

Oct. 31, 1939.

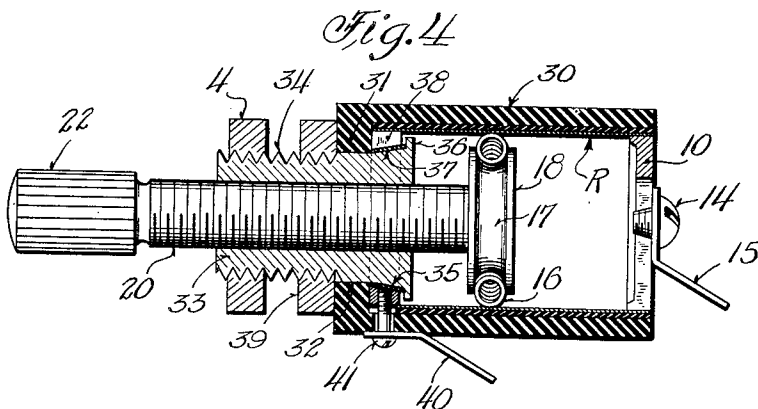
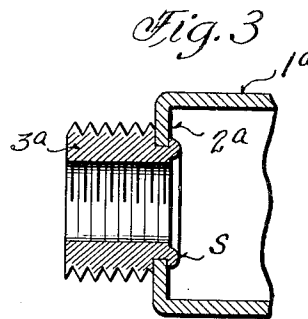
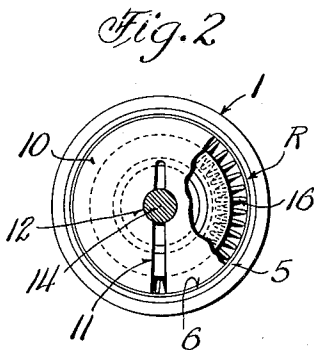
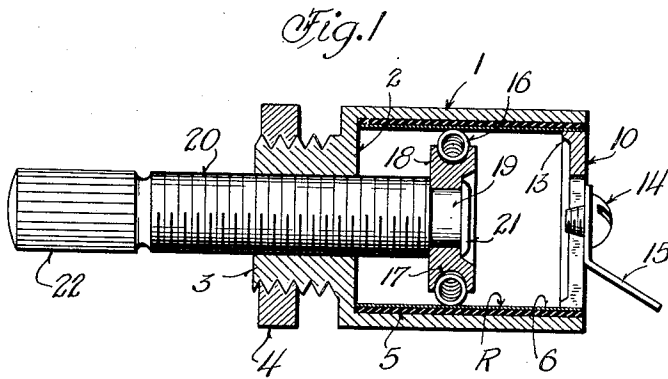
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2,178,241

VARIABLE RESISTANCE

Filed Nov. 13, 1935

3 Sheets-Sheet 1



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Oct. 31, 1939.

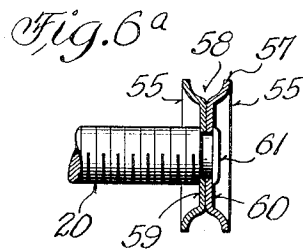
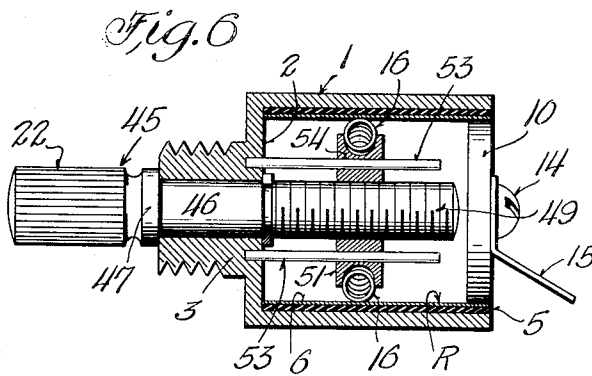
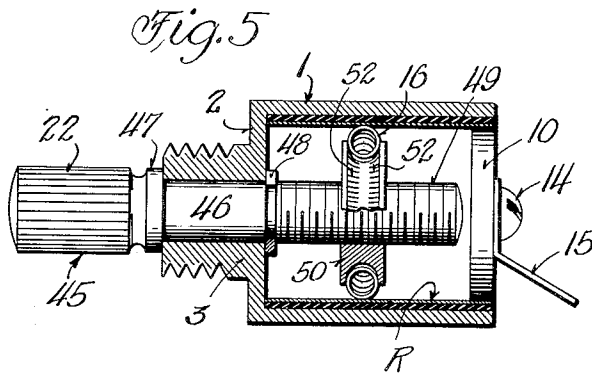
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2,178,241

VARIABLE RESISTANCE

Filed Nov. 13, 1935

3 Sheets-Sheet 2



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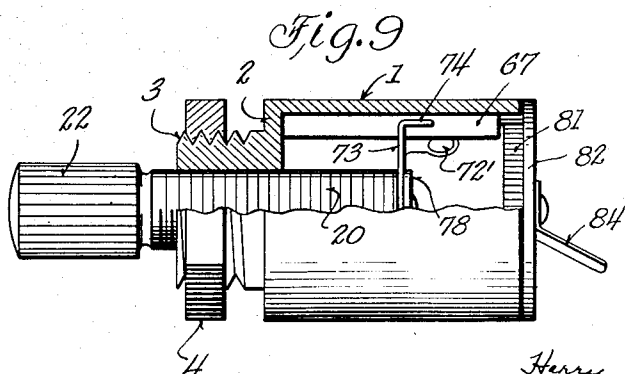
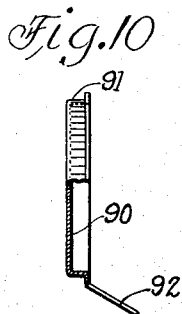
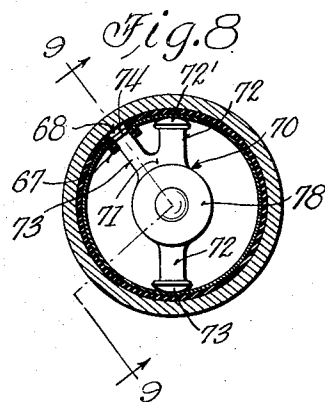
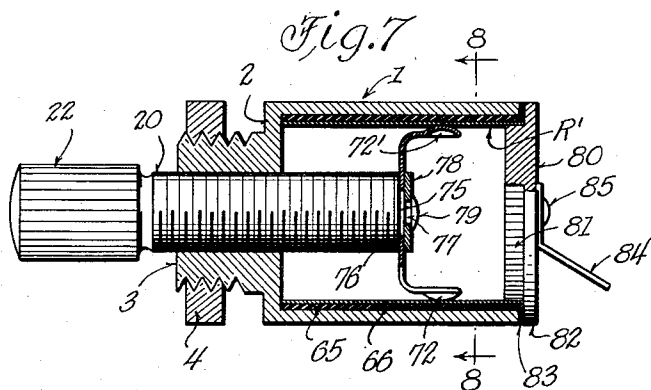
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2,178,241

VARIABLE RESISTANCE

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,178,241

VARIABLE RESISTANCE

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Application November 13, 1935, Serial No. 49,444

3 Claims. (Cl. 201—62)

This invention relates to an improvement in adjustable resistances especially designed for use with radio receivers, as, for example, radio receivers used on automobiles. The invention is not restricted to this particular use, however, and may be advantageously employed wherever space limitations require a compactly organized device of small dimensions.

One of the objects of the invention is to provide an adjustable resistance of this character which is extremely simple in its construction and of very close and compact design and yet is highly effective and efficient in operation and capable of handling the loads to which it is subjected in its various applications.

Another object of the invention is to so constitute and combine the elements of the resistance that while the parts are small and compact variations of resistance values over a wide range are obtainable and this capacity is had while providing a device which will outlast the receiver in which it is used.

In particular, these advantages are realized by an improved type of operative engagement between the adjustable contact and the resistor and by providing for the dissipation of the heat generated by the passage of current through the resistor.

Another object is to provide an adjustable resistance of this character which is operated in an extremely simple and convenient manner and which is susceptible of quantity production with economy and from materials and by means of facilities ordinarily available.

Another object of the invention is to provide a device of this character and having these advantages and which may be used as an ordinarily adjustable resistance or as a potentiometer or voltage divider.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a view partly in central vertical longitudinal section and partly in side elevation showing one form of adjustable resistance embodying the present invention;

Figure 2 is a view in end elevation looking toward the right hand end of Figure 1, with parts broken away and parts shown in section for the sake of illustration;

Figure 3 is a fragmentary sectional view showing

a slight modification of the construction of the housing and its mounting bushing;

Figure 4 is a view similar to Figure 1 but showing another form of the invention;

Figures 5 and 6 are views similar to Figures 1 and 4 but showing still further modifications of the invention;

Figure 6^a is a fragmentary view partly in elevation and partly in section showing a variation in the construction of the adjustable contact carrier;

Figure 7 is a view partly in longitudinal vertical section and partly in side elevation illustrating another embodiment of the invention;

Figure 8 is a view in transverse cross section taken on line 8—8 of Figure 7;

Figure 9 is a view of the resistor taken in the plane of line 9—9 of Figure 8 and consequently showing parts in section and parts in elevation; and

Figure 10 is a detail view illustrating a modified form of flanged disc or end cap for the housing of the adjustable resistor.

Referring to the drawings, and more especially to Figure 1, it will be seen that in this form of the invention, the adjustable resistance comprises a metal housing 1. This housing is in the form of a somewhat elongated cylinder, the outer end of which is open and the inner end of which is partially closed by an integral centrally apertured end wall 2. Integral with the end wall 2 is an externally threaded mounting bushing 3. The bushing 3 is adapted to extend through an opening therefor in a mounting panel (not shown) and to be secured in such position by means of a nut 4 interthreaded with the exterior of the bushing.

Within the housing 1 a resistor, designated generally at R, is provided and comprises a flexible backing 5 to the inner face of which a resistive coating is applied. This resistor R may have its backing 5 constituted of a flexible strip of cardboard, paper, or other flexible material, and its resistive coating 6 may be carbon, or the like, as set forth in the application of Erwin R. Stoekle, for Adjustable resistances, filed July 7, 1933, Serial No. 679,291, which has matured into Patent No. 2,041,380 or the backing strip 6 may be a strip of japanned flexible metal to one japanned and/or anodized face of which the resistive coating is applied as set forth in the application of Erwin R. Stoekle, filed August 19, 1935, Serial No. 36,771. In any event, the resistive coating 6, while electrically insulated from the metal housing 1, is in heat interchanging

relation therewith and as this housing 1 is of high thermal conductivity, heat generated in the resistive coating as a result of the passage of an electric current therethrough is rapidly dissipated to the atmosphere. It will be noted that the resistor R, although it is produced in the form of a flat sheet or strip, is, in the assembly, curved into the form of a cylinder, or, in other words, into a tubular form corresponding to the tubular formation of the housing. In such form it is securely supported on the inner peripheral wall of the housing and preferably it has an extent circumferentially and longitudinally equal to that of the inner dimensions of the housing. For securely holding the resistor R in position and establishing electrical connection between one end thereof and an external circuit, a metal disc 10 is provided. The disc 10 has a radially extending split 11 which intersects a centrally internally threaded opening 12. If desired, the periphery of the disc 10 may be slightly flanged as at 13. The disc 10 is dimensioned to fit within the confines of the resistor as shown in Figures 1 and 2 and it may be expanded by means of a tapered screw 14 which also serves to secure a terminal 15 to the disc 10. When the disc 10 is expanded it firmly clamps the adjacent end of the resistor R between itself and the housing 1.

An adjustable contact 16 is provided and preferably comprises a piece of wire coiled helically and bent or shaped into annular form. In the assembly, portions of its convolutions are received in an annular groove 17 provided in an annular carrier 18. The outer portions of this helically coiled and annular contact 16 engage the resistive coating of the resistor R. The contact 16 may be so interfitted with the groove 17 as to permit the carrier 18 to rotate relative thereto but it is essential that any axial or longitudinal movement of the carrier 18 be transmitted to the contact 16 by the walls of the groove 17.

The carrier 18 has a central opening through which the reduced end 19 of an operating screw 20 projects. The outer end of this reduced portion 19 of the operating screw may be peened or riveted over as at 21 to operatively interconnect the operating screw and the contact carrier. If desired, however, a swivel connection might, in this embodiment, be employed between the operating screw and the carrier 18, so that the screw 20 may rotate relative to the carrier 18 and yet these parts partake of the same axial or longitudinal movement. The screw 20 has its external threads meshed with internal threads provided in the bushing 3. The outer end of the screw may be provided with a serrated knob 22. Hence, when the screw 20 is turned in one direction it moves axially into the housing and the contact 16 is carried with it. Reverse turning of the screw reversely moves it and its contact 16.

With a contact of this character the adjustable contact has very intimate engagement with the resistor in all adjustments and in any particular adjustment engages the resistor at a multiplicity of points circumferentially thereof. In this way very effective contact is had between the adjustable contact and the resistor, with but very light pressure urging the contact into engagement with the surface of the resistor. A screw operator for the adjustable contact 16 provides an extremely simple and effective as well as conveniently manipulatable device for moving the adjustable contact throughout the entire range of its adjustments. However, the invention, in certain of its

aspects, is not restricted to the particular type of operator, although in its more specific aspects this type of operator is very advantageously combined with the other instrumentalities making up the resistors.

Figure 3 illustrates an embodiment having a different type of housing and bushing structure. In Figure 3 a portion of the housing is designated at 1^a and has an integral end wall 2^a. The bushing designated at 3^a is formed separately and is staked to the end wall 2^a of the housing, as indicated at S.

In the form of the invention shown in Figure 4, the adjustable resistance comprises a cylindrical housing 30 of insulating material having one end open and having its other end partially closed by an end wall 31, the end wall having a central opening 32. Within the housing a resistor R, identical with that previously described, is provided and is held in position by an expansible disc 10 and its screw 14. A terminal 15 is held to the disc 10 by the screw 14 as before. Likewise, there is an adjustable contact 16 identical with that previously described and mounted on a similar contact carrier 18 interconnected with the inner end of an operating screw 20, the outer end of which has an operating knob 21.

The bushing with which the screw 20 is inter-threaded is designated at 33. It is formed as a separate element and is externally threaded as at 34 for only a portion of its length. Inwardly of its externally threaded portion it has a tapered section 35 and beyond the tapered section a flanged or shouldered head 36. The bushing 33 not only extends to the opening 32 in the end wall of the housing but also extends through an insulating washer 37 of annular form which is surrounded by a clamping and contacting wedge ring 38. In the assembly, the bushing is secured in position by a nut 39 which coacts with the threads of the bushing and with the end wall of the housing and draws the tapered portion 35 of the bushing into the washer 37 to expand the washer and the ring 38 which surrounds the latter thereby causing the ring 38 to have clamping engagement with one end of the resistor R. This aids in securing the resistor R in position and also establishes electrical connection between the resistor R and the ring 38. In addition to the nut 39 the bushing is provided with a mounting nut 4, as before.

A terminal 40 is provided and is connected by a screw 41 with the ring 38, the screw passing through openings in the housing 30 and the resistor R. The provisions of the terminal 40 in addition to the terminal 15 along with the adjustable contact makes it convenient to employ the device as a potentiometer.

The embodiments of the invention shown in Figures 5 and 6 are, as to housing structure, resistor construction, clamping disc and adjustable contact 16, identical with that shown in Figures 1 and 2, heretofore described, and corresponding reference characters have been applied to these parts. The constructions shown in Figures 5 and 6 differ from that shown in Figure 1 in the particular means employed for transmitting the rotary movement of the knob 22 into longitudinal or axial movement of the adjustable contact 16. In Figures 5 and 6 the part corresponding to the screw 20 is designated at 45 and inwardly of its knob 22 has a plain portion 46 rotatably fitted in the bushing 3, the inner peripheral wall of the bushing being correspondingly smooth and round to provide for this rotative fit. Lock rings or sim-

ilar means constituting annular shoulders and designated at 47 and 48 are interfitted with grooves or the like in the shaft and coact with the ends of the bushing to preclude the screw 45 from moving axially while allowing it to rotate freely. Within the housing 1 the screw 45 in each of the structures shown in Figures 5 and 6 has an externally screw-threaded portion 49, which is interthreaded with a correspondingly threaded central opening in the adjustable contact carriers designated at 50 in Figure 5 and at 51 in Figure 6. In the form of the invention shown in Figure 5, the annular peripheral groove of the contact carrier 50 is serrated or knurled as indicated at 52. These serrations or knurls set up sufficient interengagement between the convolutions of the adjustable contact 16 and the contact carrier, as to preclude the carrier from rotating relative to the adjustable contact 16 under the influence of the drag of the screw 45 when it is turned in either direction. The frictional interengagement of the convolutions of the adjustable contact 16 with the carbonaceous or resistive coating of the resistor R effectively prevents rotation of the adjustable contact. As a consequence, when the screw 45 is turned the threaded interconnection which it has with the carrier 52 will cause the carrier and its adjustable contact to move bodily lengthwise of the housing in one direction or the other depending upon which way the screw is turned.

In the form of the invention shown in Figure 6, the knurls 52 need not be supplied, the carrier 51 being positively constrained against rotation by means of a pair of guide rods 53 fixed at one end to the housing and having a working or sliding fit in openings 54 formed in the body of the carrier 51. It will be understood that these rods 53 while holding the carrier 51 against rotation allow it to slide back and forth in the housing as the screw 45 is turned in one direction or the other.

Figure 6^a illustrates a slight modification in the construction of the carrier. As there illustrated, the carrier may be made up of a pair of similar sheet metal parts designated at 55 and 56 and having outwardly flanged peripheries 57 to define a groove 58 for the reception of an adjustable contact similar to the contact 16. The body portions 59 and 60 of these carrier parts may be formed to flatly engage and may also be centrally apertured so as to adapt them for convenient attachment by riveting or the like, as indicated at 61, to the inner end of the screw 20.

In the form of the invention shown in Figures 7 to 9, inclusive, the adjustable resistance is similar to the embodiment illustrated in Figure 1 in that it comprises a cylindrical housing 1 provided with an apertured end wall 2 which has an integral externally threaded mounting bushing 3 and a nut 4 coacting with the bushing 3. An operating screw 20 is also provided and is threadedly interconnected with the bushing 3. The outer end of the screw 20 is provided with an operating knob 22 as before.

Within the housing 1 and disposed against the inner cylindrical wall thereof is a resistor designated generally at R'. The resistor R' is made up of a flexible backing of insulating material or of a flexible material suitably insulated and designated at 65. To the inner face of this backing 65 is employed a resistive coating 66. These parts are illustrated in a somewhat exaggerated fashion in the drawings for the purpose of clearness and illustration. It is to be understood that

the resistor is made up in the form of a sheet from which pieces of proper size are cut and that the resistor is flexible to such an extent as to enable it to readily conform to the contour of the inner housing 1.

In the present form of the invention the longitudinal meeting edges of the resistor are returned as at 67 to provide a longitudinal guide channel 68 which performs a function which will be hereinafter more fully described.

The movable contact of the resistor is designated generally at 70 and comprises an apertured disc-like hub 71 from which a plurality of spring contact fingers 72 extend, these fingers 72 being integral with the disc and terminating in angularly disposed rounded ends 72' which bear against or contact the resistive coating of the resistor. Also integrally formed with the disc 71 and angularly spaced from the contact fingers 72 is a guide finger 73 having an appropriately shaped and angularly disposed inner end 74 which extends into the guide channel 68 and engages the insulating backing which makes up the returned edges 63.

The inner end of the screw 20 is of a reduced or stepped formation and on one of the steps 75 the apertured hub 71 of the adjustable contact is rotatably fitted, one face of the hub 71 abutting the shoulder 76 of the screw adjacent the step 75. Beyond the step 75 the screw is further reduced to provide a step 77 on which a washer 78 is mounted and secured by riveting or peening over the inner end of the screw as indicated at 79. In this way the adjustable contact is securely held to the screw against any relative axial movement but is freely rotatable relative thereto.

The open end of the housing is closed by a disc or end plate 80 which has a serrated or knurled portion 81 driven into the end of the housing and effectively held in this position by virtue of the frictional engagement of its serrated portion with the adjacent portion of the resistor. Beyond the serrated portion 81 the disc or end cap 80 is provided with a peripheral flange 82 which overlaps the inner end of the housing and confines between itself and the adjacent end of the housing a portion 83 of the insulating backing of the resistor. Thus, while one end disc is electrically connected to the resistive coating of the resistor it is electrically insulated from the housing. A terminal 84 is appropriately secured as by means of a suitable fastening device 85 to the end cap 80.

The operating screw 20 is of such length that when it is turned to a position where it has moved inwardly as far as it may into the housing the rounded contact ends 72' of the contact fingers will closely approach the disc or end plate 80 without touching. For example, these contact ends 72' may approach the end plate or disc 80 to within one-thirtysecond to one-sixtyfourth of an inch without touching whereby to give a comparatively low resistance value. Furthermore, the spring contact fingers 72 are preferably flat on the back so that they will not be deformed when the screw 20 is completely retracted. Reliable action is further insured by the nature of the connection between the movable contact and the screw which prevents distortion of the movable contact at any time.

With a structure of this character the value of the resistance may be readily varied by turning the screw 20. Turning of the screw results in movement thereof axially of the housing and this axial movement is transmitted to the mov-

able contact 70 which, though positively interconnected with the screw so as to be constrained to move axially or bodily thereof, is not influenced to any material extent to turn. In fact, any turning is precluded by the cooperation of the guide finger 73 with the longitudinal guide channel 68 defined by the inturned edges 67.

In lieu of having the guide finger working between spaced inturned edges of the resistor, the same guiding effect may be had by bringing the inturned edges into engagement and having a notch in the adjacent portion of the guide finger which straddles the inturned edges. It is also to be understood that the number of contact fingers may be varied as desired although preferably a plurality are provided.

As shown in Figure 10, the invention also contemplates a modified form of end plate, that is, one which has a body portion 90 formed with an outwardly flaring flange 91 and an integral terminal or shoulder lug 92. The outer periphery of the flange 91 may be serrated or knurled as desired. Such an end plate has the general appearance of a frying pan and may be fabricated by a simple stamping operation.

While I have shown and described several constructions in which the invention may be advantageously embodied, it is to be understood that these constructions have been selected merely for the purpose of illustration or example and that various changes in the size, shape and arrangement of the parts may be made without departing from the spirit of the invention or the scope of the subjoined claims.

The invention claimed is:

1. An adjustable resistance comprising a hollow metal housing having an apertured end wall provided with an externally threaded mounting bushing, said housing having an open end, a non-conductive flexible sheet formed to conform to and resting against the inner surface of said housing and extending longitudinally of said housing, a resistance coating upon the inwardly exposed surface of said sheet, a metallic cap for said open end, said cap being provided with a suitable electrical terminal and having a portion fitting within said housing to hold said cap in position, said portion engaging said resistance coating to form electrical contact therewith, said cap being electrically insulated from said housing, an axially movable contact member in said housing and having contact surfaces resiliently bearing on said resistance film, and means for adjustably imparting axial translation to said contact member, said last named means being carried by said apertured end and projecting from said housing and forming electrical contact between said housing and said member.

2. An adjustable resistance comprising a hollow metal housing having an apertured end wall provided with an externally threaded mounting

bushing, said housing having an open end, a non-conductive flexible sheet formed to conform to and resting against the inner surface of said housing and extending longitudinally of said housing, a resistance coating upon the inwardly exposed surface of said sheet, a metallic cap for said open end, said cap being provided with a suitable electrical terminal and having a portion fitting within said housing to hold said cap in position, said portion engaging said resistance coating to form electrical contact therewith, said cap being electrically insulated from said housing, an axially movable contact member in said housing and having contact surfaces resiliently bearing on said resistance film, said sheet having a longitudinal edge bent inwardly to provide a guide extending longitudinally of said housing, said contact member being provided with a finger slidably engageable with said edge to prevent rotation of said member while permitting axial movement thereof, an operating screw threadedly interconnected with said apertured end, said screw having a manually engageable portion outside of said housing and an inner end within said housing, and a swivel connection between said inner end and said contact member, said screw providing an electrical connection between said housing and said contact member.

3. An adjustable resistance comprising a hollow metal housing having an apertured end wall and an open end, a non-conductive flexible sheet curved to conform to and resting against the inner surface of said housing and extending longitudinally thereof, a resistance film upon the inwardly exposed surface of said sheet, a metallic cap for said open end, said cap being provided with a suitable electrical terminal and having a portion fitting within said housing to hold said cap in position, said portion engaging said resistance film to form electrical contact therewith, said cap being insulated from said housing, said sheet having adjoining longitudinal edges extending longitudinally of said housing, said edges between said apertured wall and said cap being bent inwardly and spaced to form a channel extending longitudinally of said housing, an axially moveable contact member in said housing and having contact surfaces resiliently bearing on said resistance film, said contact member being provided with a finger, said finger being slideable within said channel, and an operating screw threadedly interconnected with said apertured end, and means interconnecting the inner end of said screw and said contact member whereby said screw is freely rotatable relative to said member while transmitting longitudinal movement in opposite directions thereto, said screw providing electrical connection between said contact member and said housing.

HARRY W. RUBINSTEIN.