United States Patent [19]

Black

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[45] **March 20, 1973**

[54] **ELECTRICAL SWITCH INDICATOR**

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[21] Appl. No.: **235,742**

[52] **U.S. Cl.** .....**200/167 R,** 116/70
[51] **Int. Cl.** **H01h 9/16**
[58] **Field of Search** .....116/70, 129 R; 200/167 R, 200/167 A

[56] **References Cited**

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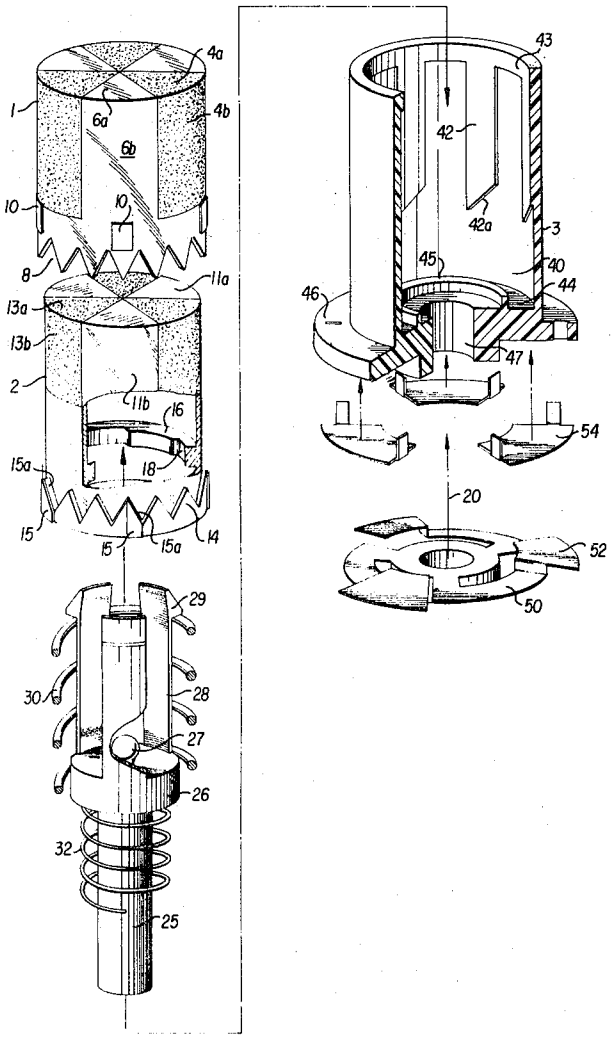
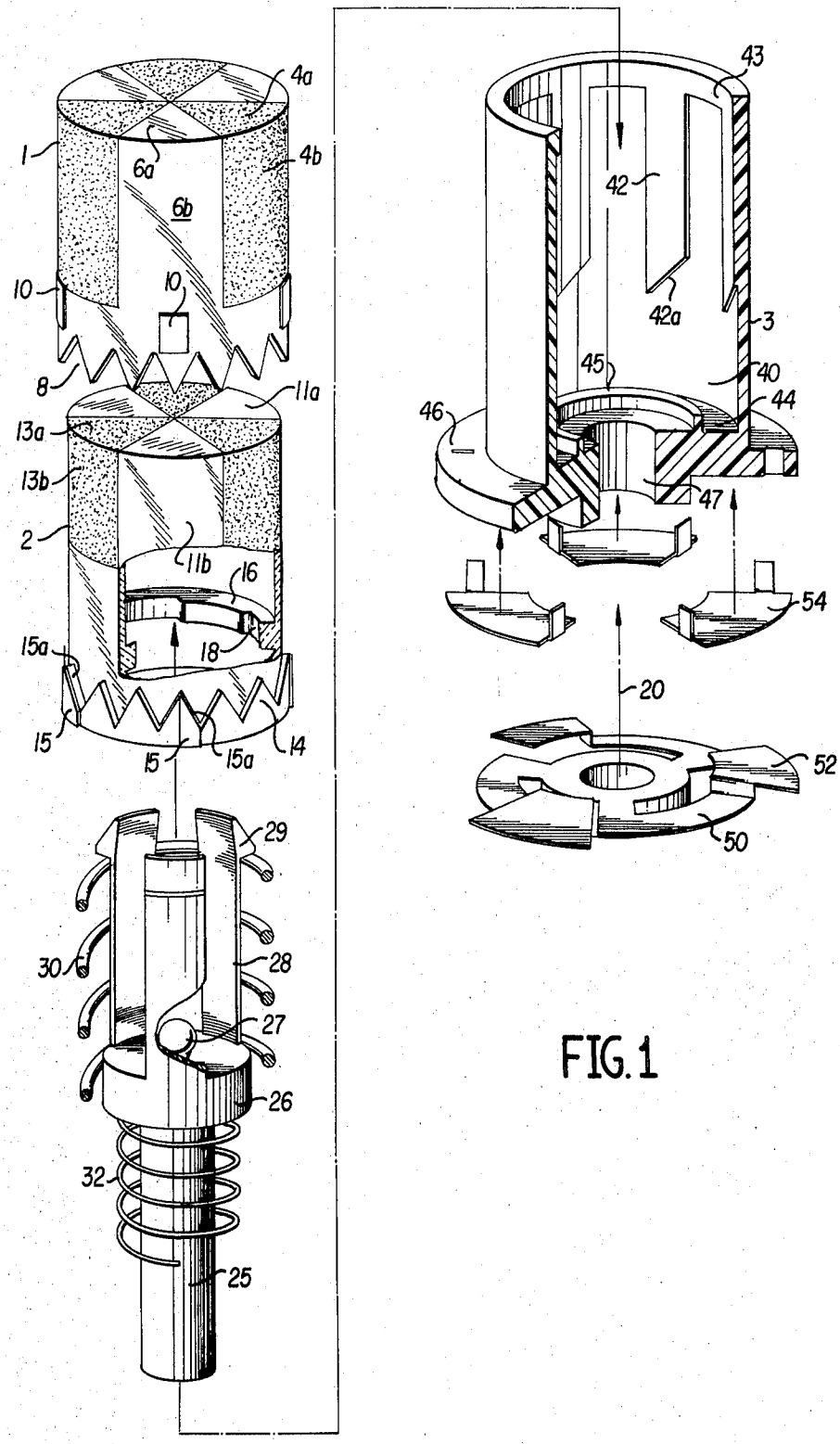
Primary Examiner—H. O. Jones
Attorney—Arthur Schwartz et al.

[57] **ABSTRACT**

A push-button electrical switch indicator for simultaneously changing an electrical contact and readily indicating a new switch position. A drive member imparts a rotary motion to an indicia-bearing rotor which connects to a central shaft to change the electrical contacts. The rotor indicia are visible from the top and side of the switch assembly.

10 Claims, 8 Drawing Figures

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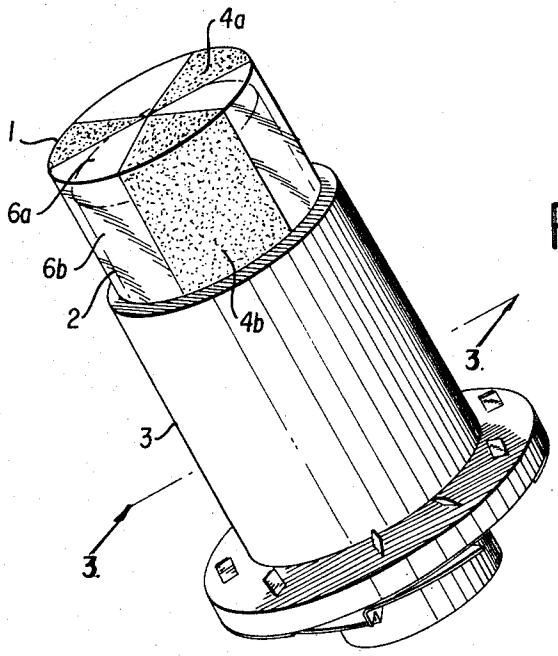
1
6a
4b
6b
10
10
8
11a
13a
13b
2
11b
16
15a
18
15
15
15a
14
29
30
28
27
26
32
25
43
42
42a
3
45
40
46
44
47
54
20
52
50

FIG. 1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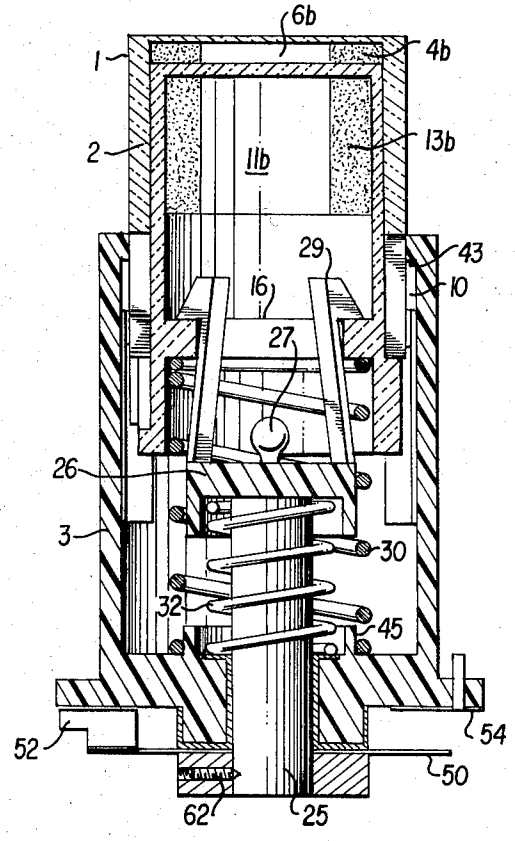
6a
6b
2
4b
3
3
3

FIG. 2


6b
1
4b
2
13b
11b
29
43
16
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27
26
3
30
32
45
52
54
50
62
25

FIG. 3

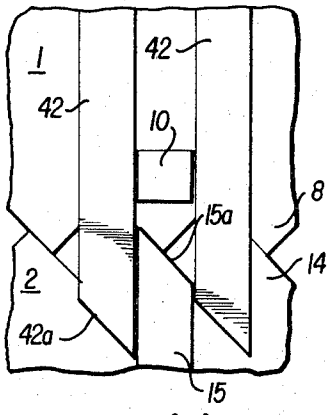

FIG. 4(a)

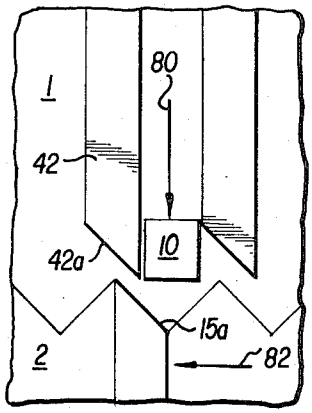

FIG. 4(b)

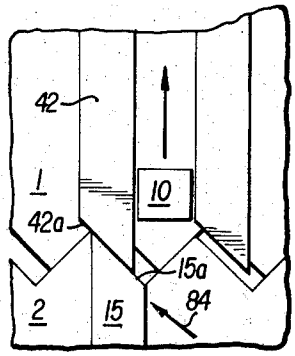

FIG. 4(c)

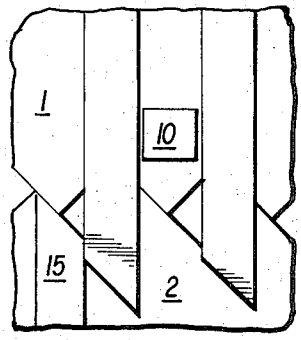

FIG. 4(d)

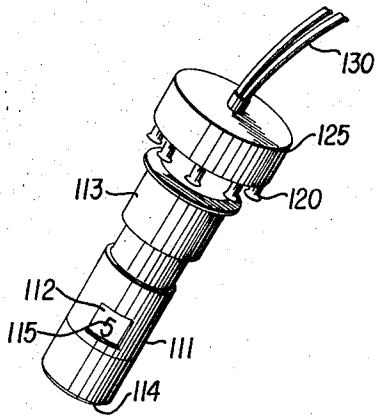

FIG. 5

top segments 11*a* and 13*a* respectively and have corresponding colors. For example, segments 11*a* and 11*b* may be white; whereas, segments 13a and 13b may be black. The bottom portion of rotor 2 contains upwardly directed teeth 14 which are spaced to mesh with the downwardly directed teeth 8 of drive member 1. A plurality of raised detent elements 15 having cam surfaces 15*a* are spaced around the surface of rotor 2 and positioned in alignment with projections 10 of drive 1. The cam surfaces 15*a* run parallel to one edge of the adjacent teeth 14 and form a raised extension thereof. The rotor 2 contains an inner contact ring 16 having recesses 18. The ring 16, teeth 14 and detent elements 15 may be molded from a single piece of nylon or made of plastic or glass.

Mounted for rotation about the switch assembly axis 20 in a rotor shaft 25. Fixed to the shaft 25 is a base 26 having a plurality of tension arms 28. A light source 27 is mounted to the base 26. The light source may alternately be mounted within rotor 2, or the shaft 25 may contain a fiber optical bundle to transmit light from an outside source to illuminate the rotor indicia or colored segments. The end of each tension arm 28 contains a stop 29 which is designed to abut against the top surface of contact ring 16 of rotor 2. The width of the tension arm is such that it fits within the recess 18 of contact ring 16 and provides a sliding frictional contact between the rotor 2 and shaft 25. The purpose of the sliding contact is to transmit the rotary motion of the rotor 2 to the shaft 25 without any linear or axial motion. For small indicator assemblies, where the axial motion of the drive and rotor are relatively small, the shaft may be rigidly attached to the rotor. A primary spring 30 surrounds the tension arms 28 and extends around the shaft 25. A secondary spring 32 surrounds the shaft 25.

Body 3 comprises an inner cylindrical surface 40 having raised guides 42, and raised edge 43. Guides 42 have complementary cam surfaces 42a. Projections 10 of drive member 1 move axially along a path on surface 40 defined by adjacent guides 42. The guides thus limit any undesired angular motion of the drive member 1. Body 3 further comprises a base surface 44, inner ridge 45, outer rim 46 and axial bore 47. Shaft 25 is mounted within bore 47 and extends beyond the body 3 to connect to an electrical contact disk 50 having contact plates 52. Complementary contact plates 54 are mounted on rim 46. FIG. 1 shows three contact plates 54 which are spaced 60° apart. The primary spring 30 is fitted around ridge 45, whereas, the secondary spring 32 is mounted within ridge 45. Both springs press against base surface 44 of body 3. Primary spring 30 controls the linear push-button force needed to actuate the switch-indicator assembly.

FIG. 2 shows an assembled switch-indicator. Rotor 2 is mounted concentrically within driver 1. Transparent front segments 6a and side segments 6*b* allow for the visual inspection of the colored segments 11 and 13 of rotor 2. By observing the color shown through the transparent segments 6*a* and 6*b*, the condition of the electrical switch is readily ascertained. For convenience, the opaque segments 4*a* and 4*b* of drive member 1 may be the same color as one of the colored segments 11 or 13. Thus, if segments 11 are white and segments 13 black, opaque segments 4 may also be black. A completely black front or side view may then indicate an "off" position of the switch, whereas alternately white and black segments indicate an "on" position.

FIG. 3 is a cross-sectional view of FIG. 2 taken along the switch-indicator assembly axis 20. The primary spring 30 exerts pressure against the bottom surface of contact ring 16 tending to move the rotor 2 out from the body 3 along the assembly axis. The rotor is prevented from moving out of body 3 by the stops 29 of tension arms 28. Drive member 1 may move along the assembly axis 20 but is held within body 3 by the contact of projections 10 with raised edge 43. The electrical contact disk 50 is secured to the shaft 25 by a set screw 62.

FIGS. 4(*a*)–4(*d*) show a one-cycle operating sequence of the cam surface in which the indicator is turned from an "on" position to an "off" position or vice-versa. The operational sequence is the same for a multiposition rotary switch-indicator in changing from one switch position to another. Only the details of the cam surfaces are shown and identical indicia are used as in FIG. 1. The sequence shown is that which would appear if the cylindrical surface 40 were transparent and the switch-indicator assembly was viewed from the outside.

FIG. 4(*a*) shows the original position of the downwardly projecting teeth 8 of drive 1 and upwardly projecting teeth 14 of rotor 2. Projection 10 is initially aligned with cam surface 15a on raised detent element 15.

In operation, the drive member 1 is pressed downwardly along the direction of arrow 80 as shown in FIG. 4(*b*). The drive teeth 8 are in contact with rotor teeth 14 and the rotor assembly is pressed downward against the restoring force of primary spring 30. The downward force exerted by the drive member 1 and the upward force exerted on the rotor through spring 30 cause the rotor assembly to rotate slightly along the direction of arrow 82. When the drive and rotor teeth completely mesh, the cam surface 15*a* of detent 15 is rotated in partial alignment with the complementary cam surface 42*a* of guide 42. Once the drive and rotor teeth fully mesh, the downward direction of the drive member 1 produces no further rotation of the rotor. The amount of rotation in going from the position in FIG. 4(*a*) to the full mesh position shown in FIG. 4(*b*) is only a small fraction of the cycle rotation. In the full mesh position of FIG. 4(*b*) the switch indicator has not changed positions and the original electrical contact of the switch has not been altered.

In FIG. 4(*c*) the drive member has been released, and rotor 2 as well as drive 1 move upward under the force of primary spring 30. During this upward motion, the cam surface 15*a* rides along the complementary cam surface 42*a* of guide 42. Since guides 42 are rigidly secured to the body 3 (see FIG. 1), a rotational motion is imparted to the rotor assembly along the direction of arrow 84 as shown in FIG. 4(*c*). The rotor assembly 2 continues to turn until cam surface 15*a* has moved out of contact with complementary cam surfaces 42(*a*). FIG. 4(*d*) shows the position of the rotor and drive just after the end of the rotation. At this point the primary spring 30 moves the rotor and drive upward until stop members 29 engages ring 16 (FIG. 1).

ELECTRICAL SWITCH INDICATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is in the field of electrical indicators and actuators for switching electrical contacts and indicating the switch position thereof.

2. Description of the Prior Art

Push-button switches and indicators have been used extensively in industrial control processes and instrumentation technology of an industrial and experimental nature. Push-button indicators employed in such switch assemblies are usually two-position (on-off) indications in the form of a light which is energized or de-energized depending upon the switch contact. Multiposition rotary switches usually employ numbered dials to indicate the switch position, and the switch assembly is actuated by a direct rotary motion.

Indicators using a color disk which rotates behind a partially transparent mask have also been employed such as disclosed in the U.S. Pat. Nos. 3,247,824 and 2,617,381. These indicators provide a two-position indication visible from the front surface. U.S. Pat. No. 3,247,824, for example, discloses a pressure indicator for use in fire extinguisher tanks. The driving shaft is non-rotatable and does not actuate any rotary switch or control device. In addition the cam surfaces of the pressure indicator are designed to cause the color disc to rotate during an upward displacement of the shaft and again during a downward displacement. The instant invention not only provides a rotatable shaft for driving a rotary control device, but also provides an indicator which is actuated upon completion of a full reciprocating shaft movement, i.e. both an upward and downward movement as desired in push-button actuators.

SUMMARY OF THE INVENTION

The electrical switch indicator assembly provides a simple design for electrical indicators in which rotary motion is attained by linear pushbutton action. An indication of the rotary switch position is visible both from the top and side surfaces of the assembly. The indicator may be used in simple two-position, on-off switches or generally in rotary switches having a plurality of rotary contact positions. The indicator comprises a cylindrical rotor having alternately light and dark-colored segments which are positioned within a drive or stator element having alternately shaded and transparent segments aligned with the colored rotor segments. In the simple two-position arrangement, the switch indicator presents a single-colored appearance in one position when viewed from either the top or side surfaces. After depression and release of the drive element and consequent rotation of the rotor, the indicator appears as alternate light and dark segments signifying the second switch position. In another embodiment the indication means is provided by numerals or other indicia fixed on the rotor cylindrical and top surfaces and visible through transparent sections or openings in the drive element. The rotary switch position of a ten-position rotary switch may be readily indicated using indicia 0–9.

The rotary motion is imparted to the rotor by means of a simple cam arrangement which is highly dependable. Upon depression of the drive member, upwardly directed teeth on the rotor mesh with downwardly directed teeth of the drive member to partially rotate and align the rotor with a cam surface which, upon release of the drive member, effects a rotation of the rotor to a new position. The rotary motion is unidirectional which is advantageous in test equipment demanding successively increasing or decreasing switch settings. A plurality of indicators may be utilized in equipment for digital readout indications visible from both the front and sides of the assembly.

The assembly design is inexpensive to fabricate and capable of ultra-miniaturization. The rotor may be made of metal, plastic, nylon or fiber material whereas the drive member may be made of a transparent material such as glass or plastic. Because of the hollow construction of the drive and rotor members, a light source may be positioned within the rotor to illuminate the indicia or colored segments. Fiber optics may also be employed to provide illumination from a source outside the indicator assembly.

It is accordingly an object of the invention to provide a simple means to indicate a rotary switch position which is visible from both the top and sides of the switch-indicator assembly.

Another object of the invention is to provide an inexpensive and dependable mechanism for translating the linear motion associated with a push-button drive element into a rotary motion for indexing the rotor position and simultaneously rotating the electrical switch contacts.

Another object of the invention is to provide an indicator having relatively few parts which are easily manufactured and capable of long, dependable use.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of the invention are apparent from the description of the preferred embodiment of the invention together with the drawings as described below, wherein:

FIG. **1** is an exploded perspective view, partially in cross-section of the switch-indicator assembly;

FIG. **2** is a perspective view of the assembled switch-indicator;

FIG. **3** is a cross-sectional view of the switch-indicator assembly of FIG. **2**;

FIGS. **4**(*a*)–**4**(*d*) are segments of the switch-indicator assembly of FIG. **1** showing the cam surfaces; and

FIG. **5** shows a side view of another embodiment of the switch-indicator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. **1**, the basic components of the switch assembly are a drive member **1**, a rotor **2** and a body **3**. The drive member **1** also serves as the indicator and comprises opaque front surfaces **4***a* having adjacent side segments **4***b*. Alternately disposed between the opaque surfaces are transparent front segments **6***a* having adjacent side segments **6***b*. The lower end of the drive member **1** contains downwardly directed teeth **8** and a plurality of projections **10** spaced around the outer surface of drive member **1**.

The rotor **2** comprises an upper portion having a top surface containing colored segments **11***a* which are alternately disposed between colored segments **13***a*. Adjacent side segments **11***b* and **13***b* adjoin the respective

The main rotation of the rotor assembly occurs when the cam surfaces **15**a of detent **15** slides along the complementary cam surface **42***a* of guide **42**. Tension arms **28** exert sufficient force within recess **18** to cause the rotational motion of rotor **2** to be imparted to shaft **25**. Rotation of shaft **25** in turn causes contact disk **50** to go through a cycle, i.e. from one set of contact positions to another. At the same time the indicator segments **11** and **13** of rotor **2** change position relative to the fixed drive segments **4** and **6**. Thus, as viewed from the top or sides of the drive member **1**, the color indication changes from all black to alternate segments of black and white or vice-versa.

It is to be noted that FIG. **4**(*d*) shows only one of a plurality of sets of guides and detent elements. Thus, while detent **15** has moved out of guides **42**, a different detent member has moved within a different set of guides substantially as shown in FIG. **4**(*a*), so that the switch-indicator cycle may be readily repeated.

FIG. **5** illustrates another embodiment of the invention in which a rotor indication means appears as numbers **115** viewable through a window **112** in drive member **111**. A body **113** contains a gear arrangement substantially as shown in FIG. **1**. A cap **114** on drive member **111** may be opaque or may be transparent to allow viewing of the rotational index from the top as well as the side of the switch assembly. The electrical switch contacts within a housing **125** provide a plurality of connections to terminals **120** for a plurality of output wires **130**. The details of the electrical switch assembly within housing **125** may be the same as standard rotary switching contacts which are well known in the art.

While the invention has been described with reference to the above disclosure relating to the preferred embodiments, it is understood the numerous modifications or alterations may be made by those skilled in the arts without departing from the scope and spirit of the invention as set forth in the claims.

I claim:

1. An indicator assembly comprising:

a. a cylindrical housing,

b. a base member attached to an end of said housing and having a central bore,

c. a control device having a plurality of rotary positions,

d. a cylindrical rotor concentrically oriented relative to said housing and adapted for rotation therein,

e. means associated with said rotor for indicating a rotational position thereof,

f. a shaft mounted within said rotor and extending through the central bore of said base member for connection to said control device,

g. means for connecting the shaft to the rotor,

h. a cylindrical drive member concentrically oriented relative to said housing and adapted for reciprocating linear motion along the axis of said housing,

i. means on said drive member for viewing said indicating means, and

j. means on said drive member, rotor and housing for translating the reciprocating linear movement of said drive member to rotational movement of said rotor and connecting shaft,

whereby the rotor rotates to successive positions and the shaft simultaneously rotates said control device to successive positions.

2. An indicator assembly as recited in claim **1** wherein said control device is a rotary switch having a plurality of electrical switch positions.

3. An indicator assembly as recited in claim **1** wherein:

a. the rotor has a top surface,

b. the drive member has a top surface,

c. said indicating means is provided on said top and cylindrical surfaces of said rotor, and

d. said viewing means is provided on said top and cylindrical surface of said drive member.

4. An indicator assembly as recited in claim **1** wherein the means for connecting the shaft to the rotor comprises a frictional contact slidably movable along the direction of the shaft.

5. An indicator assembly as recited in claim **1** further comprising means for illuminating said indicating means of said rotor.

6. An indicator assembly as recited in claim **1** wherein said translating means comprises:

a. a plurality of cam surfaces forming raised projections on the outer cylindrical surfaces of said rotor,

b. a plurality of complementary cam surfaces forming raised projections on the inner surface of said housing,

c. a plurality of teeth mounted on said drive member,

d. a plurality of teeth mounted on said rotor and aligned to mesh with the teeth on said drive member, and

e. means for biasing the rotor away from the base member, whereby the linear movement of said drive member toward said base member meshes the teeth of said rotor and drive member and aligns at least one cam surface with at least one complementary cam surface, and whereby, the biasing means causes the cam surface of said rotor to move across the complementary cam surface of said housing thereby rotating the rotor to successive rotational position and simultaneously rotating the shaft for actuating successive positions of said control device.

7. An indicator assembly as recited in claim **6** wherein said control device is a rotary switch having a plurality of electrical switch positions.

8. An indicator assembly as recited in claim **6** wherein:

a. the rotor has a top surface,

b. the drive member has a top surface,

c. said indicating means is provided on said top and cylindrical surfaces of said rotor, and

d. said viewing means is provided on said top and cylindrical surfaces of said drive member.

9. An indicator assembly as recited in claim **6** wherein the means of connecting the shaft to the rotor comprises a frictional contact slidably movable along the direction of the shaft.

10. An indicator assembly as recited in claim **6** further comprising means for illuminating said indicating means of said rotor.

* * * * *