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ROTARY SWITCH WITH ROLLER DETENT APPARATUS DIRECTLY BIASING CONTACT STRUCTURE INTO OPEN AND CLOSED POSITIONS

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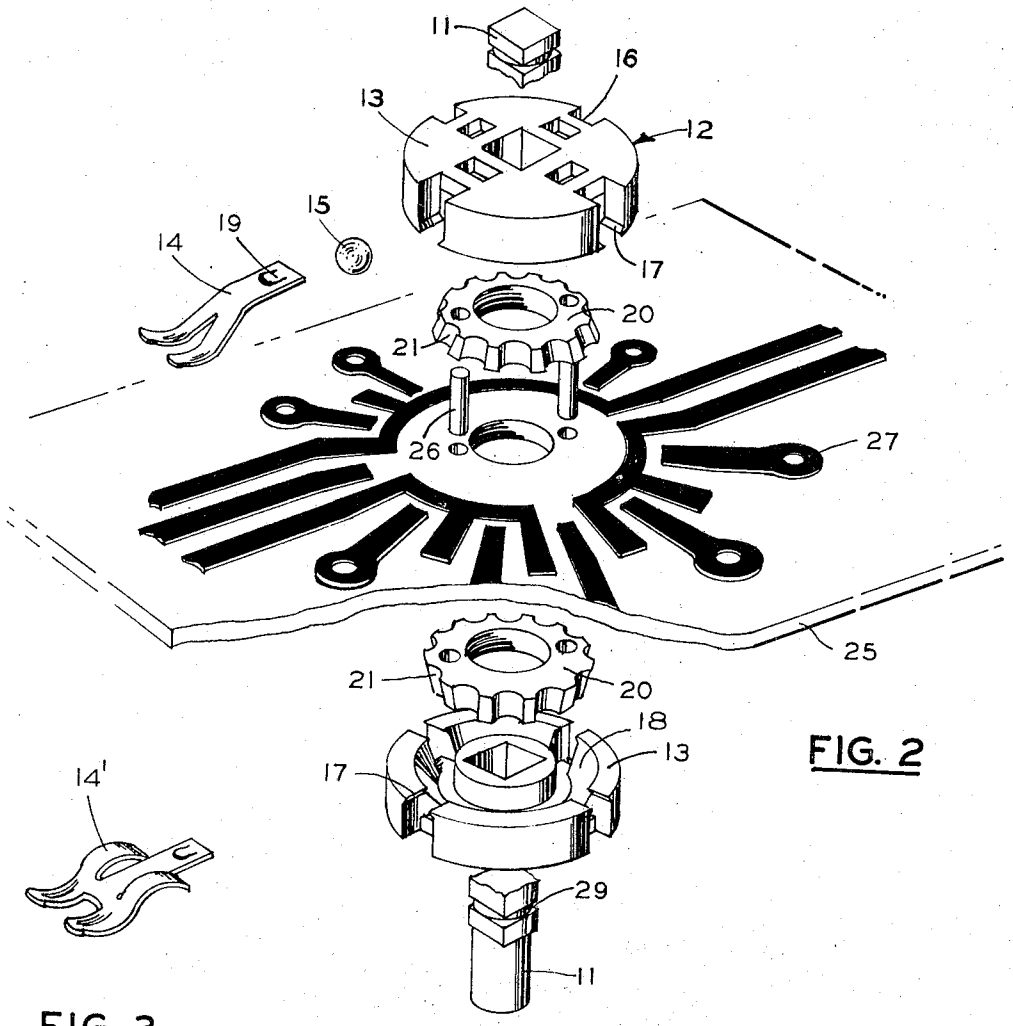


FIG. 2

FIG. 3

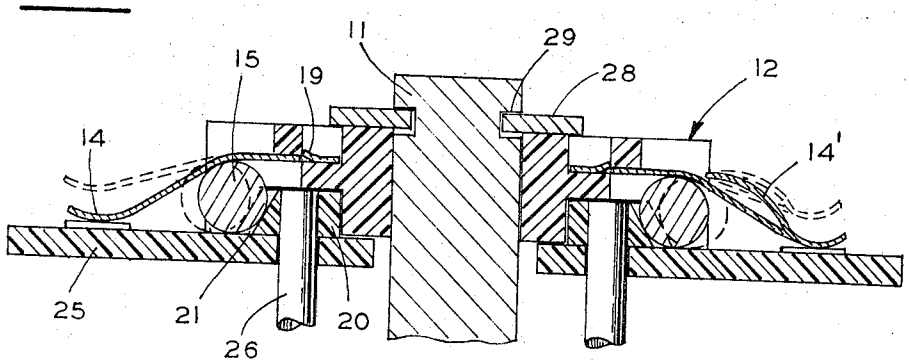


FIG. 1

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ROTARY SWITCH WITH ROLLER DETENT APPARATUS DIRECTLY BIASING CONTACT STRUCTURE INTO OPEN AND CLOSED POSITIONS

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The present invention relates in general to a switch and in particular to an improved switch for use in printed circuit board application.

The rapid development of printed circuitry for use in electronic manufacture has necessitated the development of many switches for use therein. As printed circuitry becomes more and more available for general commercial and military application, the need for an inexpensive but highly reliable switch has arisen. Such a switch must not only be inexpensive, but also have the reliability necessary to meet rigid military standards. Further, the switch must be extremely versatile and flexible from an electronic standpoint.

The main object of the present invention is to provide a highly reliable but inexpensive switch suitable for use in printed circuitry.

One feature of the present invention is to provide a switch suitable for use in printed circuitry that can easily be stacked close together for a high density printed circuit board configuration.

Another feature of the present invention is to provide a switch suitable for printed circuitry in which a minimum amount of wear due to friction occurs on the contact blades and/or the printed circuit conductors.

These and other objects and features will become apparent to a person skilled in the art of switching after a perusal of the following specification and drawings, of which:

FIGURE 1 is a cross sectional view of the improved switch,

FIGURE 2 is an exploded perspective view of FIGURE 1, and

FIGURE 3 is a perspective view of an alternative contact blade.

Referring to the drawings, there is shown a switch comprising an elongated rectangular shaft **11** extending through a rotor assembly **12**, actuating ring **20** and printed circuit board **25**.

Rotor assembly **12** comprises a flat disk **13** made of a dielectric material, a plurality of electrical contact blades **14**, and a plurality of actuator balls **15**. An opening is provided in the center of disk **13** to accommodate shaft **11** in a close tolerance fit. Actuator balls **15** are movably secured or housed in a plurality of housing cavities **16** provided around the periphery of disk **13**. Housing cavities are cut into disk **13** to a depth greater than their width to permit only radial movement of balls **15** therein. The bottom of the side walls of housing cavities **16** are each provided with an inwardly directed lip **17**. The back wall of housing cavities **16** are each slotted near the top side thereof to accommodate contact blades **14** therein. Contact blades **14** are a metallic, spring-like members having a generally double bended configuration. Several configurations of contact blades may be employed to provide either snap action or simple spring biasing. FIGURE 3 shows a snap action contact blade **14** that could be substituted for contact **14** if desired. The contact or free end of each blade is bifurcated in its preferred embodiment. The inward or fixed end of blade **14** may be generally convex in shape as it is forced into the slots in the back wall of cavities **16**. This convex shape provides a resistance to any upward force and tends to maintain

the blades in a semirigid position. A small tab **19** is provided near the fixed end of blade **14** to serve as a lock to prevent the blades **14** from being accidentally removed. When contact blades **14** are secured within the cavities **16**, actuator balls **15** are forced inwardly against the back wall thereof by downward bend of the blades **14** as best seen in FIGURE 1.

The bottom surface of disk **13** has a circular recessed area **18** formed therein to accommodate an actuating ring **20**. Actuating ring **20** is made of a dielectric material and is provided with a plurality of detents **21** spaced around the outer periphery thereof. The upper surface of actuating disk **20** is adapted to be received within the circular groove **18** provided within the bottom surface of disk **13**. In its normal at rest position, a portion of each actuating ball **15** is resting against the base of detents **21**.

Actuating ring **20** is securely mounted on a printed circuit board **25** by a plurality of reference pins **26** extending therethrough. Reference pins **26** also function as limit stop pins and may be placed so as to limit rotation of the switch **10** at any detent point. A plurality of desired conductive traces **27** on printed circuit board **25** are shown as a typical illustration of printed circuitry for a switching arrangement.

Rotor assembly **12**, actuating ring **20**, and printed circuit board **25** are secured together on shaft **11** by any convenient means, for example, spring snap rings **28** adapted to fit within annular slots **29** in shaft **11**. In the event stacked switches are desired, a single common shaft or a concentric shaft may be used.

During operation of switch **10**, and when it is desired to change positions, shaft **11** is rotated moving rotor assembly **12** either clockwise or counter-clockwise as desired. A cam-like force is exerted outwardly on actuator balls **15** by the lobes of the detents **21** of actuating ring **20**. This urges the actuating balls **15** radially outward, transferring force to the bottom side of contact blades **14**, which in turn forces the outward fingers of contact blades to lift upward, breaking electrical contact between the contact blades **14** and the circuit board **25** as shown in phantom in FIGURE 1. As rotation continues, the next or adjacent detent point **21** on actuator ring **20** is reached. Contact blades **14**, now in a biased position, will urge actuator balls **15** back into an "at rest" position against the back wall of cavity **16** and the base of detent **21**, and contact blades **14** will return down to make electrical contact with the next contact position on the circuit board **25**. As each switching occurs, a wiping action between the electrical contacts of contact clades **14** and the printed circuitry occurs. This feature allows good contact to be made and prevents excessive contact wear to preserve the metal surfaces. This becomes especially important when an expensive metal such as gold is used for the contact surfaces. The amount of wiping action may be changed by varying the surface arc of each detent **21**. A deep detent will give more wiping action if desired, and a shallow detent will pick up blades **14** almost immediately.

In its preferred embodiment it is expected that rotor assembly **12** would have a plurality of contact blades **14** to enable use of multiple pole switching. Each contact blade **14** is electrically independent of all other contact blades in the switch and each would have its own actuating ball **15** associated therewith. The use of bifurcated contact points on blades **14** permits nearly equal pressure to be exerted upon the contact points of circuit board **25**, and allows for slight variations in surface height of circuit board **25**.

It is considered that a skilled practitioner in the art of electrical switching could locate or position detents **21** in various positions around actuating ring **20** thereby permitting various switching possibilities. Also stacking of

a plurality of switch assemblies on a single shaft is contemplated as seen in FIGURE 2.

What has been shown is an inexpensive, versatile rotary switch having many advantages and improvements over state-of-the-art switches. It will become obvious to those skilled in the art that various changes and modifications may be made in the above switch without departing from the invention as defined in the following claims.

What is claimed is:

1. A rotary switch comprising in combination:

a fixed printed circuit board having a plurality of conductive traces thereon;

an actuating ring securely mounted upon said circuit board and having a plurality of spaced detents around the outer periphery thereof;

a rotor assembly movably mounted upon said actuating ring, said rotor assembly comprising a substantially circular member having a plurality of spaced housing cavities around the outer periphery thereof, a plurality of electrical contact blades each having one end fixed within each of said housing cavities and having a free end in movable electrical contact with the conductive traces of said circuit board, actuating means movably secured within each of said housing cavities in movable contact with the detents of said actuating ring and said electrical contact blades and means for rotating said rotor assembly whereby a force is exerted on said actuating means by the lobes of said detents, said force being transmitted through said actuating means to said contact blades to force the free end thereof upward as said rotor assembly is rotated.

2. The rotary switch according to claim 1 wherein said actuating means includes an actuating ball, said actuating ball movably secured with said housing cavity, said housing cavity including a pair of side walls and a back wall, said side walls including lip members inwardly extending therefrom.

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