Aug. 11, 1959 W. A. BARDEN ET AL 2,899,662

HIGH VOLTAGE VARIABLE RESISTOR

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Fig. 1.

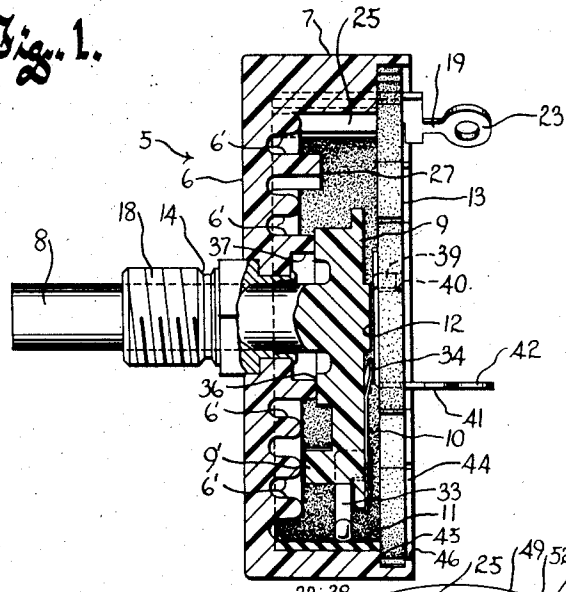

Fig. 2.

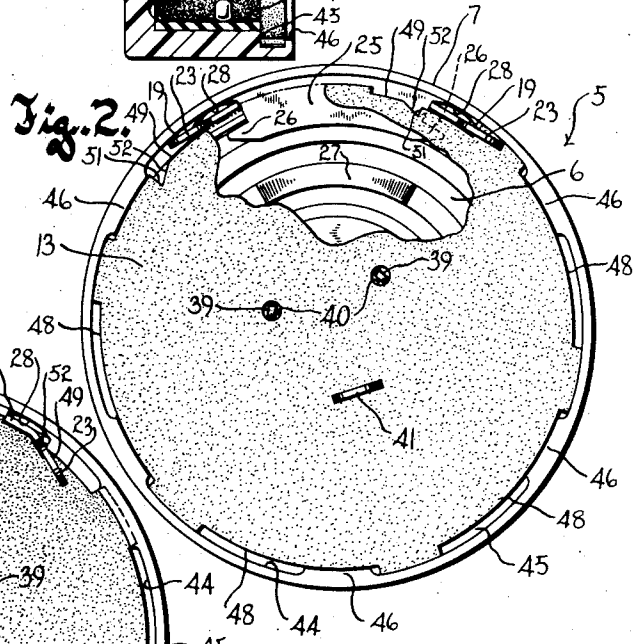

Fig. 3.

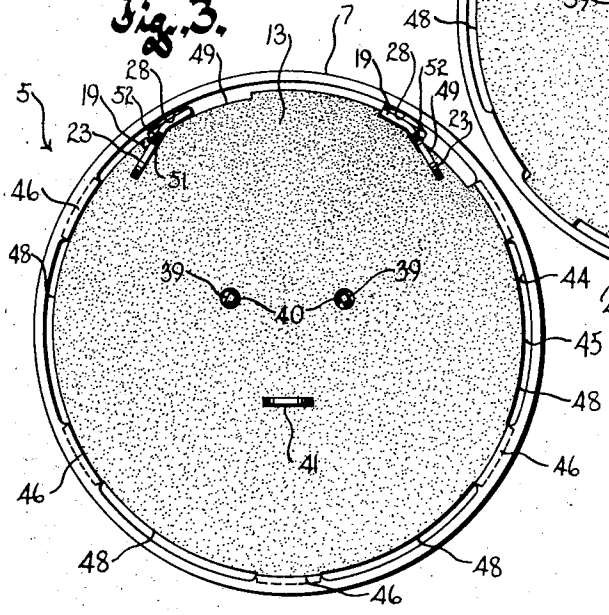

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Fig. 5.

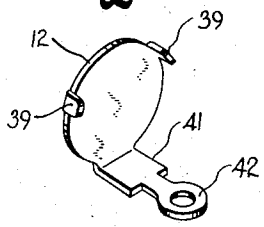

Fig. 4.

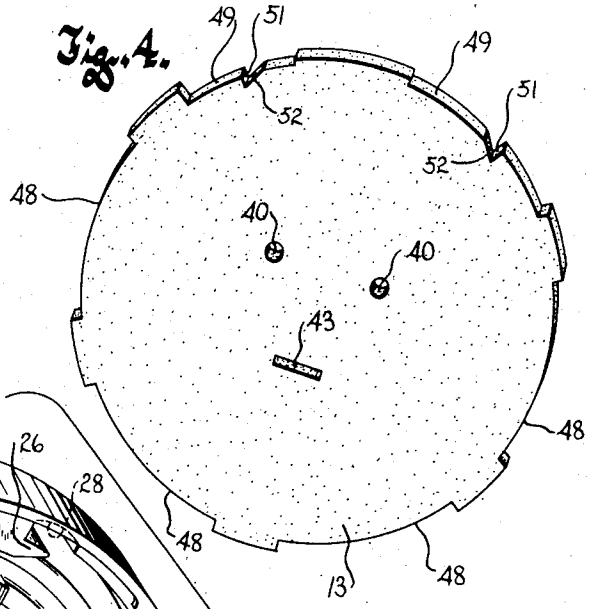

Fig. 6.

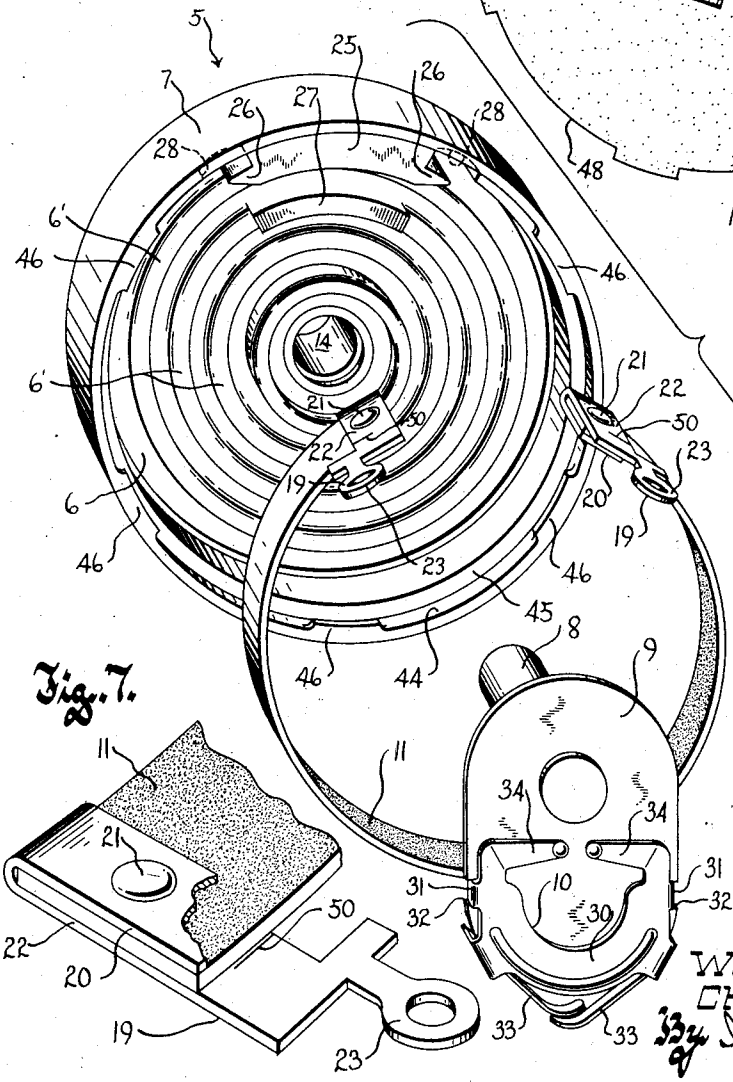

Fig. 7.

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HIGH VOLTAGE VARIABLE RESISTOR

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5 Claims. (Cl. 338—174)

This invention relates to variable resistors of the type employed in radio and television receivers and has as its principal purpose to provide a control of this character especially adapted for use with high voltages.

The advent of color television has created a demand for low cost variable resistors capable of handling voltages on the order of 15,000 volts above ground potential and 5,000 volts across the end terminals of the resistor. These voltages are much greater than those safely handled by variable resistors now commonly employed in radio and black-and-white television receivers.

Those skilled in this art will readily appreciate that voltages of this magnitude create a difficult problem of insulation, and this problem is greatly aggravated if the size of the control is limited, as it should be to attain the desired compactness of the receiving set in which it is installed. There must be adequate spacing between the terminals of the resistor, as well as between the resistance element and the collector ring, in order to prevent short circuiting within the control unit; and at the same time exposed current carrying parts of the resistor must be kept to a minimum (being preferably limited to the terminals alone) and must be so disposed as to assure adequate spacing from metal parts of the chassis upon which the unit is mounted, to insure against short circuits between such exposed parts of the unit and the grounded chassis.

It has long been recognized that maximum spacing can be obtained between the resistance element and the collector ring if the resistance element is formed as a curled strip overlying the inside surface of the cylindrical side wall of a cup-shaped housing. However, the securement of end terminals to the ends of the resistance strip, and of the resistance strip is the housing, has heretofore presented problems. One conventional expedient for effecting such securement was by means of rivets extending through the housing side wall and through the resistance element and terminals, but this entailed complications in production and therefore increased costs, and the rivet heads at the exterior of the housing offered exposed current carrying surfaces from which an arcing short circuit might occur to nearby portions of the grounded chassis.

By contrast, it is an object of this invention to provide a variable resistor which is capable of handling high voltages, both across its terminals and between its terminals and ground, by reason of the fact that the unit comprises a cup-shaped housing of insulating material with a cylindrical side wall, a resistance element overlying the inner surface of the housing side wall, and strip-like terminals secured to opposite ends of the resistance element and projecting rearwardly out of the housing, wherein the resistance element is confined against displacement relative to the housing by very simple securement means which facilitates manufacture of the unit and which exposes no current carrying surface at the exterior of the housing.

Another object of this invention resides in the provision of a variable resistor of the character described, having a cup-shaped housing, wherein a curled resistance element is held in the housing overlying the inner surface of the cylindrical side wall of the housing, and is secured against radial and circumferential displacement by simple means formed integrally with the housing, and is secured against axial displacement by means of a cover fastened across the open end of the housing, and wherein end terminals are secured only to the resistance element and extend axially out of the housing.

A further object of this invention resides in the provision of a variable resistor which is especially well adapted for handling high voltages, which resistor has a cup-shaped housing molded of insulating material, the open end of which is closed by a disc-like cover having a bayonet connection with the housing, wherein terminals connected to the ends of the resistance element hold the cover against rotation to a position in which the bayonet connection is disabled, and wherein said terminals are so disposed that when conductors are soldered to them, molten solder cannot run down along them into the interior of the housing.

It is also an object of this invention to provide a high voltage variable resistor having the features described in the preceding statement of object, and wherein the terminals comprise simple metal stampings secured only to the ends of the resistance element, wherein the resistance element and its terminals are confined against displacement by engagement of the ends of the resistance element under overhanging arms formed integrally with the housing side wall and by confinement between the front wall of the housing and said cover, and wherein the cover may be secured to the housing by simply twistingly bending the projecting outer portions of the terminals at the conclusion of the assembly operation.

Consistently with the major objective of providing a variable resistor which is capable of handling high voltages but which is nevertheless compact and inexpensive, it is also an object of this invention to provide such an instrumentality wherein the resistance element is curled around the inner surface of the cylindrical side wall of a cup-shaped housing molded of insulating material and has terminals connected to its ends and projecting straight rearwardly out of the housing, and wherein the collector ring is coaxially mounted on the inner face of a disc-like cover of insulating material which closes the open rear of the housing and has a terminal projecting rearwardly therefrom, through the cover, so that all points of high potential difference in the unit are spaced substantial distances from one another to prevent internal short circuiting, and so that the projecting portions of the terminals will be so disposed that they will normally be spaced substantial distances from any portion of a metal chassis on which the unit may be mounted.

Still another object of this invention resides in the provision of a variable resistor of the character described wherein the collector ring is mounted on a disc-like cover closing the open end of a cup-shaped housing, and is held against lateral displacement relative to the cover by a plurality of integral tangs on the collector ring engaging in holes in the cover, one of said tangs projecting through and beyond the cover to provide a terminal, and wherein the collector ring is confined against axial displacement off of the cover by a spring finger on the rotatable contactor of the unit.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being

understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a longitudinal sectional view of a variable resistor embodying the principles of this invention;

Figure 2 is a rear elevational view of the variable resistor with the cover in place across the rear of the housing but not yet secured thereto, and with part of the cover broken away to illustrate the manner in which the resistance element is held against circumferential and radial displacement;

Figure 3 is a view similar to Figure 2 but showing the cover secured in place;

Figure 4 is a rear perspective view of the cover per se;

Figure 5 is a perspective view of the collector ring of the variable resistor of this invention;

Figure 6 is a disassembled perspective view of the resistor components excluding the cover and collector ring; and

Figure 7 is a fragmentary perspective view of one end portion of the resistance element of the variable resistor of this invention, particularly illustrating the construction of the terminal and the manner of its securement to the resistance element.

Referring now to the accompanying drawings, in which like numerals designate like parts throughout the several views, the variable resistor of this invention comprises, in general, a cup shaped housing **5** of molded insulating material with a front wall **6** and an integral substantially cylindrical side wall **7**, an actuating shaft **8** rotatably journaled in the front wall of the housing, a drive arm **9** carried by the shaft inside of the housing, a contactor **10** mounted on the arm and slidingly engaging a resistance element **11** and a collector ring **12**, and a cover disc **13** which closes the rear of the housing and supports the collector ring.

Preferably the actuating shaft **8** and the arm **9** are formed as one integral molding of insulating material. The shaft is journaled in a metal bushing **14** which is secured in the front housing wall in a conventional manner. The front end portion of the bushing is threaded, as at **18**, to provide for securement of the variable resistor to a panel or other portion of a chassis on which the control is to be mounted, and the shaft **8** projects forwardly of the bushing to have a suitable actuating knob (not shown) mounted thereon.

It is a feature of the variable resistor of this invention that the resistance element **11** and collector ring **12** are separated from one another by a substantial distance to prevent any possibility of corona leakage between them when the control is used with very high voltages. To this end, the resistance element is formed as a curled strip which overlies the inner surface of the cylindrical side wall **7** of the housing, while the collector ring comprises a relatively small diameter disc-like stamping which coaxially overlies the inner face of the cover disc **13**. By reason of its overlying the inner face of the housing side wall, the resistance element is spaced radially the maximum possible distance from the periphery of the collector ring and also from the metal bushing **14**. Additional protection against corona leakage from the resistance element to the bushing is obtained by increasing the area of the inside surface of the front wall **6** through the provision of a series of integral annular barriers **6'**.

A terminal **19**, which is preferably stamped from relatively light metal, is secured to each end of the resistance element and projects rearwardly out of the housing. Each terminal has its inner end portion bent upon itself to a substantially U shape, with the legs **20** and **22** of the U embracing the resistance element and secured thereto by a rivet **21**. (See Figure 7.) One leg **22** of the U projects laterally beyond one edge of the resistance element, and when the resistance element is mounted in the housing this leg extends rearwardly out of the housing to provide a solder lug **23** to which a conductor may be secured. Attention is directed to the fact that the rearmost outer portion of each terminal, which forms the solder lug, is laterally offset relative to its inner portion which embraces the resistance element.

The resistance element is held in place, overlying the inner surface of the side wall of the housing, by a cleat-like projection **25** formed integrally with the housing and projecting radially inwardly from its side wall. This projection comprises a pair of hook-like arms **26** which extend in opposite circumferential directions, spaced radially inwardly from the housing side wall, and which overlie the end portions of the resistance element and the terminals secured thereto to prevent radial and circumferential displacement of the resistance element and its terminals. A recess **28** in the inner surface of the housing side wall, radially opposite each arm **26** of the projection, accommodates the outer leg **22** of the U-shaped portion of each terminal and the peened end of the rivet securing the terminal to the resistance element. It will be observed that with the resistance element securement means just described no portion of a rivet securing a terminal to the resistance element need project to the exterior of the housing, thus obviating the possibility of an arcing short circuit between either end of the resistance element and any part of the chassis.

The limits of rotation of the shaft are defined by the engagement of a lug **9'** on the arm **9** with the opposite ends of a stop **27** formed integrally with one of the medial annular barriers **6'**.

The contactor **10** (see Figure 6) is preferably stamped from a single piece of resilient sheet metal, and has a body portion **30** which overlies the rear face of the arm **9**, eccentrically of the shaft, and which is anchored thereto by tangs **31** bent around opposite sides of the arm and engaged in closely fitting notches **32** in the side edges thereof. Projecting toward one another at oblique outward angles from opposite sides of the body portion of the contactor, tangentially to the inner face of the resistance element, are a pair of spring arms **33**, the free outer end portions of which are axially aligned with one another and slidingly engage the resistance element under biasing force. The contactor also has a pair of spring arms **34** extending toward one another from the radially innermost portions of its side edges. These arms **34** are bent rearwardly to have their free ends slidingly engage the collector ring under biasing force. These arms **34** not only complete the circuit between the resistance element and the collector ring, but they also bias the shaft and its arm forwardly to maintain a forwardly facing shoulder **36** on the arm in rotatable engagement with an annular rearwardly facing ridge **37** on the front housing wall, thus restraining the entire rotor against axial displacement.

The collector ring **12** (see Figure 5) is a disc-like metal stamping having integral tangs **39** extending rearwardly therefrom and projecting into holes **40** in the cover disc to hold it against flatwise displacement coaxially on the front face of the cover disc. The rearward bias of the contactor arms **34** maintains the collector ring in flatwise engagement with the cover disc and thus prevents axial displacement of the collector ring.

Also extending rearwardly from the collector ring is an integral terminal **41**, which projects rearwardly a substantial distance beyond the cover through a slot **43** therein, and terminates at its rear in a solder lug portion **42**. The terminal **41** cooperates with the tangs **39** in holding the collector ring centered on the cover disc,

and thus serves, in effect, as another locating tang on the collector ring. To minimize any possibility of arcing short circuits, terminal 41 is disposed at the side of the collector ring remote from the end terminals 19 of the resistance element, as best seen in Figure 3.

At its rear the housing side wall has a shallow counterbore 44, the bottom of which is flush with the rear edge of the resistance strip and provides a rearwardly facing circumferential ledge 45 upon which the marginal edge portion of the cover disc is seated. Thus the cover cooperates with the front wall of the housing to confine the resistance element against axial displacement. The cover is in turn held in place closing the rear of the housing by means of a plurality of radially inwardly projecting lugs 46 on the rear of the housing side wall, spaced rearwardly of the ledge 45 a distance substantially equal to the thickness of the cover. The periphery of the cover disc has a series of relatively wide notches 48 (see Figure 4) to cooperate with these lugs in providing a bayonet connection between the cover and the housing.

When the cover is installed on the housing, other notches 49 in its periphery provide openings through which the end terminals 19 project. After the cover disc is rotated from the position shown in Figure 2 to that shown in Figure 3, to establish its bayonet connection with the housing, the projecting outer end portions of the terminals are twistingly bent to dispose the same at an oblique angle to the plane of the remainder thereof, and thus engage the outer end portions of the terminals against shoulders 51 provided by notches 52 in the periphery of the cover. By this engagement between the terminals and the edge of the cover, the cover is secured against rotation to a position at which its bayonet connection with the housing is disestablished.

To facilitate the twisting of the terminals, in the manner described, slits 50 are formed therein as best shown in Figure 7.

The laterally offset outer end portion of each terminal which comprises the solder lug 23, due to the twist in the terminal, is disposed inwardly from the cover periphery, and overlies the cover so that any solder running down the solder lug during securement of a conductor thereto will be stopped by the cover and prevented from flowing into the interior of the housing.

From the foregoing description taken together with the accompanying drawings, it will be readily apparent that this invention provides a compact and rugged variable resistor which is well adapted for use with high voltages because its resistance element overlies the inner surface of the cylindrical side wall of a cup-shaped housing while its collector ring is coaxially mounted on the inner face of a cover disc which closes the rear of the housing, and because the only current carrying surfaces exposed at the exterior of the housing are the terminals, all of which project directly to the rear of the housing and are spaced as far as possible from one another. It will also be apparent that the variable resistor of this invention achieves these advantages without sacrificing simplicity and low cost, because of the novel manner in which the collector ring is held in place on the cover by means of the contactor in cooperation with integral tangs on the collector ring, including its terminal, and because of the simple cleat-like securement means for the resistance element and end terminals, formed integrally with the housing, and the bayonet connection between the cover and housing which is secured by twisting the outer end portions of the terminals into locking engagement with shoulders on the edge of the cover.

What is claimed as our invention is:

1. In a variable resistor of the type having a cup-shaped housing with an end wall and a cylindrical side wall, a resistance element in the housing, a rotatable actuating shaft normal to said end wall of the housing and accessible for actuation from the exterior of the housing, and a contactor in the housing carried by said shaft for rotation therewith and slidably engaged with the resistance element: a pair of terminals connected with the ends of the resistance element, each comprising a substantially flat strip of metal overlying the inner surface of the side wall and projecting beyond the open end of the housing; means on the housing side wall defining a radially inwardly projecting circumferential ledge spaced inwardly from the open end of the housing and facing the same; a plurality of radially inwardly projecting lugs on the housing side wall spaced outwardly from said ledge and opposing the same; and a disc-like cover of insulating material having a notched periphery and having its marginal edge portions overlying said ledge, said lugs on the housing cooperating with notched portions of the cover to provide a bayonet connection between the cover and the housing, and said terminals projecting through notches in the cover periphery and having their outer end portions twisted to cooperate with edge portions of the cover to hold the cover against rotation to a position in which said bayonet connection is disestablished.

2. The variable resistor of claim 1, further characterized by the fact that said terminals have their portions outside the cover laterally offset relative to their inner portions, and extending over the cover, so that upon connection of conductors to said terminals any solder running inwardly along them will be stopped by the cover and prevented from entering the interior of the housing.

3. A variable resistor of the type having a housing with spaced apart front and rear walls and a cylindrical side wall, a resistance element overlying the inner surface of said side wall, a rotatable actuating shaft normal to the front and rear walls of the housing, and a contactor in the housing carrier by said shaft for rotation therewith and having an arm slideably engaged with the resistance element and another arm adapted to engage a collector ring: characterized by the fact that the housing has circumferential rearwardly facing ledge defining means near the rear of its side wall and circumferentially spaced apart lugs axially spaced behind said ledge and opposing the same; further characterized by the fact that the rear wall of the housing comprises a disc of insulating material having its marginal edge portion overlying said ledge, said disc having notches in its periphery cooperating with said lugs to provide a bayonet connection between the disc and the housing side wall so that the disc must be in a predetermined position of rotation relative to the side wall to enable assembly and disassembly of said parts; and further characterized by a terminal secured at each end of the resistance element, each of said terminals comprising a substantially flat metal member projecting rearwardly out of the housing through slots in the periphery of said disc, and said terminals having portions thereof twisted and engaging the edge of the disc to prevent rotation of the disc to a position in which it can be disassembled from the side wall.

4. A variable resistor having a resistance element with terminals fixed to the ends thereof, and a rotatable contactor enclosed within a housing having a cylindrical side wall and a removable cover, the resistance element being secured against rotation in the housing, characterized by the fact that the cover is a round disc of insulating material seated in a counterbore in one end of the side wall; by the fact that the side wall and the periphery of the cover have cooperating elements defining a bayonet connection requiring the cover to be in a predetermined position of rotation with respect to the side wall for assembly and disassembly of said parts; and further characterized by the fact that the terminals of the resistance element project through notches in the edge of the cover and have portions thereof twisted and engaged against shoulders on the edge of the cover to hold the same against turning from a position at which the bayonet connection holds the cover in place.

5. A variable resistor adapted to operate with high potential differences across its terminals, comprising: a cup-shaped housing of insulating material having a front wall and a substantially cylindrical side wall; an arcuate resistance element extending partially around the inner face of the housing side wall; a terminal secured to each end of the resistance element in a manner entirely independent from the side wall of the housing, so that the resistance element with its terminals constitutes a subassembly independent of the housing, the terminals projecting from the rear edge of the resistance element and beyond the rear edge of the housing side wall and being substantially tangent to the inner surface of the housing side wall; a cleat-like securement member on the housing side wall projecting into the interior thereof and having oppositely circumferentially extending arms overlying the ends of the arcuate resistance element and the terminal portions secured thereto, to confine the terminals and the resistance element against radial and circumferential displacement; a cover of insulating material closing the rear of the housing, and confining the resistance element against axial displacement, said cover being a round disc, and being encircled by the rear end of the cylindrical side wall, the cover having notches in its periphery through certain of which said terminals on the resistance element project rearwardly, the notches being circumferentially wider than the portions of the terminals received therein; radially inwardly projecting lugs on the

rear of the housing side wall rearwardly spaced from and opposing the rear edge of the resistance element, to overlie the adjacent edge portion of the cover and hold the same in place, said lugs being circumferentially spaced to cooperate with notched peripheral portions of the cover to provide a bayonet connection between the cover and the housing which requires a predetermined rotational relationship between the cover and the housing for assembly and disassembly of the cover and housing; the bottoms of the notches in the edge of the cover through which the terminals project having indentations providing circumferentially facing shoulders; and the outer end portions of said terminals on the resistance element being twisted and engaging said shoulders to secure the cover against rotation in either direction.

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