Sept. 24, 1968 D. G. TWEED ET AL 3,402,693

VARIABLE RESISTOR INDICATING AND LOCKING DEVICE

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FIG. 1.

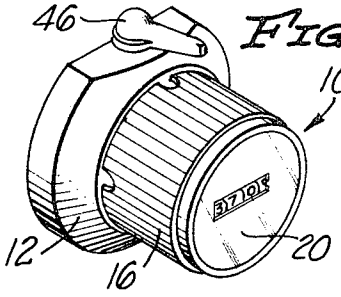


FIG. 2.

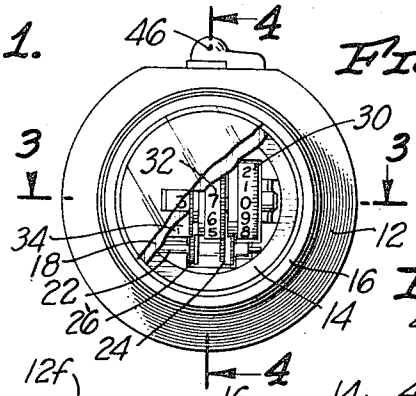


FIG. 3.

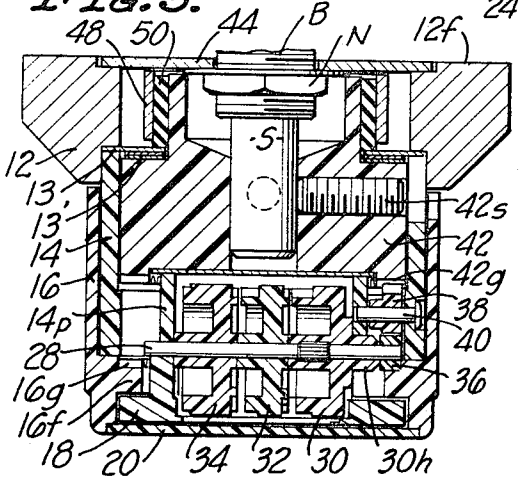


FIG. 4.

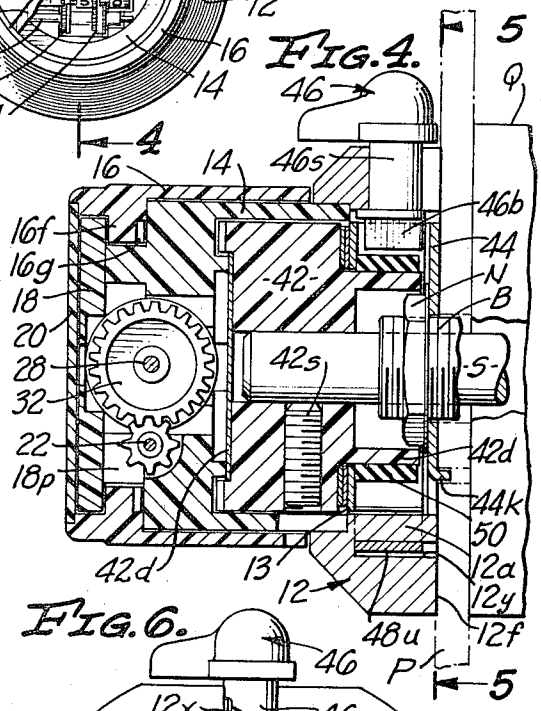


FIG. 5.

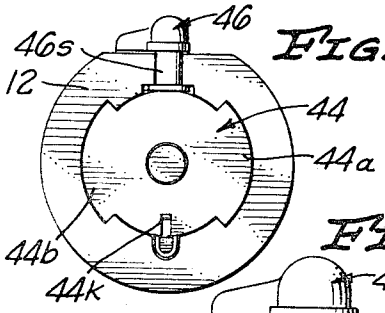


FIG. 6.

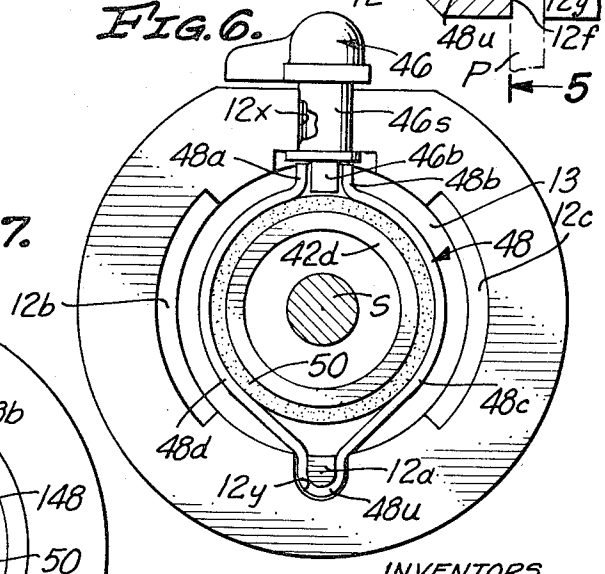
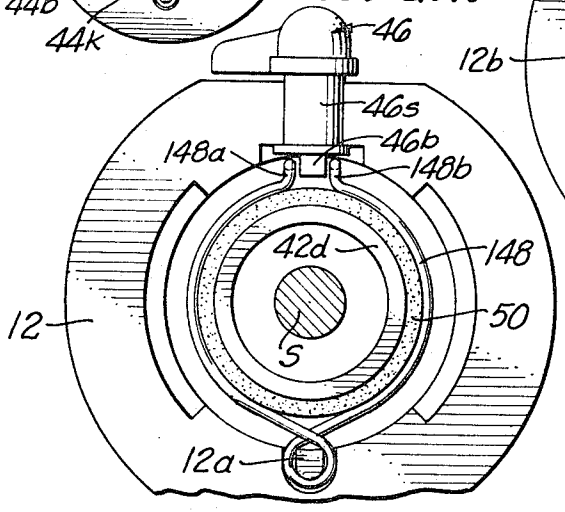


FIG. 7.



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VARIABLE RESISTOR INDICATING AND LOCKING DEVICE

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FIG. 8.

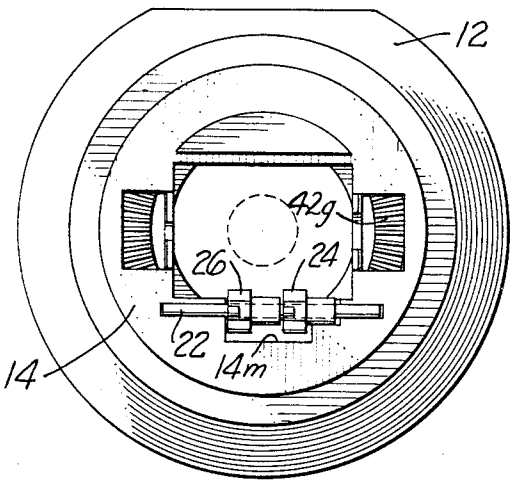


FIG. 9.

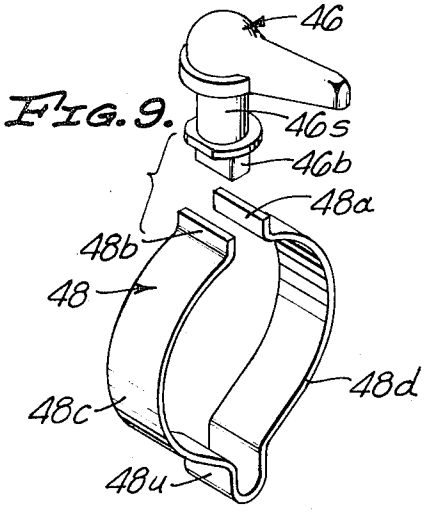


FIG. 11.

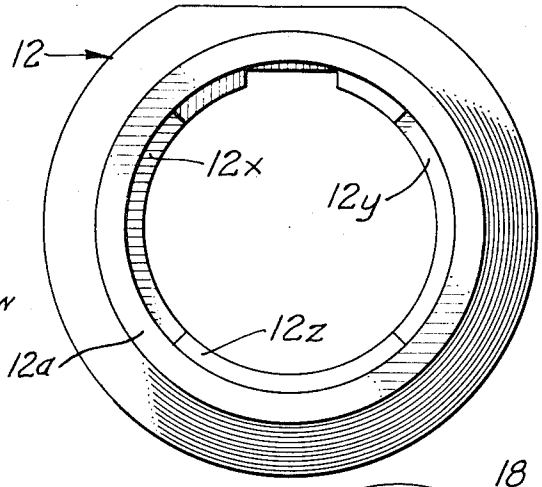


FIG. 10.

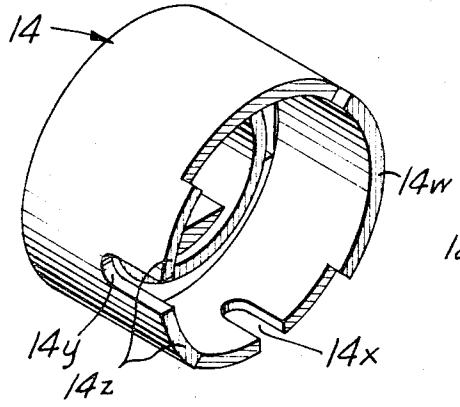


FIG. 13.

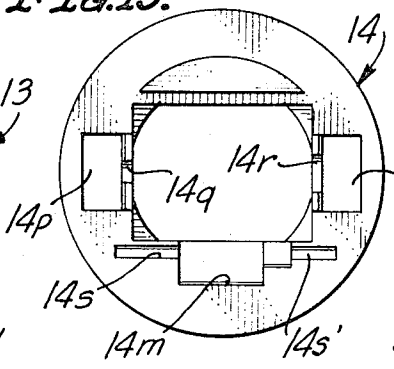


FIG. 14.

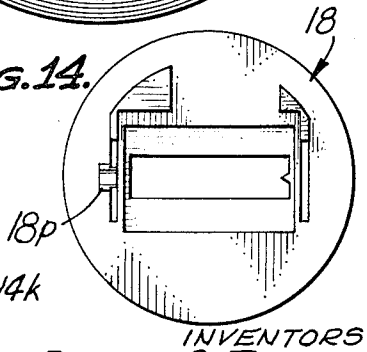
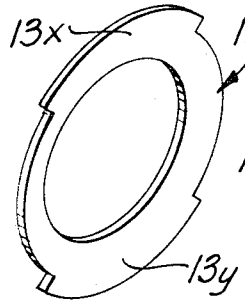


FIG. 12.



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3,402,693

VARIABLE RESISTOR INDICATING AND LOCKING DEVICE

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Filed Apr. 7, 1966, Ser. No. 540,985
6 Claims. (Cl. 116—115)

ABSTRACT OF THE DISCLOSURE

A variable resistor indicating and locking device for a multi-turn variable resistor or potentiometer, having fixed means including a base adapted to repose against a face of a panel and a rotary member to receive and be affixed to a rotary shaft of the resistor, the rotary member being rotated by gearing connected to a manually rotatable shell, and the fixed means supporting a digital counter connected to be driven by the gearing, and the fixed means having a contractile locking band and a lever operable to permit the band to clasp and lock the rotary member and operable to force the band out of engagement with the movable member to permit manual rotation of the shell and gearing to adjust the resistor.

The invention herein disclosed pertains to potentiometers, and more particularly to potentiometers of the so-called multiturn type in which adjustment of the instrument through its entire range of adjustment is effected by rotation of a shaft or like instrumentality through a plurality of turns or revolutions. Still more specifically the invention pertains to means connected to the adjustment shaft for selectively rotating the shaft for effecting adjustment and providing a visible numerical indication of the extent of the adjustment, and for locking the shaft against rotation while retaining the indication of the extent to which adjustment has been effected.

Many devices have been developed with a view toward performing some or all of the aforedescribed operational functions, among which devices may be cited those disclosed in the following numbered U.S. patents, viz: Van Dyke, 2,532,970; George, 2,539,575; Van Dyke, 2,558,-326; Coates, 2,658,395; Van Alen, 2,979,258; Arnold et al., 3,136,294; Tofita, 3,031,035; and Ihrig, 3,172,071. All such devices known to the present inventors have been characterized by one or more undesirable features, such as, for example, high cost, complex structures, difficulty of assembling, low operating lifetime, indication of extent of rotation presented on one or more scales which are difficult to read, and cumbersome structure presenting unsightly appearance. The present invention, by a unique combination, avoids the aforementioned undesirable features or characteristics of the noted prior art devices, and presents a simple, inexpensive and very effective structure which in meritorious fashion performs all of the aforenoted functions.

Briefly, according to the invention, there are provided rotary means including a transmitter adapted to be secured to the rotary adjustment shaft of a multiturn potentiometer or the like, which rotary means is arranged to support and retain against the panel through which the shaft extends, certain relatively stationary structure including support means which serves to support indicating means and which stationary structure is prevented from partaking of rotary movements in a convenient manner, as by being keyed to the panel. Further, the stationary structure rotatably supports a captive rotary shell which is arranged for manual manipulation in the manner a knob would be manipulated, the captive rotary shell being connected by gearing to the indicating means to operate the latter, and being further connected by the gearing to the

aforenoted rotary means, whereby incident to rotation of the shell the rotary means and the shaft are simultaneously rotated and concurrently the indicating means are rotated to furnish an indication of the currently effective extent of rotation of the shaft from an initial or "zero" position. Further according to the invention the stationary structure supports and holds against rotation a contractile spring device which normally is contracted and grips and locks against rotation the transmitter by its inherent tension but which spring device may be expanded by a key means which has a spreader which when rotated to a first attitude acts against the tension of the spring device to spread or expand the latter and release the locking grip of the spring device on the transmitter, and when moved to a second attitude or position releases the spring which then locks the transmitter against accidental or other unintentional rotation. Preferably, one or the other of the contractile spring device and the rotary device is equipped with friction means whereby the grip of the contractile device on the rotary means and the locking action thereof is enhanced; and that is most efficaciously accomplished by provision of an elastic preferably rubber-like or elastomer band disposed under tension on a flange or skirt of the transmitter in a position to be engaged and gripped by the contractile spring device. The contractile device may conveniently be a C-shaped band anchored at its middle to the stationary structure, or, alternatively, may be a coil spring having closely-adjacent ends arranged to be spread by the spreader and a diametrically-opposite formation engaged by the stationary structure to anchor the spring device against rotation.

By virtue of the thus generally described arrangement, the means according to the invention provides an easily-read digital indicating apparatus visible at an end of a knob-like manually operable rotary shell which blends simply and in attractive arrangement with the stationary structure, and which indicating apparatus is housed within and protected by the shell and operated thereby concurrently with operation of the rotary shaft-rotating means, the entire apparatus and means, including the locking means, being adapted for easy and rapid placement on or removal from the shaft of a potentiometer. Further, the locking device, being a resilient contractile member effective to lock the rotary means when released, does not permit of an operator exerting an excessive force thereon incident to operation of the lock, and thereby eliminates the possibility of lock-breakage and/or insufficient locking, as are both usual in the prior art devices.

The foregoing brief general description of the invention makes it evident that it is a principal object of the invention to provide improvements in means for alternatively and intermittently rotating and locking the shaft of a multiturn potentiometer while concurrently providing a digital indication of the extent of rotation of the shaft.

Another object of the invention is to provide general improvements in means for operating upon the shaft of shaft-adjusted potentiometers and providing indications of the extents of adjustments.

Another object of the invention is to provide improvements in shaft-locking devices for manually operable shaft-adjusted variable resistors.

Other objects and advantages of the invention will hereinafter be stated or made apparent in the following detailed description of a presently-preferred exemplary embodiment of the invention, in which description references are made to the accompanying drawings forming a part of this specification and in which drawings:

FIGURE 1 is a pictorial view, to no particular scale, of the noted exemplary embodiment of the invention;

FIGURE 2 is a face view of the device illustrated in

FIGURE 1, with a portion broken away to reveal internal details;

FIGURE 3 is a sectional view of the structure depicted in FIGURES 1 and 2, the section being taken as indicated by broken line and arrows **3—3** in FIGURE 2, but on a different and larger scale;

FIGURE 4 is a sectional view of the structure depicted in FIGURES 1 and 2, the section being taken as indicated by broken line and arrows **4—4** in FIGURE 2, but on a different and larger scale;

FIGURE 5 is a rear view of the device as viewed on a plane indicated at **5—5** in FIGURE 4, to approximately the same scale as that of FIGURE 1;

FIGURE 6 is a view similar to FIGURE 5, to a larger scale and with a part removed to show internal details;

FIGURE 7 is a view similar to FIGURE 6, but showing a modified form of resilient contractile locking member;

FIGURE 8 is a front view of the device, with certain parts removed to illustrate internal details;

FIGURE 9 is a pictorial view of members of the locking structure in disassembled relationship;

FIGURE 10 is a pictorial view of a support, depicting details of the rear end thereof;

FIGURE 11 is a face view of a base device forming part of relatively stationary structure comprised in the device, to no particular scale;

FIGURE 12 is a pictorial view of a retainer ring or washer;

FIGURE 13 is a front view of the support, showing details of construction; and

FIGURE 14 is a rear view of a cap element which is adapted to be secured to the front of the support depicted in FIGURES 10 and 13.

Referring first to FIGURE 1, the assembly of components comprised in the preferred embodiment, and hereinafter termed the assembly, is denoted generally by numeral **10**. The assembly includes a ring-like base **12** the flat rear face **12*f*** (FIGURE 4) of which is adapted to seat against the front face of a panel P through which an actuating shaft S of the variable resistor Q extends. The variable resistor may be, by way of example, a multiturn potentiometer of the character of that disclosed in U.S. patent to Blanco, No. 3,156,888. The variable resistor comprises a threaded bushing, B, and a nut, N, by means of which it is adapted to be secured in place on the panel in a known fashion. Fitted in an annular stepped recess (**12*x***, **12*y***, **12*z***, FIGURE 11) formed at the front of base **12**, and held in place therein as by being adhesively secured therein, is a support **14** (FIGURES 10 and 13) of hollow cylindrical shell-like form having a complex end and interior configuration. The functions of the support are several, as will presently be made evident. Arranged between base **12** and support **14**, and held clamped therebetween as indicated in FIGURES 3 and 4, is a retainer ring or washer **13** (see also FIGURE 12) and one or more annular shims **12'**, whose functions will later herein be explained.

Rotatably disposed on the cylindrical exterior of support **14** is an elongate cylindrical shell **16** (FIGURES 1, 3 and 4) the skirt of which extends back into close proximity to a flat annular front face **12*a*** of base **12**. Shell **16** has a radially inwardly-extending annular internal flange **16*f*** (FIGURE 4) the rear face of which carries a ring gear **16*g*** and an annular portion of which bears against a complementary annular front face of support **14**. Further, shell **16** is held captive in that attitude on support **14** by a fenestrated cap **18** (see also FIGURE 14) of generally circular outline and the rim portion of which is disposed in front of annular flange **16*f***, and which cap is secured to the front end of support **14** as by adhesive applied on the complementary contacting surfaces. A transparent pane or disc **20** is fitted in a bezel formed in the front end of rotatable shell **16**, whereby the interior of the assembly is effectively sealed against ingress of foreign matter.

Disposed in elongated aligned coaxial semicylindrical seats **14*s*** and **14*s'*** (FIGURE 13), provided at the front face of support **14**, are respective ends of a counter-pinion shaft **22** (FIGURES 2, 4 and 8) upon which are rotatably supported for independent rotation first and second counter pinions **24** and **26** as shown in FIGURE 8. The shaft **22** is held from escape and retained in place by a rearwardly-extending complementary pedestal **18*p*** (FIGURES 4 and 14) provided on the rear face of cap **18**; and pinions **24** and **26** are accommodated in a complementary notch **14*m*** formed between the seats in support **14** as indicated in FIGURES 8 and 13. Pinions **24** and **26** are of the type commonly employed in counting mechanisms, and have one-half of the length of alternate teeth cut away or missing.

Rotatably disposed in respective saddles **14*q*** and **14*r*** formed in forwardly extending struts such as **14*p*** (FIGURES 3 and 13) formed as integral portions of support **14** are one end of a counter wheel shaft **28** (FIGURES 3 and 4) and the hub **30*h*** of a first counter wheel **30** which is fixed to the shaft **28** to turn therewith. Loosely disposed on shaft **28** next-adjacent each other as shown are second and third counter wheels **32** and **34**. The counter wheels are of the type commonly used in decimal (tens) counters or revolution counters. Further, affixed to an extending end of shaft **28** is a pinion **36** (FIGURE 3) the teeth of which are engaged with the teeth of the previously mentioned rearwardly-facing internal ring gear **16*g***. The latter gear is preferably formed as an integral part of rotary shell **16**. Thus pinion **36** and wheel **30** are rotated incident to rotation of shell **16**, and, through operation of pinion **24** by the gear of wheel **30**, the operation of wheel **32** by pinion **24**, etc. (in the manner of conventional counters), the counter is driven to provide a direct numerical indication of the extent of rotation of shell **16**.

Rotatably supported in an accommodating recess **14*k*** formed in member **14** (FIGURE 13), and rearwardly of pinion **36**, is an idler pinion **38** (FIGURE 3) which is rotatable on a stationary pin **40** affixed at its ends in support **14**. Idler pinion **38** is in mesh with teeth of a forwardly-facing ring gear **42*g*** which preferably is formed integrally as a molded part of a rotary transmitter **42**. Rotary transmitter **42** is adapted to be locked to the shaft S of the potentiometer, as by set screw means **42*s*** as indicated in FIGURE 4. Access to the set screw means is via apertures or notches such as **14*x***, **14*y*** (FIGURE 10) provided in the skirt of support **14**, and via similar notches provided at the rear end of shell **16** as indicated in FIGURE 1. Thus it is evident that when shell **16** is rotated, the teeth of gear **16*g*** thereon rotate the counter-driving pinion **36**, the latter rotates idler pinion **38**, and pinion **38** in turn rotates transmitter **42** to cause concurrent rotation of shaft S of the potentiometer. Transmitter **42** is held captive in the interior of support **14** by the aforementioned retainer ring **13** (FIGURE 12), which is clamped between base **12** and support **14** as indicated in FIGURES 3 and 4. As indicated in FIGURES 10, 11 and 12, the retainer ring **13** has radial extensions **13*x***, **13*y*** which fit in complementary sectors of the steps **12*x***, **12*y*** formed in the bottom of the annular stepped-recess **12*z*** formed in the forward part of base **12**. Also, complementary rear extensions **14*w*** and **14*z*** (FIGURE 10) provided on support **14** are arranged to fit into the sectors or recesses **12*x*** and **12*y*** and clamp therein the radial extensions **13*x*** and **13*y*** of retainer ring **13**. Thus when support **14** and base **12** are adhesively united or secured together the transmitter **42** is confined in the interior of support **14**, and the teeth of gear **42*g*** are in contact with and are driven by pinion **38**. If the gear ratios are 1 to 1 between ring gears **16*g*** and **42*g***, as shown, the shaft is rotated one revolution per revolution of shell **16**. If necessary, one or more shims **13*s*** may be used with retainer ring **13** as indicated in FIGURE 3.

The transmitter **42** is the means whereby the base, the support, the shell, and other parts are held in together as

a united assembly; and in position at the front of a panel P. Since the transmitter **42** is captive, the entire assembly as a unit is attached in position by tightening the set screw means **42***s*, or is released by loosening the set screws. The base **12** is restrained from rotating around the axis of shaft S as the latter is rotated, by a specially formed anti-rotation member **44** (FIGURES 3, 4 and 5) which is clamped between the panel and bushing nut N and which has a rearwardly-extending key **44***k* arranged to repose in a small hole bored in the panel as indicated in FIGURE 4. Member **44** thus is prevented from rotating around the bushing, and in turn is effective to prevent rotation of base **12** by the action of radially extending arcuate keys **44***a*, **44***b* (FIGURE 5) which fit snugly in complementary shallow arcuate recesses **12***b*, **12***c* (FIGURE 6) formed at the rear face of base **12**. Thus the angular disposition of the locking indicator device or assembly relative to panel P is determined by the position of the small hole in panel P, into which key **44***k* fits. With antirotation member **44** secured in place against the front face of panel P, the locking indicator assembly is applied to the protruding end of shaft S and rotated and moved rearwardly on the shaft until arcuate keys **44***a* and **44***b* are seated in recesses **12***a* and **12***b*. Thereafter but with the potentiometer shaft S previously driven to its lower extreme of rotation and with the counter wheels registering zero, the transmitter set screw means **42***s* are tightened to thereby positively interconnect the shell **16**, the indicator and shaft S into a positively articulated chain or series of components, and to positively attach the locking indicator assembly in position on shaft S in front of panel P. It is desirable to exclude foreign material from the interior of the counter mechanism prior to application of the assembly onto shaft S, and for that purpose a thin disc, **42***d* (FIGURE 4) is fitted in a shallow recess provided in the front face of the transmitter **42**, encircled by ring gear **42***g*.

The connection of the indicator wheels **30**, **32** and **34** to shell **16** via gears **16***g* and **36** and the associated pinions is such as to provide by wheels **30**, **32** and **34** a digital indication, by tenths of a revolution, of the extent of rotation of shell **16** and shaft S. For example, when the indicator is for use with a so-called "ten-turn" potentiometer, gear **16***g* may have seventy teeth, pinion **36** seven teeth, wheel **30** two teeth, pinions **24** and **26** each four alternate full teeth and four intervening half teeth, wheel **32** twenty teeth in engagement with the full teeth of pinion **24** and wheel **32** having two teeth to engage the four full teeth of pinion **26**, and wheel **34** having twenty-two teeth to be driven by the eight teeth of pinion **26**. The numbers of teeth and arrangements thereof in the gearing are susceptible of variation to allow accommodation of the locking indicator structure to potentiometers of, for example, twenty turns, thirty turns, five turns, etc., in accord with well-known gearing design principles as used in conventional turns counting mechanisms.

To permit concurrent locking of both the shaft and indicator means there are provided novel lock means adjacent the panel at the rear end of the structure, utilizing ordinarily wasted space encircling the bushing nut, and out of the way of the operator when adjusting the instrument. For that purpose, and as depicted at the top of FIGURES 4 and 6, there is disposed in a forwardly-extending notch **12***x* formed in the top portion of base **12** the stem **46***s* of a rotatable key **46** which is held from escape from the notch by circumferential flanges provided on the stem of the key as indicated in FIGURE 9, and by the panel P. The lower end of key **46** is formed as a flat blade **46***b* (FIGURES 4, 6 and 9), which blade is positioned and disposed between the operating tips **48***a* and **48***b* of a resilient strongly contractile spring lock **48** as shown in FIGURE 6. In the preferred form, lock **48** is a spring band shaped to provide first and second contractile arcuate drum-engaging limbs **48***c* and **48***d* which when permitted to do so are effective to grip between them opposite portions of a rearwardly-extending cylindrical portion or drum **42***d* formed integral with transmitter **42** (FIGURES 4 and 6). Preferably the drum is provided with an adherent or attached friction facing **50**. Thus when the drum is gripped between the limbs of the lock **48**, the transmitter **42** and shaft S are locked against rotation. In a preferred form the friction facing **50** is in the form of a tensioned tough elastomer band which in the relaxed state is of diameter somewhat less than the outside diameter of drum **42***d*. Thus facing **50** may be secured to the drum **42***d* by its own contractive effort following elastic expansion and fitting on the drum. Lock **48** is restrained against rotation with drum **42***d* by an anchor **12***a* (FIGURES 4 and 6) which is formed as a rearwardly-extending pin-like protrusion integral with and a part of base **12**, the lock having a restricted sharply-curved bight portion **48***u* which engages the anchor as shown.

Lock **48** is constructed of strong resilient material such as spring steel, and is formed to produce a locking grip on drum **42***d* when allowed to contract as shown in FIGURE 6. Thus it is formed so that it must be expanded or have limbs **48***c* and **48***d* spread apart before receiving drum **42***d* and facing **50**. A complementary groove **12***y* is provided in base **12** around anchor **12***a* for reception of the bight **48***u* of lock **48**, as is made evident in FIGURE 6, the groove being dimensioned to accommodate expansion and contraction of the lock. The limbs of lock **48** are adapted to be expanded or spread out of locking engagement with facing **50**, by spreading force applied to tips **48***a* and **48***b* by the blade **46***b* of key **46** as the latter is rotated. Thus as the key is rotated the blade **46***b*, being longer (FIGURES 4 and 9) than the gap between tips **48***a* and **48***b*, acts as a pair of cams and spreads the tips and limbs of the lock. Since in the expanded attitude of the lock the lips thereof exert a strong frictional grip on the ends of the blade of the key, the latter is effective to maintain the lock in the released attitude until it is manually turned to the position indicated in FIGURE 6 in which the lock again is effective to lock transmitter **42**, shaft S, shell **16**, and the indicating means in their then-current relative positions. Thus the lock is effective to hold the indicating means and shell **16** against unintentional displacement and concurrently to very securely lock the shaft S at the position to which it has been adjusted.

Since a fairly strong turning effort is required to be exerted on key **46** to effect spreading of the limbs of lock **48**, there is substantially no chance of the lock being accidentally or unintentionally unlocked, a distinct advantage and improvement over prior art devices in which a strong force must be applied to effect setting of a locking device which then may with only a relatively slight accidentally-applied force be returned to unlocking attitude. Further, since the lock utilizes a space that is next-adjacent the panel P and encircling the potentiometer bushing B and nut N, it does not encroach upon space normally occupied by a technician in manually rotating the adjusting shaft by means of a knob. And since the indicator means utilizes only normally wasted space within the exterior bounds of a knob, and furnishes a single, direct, and easily-readable numerical indication of the extent to which the shaft S has been adjusted, all likelihood of incorrectly arriving at the adjustment value as indicated by two or more scale devices is obviated; and correct reading of indications is made extremely easy and simple.

A modified form of lock component is illustrated in FIGURE 7, wherein the elements previously described are the same excepting only lock **148** which in the modified form is a coil of two or more turns of strong spring wire with one or more small intermediate loops encircling anchor **12***a* and with upturned ends or tip portions **148***a* and **148***b* arranged to be spread by the blade **46***b* of key **46**. Brake **148** is strongly contractile whereby it grips and locks drum **42***d* and facing **50** until it is

forcibly expanded by forcible rotation of key **46**. In other respects the assembly operates as previously described.

The preceding description of a presently preferred physical embodiment of the invention makes it evident that the aforementioned objects have been fully achieved. In the light of the disclosure various changes and modifications within the true spirit and scope of the invention will occur to others; and accordingly we do not wish the invention to be restricted to exact details of the described structure except as is required by the appended claims.

We claim:

1. A variable resistor indicating and lock device adapted for attachment as a unit to a rotary variable resistor adjustment shaft extending through a panel to which such resistor is affixed, said device comprising:

relatively stationary means including base means arranged to abut against a panel, and said stationary means including a hollow support means secured to and extending forwardly of said base means;

relatively rotatable means, including a rotary transmitter mounted in said stationary means between said base means and said support means to be secured to such adjustment shaft, said rotatable means including a rotary shell shape to be grasped and rotated by hand, said shell being rotatably supported on said support means;

indicator means supported by and mounted on said relatively stationary means and including a series of counter wheels each bearing numerical indicia, said indicator means being enclosed in said rotary shell and presenting an aligned series of numercial indicia;

lock means including an expandable contractile spring device having oppositely curved limbs embracing said transmitter and effective to lock said transmitter against rotation, said stationary means including means anchoring said spring device to said relatively stationary means and said lock means comprising key means for spreading the limbs of said spring device to release said transmitter; and

gearing means mounted on said stationary means and interconnecting said rotary shell, said indicator means and said transmitter;

whereby when said transmitter is secured to the shaft and said key means is operated to spread said spring device, rotation of said shell causes rotation of said gearing and effects concurrent rotation of the shaft and the indicator means to indicate the extent of adjustment of said shaft, and whereby thereafter further operation of said key means releases said contractile spring device and said shaft, shell and indicator means are thereby locked against relative displacement.

2. A device according to claim **1**, in which said rotary shell comprises integral therewith a ring gear which serves as a driving gear among said gearing means, for operating said indicator means and said transmitter.

3. A device according to claim **1**, in which said gearing means comprises a first pinion connected to said indicator means for operating the latter, an idler pinion meshed with said first pinion, a ring gear on said shell engaging said first pinion to drive the latter, and a ring gear on said transmitter in mesh with said idler pinion, whereby until said key means is operated to spread said spring device, said transmitter is effective through said gearing means to prevent unintentional displacement of said indicator means and said rotary shell.

4. A device according to claim **1**, in which said indicator means is enclosed within said rotary shell and said shell comprises a transparent face through which indicia on said counter wheels are visible, and in which said stationary means comprises an end cap having a window restricting the visible portions of said wheels to a single aligned series of indicia thereon.

5. A device according to claim **1**, in which said base means comprises means for supporting said key means adjacent the rear face thereof and outwardly of the region of operation of said rotary shell, whereby said key means may easily be operated without likelihood of unintentional displacement of said rotary shell.

6. A device according to claim **1**, including means for restricting rotational displacement of said indicating and locking device about the axis of a shaft to which said device is attached.

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