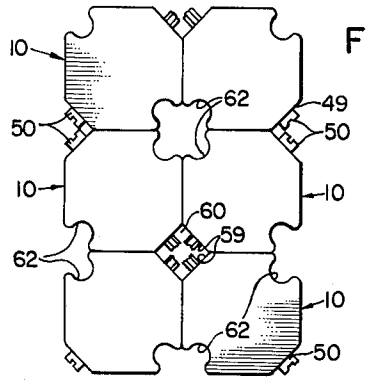
Feb. 15, 1966 D. J. BAKER 3,235,828

SUBMINIATURE POTENTIOMETER

Filed Oct. 16, 1961

FIG. 1.



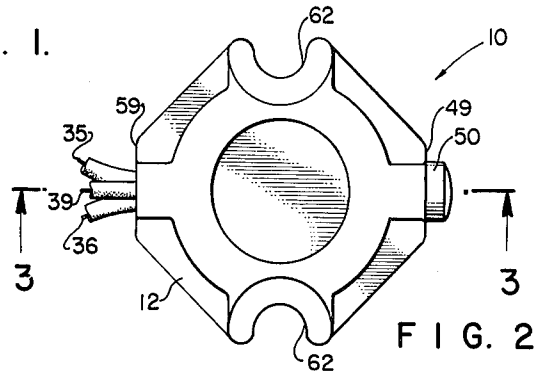


FIG. 2.

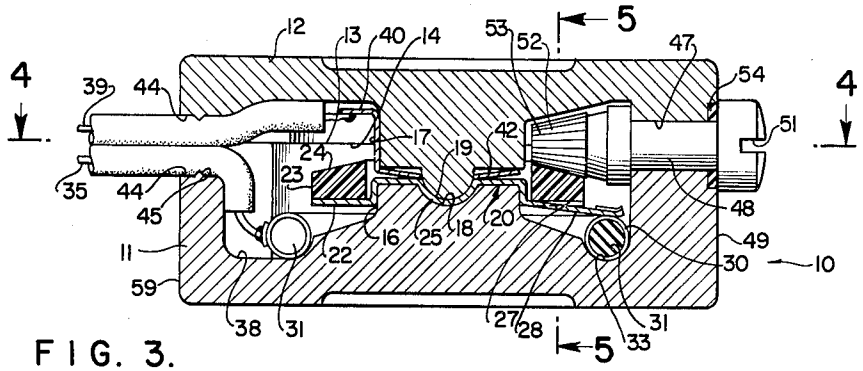


FIG. 3.

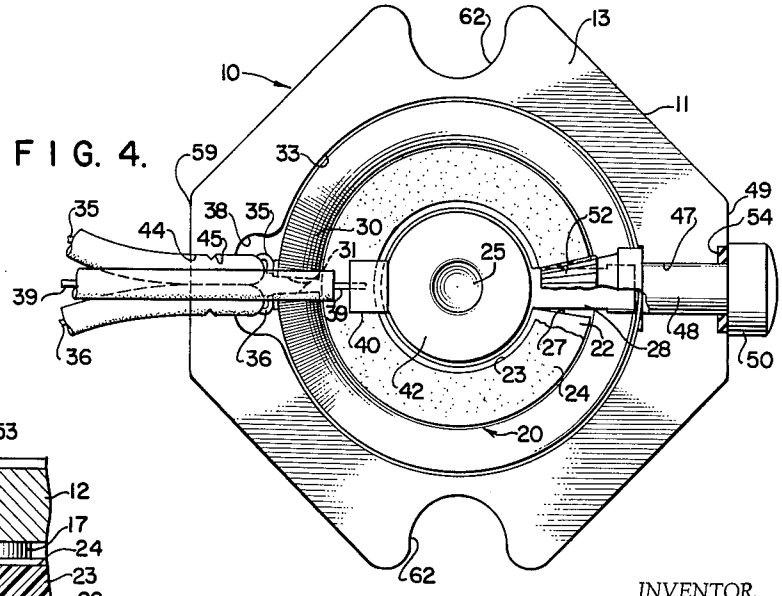


FIG. 4.

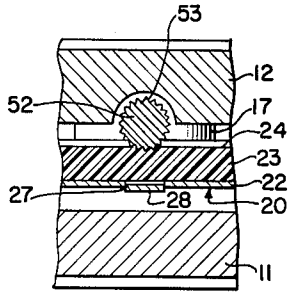


FIG. 5.

INVENTOR.
DONALD J. BAKER

BY

ATTORNEY.

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SUBMINIATURE POTENTIOMETER

Donald J. Baker, 938-D 15th St., Santa Monica, Calif.

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14 Claims. (Cl. 338—174)

This invention relates to potentiometers and more particularly to an improved subminiature device characterized by numerous unique features including the capability of being compactly stacked without interfering with the adjustment of any individual devices. The potentiometers of this invention are also characterized by the small number of individual components, the ease, speed and positiveness of operation of the adjusting means, simplicity of assembly, reliability of the product and other features pointed out below.

The subminiature potentiometer of this invention features a housing formed in two parts each of which is provided on its interior with a central boss having complementally-shaped opposed surfaces coacting with a pair of contactor components to hold the latter in assembled position while permitting at least one of the contactor components to rotate along and in contact with the wire wound resistance component of the potentiometer. An additional and important feature of the rotating contact element is that it is quickly adjusted to a new position by means of an improved adjuster utilizing an annular driven element in firm driving contact with a rotary adjusting element journaled in the casing wall and provided on its exposed outer end with a tool engaging surface. Other features include an annular resistance component designed to have a snug frictional fit with a receiving groove formed in one of the casing halves and a rotary contact member arranged to be held in excellent electrical contact with the resistance winding by reason of the resilience of the contractor finger itself and additionally by the resilience of a spring washer secured to one terminal lead and interposed between one of the casing bosses and the rotary contactor.

Another important feature of the present invention resides in the fact that the mating halves of the casing have aligned channels formed in diametrically opposed portions of their rim edges. One of these passages is designed to seat the three terminal leads which extend from direct connections to internal parts of the potentiometer to the exterior of the casing. The other pasage is formed to seat snugly the reduced central portion of the adjustable member driving the rotary contractor. The inner end of this adjusting member is provided with serrations or teeth designed to bite into and form a firm driving contact with the driven ring member fixed to the rotary contactor. Desirably, portions of the exterior peripheral side walls of the casing through which the described passages open are cut away or relieved in a manner described below to permit compact stacking of the potentiometers without, however, interfering with access to the individual adjusting members of each device.

Another unique feature of the present design is the fact that the adjusting screw for the resistance element is arranged to rotate about an axis at right angles to the axis of rotation of the rotary contactor member. This feature, coupled with the fact that adjusting member is provided with a relatively large diameter pinion having driving engagement with a driven ring mounted on the radial face of the rotary contact member, has the very distinct advantage over prior potentiometer adjusting means that it permits adjustment throughout the full range of the potentiometer with only a relatively few complete turns of the adjusting member.

It is therefore a primary object of the present invention to provide an improved subminiature potentiometer characterized by its simplicity, ruggedness, reliability,

its unusual compactness and its ability to be stacked in large numbers in a minimum amount of space without interfering with the adjustment of the individual potentiometers.

Another object of the invention is the provision of a unique potentiometer characterized by its unusual compactness, limited number of components, and the mutually cooperating nature of the components with one another to the end that they are held positively assembled in relatively movable operating arrangement without fasteners of any nature.

Another object of the invention is the provision of a fully enclosed subminiature potentiometer having rotary adjusting means accessible from the exterior and operable to drive the adjusting contactor throughout its range of movement with a minimum number of rotations of the adjusting member.

Another object of the invention is the provision of a compact, inexpensive potentiometer having diagonally opposed corners cut away to provide surfaces through one of which the terminal wires project and through the other of which the rotary adjuster member projects thereby permitting the potentiometers to be stacked in immediate proximity to one another without interfering with access to the individual adjustment means for each device.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which a preferred embodiment of the invention is illustrated.

FIGURE 1 is a top plan view showing a plurality of potentiometers constructed according to this invention in one preferred stacking arrangement in close proximity to one another;

FIGURE 2 is an enlarged plan view of an individual potentiometer;

FIGURE 3 is a cross-sectional view taken along line 3—3 on FIGURE 2 and on a still larger scale and many times larger than the actual commercial size of the devices;

FIGURE 4 is a plan view of the lower casing half and of all components in their assembled position immediately prior to the assembly of the casing cover, the view being taken generally along line 4—4 on FIGURE 3; and

FIGURE 5 is a fragmentary cross-sectional view taken along line 5—5 on FIGURE 4.

Referring more particularly to FIGURES 2 to 5, there is shown a subminiature potentiometer designated generally 10 and embodying the novel features and principles of the present invention. The enclosing casing of the potentiometer is preferably formed from a suitable nonconductive material capable of being molded to high tolerance values and not subject to distortion or deformation under a wide range of adverse conditions normally encountered in manufacture and usage. This casing is molded to form two halves including a lower half 11 and an upper half or cover 12. Both halves have continuous facing rim surfaces parallel to the respective exterior bottom surfaces. Lower half 11 has an upstanding peripheral wall provided with a flat upper surface 13 against which the mating surface 14 of cover 12 seats. Desirably, cover 12 is sealed closed against surface 13 of lower half 11 by epoxy or other suitable adhesive not soluble in water.

Both casing half 11 and cover 12 are provided centrally of their interiors with respective circular posts or bosses 16 and 17 having important mutually cooperating functions. The opposed ends of each include complementally-shaped interfitting surfaces, lower boss 16 being formed with a semi-spherical depression 18 receiving

therewithin the spherical surface of a boss 19 carried by overlying boss 17. The spacing between the opposed surfaces depression 18 and extension 19 approximates the thickness of the shallow cup-shaped rotary contactor 20 held rotatably socketed between these members.

Contactor 20 is preferably stamped from thin resilient material having excellent electrical properties and so as to embrace the upper end of boss 16 loosely for smooth rotation about this boss. The annular radially disposed lip 22 of contactor 20 has firmly bonded to its upper surface a continuous ring 23 of suitable plastic or elastomeric material and is preferably formed with a frusto-conical upper surface 24 for frictional driving contact with a rotary adjusting device to be described presently. The center of contactor 20 is formed with a semi-spherical socket 25 conforming with the shape of the recess 18 and the overlying extension 19. It is also pointed out that the radial rim 22 of contactor 20 has a pair of radial slits 27 providing a contact finger 28 which projects radially beyond the rim edge of the contactor and is depressed somewhat below the plane of rim 22, as is best shown in FIGURE 3. Contact finger 28 of the rotary contact member 20 has resilient pressure contact with a helical winding of resistance wire 30 carried by an annular core 31. The resistance unit formed by winding 30 and core 31 has a snug fit within an annular channel 33 molded into casing half 11 concentrically of boss 16.

The opposite ends of resistance 30 are welded, brazed or otherwise electrically secured to a pair of insulated terminal leads 35, 36 which extend downwardly into the lower casing half 11 through a well 38 opening at its bottom into annular groove 33 in the manner best shown in FIGURES 3 and 4. A third insulated terminal lead 39 is brazed or otherwise secured to a tab 40 integral with a dished spring washer 42 seated about the base of extension 19 integral with boss 17 of casing cover 12. Tab 40 is generally L-shaped and has its longer or vertical leg lying against the side wall of boss 17 and its horizontal leg secured to the inner end of terminal lead 39.

The three terminal leads 35, 36 and 39 extend from the interior of the casing through a radial passage 44 formed partially in lower casing 11 and partially in cover 12. The cross-sectional size and shape of passage 44 is preferably no greater than that required snugly to accommodate leads 35, 36 and 39 when firmly compacted together. Desirably, the side walls of passage 44 have one or more integral sharp-edged projections extending into the passage and adapted to bite into the insulation of the terminal wires thereby firmly anchoring them against axial movement along passage 44.

Axially aligned with passage 44 and located on the diagonally opposite side of the potentiometer casing is a semi-circular passage 47 likewise formed partly in lower casing member 11 and partly in cover 12. Passage 47 forms a cylindrical journal for the reduced midsection 48 of the adjustable driving member for rotary contactor 20. The corners of the casing and cover through which passage 47 opens is cut away to provide a flat surface 49 against which the enlarged outer end 50 of member 48 rests. Head 50 is preferably provided with a slot 51 to receive a screw driver or like tool for rotating adjuster 48, the enlarged inner end of adjuster 48 being provided with a beveled pinion-like member having sharp-edged teeth 53 which bite into surface 24 of the resilient ring 23. These teeth or serrations are highly effective in rotating contactor 20 in a direction depending upon the direction of rotation of adjuster 48. Preferably, passage 47 seating the adjuster is provided at its outer end with an annular recess seating a resilient packing gasket 54.

It is to be understood that the corner of the potentiometer casing through which terminal lead passage 44 opens is preferably cut away to provide an exterior surface 59 similar to surface 49 on the diagonally opposite corner of the potentiometer. The significance of this arrangement will be best understood be reference to FIGURE 1 showing a plurality of identical potentiometers 10 arranged in two parallel rows with their adjacent peripheral edges in direct contact with one another. The potentiometers are so arranged that the cut away corners provided with surfaces 59 of a group of four potentiometers cooperate with one another to provide a well 60 accommodating terminal leads 35, 36 and 39. Well 60 is of adequate size to accommodate the terminal leads of adjoining columns of stacked potentiometers which may be firmly secured in place by the use of suitable fasteners extending through another pair of diagonally opposed cut-away corners 62.

Also to be observed from FIGURE 1 is the fact that when the potentiometers of this invention are compactly stacked and secured in place, as thereshown, the outer ends 50 of the adjuster member 48 of the individual potentiometers are exposed and freely accessible to a technician's adjusting tool. It will therefore be understood that any desired number of the potentiometers may be arranged in two adjacent rows and stacked to any required height without posing a problem so far as the terminal leads are concerned or, more particularly, as respects accessibility of each potentiometer for individual adjustment.

The mode of assembling the described potentiometer will be quite apparent from the foregoing description of its components. It will be understood that the terminal leads are secured to the opposite ends of the resistance winding and to tab 40 of spring washer 42 prior to the assembly of the components into the casing. Desirably, these leads are sufficiently long as to permit their connection directly to a terminal board or to the components in circuit therewith. The assembler places lower casing member 11 face up and inserts the resistance unit into groove 33 and presses lead wires 35 and 36 firmly down into the lower half of passage 44. Contactor unit 20 is then socketed in the spherical depression 25 and the third terminal lead 39 and the attached spring washer and contactor are then centered over contactor 20. The next step is to assemble the reduced midportion of the one-piece adjuster 48 into the lower half of passage 47. The final assembly operation comprises applying a thin coating of adhesive to surface 14 of cover member 12, care being exercised to avoid having adhesive contact the surface of passage 47. However, adhesive is applied about the portion of the lead wires passing through passage 44. The cover is then inserted so as to seat spherical extension 19 in the complementally-shaped socket 25 of contactor 20. In this connection, care is taken to have boss 19 pass through the opening in the center of spring contactor 42. The cover is then pressed tightly against the juxtaposed rim surface 13 of the lower casing half and held in this position until the adhesive takes a set. It will be understood that the pressure assembly of the cover serves to deform or stress the washer-like spring contactor 42 thereby assuring a firm electrical contact between this washer and the surfaces of contactor 20.

From the foregoing it will be apparent that no fastener devices of any kind are employed in connection with any subassembly and that the entire assembly operation is performed without need for tools of any kind.

After assembly and connection to the equipment with which the potentiometer is to be used, the technician may apply a tool to slot 51 of adjuster element 48 and rotate it in either direction causing the sharp edges of pinion 52 to engage the surface of the driven element 23 and to rotate contactor 20 to adjust spring finger 28 to a desired position along the exposed surface of winding 30. As will be readily apparent from FIGURES 3 and 5 a single rotation of adjuster 48 serves to move contact finger 28 along a major fraction of the full length of the resistance winding. For this reason, the full adjustment of the potentiometer is accomplished through an unusually low number of rotations of adjuster 48.

In closing it is desired to point out that an appreciation of the compactness of the present potentiometer when manufactured to subminiature scale is to be gained from the fact that more than fifty of the described potentiometers may be installed within one cubic inch of space. When so stacked in accordance with the principles disclosed above, the rotary adjuster of each is exposed and accessible for individual adjustment.

While the particular subminiature potentiometer herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

I claim:

1. A subminiature potentiometer comprising a two-part wafer-like hollow casing of insulating material having a pair of opposed bosses integral with and extending toward one another from a pair of opposed interior walls thereof and positioned centrally of and cooperating with interior surfaces of said hollow casing to provide a surrounding endless channel, a wire-wound ring-like resistive unit seated in said endless channel, rotary conducting contactor means having a contactor supported for rotary movement directly on and between said opposed bosses with its contactor bearing against the winding of said resistive unit, the juxtaposed surfaces of said contactor means and of said opposed bosses being complemental to one another and shaped to permit said contactor means to rotate while holding said contactor means against displacement radially of its axis of rotation, said rotary contactor means being shaped complementally to juxtaposed surfaces of said pair of bosses so as to be held rotatably centered therebetween, separate electrical conductors electrically connected respectively with said rotary contactor and with the opposite ends of said resistive unit and having terminal ends extending to the exterior of said hollow casing, and means adjustable from the exterior of one edge of said wafer-like casing and operatively connected with said contactor means for adjusting the position of said contactor along the winding of said resistive unit.

2. A subminiature potentiometer comprising a two-part casing of generally cup-shaped non-conductive parts having mating rim edges engaged with one another and provided centrally of the interior bottom portion of each with an imperforate integral boss projecting toward and terminating closely adjacent one another and cooperating with interior surfaces of said casing parts to form a surrounding annular chamber, a unitary wire-wound resistive unit in said annular chamber having terminal leads extending to the exterior of said casing as a group between the mating rim edges thereof and electrically connnected with the opposite ends of said resistive unit, unitary conducting contactor means held captively centered between the adjacent ends of said bosses for rotary movement thereabout and including conducting means in contact with the winding on said resistive unit, a one-piece adjusting member mounted in said casing with its inner end in rotary driving relationship to said unitary conducting contactor means and having an outer end accessible for adjustment from the exterior of said casing, and third terminal lead means extending from an electrical connection with said unitary conducting contactor means to the exterior of said casing.

3. A subminiature potentiometer as defined in claim 2 characterized in that the central area of said unitary contactor means is shaped complementally to juxtaposed surfaces of at least one of said opposed bosses whereby said contactor means is held rotatably in assembled relation between said bosses and free for relative rotary movement about the axis of said opposed bosses.

4. A subminiature potentiometer as defined in claim 3 characterized in that said unitary contactor means includes an annular drive ring fixed thereto and engaged with a toothed inner end portion on said one-piece adjusting member.

5. A subminiature potentiometer as defined in claim 3 characterized in that said adjusting member is rotatable about an axis normal to the axis of rotation of said unitary contactor means and projects from said casing in general alignment with and on the opposite side of said casing from the place of exit of said group of terminal leads.

6. A subminiature potentiometer as defined in claim 5 characterized in that said adjusting member is held assembled to said casing between the facing rim edges of the cup-shaped halves thereof.

7. A subminiature potentiometer as defined in claim 3 characterized in that said casing halves are bounded along the exterior side walls thereof by four walls merging at cut-away corners, two of said opposed corners being adapted to receive mounting fastener means for securing said potentiometer fixedly in a place of use, and the remaining opposed cut-away corners serving respectively as the place of exit of the terminal leads and as the place of exit of said one-piece adjusting member for said unitary conducting contactor means.

8. A subminiature potentiometer comprising a wafer-like casing having exterior peripheral side walls arranged generally at right angles to one another, two diagonally opposed corners of said casing being cut away to form end faces extending between the adjacent side walls defining said opposed corners, an adjustable resistive assembly supported interiorly of said casing having rotary means extending outwardly through one of said cut-away corners of said casing with its axis of rotation extending crosswise of said casing and intersecting said two diagonally opposed corners and accessible exteriorly of the casing to adjust said resistive assembly, and terminal means for said resistive assembly extending outwardly through the other of said diagonally opposed cut-away corners whereby a plurality of said potentiometers can be compactly arranged edge to edge in a planar ring with the outer ends of said rotary adjusting means outermost and readily accessible for adjustment notwithstanding the compact arrangement of said casings and with the terminal means of the respective potentiometers grouped together diametrically opposite the rotary adjusting means of the associated potentiometer and centrally of the ring of potentiometers.

9. A subminiature potentiometer comprising a pair of shallow casing members of nonconductive material each having an upstanding opposed boss centrally thereof having their ends terminating closely adjacent one another in the assembled position of said casing members, the rim edges of said casing members being assembled in contact with one another, a shallow annular groove encircling at least one of said bosses, an annular wire-wound resistive element in said groove, rotary contactor means overlying said resistive element and supported for rotary adjustment about the axes and directly between the closely spaced adjacent ends of said bosses, said contactor means having rotary drive means therefor journaled in a radial passage opening through the rim edges of said casing members transversely of said contacting rim edges and held assembled by said casing members, said rotary drive means having an inner end in driving engagement with said rotary contactor means and being rotatable about an axis intersecting the axis of rotation of said rotary contactor means, and terminal wires electrically connected to said resistive element and to said rotary contactor means.

10. A potentiometer as defined in claim 9 characterized in that the portion of said rotary contactor means in driving engagement with said rotary drive means comprises a ring member having a radius substantially less

than the radius of said resistive element whereby a relatively few turns of said rotary drive means suffices to move said contactor means along the full length of said resistive element.

11. A potentiometer as defined in claim **9** characterized in that said rotary contactor means includes a ring of resilient material having its exposed surface in high friction driving contact with the inner end of said rotary drive means.

12. A potentiometer as defined in claim **9** characterized in that said casing is provided with a passage opening into the interface between the contacting rim edges of said casing members, said terminal wires extending to the exterior of said casing through said passage, said passage including sharp edged ribs projecting from the passage walls and effective to bite into said terminal wires in the assembled position of the casing members to anchor said terminal wires against movement axially of said passage.

13. A subminiature potentiometer comprising a wafer-like casing molded from insulating material and comprising a generally cup-shaped lower half having a first boss projecting upwardly from the center of its bottom wall, a cover half engaging the rim edges of said bottom half and having a second boss projecting downwardly from its center, said second boss having an end surface shaped complementally to the juxtaposed end of said first boss, a rotary contactor ring journalled between the closely-spaced complementally shaped ends of said first and second bosses and held captive therebetween in the assembled position of said casing halves, a wire-wound annular resistor element encircling said first boss and secured in place in the bottom of said lower casing half, said contactor ring having a contact finger thereon positioned to bear against said wire-wound resistor, resilient conducting ring means encircling said second boss and bearing against said rotary contactor ring, rotary means held captive in mating recesses formed between the rim edges of said casing halves adjustable from the exterior of said wafer-like casing and having driving engagement with said rotary contactor ring and effective to rotate the latter in either direction about the aligned axes of said first and second bosses, and terminal wires extending to the exterior of said casing from the opposite ends of said wire-wound resistor and from said resilient conducting ring means.

14. A potentiometer as defined in claim **13** characterized in that the juxtaposed ends of said first and second bosses are provided respectively with a depression and a complementally shaped projection extending into said depression and cooperating therewith and with the intervening complementally shaped portion of said contactor ring to hold the latter captive but free for rotation between the inner ends of said first and second bosses.

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RICHARD M. WOOD, *Primary Examiner.*