge of the backplate 19. Centrally punched through the contact plate 20 so as to be disposed on the axis of the cylindrical bushing 13 is a circular socket hole 22. Disposed in peripheral engagement with the edge of the circular socket hole 22 is a spring biased metallic contact cup 23 not visible in FIGURES 1, 2 or 3, but which is shown in FIGURES 4 and 5 as constituting a portion of the total rotor contact assembly. The contact cup 23 is symmetrically centered on the axis of the rotor shaft 14 so that it properly aligns with the socket hole 22 on the rotor contact plate 20, this alignment being best seen in the showing of FIGURE 4.

As best seen in FIGURE 3, the resistance element itself comprises a flat strip of plastic insulating material configure in the form of a split cylindrical annulus 24, the ends 25 of the annulus being straight-line tapered from top to bottom so that when sprung together the bottom points 26 would contact while leaving a gap at the upper edges 27 to thereby define a triangular opening between the ends. This tapered end construction will be seen subsequently to provide a camming action with a portion of the plastic liner for the cover shell effective to mechanically stabilize the resistance element in proper position within the interior of the unit. Wound about the annulus 24 is a continuous length of resistance wire 28, the opposite ends of which terminate proximate the ends of the annulus 24, being there secured in place by the clamping action of the end terminals 29. As best seen in FIGURE 7, each of the terminals 29 includes a U-shaped portion

30 disposed closely about the resistance wire 28 and the annulus 24 so as to clamp the latter therewithin, fixed securement being provided by the rivets 31. Turned outward from each of the U-shaped terminal portions 30 is an external terminal piece 32 by means of which external circuit connections to opposite ends of the resistance element may be made.

Staked or otherwise secured to the bottom of the shaft 14 in a plane oriented orthogonally to the axis of the shaft is the rotor support insulator disc 33 which carries the metallic rotor contact assembly, the resistance element engaging finger 34 of this contact assembly being visible in the perspective view of FIGURE 3. As best seen in FIGURES 4 and 5, the rotor contact assembly is secured to the support disc 33 by a pair of rivets 35 so positioned relative to the support disc 33 that the contact finger 34 centrally underlies the rotor stop wedge 36, which latter extends laterally from a portion of the periphery of the rotor support disc 33 and provides a stop action for the rotor contact 34 at the extreme positions of rotation by engaging the sides of the wedge portion 41 of the plastic liner 37 to be now described. The separate elements shown in exploded relationship in FIGURE 3 are assembled into the composite unit of FIGURE 1, the assembled details of which are shown principally in the illustrations of FIGURES 4 and 5 to which particular reference should now be made.

As best seen from FIGURES 4 and 5, the cover shell 10 is completely lined with a molded plastic liner 37 which conforms to the inside surface of the cover shell. The liner 37 includes a centrally apertured base surface 38 which covers the inside surface of the cover shell end closure 10a, a peripherally extending side wall portion 39 which lines the inside surface of the cylindrical scored portion of the cover shell 10, an annular wall 40 projecting from the base surface 38 concentric with the peripheral wall 39 but of smaller radius, and a triangular wedge portion 41 extending between the annular wall 40 and the peripheral wall 39 in the region between the recesses 42 of the cover shell side wall through which the terminals 32 of the resistance element assembly outwardly project. The liner peripheral wall 39 is recessed toward the base surface 38 to provide a shoulder 43 which extends substantially completely about the cylindrical wall periphery of the liner 37 but which terminates at the sides of the wedge portion 41, this being best seen in the showing of FIGURE 5. The peripheral wall 39 of the liner 37 is additionally downwardly recessed to the level of the shoulder 43 in the region of the cover shell terminal recesses 42 so that the terminals 32 may pass outwardly there-through. As most clearly seen in FIGURES 3 and 7, the liner shoulder 43 extends beyond the edge of the cover shell recesses 42 so that the projecting terminals 32 are prevented from physically engaging the cover shell. The liner peripheral wall 39 similarly prevents the terminals 32 from contacting the cover shell annular side wall portions disposed laterally thereof.

As best seen in the view of FIGURE 5, the side walls 44 of the wedge portion 41 taper outwardly as they progress from the wedge top surface toward the base surface 38 of the plastic liner 37 so that the tapered ends 25 of the resistance element annular former 24 are cammed apart from one another as the entire resistance element is slipped into the plastic liner to thereby radially expand the annular former 24 and cause it to press outward against the inside surface of the liner peripheral wall 39 between the liner shouldered region 43 and base wall 38. The length of the resistance element annulus 24 is chosen so that when the upper edges 27 thereof substantially contact the base surface 38 of the liner 37, the tapered ends 25 of the former 24 are disposed substantially at the intersection between the wedge side walls 44 and the shouldered portion 43 of the liner peripheral wall 39, and the resistance element terminals 32 side-abut the recessed

edges of the peripheral wall 39 located at the cover shell terminal recesses 42. The entire resistance element assembly is thus stabilized in a radial direction, being unable to either increase or decrease its radius without first being moved outward toward the cover shell back-plate 19. Such motion toward the cover shell backplate 19 is prevented by the tab 45 projecting in continuation of the U-shaped terminal portion 30 of each end terminal 29. These tabs are of such length that the ends thereof are just engaged by the inside surface of the cover shell backplate 19 when the latter is placed in position, thus preventing motion of the resistance element in the direction of the cover shell backplate 19 and completely mechanically stabilizing the same.

As also best seen in FIGURES 4 and 5, the rotor contact assembly is stamped out of a piece of resilient spring metal to provide a generally circularly shaped disc form from which laterally projects the contact finger 34, a C-shaped region being removed from the main body of the spring metal to provide a pair of arcuate arms 46 which connect the contact finger 34 to the securement region 47 where the contact structure is riveted to the support disc 33 by the rivets 35 as previously described. The arcuate arms 46 impart resiliency to the structure to allow the contact finger 34 to be resiliently displaced from the plane of the securement region 47 in the manner seen in FIGURE 4. The relatively long sweep of the arms 46 provides for a gradual displacement thereof from the undersurface of the rotor support disc 33 and thereby completely eliminates any localized flexing stresses. The central section of the contact structure which carries the contact cup 23 is also bent up out of the plane of the main securement region 47 in the manner indicated at 48. The bend imparted at 48 and the depth of the contact cup 23 are sufficient so that the cup engages the socket hole 22 of the rotor contact plate 20 when the cover shell backplate 19 is secured to the cover shell 10. The terminal 21 extending from the rotor contact plate 20 thus lies flatwise on the upper surface of the wedge portion 41 and is thereby supportedly clamped between the wedge and the backplate 19.

Assembly of the unit is achieved in the following manner. First, the molded liner 37 is placed inside the cover shell 10 and properly oriented as best seen in FIGURES 3 and 5. Next, the bushing 13 is projected through the central aperture in the plastic liner and the corresponding hole in the cover shell well 12, so that the bushing shoulder 49 clamps the base surface 38 of the liner 37 against the inside surface of the cover shell well 12. Then, the outwardly facing surface 50 of the bushing 13 which lies above and somewhat radially inward of the bushing shoulder 49 is radially outwardly staked or crimped as at 51 to overlie the periphery of the cover shell well 12 external surface to simultaneously fixedly secure the plastic liner 37 and bushing 13 to the cover shell 10. The resistance element is then placed into position within the liner and pressed firmly downward into seating position. Thereafter, the rotor is assembled to the unit, by projecting the shaft 14 through the bushing 13 and slipping the O ring 16 down into locking position with the annular groove 15 which separates the segments 14a and 14b of the rotor shaft 14. Finally, the backplate 19 is fitted onto the back of the cover shell with the socket hole 22 of the contact plate 20 seated onto the contact cup 23, and the locking tab 17 are bent radially inward over the outer surface of the backplate 19 to secure the entire assembly together.

From the foregoing description, and particularly the showing of FIGURE 4, it will be appreciated that assembling of the backplate 19 to the cover shell 10 imparts an upward bias to the entire rotor and shaft assembly through the resilient bend 48 which joins the contact cup 23 to the securement region 47 of the rotor contact to thereby effect a positive contact between the socket hole 22 of the contact plate 20 and the contact cup 23 of the

5

rotor contact assembly. The upward bias imparted to the rotor and shaft assembly imparts a bias to the arcuate arms 46 to thereby insure positive engagement between the rotor assembly contact finger 34 and the resistance wire 28 of the resistive unit. Additionally, the O ring groove 15 on the rotor shaft 14 is so located that axial pressure applied to the end of the shaft 14 cannot cause such displacement of the rotor assembly so as to break the contact between the resistance element and the contact finger 34 of the rotor contact assembly.

Having now described my invention in connection with one particularly illustrated embodiment thereof, it will be apparent that modifications and variations may occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit of my invention, and accordingly, it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed as new and useful is:

1. A rotary variable resistance unit comprising in combination, a hollow cylindrical housing closed at one end and open at the other end, a molded insulation liner completely lining the inside surface of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, said liner and resistance element assembly having complementally shaped engageable parts effective when engaged to radially expand the resistance element assembly into engagement with the liner substantially completely about the outer periphery of the annular resistance element assembly and retain the latter in such radially expanded condition, a rotor mounted contact assembly including a movable contact finger adapted for wiping contact with the resistance element at any desired point between the ends thereof, contact means for electrically connecting the contact assembly to a terminal projecting externally of the housing, and terminal means electrically connected to the resistance element and projecting externally of the housing.

2. The variable resistance unit according to claim 1 wherein the complementally shaped engageable parts of said liner and resistance element assembly comprise respectively, a liner wedge portion having side walls extending divergently radially inward from the liner side wall toward the rotor, said wedge portion side walls also extending in diverging fashion from the housing open end to the liner base wall lining the housing closed end, the resistance element assembly including an annular former longitudinally split to provide a pair of ends having divergently tapered facing edges, the tapered edges of the annular former being engageable with the tapered side walls of the liner wedge and being cammed apart to radially expand the annular former as the latter is moved into the housing from the open end toward the closed end thereof.

3. The variable resistance unit according to claim 1 wherein the rotor mounted contact assembly further includes a contact cup electrically coupled to the said contact finger through a pair of resilient arcuate arms, said contact cup having a curved bottom surface oriented substantially symmetrically to the axis of rotor rotation and rotatable with the rotor about that axis, and said contact cup resiliently engages the said contact means for electrically connecting the contact assembly to terminal projecting externally of the housing.

4. The variable resistance unit according to claim 1 wherein the rotor mounted contact assembly further includes a contact cup electrically coupled to the said contact finger through a pair of resilient arcuate arms, said contact cup having a curved bottom surface oriented substantially symmetrically to the axis of rotor rotation and rotatable with the rotor about that axis, and said contact cup resiliently engages the said contact means for electrically connecting the contact assembly to a terminal projecting externally of the housing, said contact means

6

comprising a socketed contact plate mounted upon the inside surface of a backplate secured to and closing the open end of the said housing, said contact cup being seated in the contact plate socket and the said terminal being an extension of the said contact plate.

5. The variable resistance unit according to claim 1 wherein the complementally shaped engageable parts of said liner and resistance element assembly comprise respectively, a liner wedge portion having side walls extending divergently radially inward from the liner side wall toward the rotor, said wedge portion side walls also extending in diverging fashion from the housing open end to the liner base wall lining the housing closed end, the resistance element assembly including an annular former longitudinally split to provide a pair of ends having diverging tapered facing edges, the tapered edges of the annular former being engageable with the tapered side walls of the liner wedge and being cammed apart to radially expand the annular former as the latter is moved into the housing from the open end toward the closed end thereof, and wherein the rotor upon which the said contact assembly is mounted includes a rotor stop projection effective to prevent more than a predetermined range of rotor rotation by abutment with the liner wedge portion side walls.

6. A rotary variable resistance unit comprising in combination, a hollow cylindrical metal housing open at one end and having a centrally apertured closure wall at the other end, a molded insulation liner disposed close fittingly within the housing for completely lining the inside surface thereof and being conformingly apertured to the central aperture of the housing closure wall and in alignment therewith, a shouldered bushing projected through the aligned apertures of the liner and housing so that the bushing shoulder presses the liner against the housing closure wall, and means securing the bushing in position to thereby fixedly clamp together the housing and liner and bushing, said bushing being centrally bored to provide therethrough a cylindrical passage coaxial with the cylindrical axis of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, a rotatable shaft close fittingly disposed within the bushing passage and extending therebeyond into the housing interior, a rotor secured to the shaft for rotation therewith within the housing interior and carrying a contact assembly for making wiping contact with the resistance element, external terminal means electrically connected to the said contact assembly and to at least one fixed point of the resistance element, and cover means for closing the open end of the said housing.

7. A rotary variable resistance unit comprising in combination, a hollow cylindrical metal housing open at one end and having a centrally apertured closure wall at the other end, a molded insulation liner disposed close fittingly within the housing for completely lining the inside surface thereof and being conformingly apertured to the central aperture of the housing closure wall and in alignment therewith, a shouldered bushing projected through the aligned apertures of the liner and housing so that the bushing shoulder presses the liner against the housing closure wall, and means securing the bushing in position to thereby fixedly clamp together the housing and liner and bushing, said bushing being centrally bored to provide there through a cylindrical passage coaxial with the cylindrical axis of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, said liner and resistance element assembly having complementally shaped engageable parts effective when engaged to radially expand the resistance element assembly into engagement with the liner substantially completely about the outer periphery of the annular resistance element assembly and retain the latter in such radially expanded condition, a rotatable

shaft close fittingly disposed within the bushing passage and extending therebeyond into the housing interior, a rotor secured to the shaft for rotation therewith within the housing interior and carrying a contact assembly for making wiping contact with the resistance element, external terminal means electrically connected to the said contact assembly and to at least one fixed point of the resistance element, and cover means for closing the open end of the said housing.

8. The variable resistance unit accordance to claim 7 wherein the complementally shaped engageable parts of said liner and resistance element assembly comprise respectively, a liner wedge portion having side walls extending divergently radially inward from the liner side wall toward the rotor, said wedge portion side walls also extending in diverging fashion from the housing open end to the liner base wall lining the housing closed end, the resistance element assembly including an annular former longitudinally split to provide a pair of ends having divergently tapered facing edges, the tapered edges of the annular former being engageable with the tapered side walls of the liner wedge and being cammed apart to radially expand the annular former as the latter is moved into the housing from the open end toward the closed end thereof.

9. The variable resistance unit according to claim 7 wherein the complementally shaped engageable parts of said liner and resistance element assembly comprise respectively, a liner wedge portion having side walls extending divergently radially inward from the liner side wall toward the rotor, said wedge portion side walls also extending in diverging fashion from the housing open end to the liner base wall lining the housing closed end, the resistance element assembly including an annular former longitudinally split to provide a pair of ends having divergently tapered facing edges, the tapered edges of the annular former being engageable with the tapered side walls of the liner wedge and being cammed apart to radially expand the annular former as the latter is moved into the housing from the open end toward the closed end thereof, and wherein the rotor upon which the said contact assembly is mounted includes a rotor stop projection effective to prevent more than a predetermined range of rotor rotation by abutment with the liner wedge portion side walls.

10. A rotary variable resistance unit comprising in combination, a hollow cylindrical housing closed at one end and open at the other end, a molded insulation liner completely lining the inside surface of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, said liner and resistance element assembly having complementally shaped engageable parts effective when engaged to radially expand the resistance element assembly into engagement with the liner substantially completely about the outer periphery of the annular resistance element assembly and retain the latter in such radially expanded condition, a rotor mounted contact assembly including a movable contact finger adapted for wiping contact with the resistance element at any desired point between the ends thereof, contact means for electrically connecting the contact assembly to a terminal projecting externally of the housing, terminal means electrically connected to the resistance element and projecting externally of the housing, and a housing backplate secured to and covering the open end of the said housing, said resistance element assembly also including means projecting therefrom toward and proximate to the inside surface of said backplate whereby said resistance element assembly is prevented from shifting axially within the cylindrical housing when said backplate is secured in position.

11. A rotary variable resistance unit comprising in

combination, a hollow cylindrical housing closed at one end and open at the other end, the exterior surface of the housing cylindrical side walls being scored with a plurality of grooves to effectively increase the heat radiating surface of the housing, a molded insulation liner completely lining the inside surface of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, said liner and resistance element assembly having complementally shaped engageable parts effective when engaged to radially expand the resistance element assembly into engagement with the liner substantially completely about the outer periphery of the annular resistance element assembly and retain the latter in such radially expanded condition, a rotor mounted contact assembly including a movable contact finger adapted for wiping contact with the resistance element at any desired point between the ends thereof, contact means for electrically connecting the contact assembly to a terminal projecting externally of the housing, and terminal means electrically connected to the resistance element and projecting externally of the housing.

12. A rotary variable resistance unit comprising in combination, a hollow cylindrical housing closed at one end and open at the other end, a molded insulation liner completely lining the inside surface of the housing, an annular resistance element assembly disposed within the housing and separated at all points therefrom by the intervening liner, said liner and resistance element assembly having complementally shaped engageable parts effective when engaged to radially expand the resistance element assembly into engagement with the liner substantially completely about the outer periphery of the annular resistance element assembly and retain the latter in such radially expanded condition, a rotor mounted contact assembly including a movable contact finger adapted for wiping contact with the resistance element at any desired point between the ends thereof, contact means for electrically connecting the contact assembly to a terminal projecting externally of the housing, terminal means electrically connected to the resistance element and projecting externally of the housing, the complementally shaped engageable part of said liner engageable with said resistance element assembly comprising a liner wedge portion having side walls extending divergently radially inward from the liner side wall toward the rotor, said wedge portion side walls also extending in diverging fashion from the housing open end to the liner base wall lining the housing closed end, the complementally shaped part of said resistance element assembly engageable with said liner including an annular former longitudinally split to provide a pair of ends having divergently tapered facing edges, the tapered edges of the annular former being engageable with the tapered side walls of the liner wedge and being cammed apart to radially expand the annular former as the latter is moved into the housing from the open end toward the closed end thereof, and a housing backplate secured to and covering the open end of the said housing, said resistance element assembly also including means projecting therefrom toward and proximate to the inside surface of said backplate whereby said resistance element assembly is prevented from shifting outward toward the housing open end when said backplate is secured in position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,751,231	Davis	Mar. 18, 1930
1,876,921	Hall	Sept. 13, 1932
2,177,290	Schellenger	Oct. 24, 1939
2,266,188	Foley et al.	Dec. 16, 1941