July 13, 1965 E. H. TUMBUSCH 3,195,092

POTENTIOMETER

Filed May 31, 1963

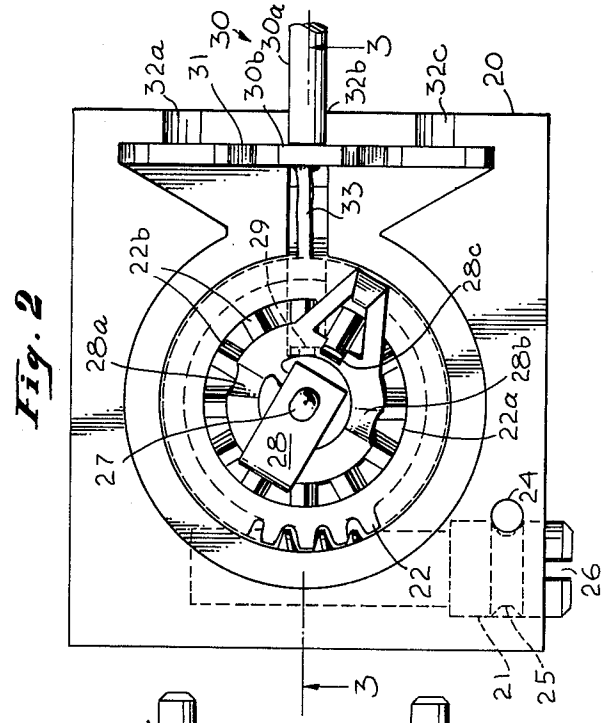


Fig. 2

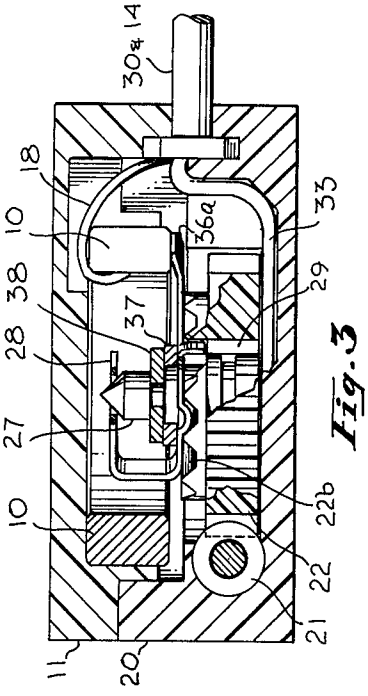


Fig. 3

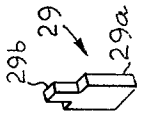


Fig. 5

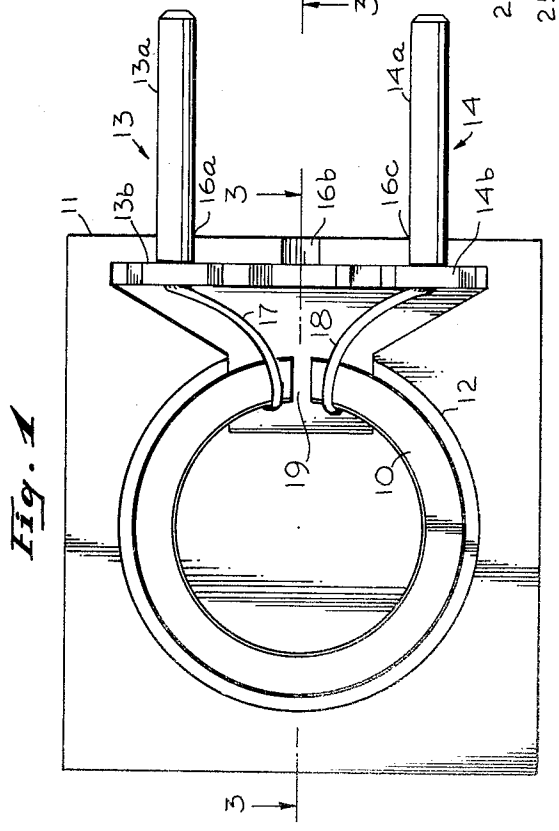


Fig. 1

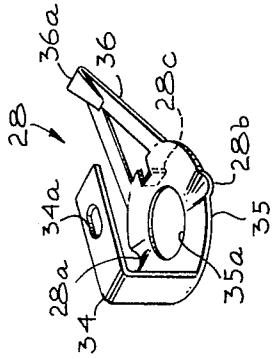


Fig. 4

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POTENTIOMETER

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1 Claim. (Cl. 338—148)

The present invention relates to a new and improved potentiometer apparatus.

A miniaturized potentiometer containing fewer parts than prior devices of this type is shown and described in the co-pending application by Edward H. Tumbusch entitled "Potentiometer," Serial No. 112,026, filed May 23, 1961, now Patent No. 3,096,498, issued July 2, 1963, and the present invention is an improvement thereof. More particularly, as taught in the abovesaid application, the potentiometer includes a wire-wound toroidal-shaped resistance element against which a rotatably mounted wiper element presses, a wiper element being rotated to vary the potentiometer output by means of a gear positioned directly beneath the wiper element and in face-to-face relationship with it. The wiper element is in frictional contact with the gear so that as the gear is turned, the wiper element is also turned.

The present invention improves upon the potentiometer disclosed in the abovesaid co-pending application in two respects. First, as may be expected, the ends of the resistor element are spaced slightly from each other, that is, a gap exists between them, and this represents a "dead" spot or, stated differently, a discontinuity in the potentiometer output. Accordingly, there are many occasions when it would be most desirable to avoid having the wiper element pass over this gap and the present invention makes this possible. Second, in the earlier potentiometer devices, including the one disclosed in the co-pending application, because the wiper element is held in position only by friction, there is always the possibility that it may accidentally rotate slightly, either from vibration, jarring, or some other cause, and thereby move out of its assigned position. The present invention provides means for reducing this possibility.

It is, therefore, an object of the present invention to provide a potentiometer whose elements can be locked in position.

It is another object of the present invention to provide a potentiometer whose wiper element is prevented from passing over the gap between the ends of its resistance element.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood form the following description considered in connection with the accompanying drawing in which an embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only and is not intended as a definition of the limits of the invention.

FIGURE 1 is a top view of the resistance element as it is mounted in the potentiometer casing;

FIGURE 2 is a top view of the remaining elements as they are mounted in the bottom part of the potentiometer casing;

FIGURE 3 is a side-view in cross-section of the entire potentiometer assembly;

FIGURE 4 is a perspective view of a novel wiper element used in the potentiometer of the present invention; and

FIGURE 5 is a perspective view of a stop blade also used in the potentiometer of the present invention.

Considering now the drawing, reference is made in

particular to FIG. 1 wherein is shown a wire-wound toroidal-shaped potentiometer resistance element **10** fixedly mounted on the upper part **11** of the potentiometer casing, a suitably shaped recess being provided in member **11** for the resistance element. The wall forming a boundary for the recess is designated **12**. The FIG. 1 section of the potentiometer also includes a pair of T-shaped connecting pins generally designated **13** and **14**, the pins being relatively rigid structurally and being mounted in position on casing member **11**. In a sense, connecting pins **13** and **14** resemble ordinary nails in that each connecting pin includes a prong-like element and a head mounted on one end thereof and at right angles thereto. The prong-like element and head for connecting pin **13** are respectively designated **13***a* and **13***b* whereas the prong-like element and head for connecting pin **14** are respectively designated **14***a* and **14***b*. Casing member **11** also includes a plurality of semi-circular openings **16***a*, **16***b*, and **16***c*, in which elements **13***a* and **14***a* respectively lie. Thus, connecting pins **13** and **14** are held in position by casing member **11** with elements **13***a* and **14***a* protruding therefrom. A pair of wire leads **17** and **18** respectively interconnect the ends of resistance element **10**, which are spaced somewhat from each other, with connecting pins **13** and **14**, lead **17** being connected at one end to head **13***b* and, therefore, to element **13***a*, while lead **18** is connected at one end thereof to head **14***b* and, therefore, to element **14***a*. Hence, connecting-pin elements **13***a* and **14***a* are electrically connected through their associated heads and wire leads to the ends of resistance element **10**, the gap between those ends being designated **19**.

Reference is now made to FIG. 2 wherein is illustrated the potentiometer arrangement in the bottom portion **20** of the potentiometer casing. As shown therein, the arrangement includes a worm screw **21** whose threads mesh with the teeth of a gear **22**, the worm screw being inserted in a tunnel **23** bored into casing **20** at one side thereof. The dimensions of tunnel **23** are such that the worm screw can be easily turned, the latter being prevented from moving out of the tunnel by means of a keeper pin **24** which extends into a groove **25** circumferentially machined in the body portion of the screw. The unthreaded end of worm screw **21** protrudes from the potentiometer casing and is slotted, that is, contains a keyway **26**, so that the worm screw can be turned with the aid of a screwdriver or other device. Although hidden from view, gear **22** is mounted on a hollow cylindrically-shaped boss which is centrally located in an upright position on the potentiometer's bottom casing, a pivot **27** being mounted in a vertical position in the hollow of the boss. On the top surface of gear **22** and extending upwards from it like a wall, is a circular serrated member **22***a* that is an integral part of the gear. In other words, gear **22** and serrated member **22***a* constitute a single element. Thus, any rotation of gear **22** would also involve rotation of serrated member **22***a*. The serrations themselves are designated **22***b*.

Immediately above gear **22** and resting on both serrated member **22***a* and pivot **27** is a wiper mechanism **28** which includes a pair of dimples **28***a* and **28***b* and a tab **28***c* extending downwardly from its bottom surface. Dimples **28***a* and **28***b* engage serrations **22***b* and, as will be shown later in connection with FIG. 3, the dimples are held firmly in contact with the serrations by means of a washer and a retaining ring, the latter being held down by a portion of pivot **27**. The arrangement in FIG. 2 also includes a stop blade **29** which is mounted in a slit or gap in the aforesaid boss directly beneath gap **19** in the resistive element. The stop blade is positioned in the path of tab **28***c* which abuts against the stop blade just

before the wiper element reaches gap 19. Thus, tab 28c and stop blade 29 together prevent the wiper element from passing over the gap between the ends of the resistive element.

Finally, the potentiometer embodiment includes a connecting pin generally designated 30, this connecting pin also having two parts to it, namely, a prong element 30a and a head 30b. The head is fitted into a slit 31 formed in the casing and the prong element rests in the center one of three semicircular openings in the casing designated 32a, 32b and 32c. Needless to say, openings 32a, 32b and 32c are respectively in registration with openings 16a, 16b and 16c in FIG. 1 so that when the arrangement of FIG. 1 is inverted and placed as a lid over the arrangement of FIG. 2, these six semicircular openings will be superimposed to form three circular openings in the casing through which the connecting pins will extend, the three circular openings thusly formed together with slit 31 firmly holding the connecting pins in position. Although it is more clearly presented in FIG. 3, a wire lead 33 electrically interconnects head 30b of connecting pin 31 with the base of pivot 27.

Having thus described the two basic units of the potentiometer as they are shown in FIGS. 1 and 2, it would be well at this point to proceed to a description of these two units as they are combined to form a complete potentiometer assembly, as shown in FIG. 3.

However, it is deemed worthwhile to present beforehand a more detailed description of wiper mechanism 28 and stop blade 29. Accordingly, for the purpose mentioned, reference is now made to FIG. 4 wherein the wiper mechanism is shown. The wiper mechanism basically includes three elements, namely, an L-shaped element 34, an annular shaped disc-like element 35 and a V-shaped element 36. Element 34 has a long side and a short side bent at a right angle to the long side to form an L-shape, the long side having an elongated hole 34a therethrough for reasons that will be more fully explained below. Element 35 is integral with and extends from the short side of element 34 and at substantially right angles to it so that element 35 is substantially parallel to the long side of element 34. Element 35 also has a circular hole 35a therethrough located beneath elongated hole 34a so that the two abovesaid holes have the same center line. In addition, element 35 also includes the aforementioned dimples 28a and 28b and tab 28c, the dimples being spaced 180° from each other, that is to say, they are spaced on opposite sides of element 35. As for V-shaped element 36, this element is integral with and extends from element 35 upwardly and away from the long side of element 34 so that its plane forms an acute angle with the plane of element 35. Finally, the apex of element 36, designated 36a, is folded back upon itself so as to provide good electrical contact with the resistive element. It will be noticed that tip 36a is substantially in line with tab 28c, this being required in order to stop tip 36a at the brink of gap 19 when tab 28c abuts against stop blade 29, as previously explained. The stop blade itself is illustrated in FIG. 5 wherein it is shown to be a small, flat and thin element whose lower portion, designated 29a, is inserted in the slit provided for it in the aforesaid boss on which gear 22 is mounted and whose upper portion, designated 29b, reaches upward from the boss to intercept tab 28c when wiper tip 36a reaches gap 19.

Reference is now made to FIG. 3 wherein the complete potentiometer assembly is illustrated in cross-section. As shown therein, pivot 27 has several major sections to it, one above the other, the fourth and uppermost section being conically shaped. Pivot 27 is firmly held in position both by casing 20 and the boss, the pivot being cemented to the casing at its base whereat may also be found a keyway (not shown) into which one end of wire lead 33 is inserted for interconnecting the pivot with pin 30. Above gear 22 is mounted wiping mechanism 28, annular-shaped element 35 of the wiper mechanism resting directly on the serrated member with its dimples 28a and 28b meshed with serrations 22b. On the other hand, the long side of L-shaped element 34 rests directly on the conical-shaped section of the pivot whereas element 35 fits around an intermediate cylindrical section of the pivot. Accordingly, the reason for holes 34a and 35a are now self-evident, hole 34a having been purposely elongated to provide a sufficient tolerance so that element 34 will fully rest on this pivot section, thereby achieving good mechanical and electrical contact between the parts. Inserted between element 35 of the wiping mechanism and the conically-shaped pivot section is a washer element 37 and a retaining ring 38 which, together with the washer, is used to maintain the wiping mechanism firmly in position. With respect to the wiping mechanism, it should be noted that when the potentiometer is completely assembled as is shown in FIG. 3, V-shaped element 36 is pushed downward by resistive element 10 until element 36 lies in the same plane as element 35. As a result, a spring action is produced which has the effect of forcing the apex portion 36a of the wiping mechanism up and against resistance element 10, thereby obtaining good electrical contact between the wiper mechanism and the resistance element.

In operation, the turning of worm screw 21 causes gear 22 to rotate about pivot 27. In turn, wiper mechanism 28, whose dimples 28a and 28b are firmly locked with serrations 22b, also rotates about the pivot, apex portion 36a thereby sliding along resistance element 10. In this way, any portion of the over-all voltage applied to the ends of the resistance element through connecting pins 13 and 14 may be tapped, the voltage thusly tapped being applied to connecting pin 30 via pivot 27 and wire lead 33. Because the wiper mechanism is thusly locked in position, it cannot accidentally turn as a result of any vibrations, jarring or other misadventure. Furthermore, as has been mentioned several times before, when the wiper mechanism is turned through substantially one complete revolution, that is, from one end of resistive element 10 to the other, tab 28c is brought into abutment with the upper portion of stop blale 29, thereby preventing any further rotation of the wiper mechanism in that same direction. If forced, however, gear 22 will turn but the dimples on the wiper mechanism will merely move out of one pair of serrations and move into an adjoining pair, thereby still leaving the wiper mechanism in a stationary position. Consequently, as previously alleged, tip 36a on the wiper mechanism is at all times prevented from moving across gap 19 between the ends of the resistive element which, in turn, prevents a sharp discontinuity from occurring in the output voltage.

Having thus described the invention, what is claimed as new is:

A potentiometer, the internal structure of said potentiometer comprising: a rigidly mounted circular resistance element; a shaft-like pivot member rigidly mounted perpendicular to and along the axis of said resistance element, said pivot member including cylindrical sections and a conical section above said cylindrical sections, a wiper mechanism having an L-shaped section, an annular section integral with and extending from the small side of said L-shaped section parallel to the long side thereof, said annular section including a pair of dimples in its surface and a tab extending vertically from it, and a V-shaped section integral with and normally extending at an angle from said annular section in a direction away from said long side, said wiper mechanism respectively having a pair of co-lined openings through said L-shaped and annular sections, said wiper mechanism being mounted on said pivot member in such a manner that said pivot member extends through said openings with the long side of said L-shaped section resting on the conical section of said pivot member and

said annular section ringing the cylindrical section thereof, whereby said mechanism is rotatable about and in electrical contact with said pivot member, the apex of said V-shaped section being pressed against said resistance element which pushes said V-shaped section out of its normal position for good electrical contact therewith; input means for applying a potential difference between the ends of said resistance element; output means electrically connected to said pivot member for developing an output potential corresponding to the point of contact between said wiper mechanism and said resistance element between the ends thereof; means for rotating said wiper mechanism to selectively obtain different points of contact between said mechanism and said resistance element, said means including an annular serrated member whose serrations mesh with said dimples for yieldably locking said wiper mechanism in position at a point of contact, and a stop blade mounted between the ends of said resistance element and in the path of

said tab for preventing said wiper mechanism from losing contact with said resistance element during rotation of the former.

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