United States Patent

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[54] **TURNS-COUNTING ROTARY INSTRUMENT DIAL INDICATOR**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **116/115,** 74/813; 188/71; 235/103; 338/134
[51] **Int. Cl.** **G01p 13/00**
[50] **Field of Search** 116/115, 115.5, 133, 124; 74/813; 188/71, 77; 235/103; 338/134

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ABSTRACT: A turns-indicating knob and dial indicator combination for rotational adjustment of a rotary shaft-operated instrument with concurrent visual indication of the full turns and fractional turn through which the adjustment shaft has been rotated, with a shaft lock or brake, the combination characterized by exceptionally few and simple parts.

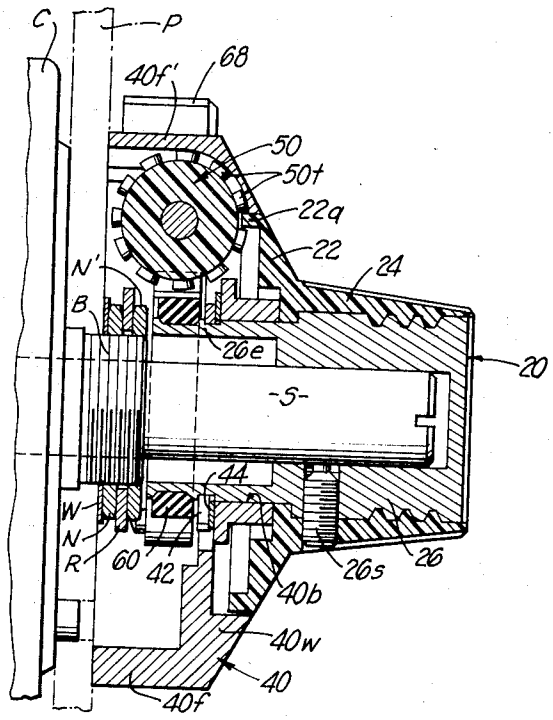


FIG. 1.

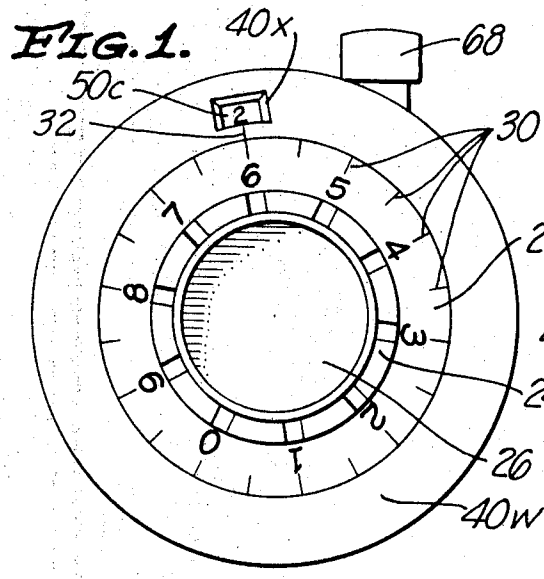


FIG. 2.

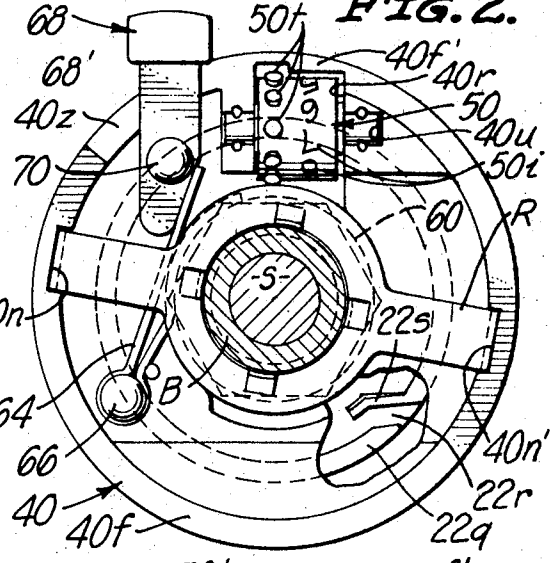


FIG. 3.

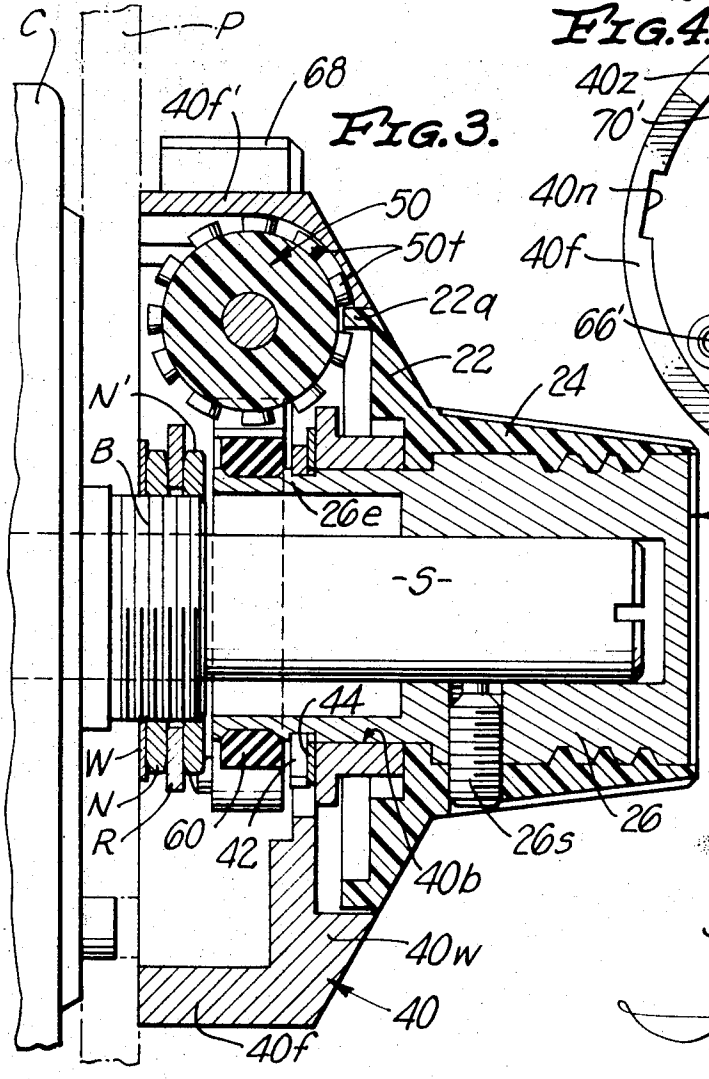


FIG. 4.

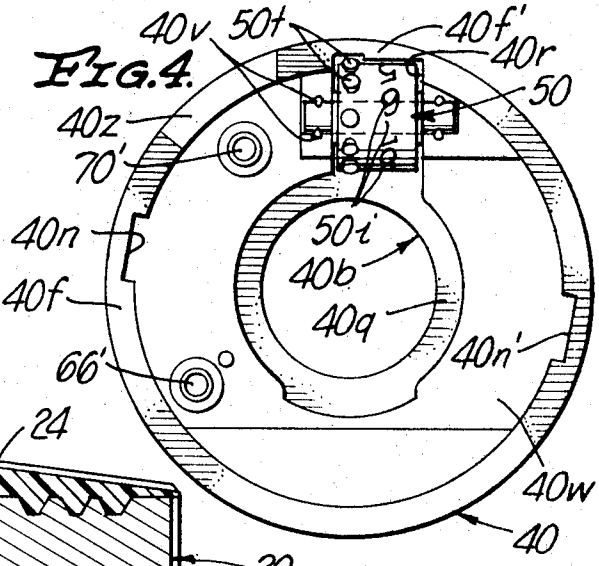
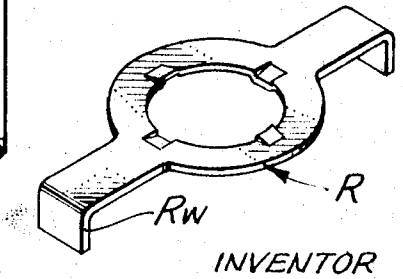


FIG. 5.



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TURNS-COUNTING ROTARY INSTRUMENT DIAL INDICATOR

BRIEF SUMMARY OF THE INVENTION

Background of the Invention

The prior art contains numerous examples of turns-counting indicators of the knob and dial type for use in connection with multiturn instruments such as helical element potentiometers. Many of such indicators include means for locking the shaft of the instrument against undesired rotation following adjustment. Generally such lock means are in the form of a friction brake with a brake-operating lever. The prior art indicators are in general characterized by a large number of parts of complicated shape, by requiring an excessive amount of time for assembly in proper correlative positioning of gears, levers, springs, pivots, wheels and the like, and by the susceptibility to breakdown or faulty operation due to the large number of small moving parts. Further, the prior art indicators were subject to operational difficulties and deficiencies caused by dimensional tolerances buildup occasioned by the use of relatively large numbers of parts.

The Present Invention

By utilizing a simple bidirectional cam means and a set of fractional-turn indicia all formed as integral portions of a one-piece knob and dial, and by utilizing a simple molded digit rotor comprising a pair of gudgeons, a set of cam-following teeth and a set of whole-turn-representing numerical indicia, disposed in cooperative relationship with a complementary housing or base, a very compact, inexpensive, easily assembled and simple indicator of the class described is provided. The integral rotary dial and knob, preferably made by molding a polymeric synthetic resin body on a metallic sleeve to provide increased strength and durability of the part, is provided with a raised nearly circular cam on its rear face. The rotary device thus produced is rotatably held captive in a bore in a generally circular frame by a resilient C-ring retainer which is disposed with an inner portion in a groove in the metallic sleeve and with a face abutting an inner face of the frame. The cam, in the form of a discontinuous ridge or land on the rear face of the dial portion of the knob, rides between teethlike projections formed around the central cylindrical body of the digit rotor or wheel. The coaxial gudgeons of the rotor are molded in as a metal axle or, alternatively, are formed integral with the rotor body and rotate in a pair of complementary recesses formed in the rear interior face of the frame. A fenestra is formed through the frame in a position of registry with a digit formed on the rotor, whereby any one of the arcuate array of numeric digits on the rotor may be viewed through the opening when the digit is brought into registry. The number of such digits is equal to the number of total turns of the instrument shaft, plus one, and generally the array commences with a zero and continues through a number equal to the full-turns count required (e.g., 10 in the case of 10-turn potentiometer). The fractional portions of any full turn or revolution of the shaft are indicated by registry of one or another of a circular array of marks on the dial, with a stationary ledger mark on the frame adjacent the fenestra. Thus the full and fractional turns may be read at a glance, without any difficulty.

The knob and dial, attached to the frame as described, are pressed onto the instrument shaft and moved toward the instrument panel until the frame abuts and presses firmly against the panel, after which a setscrew disposed in a threaded bore in the knob is turned tightly against the shaft. Thereby the indicator is retained in operative position and condition on the instrument shaft. Provision may be made, as in the form of a notch or recess in the frame, for interengagement of the frame with an antirotation washer or the like secured on the instrument bushing at the face of the panel, as may be conventional practice in the art. A lever-operated resilient brake or lock means insures maintenance of the shaft in any adjusted position.

The foregoing brief summary of the invention indicates that it is a primary object of the invention to provide a simple, inexpensive, dial indicator device for multiturn potentiometers and like instruments.

Another object of the invention is the provision of a dial indicator and lock device, having a minimum number of parts.

Another object of the invention is to provide a dial indicator device comprising only simple, easily made parts.

Other objects and advantages of the invention will hereinafter be set out or made apparent in the appended claims and the following detailed description of the exemplary and presently preferred form of the invention as illustrated in the accompanying drawing which form a part of this specification.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a face view, to no specific scale, of the presently preferred form of dial indicator and lock device according to the invention;

FIG. 2 is a rear view of the indicator device depicted in FIG. 1, with portions broken away to better illustrate internal details of a cam;

FIG. 3 is a longitudinal sectional view, to a larger scale, of the indicator device depicted in FIG. 1;

FIG. 4 is a rear view of the frame member of the indicator depicted in FIG. 1, with the digit or number rotor or wheel of the indicator installed; and

FIG. 5 is a pictorial view of the antirotation means used in connection with the indicator and lock device depicted in FIG. 1, and which antirotation means is shown installed in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

The indicator device of the invention is adapted to be secured to the rotary actuating shaft of a plural-turns potentiometer or like rotary shaft-adjusted instrument that is disposed on the rear face of an apertured panel with a mounting bushing thereof extending through the panel aperture and rigidly secured to the panel by a nut, the rotary actuating shaft being journaled in the bushing and extending forwardly therefrom for application of an actuating knob or other rotary driving means. As is indicated in FIG. 3, the exemplary potentiometer casing C abuts against the rear face of the panel P with the externally threaded bushing B extending through an aperture formed in the panel and which bushing is secured therein by nut N and lock washer W. The actuating shaft S is journaled in bushing B and extends forwardly therefrom for attachment of means such as those presently to be described. Those components thus far denominated by alphabetical characters are conventional and are well known in the art.

In accord with the invention, a rotary actuating device, herein denominated a knob **20** (FIG. 3), which comprises a rearward flange portion **22** and a forwardly-extending grip portion **24**, is provided with a metal core **26** and set screw **26***s* whereby the device is secured to the potentiometer or like instrument via the shaft S. The knob flange portion **22** comprises a set of indicia **30**, in numerical and lines form, as indicated in FIG. 1, any of which indicia may be brought into registry with a stationary ledger mark **32** presently to be described. The knob **20** is adapted to serve to integrate the indicator device as a unitary apparatus, in a manner and by means presently described.

The indicator according to the invention further comprises a shaped frame, **40**, of circular cuplike form having a rearwardly extending flange **40***f* and a forward web **40***w* which is formed with a smooth bore **40***b* (FIG. 4) at its center. The bore of the web is complementary to a rearwardly extending cylindrical extension **26***e* of the metal core **26** of the knob, whereby the two components are rotatable relative to each other on the bearing thus provided in bore **40***b*. The frame **40** is held in place on the extension **16***e* by a C-ring retainer **42**

which seats in an external annular groove formed in the extension as shown in FIG. 3. To take up looseness or end play, if any, between the knob and the frame, one or more annular ring shims such as **44** may be mounted between the C-ring retainer **42** and the inner planar annular face **40***q* (FIG. 4) of the frame. Thus the frame and the knob device are secured together as a unit, with the knob rotatable in the bearing at **40***b*; and the indicator is applied to the potentiometer by applying the integrated unit to shaft S, pressing the unit rearwardly to bring the rear face of the rim of the frame against the front face of panel P, and setting the setscrew **26***5* against the shaft. This will be more fully explained hereinafter.

In vibration environments, possibility of rotational displacement of the frame **40** relative to panel P may be positively prevented by affixing an antirotation washer R (FIGS. 3 and 5) on the potentiometer bushing B by means of a lock nut N', the washer having bent wings such as R*w* which seat in complementary notches **40***n* and **40***n'* (FIG. 4) formed in the interior of the rim of the frame, as indicated generally in FIG. 2 The washer, held against rotation by not N' and having its wings seated in the notches, effectively prevents rotation of the frame relative to the panel, without interference in any way with the rotation of the knob and shaft and appurtenant means next to be described.

Mounted for rotation in a recess **40***r* (FIG. 2 and 4) formed in the rear face of the frame **40** is an indicator rotor or wheel **50**. The wheel **50** is a molded part having series of protruding stub teeth **50***t*, and alongside the teeth a corresponding arcuate series of numerical indicia **50***n* in the form of printed or embossed numbers commencing with zero and progressing to a number equal to the total number of full turns or revolutions required of the knob to effect adjustment of the potentiometer through its total adjustment range. For example, the numerical indicia extend from zero through 10 in the case of 10-turn potentiometer. The corresponding series of teeth **50***t* would in that case include 11 teeth. As will be evident to those skilled in the art, in the case of three-turn or five-turn instruments, for example, the numerical indicia and corresponding teeth will not occupy the entire periphery of the wheel, but will occupy only a sector of appropriate angular extent. The wheel may have an integral axle rotatable in a pair of aligned slots such as **40***u* (FIG. 2) formed in the frame. The axle is held captive in the slots by means such as punch-produced deformations like those indicated at **40***v* in FIG. 4, formed in the rear face of the frame. Alternatively, the indicator may be freely rotatable upon a separate metal spindle which is locked in the slots by the same or similar deformations.

The indicator number wheel **50** serves to produce a numerical indication of the number of full turns the knob and shaft are rotated from an initial or zero position. Thus a window **40***x* (FIG. 1) is provided in the beveled front face of frame **40**, in registry with a station at which one of the numbers on wheel **50** is stationary during a principal portion of one revolution of the knob. The wheel is caused to advance one tooth each time the knob is advanced through one revolution; and to retreat one tooth for each revolution of the knob in the retreat or opposite direction. To that end, and without necessity for complex interconnected indicator wheels as in digital readout dials, the present invention provides on the rear face of the flange portion **22** of the knob **20**, a cam device which engages teeth **50***t* of the indicator wheel and moves the wheel one step per revolution of the knob. The cam device comprises an arcuate outstanding and rearwardly extending protuberance or rib **22***l* (FIGS. 2 and 3) disposed along the periphery of flange portion **22**. A portion of the cam always is present between one or another pair of the teeth of the wheel as indicated in FIG. 3. The cam device or rib is discontinuous, as at **22***r* (FIG. 2), and terminates at one of its ends in an offset or rise **22***s* spaced from the other termination by a distance permitting passage therebetween of a tooth of the wheel. Thus, as the knob is rotated, the longer arcuate portion of the cam or rib proceeds or passes between two next-adjacent teeth of the wheel, effectively holding the wheel against undesired rotation; and as rotation continues, the rise **22***s* is brought into engagement with one tooth of the pair and by cam action rotates the engaged tooth and the wheel one tooth-pitch in one direction or another depending upon the direction of rotation of the knob. Thus with the knob rotated forwardly (clockwise as viewed in FIG. 1) from a zero position at which the 0 indicia on the dial is in registry with ledger mark **32** and the 0 indicia on the wheel is in registry with window **40***x*, the number wheel **50** is held stationary during nearly all of the first revolution; and during the last few degrees of the first revolution and the first few degrees of the next revolution, the riser **22***s* engages a tooth and advances the wheel to bring the number 1 on the wheel into registry with the window. That action is continued as forward rotation of the knob is continued, the number wheel being stepped forwardly one indicia each time a revolution of the knob is completed. Reverse rotation of the knob causes reverse stepwise rotation of the number wheel, in an obvious action of the opposite face of riser **22***s* on the teeth of the wheel.

As is evident, with the number wheel rotated to the 0 position and with the 0 of the dial in registry with ledger mark **32**, the potentiometer is rotated to the appropriate end of its multiturn traverse (herein called the low end), and the dial and indicator then placed on the shaft S and the setscrew **26***s* tightened. Thereafter, fractional portions of any full turn or revolution of the knob are indicated by the dial indicia in registry with the ledger mark **32**, and full turns or revolutions are indicated by the indicia apparent in window **40***x*. Thus with very simple and few parts, an effective multiturn indicator device is provided which is integrated into a single unit for packaging, sale and installation, and which is easily synchronized in the field with the instrument to which it is applied.

For effecting locking of the potentiometer or like instrument in adjusted position, a locking band **60** (FIG. 3) of rubber or like friction material is mounted in a complementary annular groove provided in the rearmost part of the cylindrical extension **26***e* of knob core **26**; and a locking spring is arranged to alternatively hold, or leave free, the band. The locking spring **64** (FIG. 2) is a reversely-bent strip of resilient spring material, formed at the intersection or juncture of its limbs with an eye for reception of a pressed-in anchor pivot **66** upon which the spring may rock. The inner limb of the spring is formed to provide an arcuate shoe portion shaped complementary to a portion of the periphery of band **60**; and the outer limb forms an actuating arm acutely disposed as shown and arranged for engagement by a cam surface on a locking lever **68**. The pivot **66** is received in an anchor bore **66'** (FIG. 4) formed in a rearwardly-extending boss formed on the frame **40**. The locking lever is pivotally mounted on a pressed-in pivot pin **70** that is received in an anchor bore **70'** (FIG. 4) similarly formed in a boss formed on the frame. The locking lever extends outwardly of the frame **40** via an open notch **40***z* formed in the rear edge of the peripheral flange of the frame, as shown in FIGS. 2 and 4, whereby the end of the lever is accessible for manual manipulation. When moved upwardly to the releasing position or attitude as depicted in FIG. 2, the lower cam-faced end of the lever moves away from the locking band **60** and the spring **64**, relieving the force applied to the outer limb of the spring and permitting rotation of the knob for adjustment of the instrument. When moved arcuately downwardly along notch **40***z*, the lever moves its cam-faced end inwardly, deforming spring **64** and causing the latter to strongly press its arcuate inner end portion against band **60** and thereby locking the knob **20** and shaft S against rotation. As will be evident to those skilled in the art, neither application nor release of the resilient bifurcate spring brake will in any way tend to cause creeping or other rotation of shaft S, with the consequence that adjustment of the shaft and of the instrument adjusted thereby is left entirely undisturbed, in contradistinction to many prior art lock or brake devices wherein release or application of the lock involves movement of a lever or rigid pivoted member into contact with a band or

drum and consequent slight rotation of the band or drum and the instrument shaft.

Additionally, it is evident that the aforementioned objects of the invention have been attained, the indicator means being of a very few simple and easily formed parts that are self-coherent in a unitary assembly that is easily synchronized and applied to a multiturn shaft-adjusted instrument.

I claim:

1. A turns-counting rotary-instrument dial indicator comprising:

first means, including a rotary knob device having a bore defining an axis of rotation, said device comprising a manually rotatable forward portion, an annular flange portion rearwardly of the forward portion, and a rear portion presenting an annular bearing surface extending around the defined axis, said flange portion presenting on its forward peripheral face a set of indicia and on its rearward face an arcuate discontinuous outstanding cam terminated at one end by a short offset spaced radially away from the other end thereof, and said device having means wherewith to be secured to a rotary actuating shaft of an instrument;

second means, including a frame having a portion thereof presenting a bearing surface complementary to said annular bearing surface and seated therewith whereby said first and second means are rotatable about said axis relative to one another, said frame having a forward face complementary to a forward face of said annular flange and having a ledger mark thereon terminating at an edge of said flange, said frame having a rearwardly-facing recess and a window between said recess and said forward face; and

third means, including a toothed rotary indicia-bearing wheel rotatable in said recess in said frame and having an arcuate series of teeth successively engaged by said cam incident to continued rotation of said knob and having an arcuate series of numerical indicia successively presented one at a time at said window incident to said continued rotation,

whereby incident to attachment of said dial indicator to a rotary actuating shaft of a rotary instrument, fractional turns of rotation of the shaft are indicated by indicia on said annular flange portion and said ledger mark, and full turns of said shaft are indicated by indicia presented at said window, with means comprising a minimum number of parts.

2. A dial indicator as defined in claim 1, in which said wheel is of cylindrical configuration having the teeth thereof protruding from a cylindrical surface and in which said cam engages and passes between next-adjacent teeth of said wheel whereby to lock the wheel against rotation during all but a few degrees of rotation of said knob device and whereby during the said few degrees of rotation said offset rotates said wheel one step to present another numerical indicia at said window.

3. A dial indicator as defined in claim 2, in which said rear portion of said rotary knob device carries an annular friction band, and said frame carries a double-limbed brake member movable into and out of frictional engagement with said band, and lever means for moving said brake member to force the latter to engage said band whereby to lock said device against undesired rotation.

4. A dial indicator as defined in claim 3, in which said resilient double-limbed brake member comprises first and second resilient limbs arranged mutually diverging from an integral eye interconnecting the limbs, said second means comprising a pivot extending through said eye, and said second limb having an arcuate portion complementary to a portion of the surface of said band, whereby when said lever is actuated to move said brake member to engage said band the latter is resiliently engaged over an arcuate sector thereof by said arcuate portion of said second limb.