Feb. 4, 1964 E. BLANCO 3,120,650

POTENTIOMETER

Filed Jan. 27, 1961 2 Sheets-Sheet 1

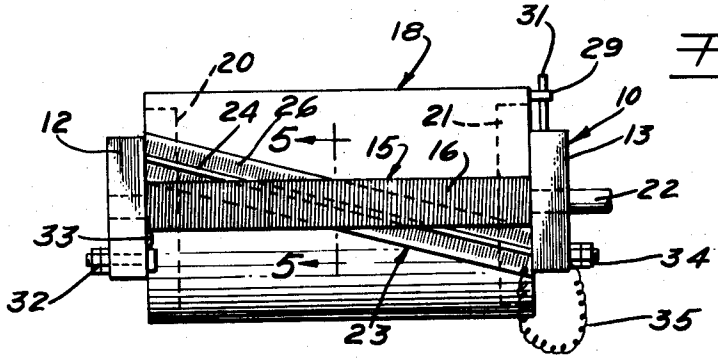


Fig. 1.

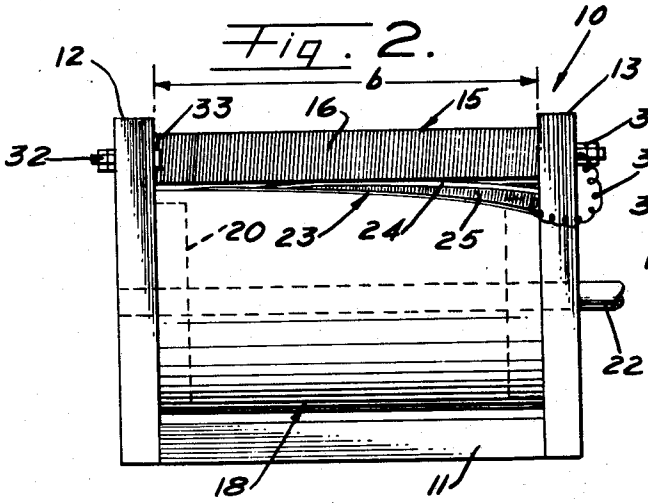


Fig. 2.

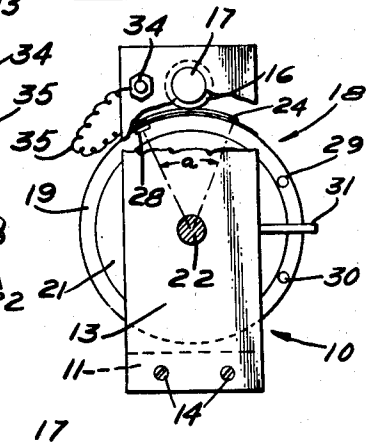


Fig. 3.

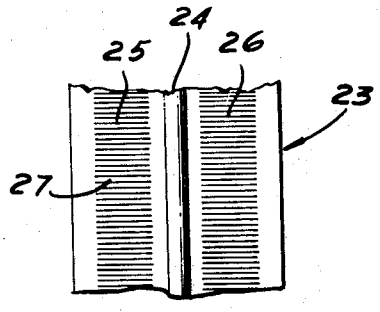


Fig. 4.

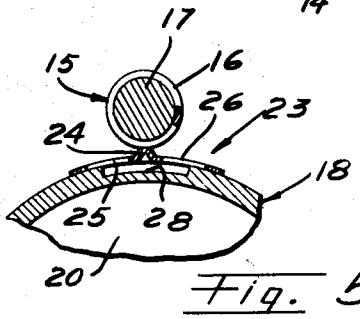


Fig. 5.

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POTENTIOMETER

Filed Jan. 27, 1961 2 Sheets-Sheet 2

Fig. 6.

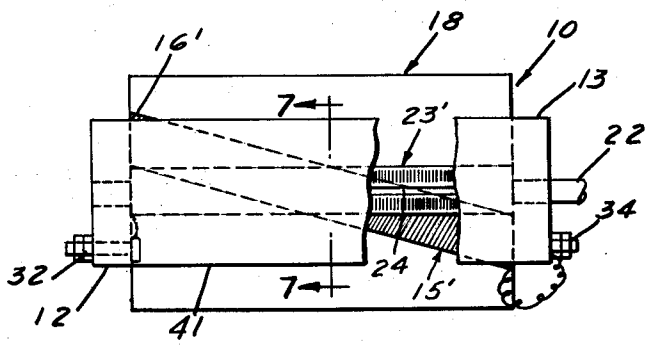
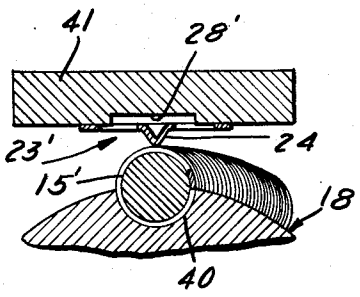


Fig. 7.



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3,120,650
POTENTIOMETER

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2 Claims. (Cl. 338—202)

The present invention relates generally to variable resistors or potentiometers, and is more particularly concerned with devices of this type which may be built in miniature or extremely small sizes.

The present application constitutes a continuation-in-part of my copending application entiled Potentiometer, Serial No. 748,305, filed July 14, 1958, now Patent No. 2,972,124.

Heretofore it has been a baffling problem to obtain in miniature or extremely small size potentiometers a high order of resolution, and in order to obtain the required fine adjustment over a relatively large number of turns of resistance wire, various expedients have been tried for amplifying the movement of the variable contact. Various mechanical arrangements have been utilized, but these have been more or less unsuccessful due to space limitations, and disadvantages which are inherent in the conventional tried mechanical movements, such as backlash, lost motion, and the like.

Having in mind the foregoing, it is one object of the herein described invention to provide a variable resistor wherein a high amplification of contact movement will be obtained to the end that fine resolution will result, and which will not embody the undesirable features of the prior devices.

A further object of the invention is to provide in devices forming the subject matter of the present application, novel motion amplifying means whereby a small angular movement may be amplified to give a materially greater effective contact movement over the coil turns of a resistance element, which means will be of simple design and devoid of backlash and other undesirable characteristics.

A further object is to provide a spiralled wound resistor on a rotatable drum and a linear contact so positioned that rotation of the drum will vary the resistor turns which engage the contact, and in which axial shifting of the drum will be ineffective to change the resistance or point of contact on the resistance element.

A still further object of the invention is to provide a wiper contact of novel construction, wherein the contact point of engagement for each turn will be at a different place on the movable contact, thus materially increasing the life of the contact over arrangements wherein wiping engagement is always at the same point on the movable contact.

Still another object is to provide a variable resistor which will have a high stability against high frequency vibrations, and wherein the wiping contact will be held in pressure engagement by a plurality of springs of different resonant frequencies, as compared to a single spring which will respond to a resonant frequency of predetermined value.

Yet another object is to provide a novel contact strip which may be produced as an article of manufacture.

Further objects of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing the invention without placing limitations thereon.

Referring to the accompanying drawings, which are for illustrative purposes only:

FIG. 1 is a plan view of a variable resistor embodying the features of the present invention;

FIG. 2 is a side elevational view of the same;

FIG. 3 is an end elevational view, portions being cut away to disclose the cooperative relationship between certain parts of the device;

FIG. 4 is an enlarged fragmentary view showing the details of construction of the wiper contact;

FIG. 5 is an enlarged fragmentary sectional view through the wiper contact and associated structure, taken substantially on line 5—5 of FIG. 1.

FIG. 6 is a view similar to FIG. 1, except showing a modified arrangement; and

FIG. 7 is an enlarged fragmentary sectional view taken substantially on line 7—7 of FIG. 6.

Referring more specifically to the drawings, for illustrative purposes, the variable resistance of the herein described invention is shown as comprising a frame structure 10 which may assume a variety of embodiments, but which is illustrated as comprising a base member 11 which has upstanding end brackets 12 and 13 secured thereto as by suitable screws 14 or other conventional means.

The end brackets at their uppermost ends support an elongate resistance element, as generally indicated by the numeral 15, which is composed of a plurality of turns of resistance wire 16 wound on a core structure 17, the wire being preferably devoid of insulation, and insulated between turns which are insulated with respect to each other by conventional means well-known in the art. It will be observed that the resistance element has its turns wound uniformly about a linear extending axis of the core 17, and in the illustrated embodiment, the turns of the resistance element are depicted as extending between the end brackets 12 and 13 for a predetermined axial length as indicated in FIG. 2 by the lettter *b*.

Below the resistance element 15, there is provided a rotatably mounted structure, as generally indicated by the numeral 18. This structure is shown as comprising a drumlike tubular shell, which may be of insulating or other suitable material. End inserts 20 and 21 support the shell upon an operating shaft 22 to which this structure is affixed in any suitable manner for rotation with the shaft. The shaft 22 has bearing support in the end brackets 12 and 13, and one end of the shaft projects, for example, from the end bracket 13 where it may be secured to a knob or other means for manual rotation or through suitable connection to an actuating device. It will be observed that the axis of rotation for the rotatably mounted structure 18 is spaced from and parallel to the linear axis of the resistance element 15.

The rotatably mounted structure 18 serves as a support for a contact element as generally indicated by the numeral 23. The contact element is fabricated from an elongate strip of electrically conducting material and is provided with a longitudinally extending bead 24 which forms the contact wiping surface. On opposite sides of the bead, there is provided a row of laterally extending slits 25 and 26 that define narrow integrally formed bridging connectors 27 which serve to resiliently support the bead 14 in wiping engagement with the turns 16 of the resistance element, when the contact element 23 is mounted on the surface of the tubular shell 19 with the bead 24 disposed over and following a helically formed groove 28, as shown in FIG. 5. The bead 24 similarly provides a helical contact surface which resiliently engages the coil turns 16 along linearly aligned points of engagement thereon.

The helically extending bead 24 is thus angularly disposed with respect to the linear axis of the resistance element 15, so that upon relative movement between the contact element and the resistance element, the bead 24 will be successively wiped against the turns of the resistance element. As shown in FIGURE 3, when the rotatably mounted structure 18 is rotated through an angle,

as indicated by the letter *a*, the contact bead **24** will move from contact with a coil turn at one end of the resistance element over the intervening coil turns to a coil turn at the other end of the resistance element. By comparison of the length of arc of the wiping contact, as indicated by the letter *a*, it will be observed that mechanical amplification results and that a small rotational angle of movement of the rotatably mounted structure **18** gives a change of contact over the greater axial length as indicated by the letter *b*. Thus, fine resolution is obtained. The mechanical structure is such that there will be no lost motion or backlash.

Further, the device utilizing the contact arrangement described above will be very stable with respect to high frequency vibrations, since each of the bridging members will in effect comprise a single spring and each of these will have a different resonant frequency so that there will be no tendency to vibrate at a single frequency as might result if a single spring were utilized.

As shown in FIG. 3, the angle of movement of the rotatably mounted structure may be limited by means of abutment pins **29** and **30** carried by the rotatably mounted structure **18**, which are spaced apart and are coactively associated with a stop member **31** which is mounted on the adjacent end bracket **13**.

Connection terminals are appropriately provided and are illustrated as comprising a terminal **32** which is carried by the end bracket **12** and is connected by means of a conductor **33** to one end of the resistance element. A terminal **34** on the end bracket **13** is connected by means of a pigtail conductor **35** to the contact element **23**.

In the modification shown in FIG. 6, the resistance element **15** instead of being fixedly mounted so as to extend between the end brackets **12** and **13** is in this arrangement mounted on the surface of the drum or rotatable structure **18**. The resistance element, as indicated by the numeral **15'**, is mounted in a spiral groove **40** or otherwise arranged so as to project above the surface of the rotatable structure.

The contact element **23'** is in this embodiment mounted over a linearly extending groove **28'** formed in the under surface of support member **41** which extends between the upper ends of the end brackets **12** and **13**. The longitudinally extending bead **24** now projects downwardly so as to be engaged by the turns of the resistance element as the rotatable structure **18** is moved in opposite directions.

The terminal **34** is now connected to the resistance element while the terminal **32** is in this case connected to the contact member **23'**.

In general, it will be observed that in the modified

structure illustrated in FIGS. 6 and 7, the resistance element and contact element have been interchanged. Thus, not only are the inherent advantages of the structure shown in FIGS. 1 and 2 retained, but further desirable advantages result from this interchange. By making the contact of linear configuration, the point of contact with the resistance element will not be changed in the event of slight axial shifting of the rotatable structure **18**. A more stable arrangement is thus obtained in which the resistance value at any set point in the resistance will remain constant and unvariable.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of my invention, and, hence, I do not wish to be restricted to the specific form shown or uses mentioned, except to the extent indicated in the appended claims.

I claim:

1. A variable resistance, comprising: a structure mounted for rotational movement about a longitudinal axis; a resistance element including a plurality of turns of resistance wire uniformly wound around an axis formed as a helix about said axis of rotation; a support above said rotatable structure having a longitudinally extending groove on its under surface; and an elongate strip of electrical conducting material secured over said groove, said strip having a resiliently supported longitudinally extending downwardly deformed surface portion for making wiping engagement with the turns of said resistance element during said rotational movement.

2. A variable resistance, comprising: a structure mounted for rotational movement about a longitudinal axis; a resistance element including a plurality of turns of resistance wire uniformly wound around an axis formed as a helix about said axis of rotation; a support above said rotatable structure having a longitudinally extending groove on its under surface; an elongate strip of electrical conducting material secured over said groove, said strip having a downwardly deformed surface portion positioned over said groove; and a row of spaced parallel slits laterally extending from each side of said surface portion, whereby spaced bridging connectors are formed for resiliently supporting said surface portion for wiping engagement with the turns of said resistance element during said rotational movement.

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