May 26, 1964 W. T. HARDISON ETAL 3,134,955

POTENTIOMETER

Filed Feb. 19, 1962 2 Sheets-Sheet 1

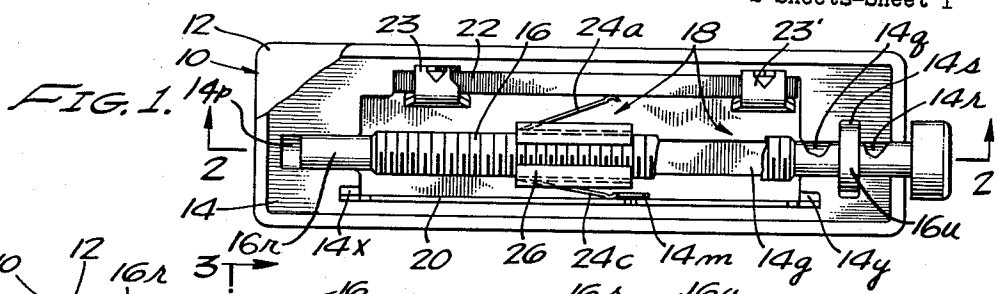


FIG. 1.

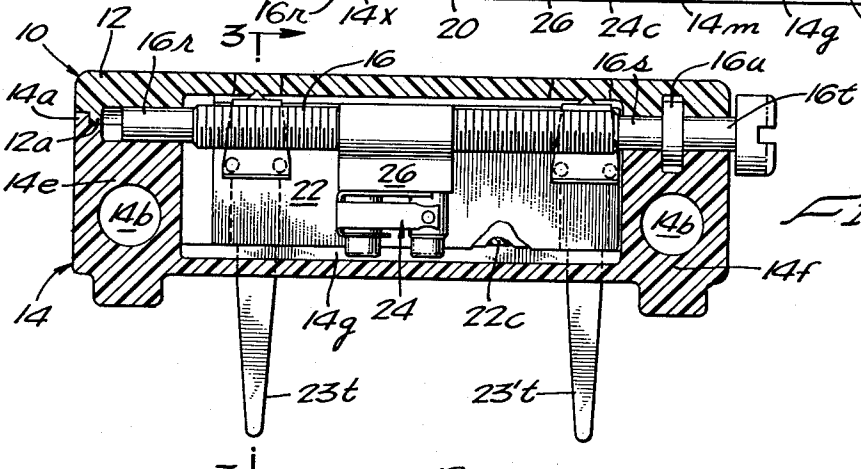


FIG. 2.

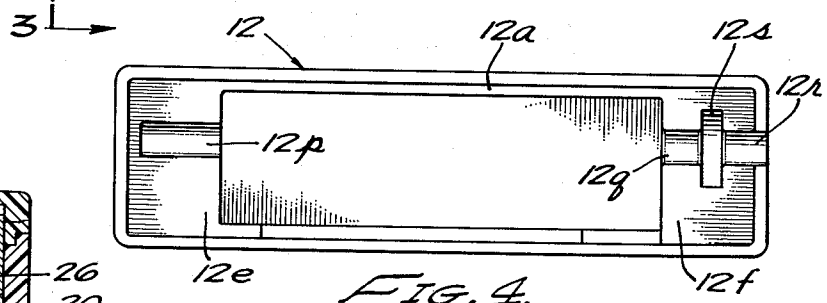


FIG. 4.

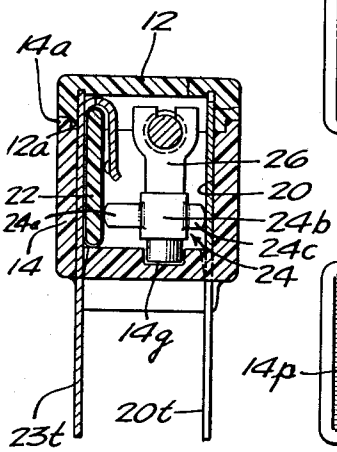


FIG. 3.

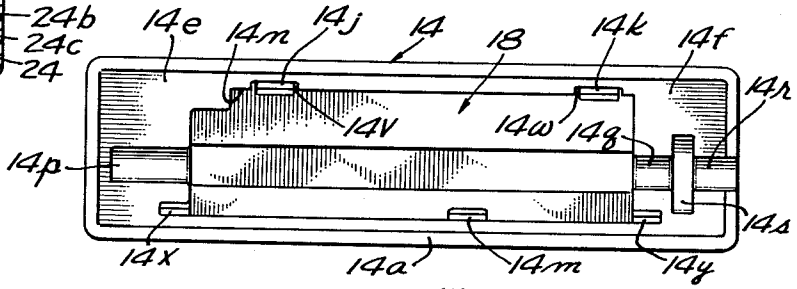


FIG. 5.

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POTENTIOMETER

Filed Feb. 19, 1962 2 Sheets-Sheet 2

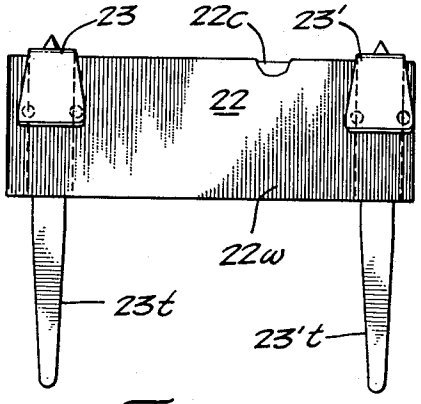


FIG. 6.

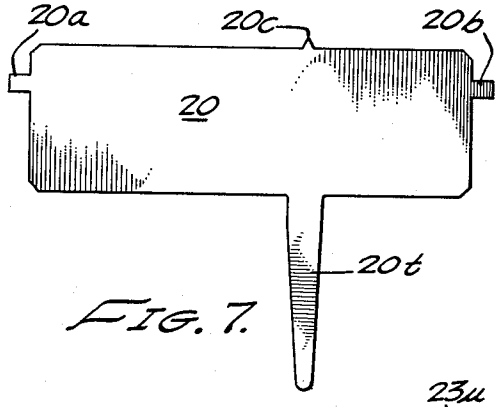


FIG. 7.

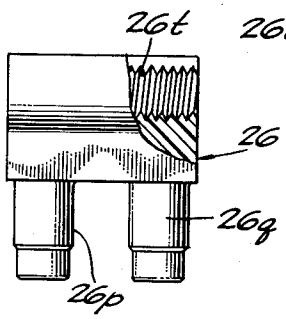


FIG. 8.

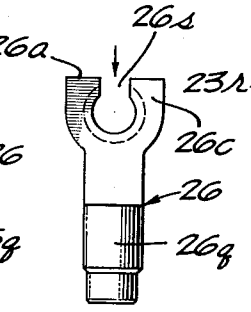


FIG. 9.

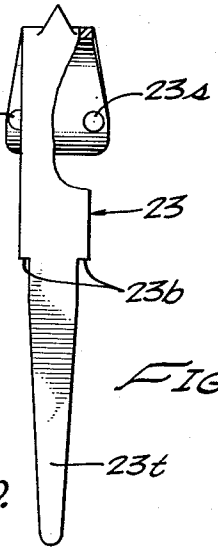


FIG. 10.

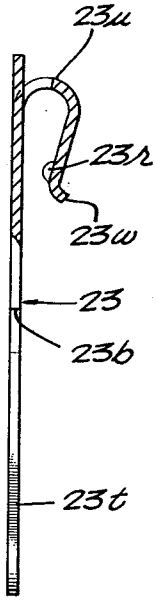


FIG. 11.

FIG. 12.

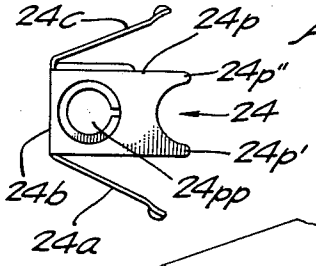
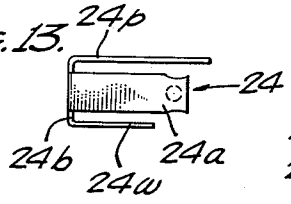


FIG. 13.



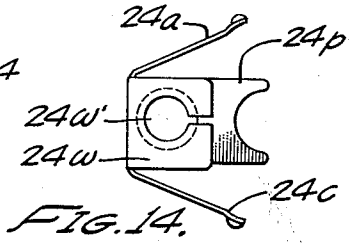


FIG. 14.

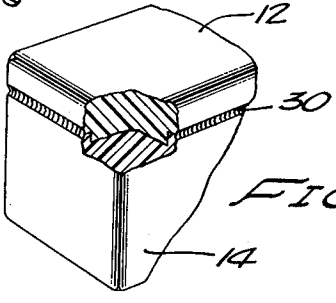


FIG. 15.

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United States Patent Office 3,134,955 Patented May 26, 1964

3,134,955

POTENTIOMETER

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Filed Feb. 19, 1962, Ser. No. 173,977
15 Claims. (Cl. 338—180)

This invention pertains to potentiometers and more specifically resides in improvements in potentiometers of a class termed "miniature leadscrew-adjusted potentiometers."

Several types of small leadscrew-adjusted variable resistors or potentiometers are known in the art, and all are characterized by one or more features of construction or assembly that results in those devices being expensive to manufacture. Essentially, a potentiometer of the type here of interest comprises an elongate resistance element, a movable member comprising a contact arranged for wiping contact with the resistance element, a leadscrew cooperating with the movable member and effective when rotated to move the contact along an extent of the resistance element, electrical connecting means such as an electrical return bus and terminals or conductive means providing electrical access to the contact and to end portions of the resistance element, and supporting means usually in the form of a case or housing by which the other essential parts are supported and, in most instances, enclosed for protection against external agents.

The present invention utilizes several novel features of construction and assembly, by means of which the size and cost of manufacturing a leadscrew-adjusted potentiometer of the indicated class are considerably reduced. As is well known to those experienced in arts in which reduction of size or so-called miniaturization of instruments has been carried to great lengths, a stage is reached at which great difficulties are experienced in forming parts that are sufficiently strong and rigid when reduced to the desired size, and in maintaining requisite spatial arrangements to insure electrical isolation of parts subjected to differing electric potentials, etc. As is well known, miniaturization involves much more than simple scale-reduction of parts of a standard-size instrument. Parts that are long and slender in standard instruments, when subjected to scalar reduction in size, lose required rigidity, for example. The spacing of electrically isolated parts may not in many instances be reduced at all lest electrical break-down result. Similarly, containers or housings that in standard-size instruments are strong and rigid, become flimsy and entirely unsuitable when subjected to scalar reduction. Further, as is usual when physical dimensions of instruments are reduced, difficulties in making and assembling components into complete instruments increase. Manipulation and assembly of individual parts becomes markedly more difficult and more expensive as the parts become so small that direct manual handling is impractical. At that stage of miniaturization of instruments, assembly under magnifiers and with manipulation of parts by tweezers and like tools becomes standard practice. Obviously such operations are relatively expensive.

The present invention, by reduction of the number and complexity of parts and by employing novel shapes and proportions of parts, and novel arrangements of parts, provides a miniature leadscrew-adjusted potentiometer that is composed of few and relatively inexpensive parts, that is easily and inexpensively assembled, and is exceptionally strong and durable despite its very small size. The body or housing of the instrument is made inexpensive by forming parts by simple molding techniques, and is made strong despite being dimensionally small, by being formed as a two-piece box the pieces of which act in mutual reinforcing relation and which become fusion-united

to form what is in effect an integral hollow case or housing. Effective but simple and economical electrical isolation of parts subjected to maximum differences of potential is attained in part by positioning those parts against opposite walls in the box or housing, while at the same time shaping and arranging at least certain of the parts so they perform dual functions whereby each may be somewhat reduced in dimension. Assembly is greatly facilitated and made inexpensive partly by reducing the number and complexity of parts and forming the housing and the operating parts so the latter may be quickly and very easily slipped or dropped into position in the housing whereby assembly of the parts may be performed alternatively by automatic machine or by hand; and partly by so forming individual parts that they are not only easily and inexpensively made but also are easily combined into sub-assembly form for insertion into the housing. For example, installation of the contact-carrying member or slider onto the adjusting leadscrew is effected by a simple push or squeeze action, and the leadscrew and cooperating support means of the instrument case are so constructed and arranged as to permit the leadscrew to be merely pressed into position. The resistance element and electrical connections to the end portions thereof are so constructed that the electrical connectors serve both as leads and as first and second respective pin-like external terminals. The connectors are assembled by merely pressing them onto the resistance element; and the thus completed subassembly and the instrument case are so constructed and arranged that assembly of the element and terminals into the case is effected by a simple pressing operation performed alternatively by the fingers of an assembler or by a ram of an automatic machine. The terminal pins are so made that they automatically produce electrical connections with the resistive part of the resistance element as they are pressed into place on the element. The electrical return conductor or bus, between which bus and the resistance element the movable contact makes spatially variable electrical connection, comprises an integral limb or spike which serves as an external terminal and to secure the bus in position, and the bus is constructed and arranged to cooperate with one wall of the case to reinforce the latter. Further, the bus is so shaped that it may be assembled with the case by a simple pressing action by hand or by machine. The slider or contact-carrying member is formed as a simple injection-molded piece which despite having a threaded portion somewhat similar to a half-nut, is constructed and arranged to expand and slip relative to the thread of the leadscrew when further travel along the latter is impeded or prevented, as, for example, when the member contacts a stop or end wall of the case. Thus over-turning of the leadscrew does not result in jamming of the slider and resultant damage to parts of the instrument. The housing or case of the instrument comprises essentially a box-like base into which the electrical and operating parts of the instruments are disposed, and a cap or cover which is constructed and arranged to mate with the base and to be fusion united thereto. The cover is provided with half-bearings complementing similar half-bearings formed in the base, for retaining and rotatably supporting the leadscrew. The base and cap or cover may be formed as injection-molded parts composed of thermoplastic insulative material whereby a simple heat-sealing or fusion operation may serve to secure the two parts together and concurrently effect a seal to preclude passage of foreign material into the case. By the described means and modes it has been made possible to produce an exceptionally inexpensive miniature instrument without sacrifice of reliability or other desirable characteristic of instruments of the type here of interest. A typical potentiometer according to the invention is very

small (of the order of one inch long, one-fourth inch wide, and five-sixteenth inch in depth).

The preceding brief description of the invention makes it evident that one object of the invention is to provide improvements in leadscrew-adjusted potentiometers.

A more specific object of the invention is to provide potentiometer components so constructed and arranged that manufacture and assembly of the components are facilitated and made less expensive.

Another object of the invention is to provide a potentiometer that is easier and cheaper to manufacture than are its counterparts in the prior art.

Another object of the invention is to provide a simple miniature leadscrew-adjusted potentiometer.

Another object of the invention is to provide in a potentiometer a simplified component, whereby assembly of the potentiometer is facilitated and the cost of manufacture is decreased.

Other objects and advantages of the invention will hereinafter be set out or made apparent in the appended claims and the following description of a preferred embodiment of the invention as illustrated in the accompanying drawings which illustrate the device and components thereof and comprise a part of this specification. In the drawings:

FIGURE 1 is a top or plan view of a potentiometer, with a portion of the cover or lid broken away to reveal interior details;

FIGURE 2 is a longitudinal sectional view of the case or housing of the potentiometer depicted in FIGURE 1, taken as indicated by line 2—2 of FIGURE 1, with operating components assembled in place, and details;

FIGURE 3 is a transverse sectional view of the potentiometer illustrated in FIGURE 1, taken on a plane and in a direction indicated by line 3—3 in FIGURE 2;

FIGURE 4 is a view of the inside face of the lid or cover of the case or housing of the device depicted in FIGURE 1;

FIGURE 5 is a top or plan view of the box or base portion of the potentiometer case, prior to insertion of operating components;

FIGURE 6 is a detail view of a resistance element device depicted in part in FIGURE 1;

FIGURE 7 is a detail view of a collector plate or return conductor and integral terminal, comprised in the potentiometer;

FIGURE 8 is a face view of a contact-carrier or slider comprised in the potentiometer, with a portion broken away to show a detail;

FIGURE 9 is an end view of the contact-carrier or slider shown in FIGURE 8;

FIGURE 10 is a rear view of a multiple-function termination clip comprised in the potentiometer, with a portion broken away to reveal a detail;

FIGURE 11 is a side view of the clip depicted in FIGURE 10 with a portion broken away to illustrate a detail;

FIGURES 12, 13, and 14 are top, side, and bottom views, respectively, of a contact comprised in the potentiometer; and

FIGURE 15 is a fragmentary sectional view of a part of the juncture of the lid or cover with the box or base of the potentiometer case, illustrating the mode of securing the two together and sealing the case against ingress of foreign matter.

It being an important object of the invention to provide a durable but inexpensive variable resistor of high quality and excellent reliability but of very small size, the structure or device is of necessity simple and composed of parts that are very easily assembled despite being of small dimensions. The device must be simple (a minimum number of parts and each part of simple construction) since space for parts is at a premium in a miniature instrument and since in general the cost of parts that are not easily and inexpensively formed is such as to preclude attainment of an inexpensive instrument. Further, the parts must be so formed and proportioned that they may be easily assembled in precise predetermined structural juxtaposition, if reliability and desirable uniformity (alikeness) are to be attained. In the present invention precision of placement of parts in proper cooperative relationship without loss of desirable electrical and structural-strength characteristics and with an attendant decrease in cost of components and assembly, is attained in part by a novel construction of the housing or case in which the operating components are disposed, and in part by the shapes and other characteristics of the individual operating components.

The housing or case in which the operating parts are principally disposed is produced from two inexpensive but ingeniously formed moldings produced from suitable insulative material such as a synthetic resin or the like (for example, a material sold on the market under the trade name "nylon"). Referring now to FIGURES 1, 2 and 3, the housing, **10**, is constructed from and initially comprises a lid or cover **12** and a box-like base **14**. As indicated in FIGURES 2 and 3, the upper edge face of the base and the lower periphery of the lower face of the cover are formed with cooperating projections or lips **12***a* and **14***a*, respectively, so shaped and disposed as to permit easy and accurate placement of the cover on the base. The base **14** is formed with relatively thick endwalls **14***e*, **14***f*, each of which is provided with a respective one of bores **14***b* (FIGURE 2) extending transversely through the base for reception of screws or other hardware employed in affixing the resistor to other means with which it is to be used. Alternatively the potentiometer may be secured in place in apparatus by using the terminals for mounting purposes. The thick endwalls further provide facilities for the reception and accurate positioning of a leadscrew **16** by means of which adjustments of the resistance offered by the instrument are effected, and of a collector device forming one part of the electrical components of the instrument.

Thus as indicated in FIGURES 1, 2 and 5, endwall **14***e* of the base has formed therein a trough-like depression or recess **14***p* of semi-cylindrical configuration and adapted to receive and provide one-half of the bearing surface for the inner reduced end **16***r* of the leadscrew **16**. Similarly, the opposite endwall **14***f* of the base is provided with a pair of aligned semi-cylindrical recesses **14***q*, **14***r*, formed to receive and rotatably support respective smooth-surfaced portions **16***s*, **16***t*, of leadscrew **16**; and is provided with a larger semi-cylindrical recess **14***s* adapted to receive a stop-head **16***u* of the leadscrew. As indicated in FIGURE 1, recess **14***s* is somewhat larger in diameter than the stop-head **16***u*, whereby the leadscrew may more readily be caused to become properly oriented and positioned when dropped or otherwise lowered into position on the base. As is evident from examination of FIGURES 2 and 4, cover **12** is provided with corresponding endwalls **12***e*, **12***f* and complementary semi-cylindrical depressions or recesses **12***p*, **12***q*, **12***r* and **12***s*, formed and disposed to receive respective cylindrical portions of the leadscrew **16** and thus act as upper half-shells of bearings for the leadscrew. Stop-head **16***u* of the leadscrew is of length such as to permit relatively easy rotation of the leadscrew and still prevent appreciable endwise movement relative to the housing **10**. Similarly the walls of the trough-like recesses in the cover and base of the housing are dimensioned to permit easy placement and free rotation of the leadscrew while preventing appreciable lateral or vertical displacements of the leadscrew relative to the housing. The "nylon" material of which the base and cover are preferably made, provides excellent antifriction properties for the bearings. Also, to facilitate assembly of the leadscrew into the base and to provide adequate longitudinal tolerance, recess **14***p* is, as shown, formed of length in excess of that required to accommodate the inner end **16***r* of the leadscrew; and recess **14***s*

is of greater radius than that of stop-head **16***u*, so the stop-head may easily rotate into position in the base.

Returning to description of housing base **14** (FIGURES 1 and 5), that box-like structure provides an elongate open space or cavity, **18**, bounded by walls dimensioned and shaped to receive and accurately position and guide operative parts of the potentiometer. Disposed along one inner sidewall of the housing is the lower portion of a plate-like conductive element **20** (FIGURE 7) herein termed a collector, small end tabs **20***a* and **20***b* of which are received in respective complementary recesses **14***x* and **14***y* (FIGURES 1 and 5) provided in respective endwalls **14***e*, **14***f* of the base **14**. As indicated in FIGURES 3 and 7, the upper edge of the collector **20** is provided with one or more small sharp protrusions (such as **20***c*) each of which is adapted to "bite" or be pressed into the lower inside face of cover **12** when the cover is applied to the base. Obviously, complementary recesses (not shown) may be provided in the lower face of the cover **12**. The collector is provided at its lower edge, intermediate its ends, with a depending tapered spike or limb **20***t*, which serves the dual functions of providing an integral electrical terminal **20***t* and a means for retaining the collector in place in the base. As indicated in FIGURES 3 and 5, terminal limb **20***t* is adapted for easy downward insertion into and through a complementary tapered aperture **14***m* (FIGURE 5) provided in the floor of base **14**. The base **14** is, as noted, preferably molded of a slightly elastic material such as "nylon," and aperture **14***m* and others to be presently mentioned may be accordingly formed with one tapered sidewall and two tapered endwalls and with the lower face dimensions of the aperture very slightly smaller than the corresponding dimensions of the terminal limbs they are adapted to receive and retain, whereby entry of a spike or terminal is facilitated and the latter is gripped and held in place. By the described construction of complementary parts and surfaces, collector **20**, as a simple flat stamping, is not only very inexpensive to produce but is very easily and inxepensively pressed into position in base **14**, where it is held in reinforcing relation to the sidewall of the base and wherein terminal limb **20***t* seals aperture **14***m* by slight elastic deformation of the material at the lower end of the aperture. Also, it is noted that the integral terminal limb **20***t* serves, with tabs **20***a* and **20***b*, to maintain the collector securely in place in the box.

An elongate thin flat resistance element **22** which comprises essentially a card **22***c* (FIGURES 2 and 6) and resistive material (for example, and as illustrated, a winding of spaced turns of resistance wire **22***w*) thereon, is disposed in an elongate depression or recess **14***n* (FIGURE 5) in the sidewall of base **14** opposite collector **20**. By such arrangement a maximum of electrical spacing is provided between the collector conductor **20** and the resistance element **22**. The core or "card" of the resistance element may be made from any of several easily formed, durable, insulative materials not adversely affected by the heat produced in the resistive material during operation of the potentiometer. For example, ceramic such as steatite, or rigid synthetic resins not susceptible to serious degradation by heat, may be used, depending upon the service to which the potentiometer is to be applied. The resistance element is both terminated and held firmly in position in the base **14** by first and second substantially identical spring termination clips **23**, **23'** (FIGURES 1, 10 and 11).

As is indicated in FIGURES 10 and 11, each termination clip is formed with a dependent tapered lower end portion **23***t* and a reversely bent upper end portion **23***u* which serves as a spring clamp. The lip or wing of the clamp is formed with a beveled or outwardly flared free end **23***w* (FIGURE 11), whereby the clip may be readily pressed onto the resistance element into the relative position indicated in FIGURES 3 and 6. When thus pressed onto an end portion of the resistance element, the respective end portion of the element is automatically electrically connected to the depending terminal end **23***t* of the clip by action of either or both of a pair of protuberances **23***r*, **23***s* (FIGURE 10) provided on the inner face of the clamping leaf of the clip. The protuberances, formed by a simple punching operation, are by spring action firmly pressed against the resistive material to make electrical contact, and firmly clamp the element against the adjacent surface of the long limb of clip **23**. Thus when the tapered lower limbs or terminals of the clips are pressed downwardly through respective tapered apertures **14***j*, **14***k* (FIGURES 3 and 5) provided in the floor of the box or base **14** until shoulders or abutments such as those labeled **23***b* repose on the floor of the housing, the terminations are precisely spaced, and the resistance element is also firmly held in place in the recess **14***n* in the sidewall of the base. The central body portion of each termination clip is constructed to repose in a respective groove or slot **14***v*, **14***w* (FIGURE 5) formed in the sidewall of the box or case in alignment with a respective one of the apertures **14***j*, **14***k*, as is indicated in FIGURE 1. By the described means, assembly of the resistance element and termination clips into the base **14** is made simple and easy, and the resistance element is prevented from shifting under the influence of moving parts of the device and/or acceleration. The depending limbs **23***t*, **23***t'* of the clips extend outwardly (downwardly as shown) from the body of the potentiometer (FIGURE 2) and provide external pin terminals for the resistance element. Thus it is seen that each of the clips performs several functions, each formerly performed by a repective different part of a potentiometer. The terminations are dimensionally and electrically accurate and thus substantially the same in each of all like potentiometers, promoting desired uniformity of product.

Disposed for yielding wiping contact with the collector **20** and the resistance element **22**, and serving to provide a movable electrical interconnection between selected areas thereof, is a resilient contact **24** (FIGURES 2 and 3) made of a suitable resilient conductive material, such as copper-beryllium alloy. The contact **24** is mounted upon the carried by a contact-carrier or "slider," **26**, of insulative material, as will be presently explained and described. The slider **26** is constructed and arranged to move or traverse the contact **24** along an extent of the surface of the resistance element in response to rotation of the leadscrew **16**, upon which leadscrew the slider is mounted. As is indicated in FIGURES 12, 13 and 14, the contact **24** is formed from sheet material, by punching and deforming operations. From a somewhat rectangular body portion **24***b* there extend two diverging resilient contact arms **24***a* and **24***c*, an upper perforated anchor limb **24***p* provided with a pair of horns **24***p'* and **24***p''* and a keyhole-shaped perforation **24***pp*, and a lower slotted clamping limb **24***w* provided with a keyhole slot **24***w'*. The terminal ends of contact arms **24***a* and **24***c* are deformed to provide respective spherical-surface contact areas adapted (as indicated in FIGURES 1 and 3) to press oppositely against resistance element **22** and collector **20**, respectively.

The contact **24** is adapted, as is indicated in FIGURES 1–3, to be mounted upon and supported by slider **26** for movement along an appropriate extent of the resistance element **22** and in contact with collector **20**. To that end, slider **26** is provided at its lower face with a pair of depending cylindrical stepped posts **26***p*, **26***q* (FIGURE 8), the former of which posts passes through and is gripped in the perforation **24***pp* of contact limb **24***p* and by the keyhole slot **24***w'* of limb **24***w*, and the latter of which posts is tightly engaged by the horns **24***p'* and **24***p''* of limb **24***p*. The relative shapes and sizes of the perforations and slots, and the depending posts, are such that the contact must be forcefully pressed into place on the slider posts; the keyhole aperture, the keyhole slot, and the horns deforming the slightly elastic insulative ma-

terial of the slider posts and thus firmly securing the contact **24** on the slider **26** in the disposition illustrated in FIGURES 2 and 3.

The slider **26** is constructed and arranged to be supported by the leadscrew **16** and to be traversed along the leadscrew incident to rotation of the latter component. To those ends the slider is provided along its upper portion with a longitudinally extending C-shaped slot **26*s*** (FIGURE 9), the interior curved surface of which is preferably provided with lands and grooves, such as those indicated at **26*t*** in FIGURE 8, of shape and pitch complementary to the thread of leadscrew **16**, as is indicated in FIGURES 3 and 8. The tough resilient insulative material ("nylon" for example) of which the slider is made permits the leadscrew **16** to be pressed straight into the slot **26*s*** in the direction indicated by the arrow point in FIGURE 9; the portions or "horns" **26*a*, 26*c*** of the slider elastically deforming during the pressing operation and springing back to firmly engage the leadscrew. Following assembly of the slider onto the leadscrew, the contact arms of contact **24** are pressed toward each other and the leadscrew dropped into position in base **14**. The slider being then disposed between the collector and the resistance element, the contact arms are then released to spring into the attitude indicated in FIGURE 3. Rotation of the slider incident to rotation of the leadscrew is prevented by sidewise engagement of the posts **26*p*** and **26*q*** of the slider with the sideawlls of the longitudinally extending groove **14*g*** (FIGURE 3) formed in the floor of the potentiometer base **14**.

The preceding description makes it evident that with the operating parts secured in place as depicted in FIGURES 1–3, rotation of leadscrew **16** results in application of traversing effort to slider **26**. The reaction force is applied by stop-head **16*u*** of the leadscrew to the case of the potentiometer, and the slider is moved in one or the other direction along the leadscrew, and successive different portions of resistance element **22** and collector **20** are progressively electrically interconnected by contact **24**, whereby the resistance exhibited between terminal **20*t*** and terminal **23*t*** (or **23*t'***) is varied. The previously described operating parts, assembled as described and indicated, are maintained in place as described with the aid of cover or lid **12**. With the operating components in place, the cover is dropped into place on body **14**, and while clamped to the latter is secured thereto preferably by heat-sealing around the exterior line of contact of those two housing members, as indicated at line **30** in FIGURE 15. While adhesive means may be used in certain instances to secure the lid to the body, danger of getting adhesive into the interior of the housing, where it may interfere with proper operation of the device, is avoided by fusion-uniting the lid and body by applying a hot tool along the exterior line of contact of the two, melting the synthetic resin of the lid and body along the line of juncture. Obviously such fusion together of the parts provides more effective exclusion of foreign material from the housing.

The preceding description further makes it evident that the illustrated instrument, by the special construction and arrangement of the parts, fully attains the mentioned objects of the invention. While a preferred construction and mode of fabrication and assembly have been described in detail, and preferred materials have been indicated, it is evident that changes and modifications will occur to those skilled in the art in the light of the present disclosure; and accordingly it is desired that the invention be not limited by the exact details shown and described but that the invention be construed as defined in the appended claims.

We claim:

1. A miniature leadscrew-adjusted potentiometer comprising:

first means, comprising an insulative housing having internal walls and comprising tapered apertures through a wall thereof, said housing comprising base and cover members constructed and arranged to interfit;

second means, comprising resistance-element means including a resistance element and first and second elongate spring termination clips conductively gripping said element, said termination clips having tapered end portions each extending through a respective one of said tapered apertures and gripped by said housing at said apertures;

third means, comprising an electric collector conductor and terminal means therefor extending from said housing;

fourth means, including movable means comprising resilient contact means movable along and in electrical contact with said resistance element and electrically connected to said collector conductor; and

fifth means, comprising rotary screw means, positioned and retained by said housing and engaging said fourth means and constructed and arranged for moving said movable means incident to rotation of said screw means.

2. A miniature leadscrew-adjusted potentiometer according to claim 1, said collector conductor and terminal means therefor being a plate-like structure with an integral elongate tapered extension forming the terminal means, and said extension extending through a respective tapered aperture through the wall of said housing and being gripped by said housing at said aperture.

3. A miniature leadscrew-adjusted potentiometer according to claim 2, said collector conductor comprising tabs, and said housing having internal recesses in which said tabs are firmly retained, and said collector being disposed against an internal wall of said housing in reinforcing relationship therewith.

4. A miniature leadscrew-adjusted potentiometer according to claim 1, said housing comprising a box-like base and a cover, said box-like base providing internal walls including first and second sidewalls and a floor, said resistance element being disposed against said first sidewall, said collector conductor being disposed against said second sidewall, and said fourth means being disposed between said collector and said resistance element with said contact means pressing each of said collector and said resistance element toward a respective one of said sidewalls.

5. A miniature leadscrew-adjusted potentiometer according to claim 1, said screw means comprising a cylindrical tip end, spaced-apart cylindrical head-end portions and a stop-head portion between said head-end portions; and said housing base and cover members each comprising integral half-bearings for the said cylindrical tip end and cylindrical head-end portions of said screw means and having stop shoulders for restraining axial movement of said stop-head portion of said screw means.

6. A miniature leadscrew-adjusted potentiometer according to claim 1, said movable means comprising a dielectric body having first and second protruding posts extending from one surface thereof and having means defining an elongate slot along the top thereof, said means defining said slot confirming generally to the exterior configuration of said screw means and closely engaging said screw means to support the movable means therefrom for traverse therealong incident to rotation of the screw means, said contact means closely gripping said posts to be thereby supported; and said base member being formed to provide an elongate trough parallel to said resistance element, into which trough the extremities of said posts extend for guiding engagement to prevent rotation of said movable means around said screw means incident to rotation of the latter.

7. In a miniature leadscrew-adjusted potentiometer, the combination comprising:

first means, comprising housing means including cover means and base means formed to provide an

enclosed space with first and second sidewalls and a bottom wall, leadscrew means, slider means and contact means, supported and adjusted by said slider means, said base means being formed to provide at least first and second spaced-apart tapered apertures extending through said bottom wall;

second means, comprising electrical return conductor means in the form of a collector plate constructed and arranged to be contacted by said contact means and mounted against a first of said side walls; and

third means, comprising an elongate resistance element and first and second conductive terminal clips therefor each having a respective spring-clamp conductively gripping a respective end of said element and each having a tapered extension extending through and tightly fitting in a respective one of said first and second spaced-apart tapered apertures and secured against the second of said side walls, said contact means comprising resilient contact arms pressing laterally against respective ones of said collector plate and said resistance element to aid in maintaining said second and third means in position in said housing means.

8. In a miniature leadscrew-adjusted potentiometer, the combination comprising:

first means, comprising housing means including base means and cover means, leadscrew means and slider means and contact means supported and adjusted by said slider means, said base means being formed to provide at least first and second spaced-apart apertures bounded by tapered walls;

second means, comprising electrical return conductor means in the form of a collector plate constructed and arranged to be contacted by said contact means; and

third means, comprising an elongate resistance element and first and second conductive terminal clips therefor each having a respective spring-clamp conductively gripping a respective end of said element and each having a tapered extension extending through a respective one of said first and second apertures and secured thereat by said base means, said base means comprising means providing a third tapered aperture, and said collector plate comprising an integral tapered terminal limb, said limb extending through said third tapered aperture and being gripped thereat by said base means.

9. A miniature leadscrew-adjusted potentiometer comprising:

first means, including housing means comprising a base and a cover constructed and arranged to interfit and produce an elongate substantially closed box-like structure providing an elongate chamber defined by sidewalls, endwalls and upper and lower walls, said lower wall being formed to provide an elongate trough-like groove disposed longitudinally of the chamber; and said housing means having bearing surfaces formed in respective end portions thereof;

second means, comprising screw means seated in said bearing surfaces and retained for rotation therein about an axis extending lengthwise of said chamber;

third means, comprising slider means yieldingly engaging and supported by and laterally removable from said screw means and constructed for traverse therealong incident to rotation of the screw means, said slider means comprising projections fitting in said trough-like groove and thereby being restrained by said base from rotation with said screw means;

fourth means, comprising electrical means including an elongate resistance element disposed at one side of said chamber and a conductive collector disposed at the opposite side of said chamber, said housing means retaining said resistance element and said collector in fixed position therein; and

fifth means, comprising contact means mounted upon said slider means and effective to contact and electrically interconnect said resistance element and said collector.

10. For a miniature potentiometer having an elongate adjusting leadscrew, an elongate resistance element disposed generally parallel to the leadscrew, and a collector conductor spaced from and opposite to said element and generally parallel thereto, with terminal means and electrical connections and housing means supporting the leadscrew, the subassembly comprising:

a slightly elastic insulative slider device comprising a body portion having first and second elongate lips providing a longitudinally extending open-faced slot along the upper portion thereof, and first and second depending post-like protuberances extending from the lower portion thereof, said lips being formed generally complementary to the surface of a leadscrew to be admitted therebetween and adapted to spread apart to receive and retain such leadscrew for support of the slider device by and upon the leadscrew;

and an integral resilient conductive contact device comprising a body portion and upper and lower spaced-apart limbs substantially at right angles to said body portion, and further comprising first and second divergent side contact arms, said upper limb encircling and gripping said first protuberance at the root thereof and tightly gripping said second protuberance at the root thereof, and said lower limb firmly gripping said first protuberance at a location spaced from said upper limb, whereby said contact device is firmly attached to said slider for movement therewith.

11. For a miniature potentiometer having an apertured housing base, an elongate adjusting leadscrew, a contact-carrying slider supported on and traversable by the leadscrew, and a terminated collector conductor disposed generally parallel to the leadscrew, the subassembly comprising:

an elongate resistance element adapted to be inserted into such housing base for engagement by the contact of the contact-carrying slider;

and first and second spring-clamp termination clips each disposed at a respective end of said resistance element and each having a respective reversely-bent end portion providing a beveled lip and said end portion forming an open spring-clamp having an element-terminating protuberance on the inner face thereof in gripping electrical engagement with said element, each of said clips including a terminal limb extending away from said open spring-clamp and disposed for insertion through a respective aperture of the housing to provide an external resistance-element terminal.

12. In a miniature leadscrew-adjusted potentiometer having an elongate leadscrew, an elongate resistance element disposed generally parallel to the leadscrew, terminal means for the resistance element, and a contact-carrying slider traversable by the leadscrew along and in wiping contact with the resistance element, the combination comprising:

housing means for supporting and protecting the operating parts of the potentiometer, said housing means comprising an open-top box-like base member and a complementary cover member, said base member being of slightly resilient molded material and being formed with first and second interior endwalls, first and second sidewalls and a floor wall, and said floor wall being formed with an outwardly converging tapered aperture in the floor wall thereof next adjacent said first sidewall and with first and second recesses in respective ones of said endwalls at the top thereof next-adjacent said first sidewall;

integral collector-conductor and terminal means comprising essentially an elongate conductive plate-like member having first and second tab extensions at re-

spective ends thereof constructed and arranged to be complementary with respective ones of said recesses and seated therein, and further having an elongate tapered extension intermediate the ends thereof, the said tapered extension extending through said tapered aperture in said base member and being gripped by the material of said base member thereat, whereby said collector conductor is easily assembled in said base by a simple pressing operation and is firmly secured in place in said housing.

13. A miniature leadscrew-adjusted potentiometer comprising:

first means, comprising an elongate hollow housing comprising a base member and a complementary cover member, said base member and cover member each having mutually complementary semi-cylindrical depressions formed and disposed for reception and retention of a leadscrew, and said housing having first and second interior sidewalls and first and second endwalls and a floor wall having an elongate trough-like groove therein, and said base member having first and second recesses in respective ones of said endwalls next adjacent said first sidewall and a tapered aperture in said floor wall intermediate said endwalls next adjacent said first sidewall, and said base member further having first and second spaced-apart apertures through said floor wall next adjacent said second sidewall;

second means, comprising resistive means comprising an elongate resistance element and first and second elongate tapered spring-clamp termination clips each clamping and terminating a respective end portion of said element and extending through a respective one of said first and second spaced-apart apertures to secure said element in said housing and provide external terminals therefor;

third means, comprising an elongate plate-like collector conductor having first and second extending tabs at the ends thereof disposed in respective ones of said first and second recesses and having an elongate tapered extension between the ends thereof extending through said tapered aperture in said floor wall intermediate said endwall next adjacent said first sidewall;

fourth means, comprising an elongate leadscrew means having cylindrical end portions rotatable in and retained by said base member and said cover member in said depressions; and

fifth means, comprising movable means, supported by and movable by said leadscrew and comprising an insulative body having opposed resilient elongate lips forming an elongate open-sided slot and clasping said leadscrew for support thereby and for traversing coaction therewith, said body comprising first and second depending post-like protuberances of round cross-section and said protuberances being firmly engaged by a plural-limbed contact device comprised in said movable means, said body and said contact device being disposed between said element and said collector conductor and said contact device having an upper limb encircling one of said protuberances and gripping the other thereof and said contact device further having a lower limb encircling and gripping said one of said protuberances, and further having divergent first and second contact arms each electrically engaging and interconnecting said element and said conductor, and said protuberances extending into said trough-like groove for guidance and to prevent rotation of said movable means with said leadscrew incident to rotation of the latter.

14. A very small leadscrew-adjusted potentiometer comprising:

first means, including a box-like base member and a complementary cover member therefor, said members being formed of slightly resilient synthetic resin, and said base member having first and second sidewalls and a floor, and said floor being formed with outwardly convergent tapered apertures therethrough next-adjacent to said sidewalls;

second means, comprising an integral collector plate and tapered terminal disposed against said first sidewall in said base member and with said terminal protruding through one of said apertures and gripped by said base member thereat;

third means, comprising a flat elongate resistance element disposed against said second sidewall in said base member, and resistance element terminals gripping respective ends of said element and each having a portion extending through a respective one of said apertures and each gripped by said base member at the respective aperture;

and fourth means, comprising a leadscrew disposed between said second means and said third means, and a slider and a contact device, said slider being supported upon said leadscrew and arranged for translation thereby, and said contact device being supported by said slider and including opposed interconnected contact-including resilient limbs pressing outwardly against respective ones of said resistance element and said collector plate, for wiping contact therewith and electrically interconnected thereof incident to rotation of said leadscrew, said contact device tending to hold said collector plate and said resistance element against respective ones of said first and second side walls.

15. For a leadscrew-adjusted potentiometer, the combination comprising:

first means, comprising a resilient dielectric slider having a body portion and first and second opposed elongate limbs extending divergently from said body portion and separated at their extremities by an open slot, said limbs being arranged to embrace and grip a longitudinal portion of a leadscrew for support and movement incident to rotation of the leadscrew relative thereto, and said limbs being constructed and arranged to spread apart to receive the leadscrew therebetween, said slider having first and second post-like members extending outwardly from said body portion; and

second means, comprising a contact device including electrically-connected first and second resilient divergent contacts and first and second flat strip-like limbs the first limb of which is perforated and is also bifurcate at its extremity and the second limb of which is formed to clasp the first of said post-like members, said contact device being mounted on said slider with said first post-like member extending through the perforation of said first strip-like limb and clasped by said second strip-like limb and the bifurcate extremity of said first strip-like limb tightly engaging said second post-like member.

whereby said contact device is firmly secured to said slider for support and movement thereby.

References Cited in the file of this patent

UNITED STATES PATENTS

2,662,955	Erkelens	Dec. 15, 1953
2,898,568	Bourns et al.	Aug. 4, 1959
2,926,324	Barden et al.	Feb. 23, 1960
2,999,994	Bourns et al.	Sept. 12, 1961