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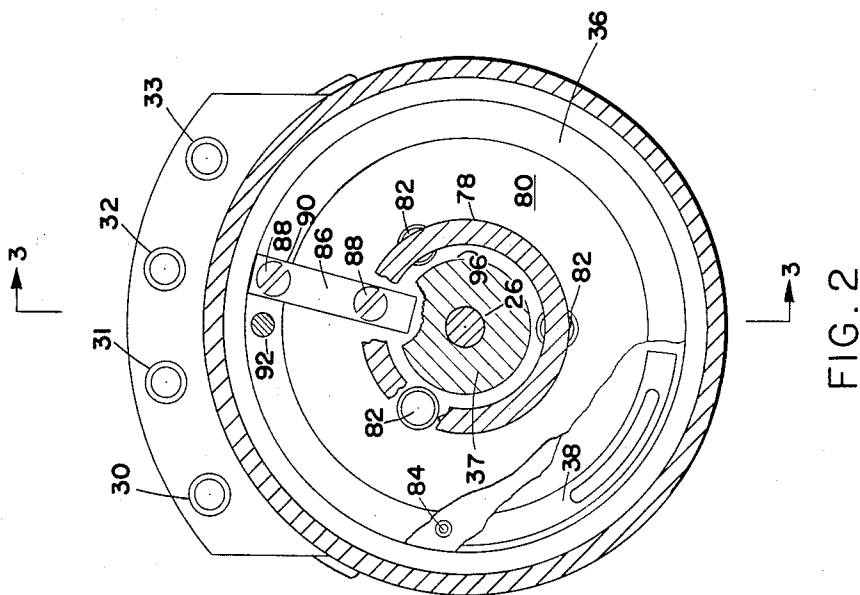
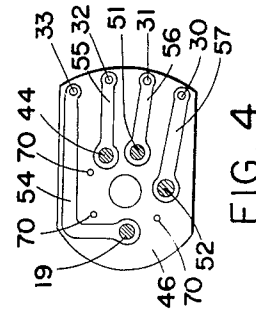
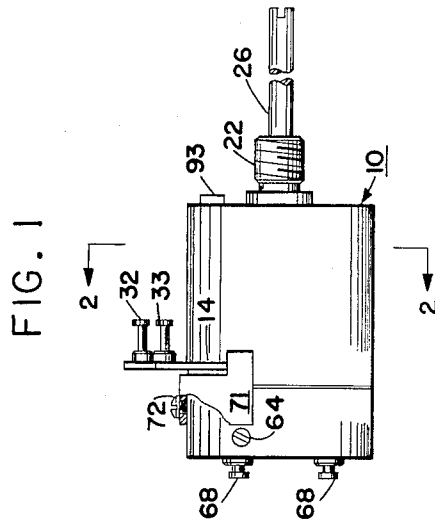
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2,926,322

SELF-LOCKING ADJUSTABLE POTENTIOMETER

Filed March 28, 1958

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

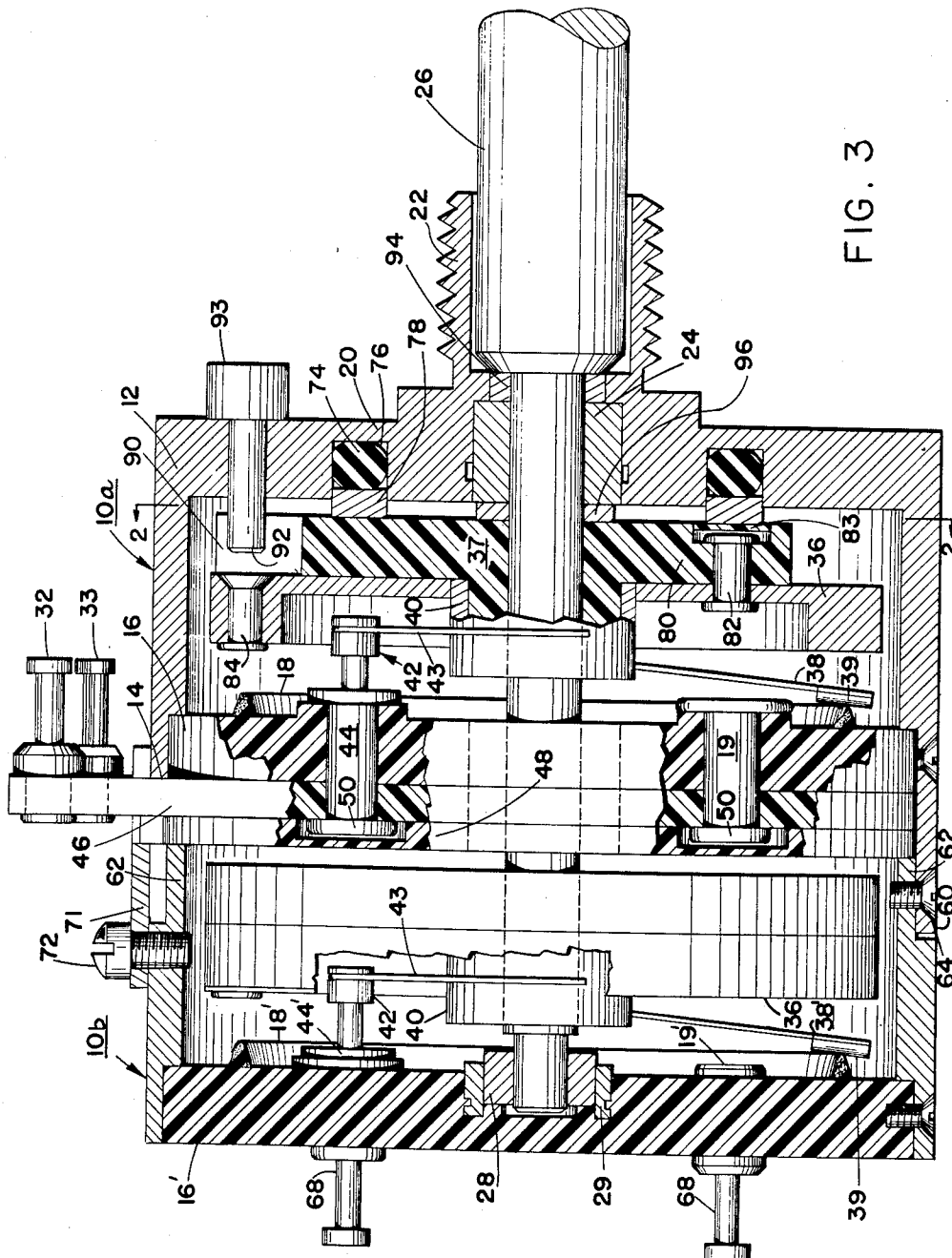


FIG. 3

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SELF-LOCKING ADJUSTABLE POTENTIOMETER

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6 Claims. (Cl. 338—167)

This invention relates to a precision potentiometer, adapted to be used in applications requiring a fixed setting of the device, wherein this setting may be readily changed when desired, while remaining resistant to changes in position resulting from vibration or shock.

Precision potentiometers have a wide range of application, such as in computers, guided missiles and many other fields. The present invention contemplates a potentiometer that can be produced to function as a precision manually adjustable variable resistance unit which is resistant to change of setting resulting from mechanical shock or vibration of the unit.

It is the principal object of the present invention to provide a precision variable resistance device suitable for manual adjustment wherein novel positive frictional means are incorporated in the device to prevent accidental disturbing of shaft position.

It is an important advantage of the disclosed device in that manual readjustments may be readily made without the necessity of loosening any auxiliary locking devices, and that the predetermined setting may be maintained without the use of such auxiliary locking devices.

Another feature of this invention is the provision of an improved rotational stop means.

Another advantage of this invention is the provision of an improved rotational stop characterized by simplicity, ruggedness, low cost and ease of installation.

Further objects and advantages of the present invention will in part be pointed out and will in part be apparent from the following description and accompanying drawings, wherein:

Figure 1 is a side elevational view of a device of the present invention, with the cover plate shown partially broken away.

Figure 2 is an end view, partly in cross-section and partially broken away, taken along lines 2—2 of Figure 1.

Figure 3 is a partially broken away cross-section taken along line 3—3 of Figure 2.

Figure 4 is a rear view of a terminal board incorporated in the device of this invention, showing rivets in place.

Referring now to the drawings, there is shown in Figure 1, a side elevational view of the device of the present invention characterized generally by the numeral 10. There is shown in greater detail in Figures 2 and 3, a ganged potentiometer assembly comprising potentiometer unit 10a and unit 10b, which are simultaneously adjusted by shaft 26. Shaft 26 is axially positioned within cylindrical shell 12. The construction of the potentiometer units, 10a and 10b is essentially similar, except that the terminal connections for unit 10a are mounted transversely, passing through a slot 14 formed in shell 12. The output terminals for unit 10b are positioned in the rear wall of shell 12. The following description, in other respects is common to both potentiometer units.

An insulator disc 16 is disposed transversely within shell 12 (disc 16' associated with unit 10b is here also employed as a closure plate for shell 12). A circular resistance path 18 is formed on the inner face of disc 16

and a similar path 18 is formed on disc 16'. The resistance path is preferably molded of an electrically conductive plastic. Closure plate 20, having a threaded mounting portion 22 may conveniently be formed integrally with the cylindrical shell portion, to define a cup-shaped member, as shown in Figure 3. A bushing member 24 is press-fit into a central aperture formed in this closure plate, and shaft 26 is axially disposed and rotatably mounted within the shell, with the free end of this shaft protruding from the closure plate through bushing 24. Disc 16' is formed as a second closure plate. Shaft 26 may be conveniently mounted on Phosphor-bronze sleeve bearings 24 and 28 positioned on plates 26 and 16', respectively. Bushing 28 is press-fit into 29, which is insert molded into plastic disc 16.

Insulator 16 has formed thereon flat silver metal conductive paths (not shown), which are bonded to the plastic member. The conductor paths connect terminals carried by insulator 16 with the resistance path 18. If a center tap is employed then three such terminals are required. Only one such terminal 19 is visible in the view. Terminal 19 is in the form of a rivet positioned transversely through disc 16. The function of this rivet structure will be explained in greater detail hereinafter.

Collector plate 36 is mounted on shaft 26 and is rotatable thereby, this plate being disposed close to and confronting inner-face 17 of insulator disc 16. Plate 36 is rigidly mounted on an insulator plastic member 37, which is force-fitted onto shaft 26 and electrically insulates plate 36 from shaft 26. A resilient electrically conductive contact arm 38 is mounted on collector plate 36 and carries a precious metal contact member 39 which is adapted to wipe resistance path 18 as the collector plate 36 is rotated. Arm 38 is in electrical connection with hub portion 40 of the collector plate.

Hub portion 40 consists, in a preferred embodiment, of a coin silver tube provided with a splined end which is forced-fitted into an opening of slight smaller diameter located in the center of plate 36, as shown in unit 10a of Figure 3. The resulting force-fit assembly is then soldered to assure electrical continuity between hub portion 40 and plate 36.

A low resistance take-off means 42 is mounted on the inner face of the disc, and is adapted to wipe against hub portion 40 of the collector plate.

As shown in Figure 3, take-off means 42 comprises a thin hairpin-shaped resilient wire member 43, of rather fine diameter, approximately 0.003 of an inch, mounted on base 44 which forms a rivet structure. The legs of the "hairpin" are tensioned against opposite sides of cylindrical hub portion 40. This construction has been found to introduce extremely low torque, which is important when the apparatus is used in applications requiring a low torque sensing device.

Referring to unit 10a, there is provided means for connecting the end portions of the resistance track 18, a center tap (not shown) and the take-off means 42 to terminals 30, 31, 32, and 33 positioned externally of the housing 12 so as to permit connection to external circuits.

A flat strip of insulator material 46 abuts the outer face of disc member 16. Strip 46 may be conveniently formed of epoxy resin sheet filled with glass fibre. Abutting the outer face of strip 46 there is disposed a second insulator disc 48, the juxtaposition of disc 16, strip 46 and disc 48 defining a laminated structure. This structure is mechanically clamped together by rivets (not shown) passed transversely through these three elements, to form a rigid integral structure. Registering apertures are formed in these elements to accommodate shaft 26, passed therethrough.

In addition, strip 46 is joined to disc 16 by four rivet-like connectors, 19, 44, 51 and 52, two of which are

visible in Figure 3 (members 19 and 44), which are primarily electrically conductive elements, but which also impart a mechanical support between strip 46 and disc 16. The head portion 50 of these connectors are disposed in recesses formed in disc 48 (see Figure 3) and abut closely on the outer surface of strip 46. The body portion of these connectors pass transversely through openings in strip 46 and corresponding openings in disc 16, where connectors 19 and 44 are joined to the resistance element 18 and take-off element 42 respectively. Two other rivet-type connectors, 51 and 52, are connected to the aforementioned conductive path, making contact with the resistance element 18 by means of silver metal conductive paths bonded to plastic disc 16.

As shown in Figure 4, electrical conductive paths 54, 55, 56 and 57 are formed on the outer face of strip 46 preferably by printed circuit means, whereby these conductive paths form a very thin layer of metal deposited on the strip, in the neighborhood of several thousandths of an inch of thickness, and of a width of about one-eighth of an inch. These paths are disposed in spaced relationship to make electrical contact with connectors 19, 44, 51 and 52 respectively. Apertures 70 are formed on this strip to permit passage of clamping rivets therethrough, as stated previously. The paths may be formed by "Printed Circuit" techniques.

It will be noted from Figure 4 that the aforementioned conductive paths on strip 46 are circular at their termination, to provide adequate area for electrical connection with the rivet head portion 50 of the aforesaid connectors, which abut closely thereon. Rivets 19, 44, 51 and 52 are soldered to conductive paths 54, 55, 56 and 57 to insure good electrical connection.

It should be noted that the use of terminal strip 46 provides a compact sturdy device whereby connections to the unit can be made from the side of the casing, thus readily adapting the unit to be used in ganged potentiometer applications, wherein a single shaft rotates a plurality of potentiometer units. Further, there has been eliminated the conventional wire leads which are subject to breakage and shorting.

It will thus be seen that a variable potentiometer circuit path has been attained wherein a selected proportion of the electrical potential existing across terminals of resistance strip 18 is obtained by moving contact arm 38 along this resistance path. The desired potential in turn, is brought out to an external circuit by take-off means 42.

Extending portions of cylindrical shell 12 define overlapping portions as shown in Figure 3, where a ganged potentiometer comprising sections 10a and 10b is illustrated. These extensions are formed in off-set relationship whereby end portion 60 of unit 10a will mate with and overlap adjoining end portion 62 of second unit 10b. Screws 64 secure 10a and 10b together.

Insulator plate 16' forms a closure plate for unit 10b. The rivet-terminal structure 44' is provided with a terminal pin portion 68 to which external circuits may be connected. Shown in the drawing is one of the rivet-terminals 19' connected to the resistance path 18'. These terminals are likewise provided with pin portions 68. It is to be understood that the printed circuit conductive means described, as applied to unit 10a may be substituted for the end terminals 68.

A cover plate 71, secured by screws 72, covers the opening in housing 12 through which member 46 passes and comprises one wall of slot 14.

Insulator plastic core member 37 is provided with a circular flange member 80. The flange member is secured to collector plate 36 by means of rivets 82. As may be observed by referring to the broken-away portion of members 36 and 37 in Figure 2, contact arm 38 is attached to one face of the collector plate by rivets 84.

One feature of this invention is the provision of a simple and yet rugged stop means for a potentiometer. A reinforced plastic stop block 86 is bolted to collector

plate 36 by means of screws 88. A suitable material for the stop block is linen cloth impregnated with a phenol formaldehyde resin. It will be noted that block 86 partially fits a recess in flange member 80 and has an exposed portion 90 which protrudes so as to interfere with pin 92 which acts as a stop when shaft 26 is rotated to a predetermined angle.

Shaft 26 may be rotated to change the position of wiper 39 with relation to track 18, and thereby change the output voltage of the potentiometer.

In order to prevent unintentional movement of the shaft, this invention provides a simple and effectively functioning lock means which engages the moveable components and which may be intentionally overridden.

Contrary to conventional locking means, no additional set screw, split-collars or other clamping means need be adjusted to introduce desired change in shaft position.

The device of this invention is selectably adjustable, employing a resilient O-ring 74, preferably formed of neoprene, disposed in an annular groove 76 formed in the inner surface of closure plate 20. The ring is compressed so as to provide pressure against clutch plate 78. Plate 78 is formed as a metal ring which fits into groove 76 and can move axially under pressure from O-ring 74 to press in frictional relation against flange portion 80 of insulator plastic core member 37, thus providing a degree of locking action, to insure that a setting is not altered by vibration, once a particular setting has been made. However, without the necessity of loosening lock screws or the like one may readily readjust the setting manually by overcoming the friction. The annular groove acts as a guide means for the annular clutch plate 78 thus maintaining it in juxtaposition with resilient member 74. Insulators 83 cover the exposed ends of rivets 82 to prevent high potential leakage from the ends of the rivets to clutch plate 78. As an alternative a potting compound such as epoxy resin may be used for insulation.

Proper tensioning of the O-ring is obtained by the use of stainless steel spacer 96 which provides proper clearance when plastic core member 37 is force-fitted to shaft 26. Shaft 26 is preferably splined at the points at which plastic core members 37 are positioned. Member 94 serves to fill in the case beyond bearing 24 and provide a seat for the step in the shaft 26.

It is to be noted that it is conventional in potentiometers to provide an alignment pin 93 and that by extending it to meet stop member 86, at negligible cost, a standard pin can be modified to form part of a stop means. This permits the use of standard units for either type of application, i.e., 360° or limited rotation.

There has thus been provided, in accordance with the present invention, a versatile potentiometer unit adapted to function as a precision variable resistor unit, also as part of an improved ganged potentiometer assembly. It should be particularly noted that the use of the brake means employed in the present invention involves maximum compactness and simplicity of construction, and afford positive frictional abutment without however causing transverse pressure against the shaft, which would result in misalignment or cocking of the shaft.

It should be noted that the stop means employed in the present invention also involves compactness and simplicity of construction and provides an effective means for limiting shaft rotation.

Various changes and modifications may be made in the device of the present invention by those skilled in the art without however departing from the spirit thereof.

What is claimed is:

1. In a rotational potentiometer assembly, the combination of a cup-shaped member formed by a cylindrical shell closed at one end by a transverse closure plate having an inner wall and an outer wall, a rotatable shaft extending through said closure plate, at least one recess formed in said inner wall of said closure plate, non-metallic resilient means disposed in said recess and

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retained thereby, a friction plate carried by said shaft and extending radially therefrom, said friction plate being in spaced relation to said inner wall, braking means disposed between said resilient means and said friction plate, and braking means being urged into frictional engagement with said friction plate by said resilient means, and guide means for said braking means whereby said braking means is maintained in abutting relation with said resilient means and wherein at least one of said friction plate and said braking means is non-metallic.

2. A device as in claim 1, wherein an annular groove is formed in the inner wall of said closure plate, said annular groove in longitudinal cross-section having horizontal sidewalls and a vertical rear wall, said resilient member comprises an O-ring disposed in said annular groove and normally abutting said rear wall, the transverse cross-sectional diameter of said O-ring being less than the depth of said groove whereby a portion of said sidewalls adjacent to said inner wall of said closure plate is left exposed to define said guide means, said friction plate carried by said shaft being in relatively close confronting relation to said annular groove, said braking means comprises an inflexible ring disposed between said friction plate and said O-ring and partly retained by said guide means, said braking means abutting and being urged by said O-ring into frictional engagement with said friction plate, said sidewalls of said annular groove constraining said braking means against transverse movement relative to said friction plate.

3. A device as in claim 2 wherein said closure plate provided with said annular groove is in addition provided with an alignment pin passed transversely therethrough, said alignment pin having a head portion extending from the outer wall of said closure plate and a shank portion projecting from the inner wall of said closure plate, a stop member attached to said friction plate and disposed in spaced relation to said shank portion of said pin whereby rotation of said friction plate by said shaft will cause said stop member to abut said shank portion of said pin at a selected point of angular rotation of said shaft to define a stop for said shaft.

4. The device of claim 3, including a metal member extending radially from said shaft and mechanically supported by and electrically isolated from said shaft by an insulator plastic friction plate member and wherein said

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stop member is an electrically non-conductive block attached to said metal member by fastening means.

5. In a rotary potentiometer, the combination of a cup-shaped member formed by a cylindrical shell closed at one end by a transverse closure plate, a rotatable shaft extending through said closure plate, non-metallic resilient means disposed in an annular groove formed in the inner wall of said closure plate and retained thereby, a friction plate carried by said shaft and extending radially therefrom, said friction plate being in spaced relation to said inner wall, annular braking means interposed between said resilient means and said friction plate, said braking means being urged into frictional engagement with said friction plate by said resilient means, and guide means for said braking means whereby said braking means are maintained in abutting relation with said resilient means, and wherein at least one of said friction plate and said braking means is non-metallic.

6. A potentiometer including a tubular housing and a transverse plate closing one end of said housing, a resistance element, a shaft extending through said transverse plate and having a disc mounted thereon so as to be rotatable with said shaft, a movable contact making means carried by said disc adapted to contact said resistance element and means for electrically connecting said movable contact and said resistance element with external circuits, wherein there is provided a rotational stop means consisting of a stop member extending from said disc toward said transverse plate and a pin extending through said transverse plate so as to provide a shank portion inside said housing adapted to intersect said stop member, and a head portion extending outside said housing to provide means for aligning said potentiometer with associated devices.

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