

Aug. 21, 1962

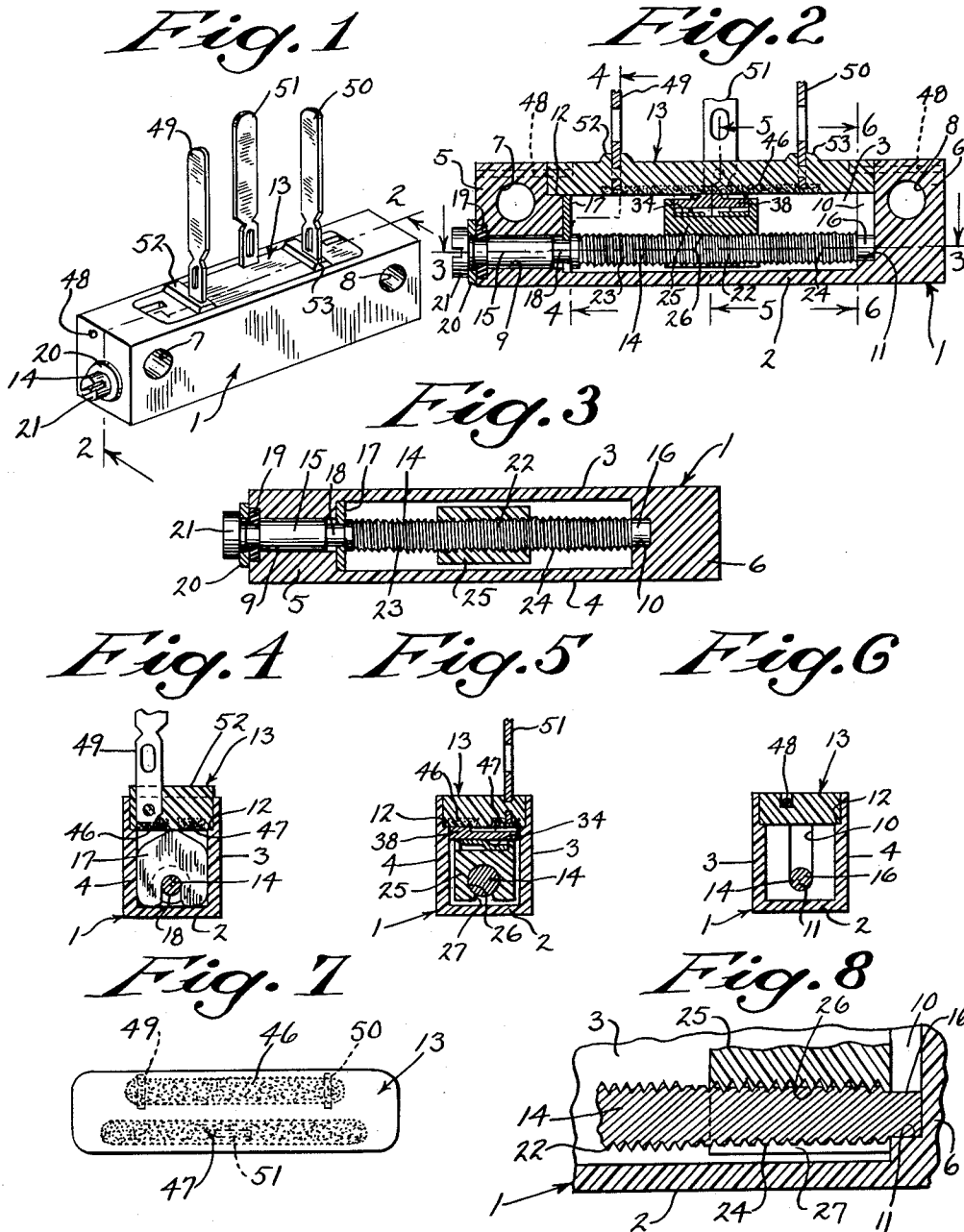
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3,050,704

RECTILINEAR VARIABLE RESISTOR

Filed May 4, 1959

3 Sheets-Sheet 1



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Fig. 9

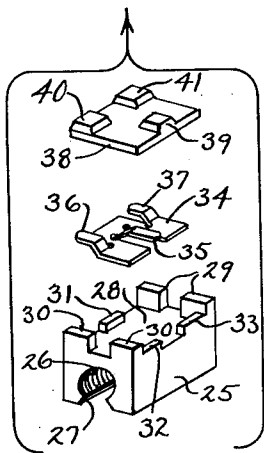


Fig. 10

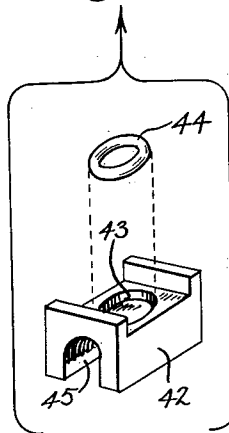
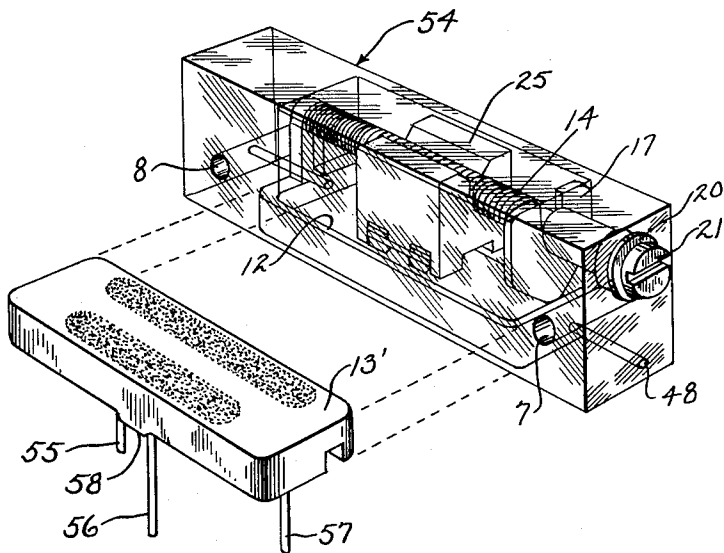


Fig. 11



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Fig. 12

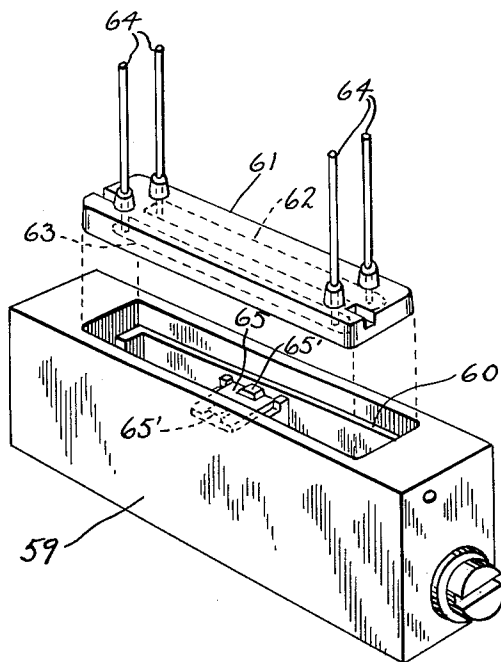


Fig. 13

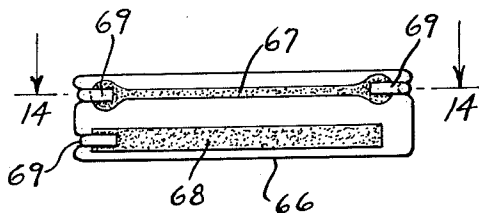
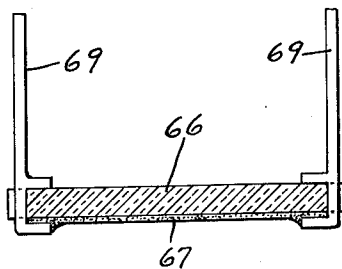


Fig. 14



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RECTILINEAR VARIABLE RESISTOR

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Filed May 4, 1959, Ser. No. 810,676
1 Claim. (Cl. 338—180)

This invention relates to rectilinear variable resistors such as those adopted for use in adjustment or balancing of electronic and control circuits, and it more specifically relates to a small compact resistor that contains a resistance track within a housing supporting an operating shaft adapted to slide a contact along the resistance track in order to achieve variation of the resistance value.

In the construction of electronic apparatus the rectilinear variable resistor is frequently used where its compactness, or its means of adjustment through the use of a rotatable lead screw, may be of advantage. The need arises for such a resistor that can cover a wide range of resistance values and exhibit desirable electrical characteristics such as a low internal noise level and minimal inductance and capacitance. In one embodiment of the present invention a casing is provided that receives a relatively thin member of rectangular configuration, which serves as a supporting base for the resistance track. Such base member encloses one side of the casing, and can be furnished with any of a variety of resistance track materials. The simple geometry of the base allows manufacture from a variety of materials and molded resistance tracks, film resistances, or wire wound resistances may be selected. Hence, in one form of the present invention the advantages of the integrally molded resistance track, which is characterized by the dispersion of conductive particles within a defined area of an insulating resin, are made available in a compact variable resistor of rectilinear form. The desired electrical characteristics, above stated, as well as other advantages of this form of resistor are thus presented in the rectilinear form.

It is a particular purpose of the invention to provide a rectilinear variable resistor that is compact for use in printed circuits where it is required to have a variable resistor that may be adjusted to compensate for the errors in value and tolerances of other circuit components. A resistor that will reliably hold its value is made available, and a resistance element may be used which is mechanically rugged and not subject to open or short circuits.

In one preferred form of the invention terminals are extended normal from a face of the resistor housing for ready insertion in a printed circuit board. Solder connections can then readily be made and rapid assembly of a circuit network is thus facilitated. The use of the resistor in this manner is enhanced by the provision of mounting feet integrally formed as a part of the base incorporating the resistance track. The mounting feet maintain a physical separation between the resistor housing and the wiring board upon which the resistor is mounted. Moisture is thus prevented from accumulating between board and resistor by capillary action. It is preferable that such mounting feet surround the terminal leads, thereby lending mechanical support to the leads.

The resistor of this invention may also include a contact carrier on the lead screw that has a slipping engagement with the screw whenever it approaches either end of its path of travel. A rectilinear variable resistor is, by its very nature, an adjustable resistance that must hold its adjustment for satisfactory circuit operation. In some applications an adjustment is quite permanent, and after being set an adhesive may be applied between the lead screw head and the adjacent case. In other applications adjustments may be more periodic, and the lead screw itself must retain its position. It is customary to

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have a sufficient frictional restraint on the lead screw to hold an adjustment, even under severe mechanical shock and vibration. Hence, a substantial torque, for the size of the device, is customarily required for turning the adjustment screw, and if an operator has caused the contact carrier to reach one end of its travel, and he is not careful, continued turning may strip threads and render the device useless. In the present invention the threaded engagement between lead screw and contact carrier is such that slippage occurs if the contact carrier is moved into the terminus of its travel and rotation of the lead screw is continued in like direction. A reversal of the lead screw rotation will pick up the contact carrier and move it out of the terminal position.

It is an object of the present invention to provide a screw driven, linear motion, variable resistor assembled in a case that is enclosed by an integrally molded element comprising a resin base, resistor and collector tracks in the base and appropriate terminals.

It is another object of this invention to provide a three-point conducting contact adapted for movement in a straight line motion, which contact is maintained in electrical engagement with the resistor and collector tracks by means of an improved carrier that includes a non-current carrying resilient contact bias.

It is another object of this invention to provide a slip engagement between a lead screw and a contact carrier of a linear motion variable resistor.

It is a further object of this invention to provide a compact rectilinear variable resistor having enhanced electrical characteristics.

Still another object of this invention is to provide a variable resistor that may be advantageously manufactured.

A further object of the invention is to provide a rectilinear variable resistor that has improved contact means engaging the resistance track.

The foregoing and other objects and advantages of this invention will appear from the following description. In the description reference is made to the accompanying drawings which form a part hereof, and in which there is shown by way of illustration and not of limitation particular forms in which the invention may be embodied.

In the drawings:

FIG. 1 is a perspective view of a variable resistor which embodies the present invention,

FIG. 2 is a view in longitudinal cross section of the apparatus shown in FIG. 1, as viewed through the plane 2—2,

FIG. 3 is a view in section taken on plane 3—3 of FIG. 2,

FIGS. 4, 5 and 6 are views in cross section taken at spaced intervals through the planes 4—4, 5—5 and 6—6, respectively, of FIG. 2,

FIG. 7 is a plan view of the interior surface of the base member which discloses resistance and collector tracks integrally molded in the base,

FIG. 8 is an enlarged fragmentary view in section illustrating the lead screw and the contact carrier in threaded engagement therewith,

FIG. 9 is an exploded view in perspective of the contact carrier, bias spring and contact of the apparatus,

FIG. 10 is a view in perspective of an alternate form of contact carrier and bias member,

FIG. 11 is a view in perspective of another embodiment of the invention in which the contact carrier is rendered visible, and in which the molded resistor base is removed from the case for purposes of clarity,

FIG. 12 is a view of another embodiment of the invention in which the casing acts as a metallic shield, and as in FIG. 11 the base is removed from the casing for clarity,

FIG. 13 is a plan view of another form of base in which a film resistance track is employed, and

FIG. 14 is a view in section of the base of FIG. 13.

Referring now to the drawings, there is shown a variable resistor, suitable for use as a rheostat or potentiometer, having a box-like case 1 of elongated rectangular configuration formed from an appropriate molding resin, such as a phenol condensation composition or a methacrylate resin. The case 1 has a bottom wall 2, side walls 3, 4 and thickened end walls 5, 6 which define a hollow interior. Longitudinally spaced transverse openings 7 and 8 are provided in the end walls 5, 6 of the case 1 for the purpose of facilitating mounting of the resistor. A longitudinal opening 9 also extends through the end wall 5 to serve as a bearing, and a vertical slot 10 in the end wall 6 has a curved bearing surface 11 which is in alignment with the opening 9. A ledge 12 extends about the inner sides of the upper edges of both the side walls 3, 4 and the end walls 5, 6, to thereby form a seat that rings the opening of the box-like case 1. Seated on the ledge 12 is a molded base 13 that serves as a cover enclosing the interior of the case 1. The construction of the base 13 will be more fully described hereinafter.

The case 1 rotatably supports a lead screw 14 that has a journal portion 15 bearing upon the surface of the opening 9 and an inner end 16 bearing upon the curved surface 11 of the groove 10. The lead screw 14 is restrained from axial displacement relative to the case 1 by means of a slotted retaining plate 17 that straddles a reduced diameter portion 18 of the screw 14. The plate 17 fits snugly between the bottom wall 2 and the base 13 so as to be held captive upon assembly of the base 13 into the case 1.

The outer end of the opening 9 is enlarged to receive a resilient O-ring 19, which bears against a washer 20 disposed between the outer surface of the end wall 5 and a slotted head 21 for the lead screw 14. The O-ring 19 serves as a seal and also acts to take up endwise play of the screw 14.

The threaded portion of the lead screw 14 is preferably sub-divided into three adjacent sections. A central section 22 has a standard full thread, and this section is flanked by end sections 23, 24 that are characterized by a reduced outer thread diameter. FIG. 8 clearly shows the end section 24 with its characteristic flattened threads, and this is seen to be in contrast to the portion of the adjacent center section 22 that also appears in FIG. 8. To achieve the desired thread arrangement the lead screw 14 may first be made in accordance with standard threading procedures to initially provide a continuous full thread encompassing all three sections 22, 23, 24. The reduced diameter sections 23, 24 may then be formed by a grinding operation that reduces the major thread diameter, as more clearly shown in FIG. 8. Other means of forming the special threads may also be used. For example, the threads may be roled in final form, or the screw diameter at the end sections 23, 24 may be reduced before threading.

A contact carrier 25 is mounted upon the lead screw 14 and is in threaded engagement therewith, so that upon rotation of the screw 14 the carrier 25 may be moved axially within the interior of the case 1. The carrier 25 is shown in perspective in FIG. 9, wherein it is seen that it is of a generally blocklike configuration with a threaded opening 26 which includes a keyhole slot 27 along the entire underside of the carrier. The carrier 25 is thereby bifurcated so that there may be a slight separation of the opposite sides of the threaded opening 26. The length of the carrier 25 is slightly less than the axial extent of the threaded sections 23, 24 of the lead screw 14, and in FIG. 8 the relative length of the carrier 25 is shown with respect to the length of the threaded end section 24. With the foregoing construction the carrier 25 may be moved against one of the end walls 5, 6 and a continued rotation of the lead screw 14 will only produce a slippage between the carrier 25 and screw 14 without any attend-

ant damage of the threaded parts. With the carrier 25 against an end wall 5 or 6, it is riding upon a portion of the screw 14 that is of reduced outer diameter. A rotation of the screw 14 which continues to urge the carrier 25 into the adjacent end wall will cause a slight spreading of the lower bifurcated portion of the carrier 25 and slippage will result. Upon reversing the rotation of the screw 14 the screw threads will pick up and engage the carrier 25, so as to move the same towards the opposite end of the resistor. Thus, the invention provides slippage between the threaded parts which eliminates damage to the threads as has occurred in devices heretofore obtainable.

Referring again to FIG. 9, it is seen that the upper portion of the carrier 25 has a rectangular recess 28 defined by end ridges 29, 30 and partial side ridges 31, 32 and 33 which are of less height than the end ridges 29, 30. A contact bias spring 34 formed from sheet material is seated in the recess 28. A set of three raised spring fingers 35, 36 and 37 are formed in the spring 34, each of which overlays a gap in the side ridges 31-33. Seated upon the raised fingers 35-37 is a flat backed rectangular contact 38 presenting a set of three raised contact points 39, 40 and 41 which directly overlay the spring fingers 35-37. The contact 38 is preferably of a hardened graphite and it is seated between end ridges 29 and 30 of the contact carrier 25 to be carried with the contact carrier 25.

As shown more specifically in FIGS. 2 and 5, the contact points 39-41 of the contact 38 bear upon the under surface of the base 13, such that the spring fingers 35-37 are compressed to create a substantial engaging force between the contact 38 and the base 13. The tripodal engagement presented by the spring fingers 35-37 with the flat back of the contact 38 is a stable engagement that precludes tipping of the contact 38, and which restrains the carrier 25 from turning with the lead screw 14. The carrier 25 will therefore retain its upright position, as shown in the drawings, as the screw 14 is rotated, and hence the contact 38 serves both the function of an electrical contact sliding along the base 13 and of retaining the carrier 25 in position.

In FIG. 10 there is shown an alternative form of contact carrier 42. It is characterized by a circular recess 43 on the upper face which seats a bias member 44 of resilient compressible material. Such material may be non-conductive, since in the present invention the contact 38 is the sole member of the movable contact assembly that need carry current. The carrier 42 also has a keyhole slot 45 at the bottom of a width equal to the threads. In this form, it is not necessary to have the bifurcated lower portions of the carrier 42 expand sidewardly as slippage occurs with the lead screw 14. The carrier 42 can slip by rising with respect to the screw 14.

The base member 13 is of insulating material preferably formed of molded synthetic resin and incorporates an integral resistance track 46 and collector track 47. The tracks 46, 47 are formed by dispersing conducting material, such as carbon particles, in the resin preparatory to molding. The amount of carbon determines resistance value, and the carbon is confined to shallow layers with exposed surfaces, as particularly shown in FIGS. 2, 4-6 and 7. Hence, the conductive tracks 46, 47 are an integral co-molded part of the insulating base 13.

As shown in the drawings, the base 13 is of thin cross section and when seated on the ledge 12 forms a cover, or top wall, for the supporting case 1 such that these two components complete a fully enclosed housing that is dirt and water tight. To retain the base 13 in assembled position a pair of pins 48 are employed which are inserted in appropriate openings in the end walls 5, 6 with a tight fit and which protrude into appropriate grooves of the base 13 to overlay the base and restrain it from movement relative to the case 1. A suitable sealer may also be coated over the mating edges of the base 13 and case 1 to improve the seal and to further cement the base 13 in position.

With the base 13 in assembled position the resistance

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track 46 is engaged by the single contact point 39 and the collector track 47 is engaged by the pair of contact points 40, 41. The tripodal engagement of the contact 38 with the base 13 enhances stability whereby a free floating contact may be utilized. The contact 38 is further characterized by a rectangular form, whereby engagement with the transverse ridges 29, 30 of the carrier 25 insures a proper axial travel for the contact.

Terminals 49, 50 and 51 are embedded in the base 13 at the time of molding, and extend through the exterior side of the base 13 for suitable connection with the conductive tracks 46, 47. Terminals 49, 50 are at opposite ends of the resistance track 46 and terminal 51 is in electrical junction with the collector track 47. A pair of stand-off feet 52, 53 are molded as an integral part of the exterior of the base 13, upon which the resistor may be mounted when assembled in a circuit. In this manner moisture will not be collected between the resistor and a board upon which it may be mounted. By placing the feet 52, 53 about the terminals greater strength is imparted to the base construction.

Referring now to FIG. 11 there is shown therein a variable resistor similar to that of the other figures, with the principal exception that the case 54 in FIG. 11 is transparent. Adjustment of the resistor is greatly facilitated by providing vision of the contact carrier, which in FIG. 11 is designated by the same numeral 25, as in FIGS. 2-5, 8 and 9. A technician adjusting a circuit can readily grasp a sense of adjustment direction when he is afforded a visual inspection. The base 13' for the resistor of FIG. 11 is shown to the side of the case 54. The base 13' is of an alternative form in which pins 55, 56 and 57 are employed as terminal leads, and a mounting foot 58 in the form of a boss encircles each pin 55-57.

Referring now to FIG. 12, there is shown a case 59 formed of metal which acts as a shield to the interior. This case 59 is of like configuration as the other cases 1, 54 and may be suitably formed by a die casting process. It is further contemplated that the case may be formed of other materials, such as a ceramic, where the properties of such materials are particularly desired. The metallic shielding case 59 has a ledge 60 to receive a resistance base 61. The base 61 of FIG. 12 has a pair of resistance tracks 62, 63 running parallel to one another. These tracks may be a carbon film secured to the base 61, or some other form of resistance material such as a co-molded track as used in the base 13. At each end of each of the tracks 62, 63 there is a terminal 64, so that a four terminal network is provided by the base 61. A dual potentiometer is thus made available. The two resistance tracks 62, 63 may have different values of resistance, and one may be very low so as to act as a collector track.

A movable contact brush 65 is shown in FIG. 12 with a pair of contact toes 65', one toe being provided for each track 62, 63. The contact brush 65 has a flat back, and stability is thereby achieved, as in the instance of the contact brush 38.

The versatility of the invention is illustrated by reference to FIGS. 13 and 14, wherein a glass base 66 having a deposited metal film resistance 67 and a metal collector track 68 is shown. Appropriate leads 69 are secured to the resistance 67 and track 68, and the base 66 is of a dimension that it may be inserted in any of the illustrated cases 1, 54, 59. Hence, the advantages of precision metal film resistors may be availed of in a rectilinear variable resistor. When employing a metal film the portion of the movable contact engaging the film is formed of a compatible material, or may be coated with a material such as platinum or some other precious metal. It is apparent from the foregoing descriptions that an important aspect of the invention is the provision of a case which mounts the moving elements of a recti-

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linear variable resistor, and which presents a ledge to receive a resistance track base of simple rectangular configuration. The base and its resistance, in turn, can be composed of any of several materials, whereby, a novel interchangeability of base and resistance is achieved.

The foregoing specification, together with the accompanying drawings, discloses a novel rectilinear variable resistor having the several advantages as discussed. The specification is not intended as being definitive of the scope of the invention, but rather as a means of setting forth exemplary specific illustrations. The scope of the invention is to be more fully understood and defined by the following claim, which is deemed inter alia as entitled to a range of equivalents.

We claim:

In a rectilinear variable resistance the combination comprising: a molded case having a bottom, side walls and end walls to present a housing closed at its bottom and along its sides with an open top and hollow interior, said walls being stepped downwardly at their upper, inner edges to form a recessed ledge extending along the open top that presents a seat for receiving and positioning an enclosing base, said molded case also having a bearing opening paralleling said recessed ledge which extends through an end from the exterior to said hollow interior at a point near said case bottom; a rotatable lead screw extending through said bearing opening and across said hollow interior with a journal portion in bearing engagement with said bearing opening to be held in fixed relation with said case; a molded enclosing base that seats upon said recessed ledge and has a close fit with the upper edges of said side and end walls to cover the open top of said case, said base having resistance and collector tracks parallel to one another which are of dispersed carbon particles integrally molded therein, which tracks have their surfaces coplanar with the recessed ledge of said case; a contact carrier within said case in threaded engagement with said lead screw for movement longitudinally along the lead screw, said contact carrier having a spring seat facing said base of a rectangular configuration defined by ridges rising toward the base which are located at the longitudinal ends thereof, with the ridges at an end being disposed transversely toward the side walls in positions closely adjacent such side walls; a rectangular contact brush seated between said ridges to be moved longitudinally with the contact carrier upon a turning of said lead screw, which brush has a set of three raised contact points in engagement with said tracks, such contact points having both transverse and longitudinal spacing with respect to one another for stable engagement with said base; and a bias spring interposed between said spring seat of said carrier and said contact brush to urge the brush against said base, which spring has a plurality of raised spring fingers spaced both transversely and longitudinally with respect to one another for stable engagement with both said contact carrier and said contact brush.

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