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[54] **ELECTRICAL COMPONENT WITH PUSH-PUSH SWITCH ACTUATOR**

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[52] **U.S. Cl.** ..... **200/330**; 200/18; 200/153 J

[51] **Int. Cl.** **H01h 13/60**

[58] **Field of Search** ..... 200/153 J, 330, 331, 64, 200/156, 17 R, 18; 338/172, 198; 74/99 R, 100 R

[56] **References Cited**

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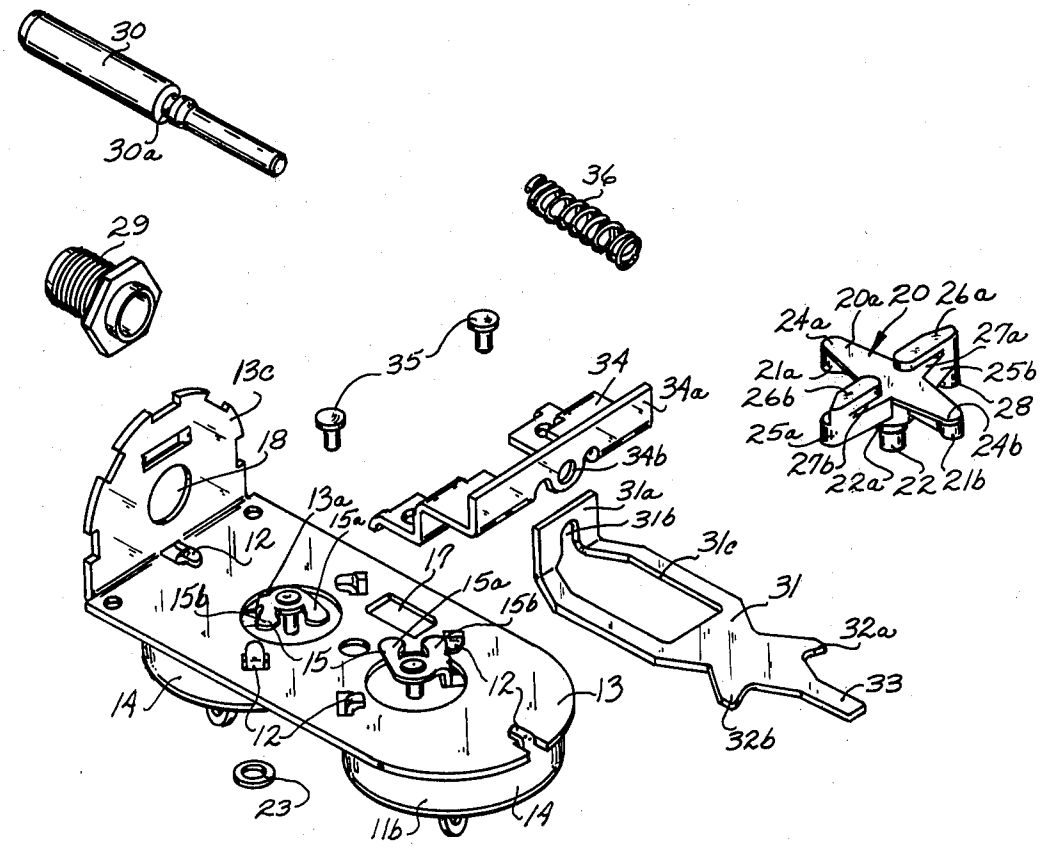
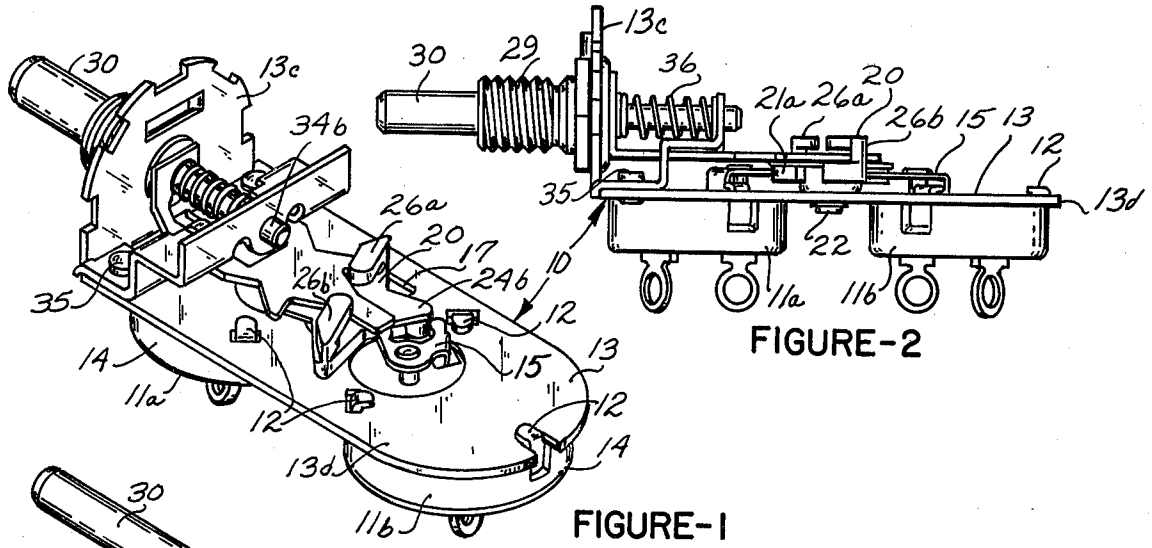
Primary Examiner—Robert K. Schaefer
Assistant Examiner—William J. Smith

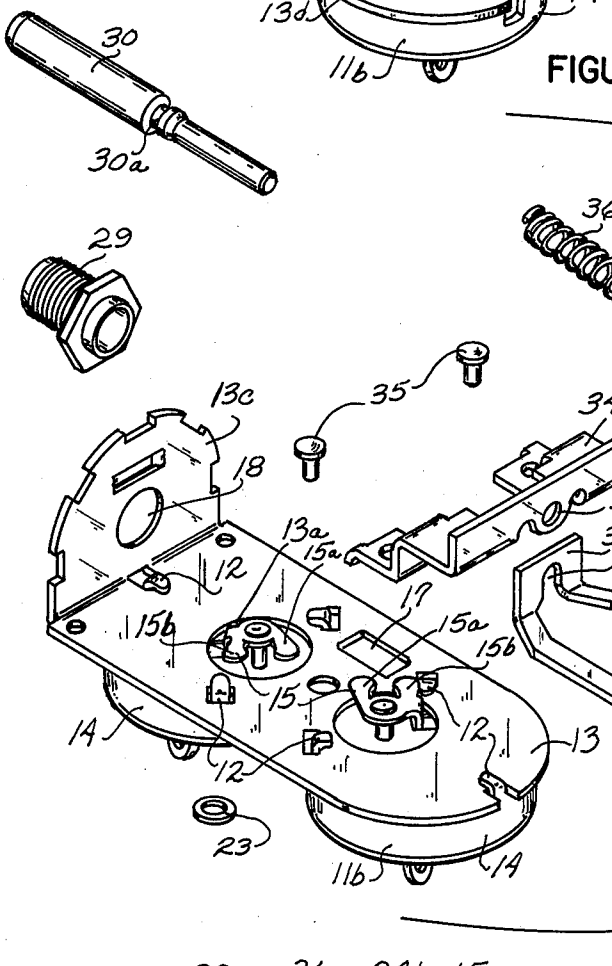
[57] **ABSTRACT**

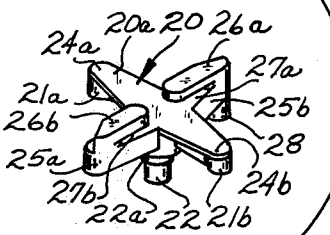
An electrical component having a pair of rotary switches secured to a mounting bracket and simultaneously operable with a common axially movable shaft. A star cam pivotally secured to the mounting bracket cooperates with the switches simultaneously operating both of the switches between two positions. A drive actuator interconnects the axially movable shaft with the star cam. A unidirectional axial force applied to the shaft causes one of a pair of laterally spaced shoulders or cams on the drive actuator to engage in the alternative one of the fingers of the star cam and pivotally shift the star cam through a predetermined angle from a first to a second switch position. A spring returns the shaft to its original position, and a subsequent unidirectional axial force applied to the shaft causes the other of the shoulders to engage the other of the fingers of the star cam and pivotally shift the star cam back to the first switch position. Such action results in opening and closing of the rotary switches.

13 Claims, 5 Drawing Figures









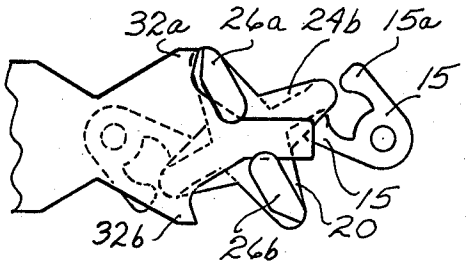


FIGURE-4a

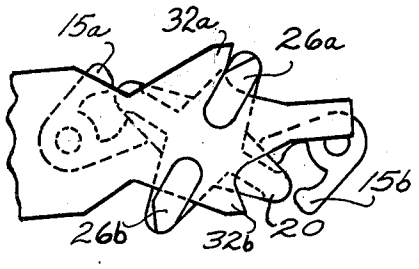


FIGURE-4b

ELECTRICAL COMPONENT WITH PUSH-PUSH SWITCH ACTUATOR

The present invention relates to an electrical component and, more particularly, to a component having push-push switch actuator.

Many types of electronic equipment contain a plurality of independent electronic circuits operable at different voltages. Switches are normally provided in the circuits for connecting the circuits to the various voltage sources or to other circuits, or for connecting other components to a circuit. Although the switches usually can be individually operated in succession, it is preferable, for example, in television sets, to employ a single actuating shaft for operating a plurality of switches simultaneously. Rotary switches are well known in the art and currently are used in large volume by many electronic equipment manufacturers. Several decades ago, a rotary switch was combined with a variable resistance control and an improved form of such switch is still used today. Rotation of the shaft connected to the variable resistance control and the rotary switch, closes the switch and energizes a circuit, and further rotation of the shaft alters the resistance of the variable resistance control and changing, for example, the audio signal of a television or radio set. Due to the popularity of such combination control and switch, the rotary switch art has become highly developed. Moreover, such rotary switches have a long life and comply with and have been approved by Underwriter's Laboratories and do not support combustion. Usually certain equipment manufacturers desire to use a single push-push switch actuator in their equipment instead of the push-pull type described in U.S. Pat. No. 3,023,388 and currently available on the market. Desirable push-push mechanisms are commercially unavailable or if known in the prior art have limited life or are limited for operation of a single rotary switch such as shown in U.S. Pat. No. 3,200,657. It would therefore be desirable to operate a plurality of rotary switches with unidirectional axial movement of a common shaft, i.e., a double push movement of the actuating shaft for opening and closing the switches.

Accordingly, it is an object of the present invention to provide a plurality of rotary switches simultaneously operable with a common actuator. Another object of the present invention is to provide a mechanism converting unidirectional axial motion to rotary motion for operating simultaneously a plurality of rotary switches. Still another object of the present invention is to provide a switch mechanism of the push-push type for operating simultaneously a plurality of rotary switches. Yet another object of the present invention is to provide an electrical component containing a plurality of rotary switches that can be turned on with an unidirectional motion of a shaft and turned off with the same unidirectional motion. Further objects and advantages of the present invention will become apparent as the following description proceeds, and the features of novelty characterizing the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly, the present invention comprises an electrical component having a pair of rotary switches secured to a mounting bracket and simultaneously operable with a common axially movable shaft. Each of the switches is provided with an actuating means. A star cam pivotally secured to the mounting bracket between the switches and cooperable with the actuating means simultaneously operates both of the switches. The star cam is provided with a pair of laterally spaced fingers or cam followers. A drive actuator interconnects the axially movable shaft with the star cam and one of a pair of laterally spaced shoulders or cams on the drive actuator is engageable in the alternative with one of the fingers of the star cam for pivotally shifting the cam through a predetermined angle. A unidirectional axial force applied to the shaft causes one of the shoulders of the drive actuator to engage one of the fingers of the star cam resulting in rotation of the star cam through the predetermined angle and energization of the switches. Upon removal of the force, a spring returns the shaft to its original position. A subsequent unidirectional axial force applied to the shaft causes the other of the shoulders to engage the other of the fingers of the star cam shifting the star cam back to the first position and de-energizing the switches.

For a better understanding of the present invention, reference may be had to the accompanying drawings wherein the same reference numerals have been applied to like parts and wherein:

FIG. **1** is an isometric view of an electrical component having an axially movable shaft for operating a pair of rotary switches;

FIG. **2** is a side view of the electrical component shown in FIG. **1**;

FIG. **3** is an exploded view of the electrical component shown in FIG. **1**; and

FIGS. **4***a* and **4***b* are fragmentary sections of a star cam and a drive actuator of the component in the first and second switch positions.

Referring now to FIGS. **1** and **2** of the drawings, there is illustrated an electrical component of the type employed in electrical apparatus, such as television receivers, generally indicated at **10** comprising a pair of rotary switches, **11***a*, **11***b* fixedly secured in a suitable manner such as with ears **12** to a mounting bracket **13.** The switches are well known in the art as exemplified by U.S. Pat. Nos. 2,286,162 and 2,524,784 assigned to the same assignee as the present invention and currently are used in large volume by many electronic equipment manufacturers. Each of the switches is mounted in a cup-shaped cover **14** and usually is of the single pole or double pole type. Extending outwardly from the cover of each of the switches is an actuating means **15** containing a pair of spaced tangs **15***a* and **15***b*. The mounting bracket **13** is provided with a pair of spaced openings **13***a*, **13***b*, receiving the actuating means **15** of the switches **11***a*, **11***b*. Although the switches are secured to the mounting bracket **13** in the same plane, the switches **11***a*, **11***b* are preferably mounted 180° out of phase with each other to facilitate, as will be further explained, simultaneous operation of the switches, i.e., opening or closing of the switches together. Obviously the switches can operate in the alternative. When the actuating means **15** of either of the switches is in the first position, i.e., the position as shown in FIGS. **1**, **3** and **4***a*, the movable contact engages the stationary contact and the switch is in the energized or closed position. A rotary force applied to the actuating means **15** of the switches **11***a*, **11***b* in the counterclockwise direction causes the actuating means to rotate from the first switch position, that is, a stable position, through a labile position, and then to a second switch position, as shown in FIG. **4***b*, the unenergized

or open position of the switch. A reverse rotary force applied to the actuating means 15 shifts the actuating means back to the first switch position.

Preferably, and in accord with the present invention, in order to operate simultaneously the rotary switches **11***a*, **11***b*, a star cam **20** provided with a pair of diametrically spaced lobes **21***a*, **21***b* cooperable with the actuating means and movable in an interference path with the spaced tangs **15***a*, **15***b* shifts the actuating means **15** from the first switch position to the second switch position and then back to the first switch position. The star cam **20** contains a stub shaft **22** receivable in an opening **16** provided in the mounting bracket **13** between the pair of rotary switches **11***a*, **11***b*. As best seen in FIGS. **2** and **3** of the drawings, a washer **23** engages a shoulder **22***a* (see FIG. **3**) and the end of the stub shaft is swaged radially outwardly preventing removal of the star cam **20** from the mounting bracket **13** but still providing pivotal or rotary movement of the star cam **20** in the opening **16.** The star cam **20** contains four arms at 90° to each other. The lobes **21***a*, **21***b* cooperable with the tangs **15***a*, **15***b* of the actuating means **15** depend from the ends of diametrically disposed arms **24***a*, **24***b* and the other arms **25***a*, **25***b* at 90° to the arms **24***a*, **24***b*, support a pair of laterally spaced fingers **26***a*, **26***b* extending upwardly and toward each other defining a pair of channel sections **27***a*, **27***b* or channel **27.** For the purpose of limiting angular rotation of the star cam, a stop member **28** (see FIG. **3**) integral with the star cam **20** and depending from the arm **25***b* is received in a slot **17** (see FIGS. **1** and **3**) provided in the mounting bracket **13.** Limiting angular rotation of the star cam **20** assures continuous proper cooperating relationship between the lobes **21** of the star cam **20** and the tangs **15***a*, **15***b* of the actuating means **15.**

For securing the mounting bracket **13** to a not shown panel of a television receiver or the like, one end **13***c* of the mounting bracket **13** is formed at a right angle to the main portion **13***d* of the mounting bracket **13.** A threaded bushing **29** suitably secured to the one end **13***c* of the bracket is received in an opening **18** provided therein and a not shown fastener threadedly securable to the bushing fixedly secures the bracket **13** to the panel. An axially movable shaft **30** is received in an opening **29***a* provided in the bushing **29.**

As best seen in FIGS. **1** and **2** of the drawings, a drive actuator **31** interconnects the shaft **30** with the star cam **20.** The drive actuator **31** comprises a pair of laterally spaced shoulders **32***a*, **32***b*, one of the shoulders being engageable in the alternative with one of the fingers **26***a*, **26***b* of the star cam **20.** A stem **33** extending beyond the shoulders and received in the channel **27** defined by the fingers **26***a*, **26***b* retains the drive actuator **31** during reciprocal movement of the stem **33.** Supporting the stem **33** on the flat surface **20***a* of the star cam **20** prevents downward movement of the drive actuator **31.** The width of the stem is less than the width of the channel **27** defined by the two inner portions of the fingers for limiting lateral movement of the stem **33** in the channel **27** while the shoulders **32***a*, **32***b* have a greater width between the outer tips than the width of the channel thereby assuring that one of the shoulders **32***a*, **32***b* engages the corresponding inner portion of one of the fingers. More specifically, the inner portion of each of the fingers **26***a*, **26***b* is effectively a cam follower and each of the shoulders is a cam. Preferably and as best shown in FIGS. **4***a* and **4***b*, the inner portions of the fingers **26***a*, **26***b* are also beveled to increase the contact area between the shoulders **32***a*, **32***b* and the fingers **26***a*, **26***b* the plane of the bevel being parallel to the plane or leading edge of the shoulders. The other end **31***a* of the drive actuator **31** is formed upwardly at a right angle to the main portion thereof and is provided with a key slot **31***b*. A portion of the shaft **30** provided with an circumferential groove **30***a* (see FIG. **3**) interfits with the slot **31***b* provided in the drive actuator **31** interlocking the shaft **30** to the drive actuator. The end **31***a* of the drive actuator also engages the inner end of the bushing **29** or the end **13***c* of the mounting bracket **13** and limits outward axial movement of the shaft. A double angled keeper **34** fixedly secured to the mounting bracket **13** with suitable means, e.g., a pair of rivets **35,** maintains the drive actuator **31** in proper axial relationship with the shaft **30** by preventing upward movement of the drive actuator and maintaining the end **31***a* of the drive actuator **31** in the circumferential groove **30***a* of the shaft. When the keeper maintains the drive actuator **31** against the star cam **20,** it is unnecessary for the fingers **26***a*, **26***b* to extend inwardly toward each other since the keeper prevents upward movement of the drive actuator. An end portion **34***a* of the keeper **34** in spaced parallel relationship to the end **13***c* is provided with an opening **34***b* and receives the inner end **30***b* of the shaft **30** and provides further radial support for the shaft.

For the purpose of biasing the end of the drive actuator **31** against the end **13***c* of the mounting bracket, and as best shown in FIGS. **1** and **2** of the drawings, a coiled helical spring **36** extends around the portion of the shaft disposed between the end **31***a* of the drive actuator **31** and the keeper **34.** The drive actuator **31** is provided with an elongated slot **31***c* to provide clearance between the keeper **34** and the spring **36.**

Assuming that the rotary switches **11***a*, **11***b* of the electrical component **10** are in the first switch position, that is, the position shown in FIGS. **1** and **4***a* of the drawings, the first push or axial force applied to the shaft **30** causes compression of the spring **36** and axial movement of the drive actuator **31** until shoulder **32***a* engages the corresponding finger **26***b* of the star cam **20.** But as the shoulder **32***a* of the drive actuator **31** engages the finger **26***a*, and starts rotation of the star cam **20** through the predetermined angle, the other shoulder **32***b* does not engage the other finger **26***b* but instead moves inside and beneath the finger **26***b*. Further inward axial movement of the shaft causes the star cam **20** to complete rotation through a predetermined angle while the lobes **21** engage the tangs **15***a* of the actuating means of the rotary switches and shift the actuating means from the first switch position through a labile position to a second switch position. After the actuating means **15** shifts to the second switch position and the spring is compressed, the stop member **28** engages an edge of the slot **17** and limits further rotation of the star cam **20** thereby maintaining the lobes **21** between the tangs **15***a*, **15***b*. Upon releasing the force applied to the shaft **30,** the compressed spring **36** biases the shaft outwardly, and the other shoulder **32***b* leaves the channel **27** with the star cam remaining in the position shown in FIG. **4***b* of the drawings. During the return action, the drive actuator **31** pivots slightly when the shoulder **32***b* engages the inner portion of the finger **26***b*. As soon as the shoulder **32***b* returns beyond the finger **26***b*, the drive actuator **31** again centers itself be-

tween the two fingers **26***a*, **26***b*. A second push or subsequent axial force applied to the shaft results in the other shoulder **32***b* engaging finger **26***b* of the star cam **20** causing reverse rotation of the star cam **20** and shifting of the actuating means **15** from the second switch position through the labile position back to the first switch position. Since the force applied to the shaft to operate the rotary switches always is in the same direction, the electrical component **10** is commonly referred to as a push-push switch, i.e., a push action is necessary to close or open the contacts of the rotary switches and a subsequent push action is necessary to open or close the contacts of the rotary switches. Thus every other push action or alternate axial movement of the shaft closes the contacts of the rotary switches while subsequent axial movement opens the contacts of the rotary switches.

Although the electrical component **10** is normally manufactured as a complete assembly with the rotary switches **11***a*, **11***b*, it is to be understood that the electrical component **10** can be manufactured and sold without the switches to a third party who would assemble the switches to the mounting bracket **13.**

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention, it will be appreciated that numerous changes and modifications are likely to occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an electrical component, the combination of a mounting bracket provided with a pair of openings, a pair of rotary switches fixedly secured to the mounting bracket, actuating means carried by each of the switches and extending through the openings in the mounting plate, one of the actuating means being 180° out of phase to the other of the actuating means, a star cam pivotally secured to the mounting bracket between the switches and cooperable with the actuating means, the star cam comprising a pair of laterally spaced fingers extending toward each other and defining a pair of slots, a drive actuator engageable with the star cam and movable in the slots defined by the fingers, and a shaft supported by the bracket and interconnected with the drive actuator whereby initial axial movement of the shaft causes the drive actuator to engage one of the fingers of the star cam and further axial movement of the shaft pivots the star cam until the actuating means shift from the first switch position through a labile position to a second switch position.

2. The electrical component of claim **1,** wherein the drive actuator comprises a pair of laterally disposed shoulders cooperable with the fingers, one of the shoulders being engageable with one of the fingers for pivotally shifting the star cam in one direction through a predetermined angle, the other of the shoulders of the drive actuator being engageable with the other of the fingers for pivotally shifting the star cam in the other direction through the predetermined angle upon alternate axial movements of the shaft.

3. The electrical component of claim **1,** wherein the actuating means comprises a pair of radially spaced tangs and the star cam comprises a pair of diametrically spaced lobes movable in an interference path with the spaced tangs for pivotally shifting the actuating means through a predetermined angle during pivotal shifting of the star cam resulting from axial movement of the drive actuator.

4. In an electrical component, the combination of a mounting bracket, a rotary switch fixedly secured to the mounting bracket, actuating means carried by the switch, a cam pivotally secured to the mounting bracket and cooperable with the actuating means, the cam comprising a pair of laterally spaced fingers, a pivotally shiftable drive actuator engageable with the cam, and shaft means supported by the bracket and interconnected with the drive actuator whereby initial axial movement of the shaft means pivotally shifts the drive actuator toward and into engagement with one of the fingers of the cam and pivots the cam until the actuating means of the switch shifts from a first switch position through a labile position to a second switch position.

5. The electrical component of claim **4,** wherein the drive actuator comprises a pair of laterally disposed shoulders cooperable with the fingers, one of the shoulders being engageable with one of the fingers for pivotally shifting the cam in one direction through a predetermined angle, the other of the shoulders of the drive actuator being engageable with the other of the fingers for pivotally shifting the cam in the other direction through the predetermined angle upon alternate axial movements of the shaft means.

6. The electrical component of claim **4,** wherein means maintain the drive actuator interconnected with the shaft means.

7. A mechanism for operating a plurality of rotary switches comprising a mounting bracket, a reciprocating drive actuator supported by the mounting bracket, and a cam pivotally mounted on the mounting bracket between the rotary switches, the cam comprising a pair of lobes engageable with the rotary switches, and a pair of fingers engageable with the drive actuator whereby selective movement of the drive actuator causes the lobes to operate the switches simultaneously.

8. The electrical component of claim **7,** wherein means maintain the drive actuator interconnected with the shaft.

9. The electrical component of claim **7,** wherein the fingers define a slot therebetween, the drive actuator is disposed in the slot, and means maintain the actuator in the slot.

10. In an electrical component, the combination of a mounting bracket, a pair of rotary switches fixedly secured to the mounting bracket, a pair of spaced tangs carried by the actuating means, a cam pivotally secured to the mounting bracket and cooperable with the actuating means, the cam comprising a pair of laterally spaced fingers and a pair of diametrically spaced lobes movable in an interference path with the spaced tangs for pivotally shifting the actuating means through a predetermined angle, a drive actuator engageable with the cam, and shaft means supported by the bracket and interconnected with the drive actuator whereby initial axial movement of the shaft means shifts the drive actuator into engagement with one of the fingers pivoting the cam and the spaced lobes against the spaced tangs until the actuator means of the switch shifts from a first switch position through a labile position to a second switch position.

11. In an electrical component, the combination of a mounting bracket, a rotary switch fixedly secured to the mounting bracket, actuating means carried by the switch, a cam pivotally secured to the mounting bracket and cooperable with the actuating means, the cam comprising a pair of laterally spaced fingers defining a slot therebetween, a drive actuator engageable with the cam, means for maintaining the drive actuator in the slot defined by the fingers, and shaft means supported by the bracket and interconnected with the drive actuator whereby initial axial movement of the shaft means shifts the drive actuator into engagement with one of the fingers of the cam and pivots the cam until the actuating means of the switch shifts from a first switch position through a labile position to a second switch position.

12. The electrical component of claim 11, wherein the fingers extend toward each other and limit movement of the actuator in the slot defined by the fingers.

13. The electrical component of claim 11, wherein the drive actuator comprises a forwardly extending stem disposed in the slot.

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