May 6, 1941. J. MARSTEN 2,240,565

VOLUME CONTROL

Filed Jan. 7, 1937 2 Sheets-Sheet 1

Fig. 1.

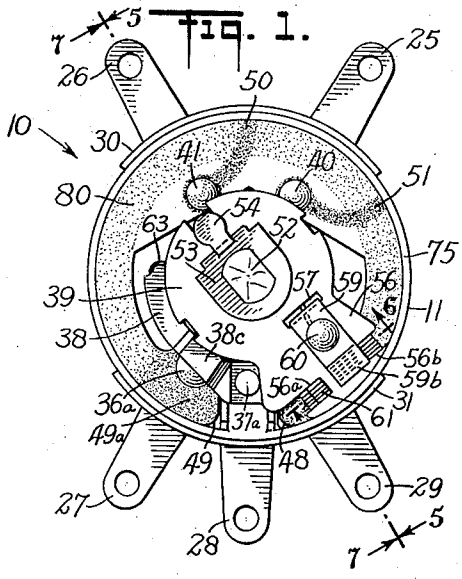


Fig. 2.

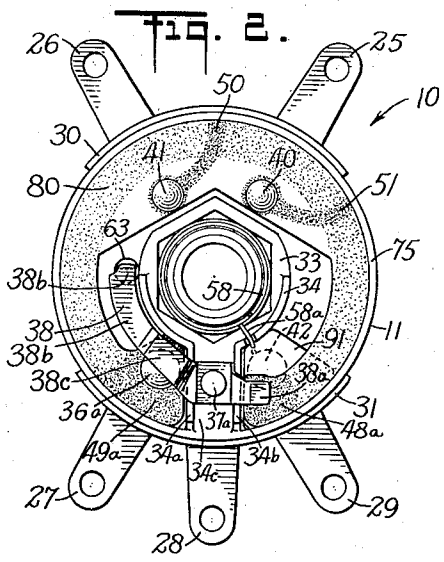


Fig. 3.

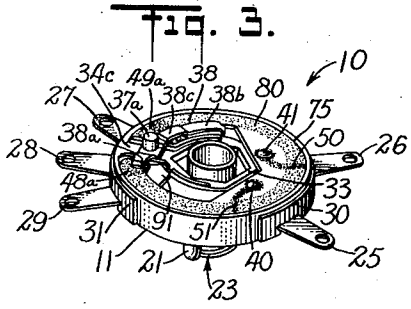


Fig. 4.

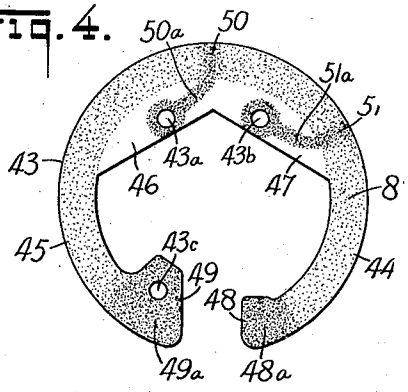


Fig. 5.

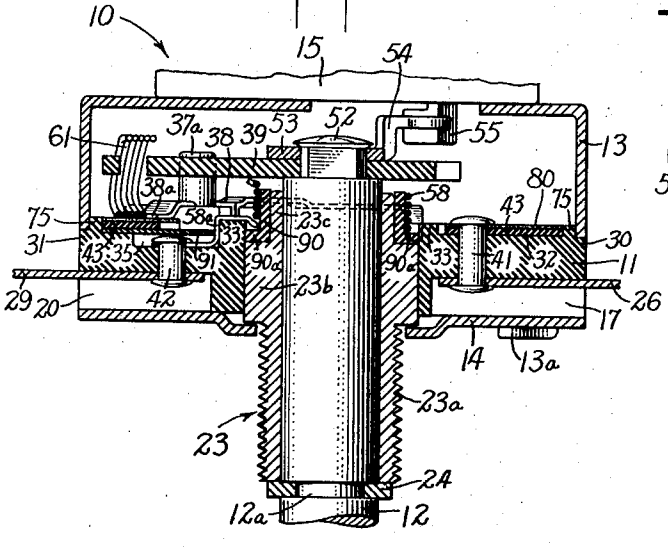
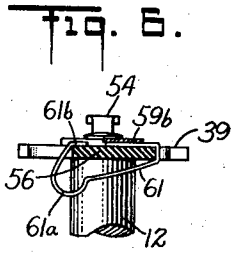


Fig. 6.



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Fig. 7.

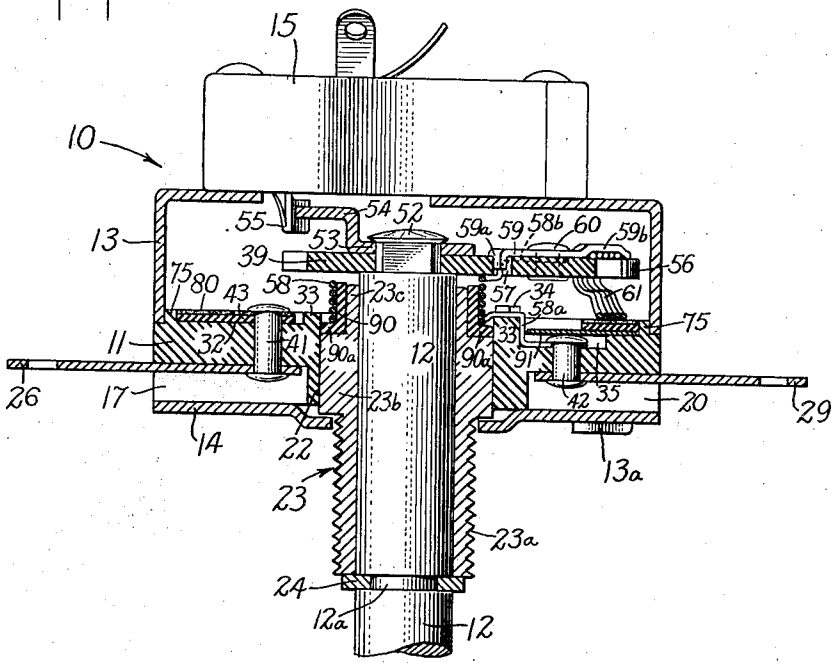


Fig. 8.

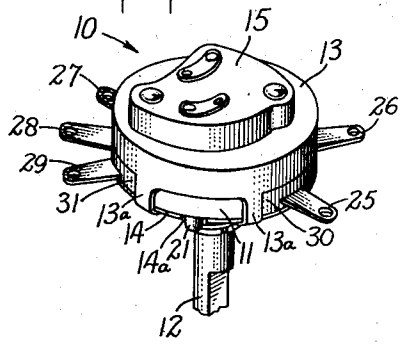
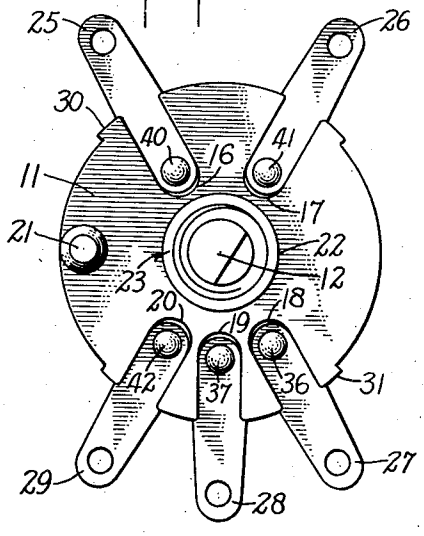


Fig. 9.



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UNITED STATES PATENT OFFICE

2,240,565

VOLUME CONTROL

Jesse Marsten, Philadelphia, Pa., assignor to International Resistance Company, Philadelphia, Pa., a corporation of Delaware

Application January 7, 1937, Serial No. 119,469

6 Claims. (Cl. 201—55)

This invention relates to rheostats or potentiometers, and more particularly to rheostats or potentiometers for volume control in connection with radios.

One of the objects of this invention is to provide a rheostat or potentiometer which is simple in construction, inexpensive in manufacture and thoroughly reliable and efficient in operation. Another object is to provide a device of the above nature which is sturdy and well able to withstand continued, rigorous use. Another object is to provide a device of the above nature by which the sound volume in a radio or the like may be effectively controlled without the production of static. Another object is to provide a device of the above nature, the several parts of which are standardized and which, accordingly, permits high production requirements to be met readily. Another object is to provide a device of the above nature readily adaptable for installation in commercial radio sets and easily connectable in circuit therein as desired. Other objects will be in part apparent and in part pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which is shown one of the various possible embodiments of this invention,

Figure 1 is a rear elevation of the rheostat;

Figure 2 is a rear elevation of the rheostat with certain parts thereof removed;

Figure 3 is a perspective of the rheostat, certain parts thereof being removed;

Figure 4 is an elevation of the resistance strip of the rheostat;

Figure 5 is a sectional elevation taken on the line 5—5 of Figure 1;

Figure 6 is a sectional elevation of the contactor of the rheostat taken on the line 6—6 of Figure 1;

Figure 7 is a sectional elevation taken on the line 7—7 of Figure 1;

Figure 8 is a perspective view of the rheostat with a snap switch mounted thereon; and,

Figure 9 is a front elevation of the rheostat.

Similar reference characters refer to similar parts throughout the several views of the drawings.

In order that certain features of this invention may be more clearly understood, it might be well to point out first that many variable resistance devices of this character are productive of undesirable noises or static during operation. Much of this noise can be ascribed to the imperfect engagement between the sliding contact and the resistance strip. Still another source of static noise results where resistance strips of substantial width are employed. Other rheostats are unduly complicated and accordingly expensive due to the manner in which taps are brought out in them. Such taps must be located with respect to the resistance strip in accordance with the requirements of purchasers of the rheostat. In many instances it becomes necessary to make special dies for stamping out various parts of the rheostat, thus precluding standardization of parts. In still other rheostats, particularly in high range volume controls, it is difficult to attain good tone quality, due to leakage current between the parts connected to the sliding contact and the high potential end of the control. It is accordingly another object of this invention to rectify the above conditions in a thoroughly efficient and practical manner.

Referring first to Figure 8, my rheostat, generally indicated at 10, comprises a base portion 11 rotatably journaling a shaft 12, and covered by a housing or cover 13. The front surface of base 11 is covered by a plate 14 (see also Figure 7), this plate being held in place by ears or lugs 13a extending from cover 13. As is best shown in Figure 7, lugs 13a are clamped over the edge of plate 14, thus holding both the plate and cover in position on base 11. Mounted on the top of cover 13 is a snap switch 15 of conventional form. Thus switch 15 may be substantially similar to that described in my copending application, Serial No. 706,343, filed January 12, 1934.

Base 11 is preferably molded from a suitable dielectric such as phenolic condensation product, and has formed in the front surface thereof (see Figures 5, 7 and 9) radially extending recesses 16, 17, 18, 19 and 20 (Figure 9) which will be more fully described below. Extending from the front surface of base 11, I also provide a locating lug or projection 21, which extends through a slot 14a (Figure 8) in cover plate 14 to properly locate the cover. A central hole 22 (Figure 9) is formed in base 11, which, as shown in Figure 7, receives a fitting or bearing generally indicated at 23. The forward end 23a of bearing 23 is preferably threaded to provide a suitable mounting for the rheostat in the panel of a radio set or the like. A collar portion 23b is provided on bearing 23, this collar portion being

forced into central hole 22 of base 11. The upper portion 23c of bearing 23 is preferably reduced in diameter for a purpose described hereinafter. Thus, bearing 23 provides a suitable journal for shaft 12, shaft 12 being provided with an annular slot 12a (Figure 7) which receives a spring washer 24 to prevent axial movement of shaft 12 in bearing 23.

Referring to Figures 2 and 3, it may be seen that the inner surface of base 11 is provided with an annular ridge 75 (see also Figures 5 and 7), base 11 also being provided with shoulder portions 30 and 31 (Figures 2 and 3), respectively adjacent leads 25, 26 and leads 27, 28, 29. As is more clearly shown in Figure 5, shoulders 30 and 31 provide a suitable support on base 11 for cover 13, whose lugs 13a extend downwardly along the sides of base 11 between shoulders 30 and 31.

The portion of base 11 immediately surrounded by ridge 75 (Figure 5) is preferably recessed as at 32, this recess being provided with an inside border or ridge 33 extending inwardly from base 11. As is more clearly shown in Figure 7, a wall 34 projects inwardly from a portion of ridge 33, this wall including straight portions 34a and 34b (Figure 2), forming a channel 34c therebetween on the inside surface of base 11, this channel being for a purpose disclosed hereinafter. A hole in base 11 and channel 34c between walls 34a and 34b receives a rivet 37 (Figure 9) whose outer head retains lead 28 in recess 19. The inner end 37a (Figure 2) of rivet 37 forms an elongated lug or projection (Figure 3) which acts both to retain one end of a shielding strip 38 in operative position in channel 34c and to provide a stop for a rotatable contact arm 39 (Figure 1), all as will be described in greater detail hereinafter. Formed adjacent straight portion 34b of wall 34 and depressed from the level of base recess 32, I provide a depression 35 (Figure 5) this depression preferably being substantially circular in form and sufficiently deep to receive the head of a rivet 36, the other head of which fastens lead 27 in recess 18.

Base 11 is also provided with additional holes opening into recesses 16, 17, and 20 (Figure 9) which respectively receive rivets 40, 41 and 42, the outer ends of which retain respectively leads 25, 26 and 29 in their respective recesses. The inner heads of rivets 40, 41 and 42 (Figure 2) retain, within body recess 32, a resistance strip 43 (Figure 5), this strip being accordingly provided with holes 43a, 43b and 43c (see Figure 4).

Resistance strip 43 (Figure 4) is preferably formed in the general shape of a horseshoe or annular strip having narrow annular portions 44 and 45 and secant portions 46 and 47. Annular portions 44 and 45 are respectively provided with enlarged portions 48 and 49, these portions having highly conductive coatings 48a and 49a forming a part of the terminal structure, as will be pointed out later. Accordingly, holes 43a, 43b and 43c extend through secant portions 46 and 47 and terminal portions 49 respectively. Preferably strip 43 is stamped out of any suitable fibrous dielectric material such as canvas impregnated with phenolic condensation product, which has previously been coated with a resistance ink of suitable conductivity. The resistance ink is then removed from secant portions 46 and 47 to leave a continuous circular path 80 of resistance coating of equal width throughout the circumferential length of the strip. Resistance path 80 is bordered by the non-conductive surface of the secant portions 46 and 47. Furthermore, no additional material is wasted in providing secant portions 46 and 47 for in stamping out the usual circular strip the central portion is pure waste.

Preferably the width of resistance path 80 does not exceed one-eighth of an inch. The advantage in using such a narrow resistance strip resides in the reduction of the noise level of the volume control during its operation because it is possible to use higher conductivity inks on the narrow strip. Resistance value depends upon the width of the conducting path as well as the length thereof. The narrower the width of the path, the less conductivity and the greater the resistance for a given length. Thus the narrow path allows the use of a coating of greater conductivity for a given resistance value. As noise due to contact of slider on the resistance element varies inversely with the conductivity of the resistance ink, a quieter operation is assured by providing the narrow resistance path and high conductivity resistance ink.

It should be pointed out at this time that by forming base 11 (Figure 3), cover plate 14, housing 13 and resistance strip 43, as described hereinabove, all of these parts may be standardized and subsequently adapted to the requirements of different purchasers. In this connection it should first be pointed out that various purchasers of volume controls require taps to be brought out at various positions about resistance strip 43, these taps being connected to leads 25 and 26. It is obvious that the requirements of different purchasers will vary, that is, one set of requirements may require taps to be brought out in the 12 o'clock and 2 o'clock positions on strip 43 as indicated by taps 50 and 51 (Figure 4). Other requirements may necessitate bringing the taps out at 11 o'clock and 1 o'clock positions. To meet such varying requirements, many manufacturers of volume controls resort to resistance strips stamped with projecting lugs for example, at exactly the positions at which taps are required to be taken off. To accommodate such lugs it is necessary for such manufacturers to form registering recesses or the like in the support and in the casing or housing. Thus a number of the parts of the control must be varied to suit the individual requirements of each purchaser, necessitating changes in tools and considerable additional expense.

These difficulties and their attendant waste are overcome in the present construction by standardization of all of the parts of my control. Thus, as pointed out above, tap leads 25 and 26 are always in a predetermined location registering with holes 43a and 43b (Figure 4) of the standardized resistance strip 43. Nevertheless, I may tap resistance path 80 at any point throughout a large portion of its length. For example, highly conductive coatings or taps 50 and 51 are painted on path 80 at the required points, portions 50a and 51a thereof extending over the insulated surfaces of secants 46 and 47 to points adjacent holes 43a and 43b. Taps 50 and 51 extend radially across resistance path 80 and terminate beneath the heads of rivets 40 and 41 (Figures 2, 5 and 7). Rivets 40 and 41 extend through base 11 to hold tap leads 25 and 26 in position. Accordingly, tap leads 25 and 26 may be connected to different points along resistance path 80 without changes in tools and with no waste of materials. For a better understanding of the difficulties overcome by the

above-noted standardization, reference is made to my copending application Serial No. 706,343, filed January 12, 1934.

Contact arm 39 (Figure 1) is preferably stamped from suitable dielectric fibrous material, and is secured to the top of shaft 12 (Figure 5) by a rivet 52, thus coacting with spring washer 24 to hold shaft 12 in place. The headed portion of rivet 52 rests on the top of a clip 53 provided with an upstanding arm 54 suitably positioned to engage an actuating arm 55 of snap switch 15. Thus, upon rotation of contact arm 39, clip 53 and its arm 54 operate snap switch 15.

Referring to Figure 1, contact arm 39 has a radially projecting portion 56 provided with a hole or slot 57, through which extends one end 59a (Figure 7) of a retaining strap 59. The other end 59b of strap 59 is preferably bowed to receive thereunder a suitable number of contact wires 61 (preferably 5); wires 61 are preferably phosphor bronze and round in cross section. As best shown in Figure 1, portion 56 of arm 39 is provided with a pair of slots 56a and 56b, and wires 61 which are held under end portion 59b by solder or the like, extend down through slot 56b, thence substantially horizontally to form arcuate portions 61a (Figure 6) and thence upwardly through slot 56a to terminate in hook portions 61b. The arcuate portions 61a of wires 61 comprise the contacting portions thereof, and I have found it highly desirable to use wire for this purpose because of its smooth surface. I thus provide an unusually smooth surface to contact resistance path 80; these portions 61a are free from burrs or sharp projections which might dig into the resistance strip 43 during the travel of the contact thereover. Furthermore, by providing a number of independent wires, each of which is free to move independently of the others, any particular wire which encounters any obstruction on resistance path 80 is free to ride over such obstruction while the other wires continue along their normal path of travel on the strip. Furthermore, by using wires of the nature described, it is possible to provide a contact of adequate contacting area, but of relatively narrow overall width, well adapted to cooperate with the narrow resistance path described hereinabove.

To connect contact wires 61 (Figure 7) to terminal 27, I provide a coil spring wire 58 wound about an insulating bushing 90 mounted on base 11. The lower coil of spring 58 rests on shoulder 90a of bushing 90 while the upper coil of the spring bears against contact arm 39. One end 58a of the spring is bent into depression 35 and is fastened therein under the head of rivet 36, spring end 58a thus being electrically connected to terminal 27. Preferably I interpose a piece 91 of insulating material between resistance strip 43 and the head of rivet 36 to insulate the strip from spring end 58a. The other end 58b of the spring is trained upwardly through contact arm slot 57 and thence along the surface of contact arm 39 under strap 59 to which the spring end is electrically connected, preferably by encircling rivet 60. In this manner spring end 58b is electrically connected to contact wires 61. Preferably spring 58 has a substantial number of coils to distribute movement thereof over a considerable length of wire; thus breakage of the wire is avoided even after extended use of the control and consequent rotation of arm 39.

Rheostat 10 can be connected in an electrical circuit having portions at higher potentials than the ground potential thereof. Thus end 49 of resistance strip 43, hereinafter referred to as the high potential end, can be connected to the high potential side of the circuit and end 48 thereof, hereinabove referred to as the low potential end can be connected to the low potential side of the circuit. Accordingly, resistance strip end 49 is hereinafter called the high potential end, and end 48 thereof is called the low potential end.

The high potential end 49 of resistance strip 43 (Figure 2) is secured on base 11 by rivet 36 which connects this end of the strip to lead 27. Thus the head 36a of rivet 36 contacts highly conductive coating 49a to make a good electrical connection therewith. Thus the total resistance to a current flowing from high potential lead 27 to the slider lead 29 is determined according to the position of contact wires 61 along their annular path of travel on resistance path 80; current flows by way of lead 27, resistance strip 43, contact wires 61, contact strip projection 59 and coil spring 58 to lead 29. It will now be clear that tap 28, the ground or low potential tap, is located between high potential tap 27 and slider tap 29. Thus taps 27 and 29 are not only spaced a substantial distance from each other but are effectively shielded from each other.

Low potential or ground lead 28 is preferably positioned between high potential lead 27 and slider lead 29, as best shown in Figure 9. As described above, ground lead 28 is held in its recess 19 by rivet 37, which secures shield 38 in its position. Shield 38 also includes a portion 38a which depends downwardly (Figures 2 and 5) and contacts highly conductive end portion 48a, the low potential end of resistance strip 43, thus effecting the ground circuit. The other end 38d of shield 38 extends into a depression 63 in base 11 where it is suitably anchored. Intermediate ends 38a and 38d of shield 38 are arcuate shaped portion 38b and raised portion 38c extending over head 36a of rivet 36. As is more clearly shown in Figure 1, shield 38 is positioned to overlie the high potential end 49 of resistance strip 43 to shield it from rivet 60 (Figures 1 and 7) as well as the other parts connected thereto. Thus the armature of the control is electrostatically shielded from the high potential end of the volume control, and I have found that this results in better tone quality especially in a high range volume control of, for example, controls of two megohms capacity or more.

In operation, the contact arm 39, when in the position shown in Figure 1, provides maximum resistance, being at this point at its greatest distance from the high potential end 49 of resistance strip 43. Consequently, as the slider contact 39 is rotated in a counterclockwise direction, as viewed in Figure 1, the resistance decreases until the slider has reached its maximum volume position, i. e., when the edge of arm 39 abuts against stop 37a. It should also be noted that when in this position shield 38 effectively shields the high potential terminal from the slider contact.

Accordingly, I have provided a rheostat or volume control which effectively accomplishes the several objects noted hereinabove in a thoroughly efficient and practical manner.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter here-

inbefore set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the class described, in combination, a dielectric base, a shaft, a contactor secured to said shaft, said base having a flat surface the plane of which is substantially at right angles to the axis of said shaft, a resistance path comprising an annular carbonaceous coating of even width on said flat surface of said base in position for engagement by said contactor and spaced outwardly from said shaft, terminal connections at the opposite end portions of said path, a tap on said base located between said path and said shaft, and a strip of highly conductive material applied to said base and running from said tap across a predetermined point on said path intermediate said terminal connections to form a good electrical connection between said point and said tap, said tap being insulated from said path except at said point by way of said last-mentioned connection.

2. In apparatus of the class described, in combination, a base, a shaft, a contactor secured to said shaft, said base having a flat dielectric surface the plane of which is substantially at right angles to the axis of said shaft, a resistance path in the form of an annular coating of even width on said flat surface of said base in position for engagement by said contactor and spaced outwardly from said shaft, terminal connections at the opposite end portions of said path, a tap on said base located between said path and said shaft, and an electrical connection comprising a strip-like coating of highly conductive material on said flat surface of said base and running from said tap across a predetermined point on said resistance path intermediate said terminal connections to form a good electrical connection between said point and said tap, said tap being insulated from said path except at said point by way of said last-mentioned connection.

3 In apparatus of the class described, in combination, a flat piece of insulating material substantially horse-shoe shaped and having a secant portion, an annular coating of resistance material on one surface of said piece having a substantially even width bordered on its inner edge throughout a portion of its length by said secant portion, an electrical connector mounted on said secant portion, and a ribbon-like highly conductive coating extending radially from said resistance coating and across said secant portion to said connector.

4. In apparatus of the class described, in combination, a base, a resistance strip mounted on said base, a contact slider mounted for sliding contact with said resistance strip, a high potential terminal, a low potential terminal and a slider terminal, all of said terminals being mounted on said base, said high potential and slider terminals being respectively connected to the high potential end of said strip and said slider contact and said low potential terminal being connected with the low potential end of said strip and disposed between said high potential terminal and said slider contact, said base being substantially annular in shape and having one portion wider than the remaining portion, and extending inwardly therefrom, said resistance strip comprising a substantially annular coating of resistance material of substantially even width and following the outer edge of said base, the enlarged portion of said base adjacent said coating having a dielectric surface, a tap mounted on said enlarged portion, and a ribbon-like coating of highly conductive material extending across said resistance coating and across said dielectric surface and engaging said tap.

5. In apparatus of the class described, in combination, a base, a substantially circular resistance strip comprising a coating of carbonaceous material on said base, a rotatable shaft mounted in said base, a contact support mounted on said shaft and extending radially therefrom over said strip, said support having a slot formed therein above said strip, and a contactor for slidably contacting said strip comprising a plurality of spring wires round in cross-section, each having an end anchored to said support and thence extending downwardly and outwardly from said support in a direction substantially at right angles to the radial center line of said support to engage the flat surface of said resistance strip, the free ends of each of said wires then turning upwardly away from said resistance strip through said slot in said support to form a smooth rounded portion thereof in engagement with the carbonaceous surface of said strip.

6. In apparatus of the class described, in combination, a flat piece of insulating material having the general shape of a horseshoe and having a flat surface, an annular strip of resistance material on said surface, said piece having a secant portion adjacent the inner edge of said strip and extending throughout a portion of the length of said strip, the surface of said secant portion being dielectric, an electrical connector mounted on said secant portion, and a highly conductive coating connected to a point on said resistance strip adjacent said secant portion and extending therefrom across said secant portion, said coating being connected to said connector.

JESSE MARSTEN.