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.
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 available 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 cam 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. 4a and 4b 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, 11a, 11b 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 15a and 15b. The mounting bracket 13 is provided with a pair of spaced openings 13a, 13b, receiving the actuating means 15 of the switches 11a, 11b. Although the switches are secured to the mounting bracket 13 in the same plane, the switches 11a, 11b 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 4a, 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 11a, 11b 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. 4b, 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 11a, 11b, a star cam 20 provided with a pair of diametrically spaced lobes 21a, 21b, cooperate with the actuating means and movable in an interference path with the spaced tangs 15a, 15b, 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 11a, 11b. As best seen in FIGS. 2 and 3 of the drawings, a washer 23 engages a shoulder 22a (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 21a, 21b cooperate with the tangs 15a, 15b of the actuating means 15 depend from the ends of diametrically disposed arms 24a, 24b and the other arms 25a, 25b at 90° to the arms 24a, 24b, support a pair of laterally spaced fingers 26a, 26b extending upwardly and toward each other defining a pair of channel sections 27a, 27b 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 25b 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 15a, 15b 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 13c of the mounting bracket 13 is formed at a right angle to the main portion 13d of the mounting bracket 13. A threaded bushing 29 suitably secured to the end one 13c of the bracket is received in an opening 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 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 32a, 32b, one of the shoulders being engageable in the alternative with one of the fingers 26a, 26b of the star cam 20. A stem 33 extending beyond the shoulders and received in the channel 27 defined by the fingers 26a, 26b retains the drive actuator 31 during reciprocal movement of the stem 33. Supporting the stem 33 on the flat surface 20a 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 greater width between the outer tips than the width of the channel thereby assuring that one of the shoulders 32a, 32b engages the corresponding inner portion of one of the fingers. More specifically, the inner portion of each of the fingers 26a, 26b is effectively a cam follower and each of the shoulders is a cam. Preferably and as best shown in FIGS. 4a and 4b, the inner portions of the fingers 26a, 26b are also beveled to increase the contact area between the shoulders 32a, 32b and the fingers 26a, 26b the plane of the bevel being parallel to the plane or leading edge of the shoulders.

The other end 31a of the drive actuator 31 is formed upwardly at a right angle to the main portion thereof and is provided with a key slot 31b. A portion of the shaft 30 provided with an circumferential groove 30a (see FIG. 3) interfits with the slot 31b provided in the drive actuator 31 interlocking the shaft 30 to the drive actuator. The end 31a of the drive actuator also engages the inner end of the bushing 29 or the end 13c 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 31a of the drive actuator 31 in the circumferential groove 30a of the shaft. When the keeper maintains the drive actuator 31 against the star cam 20, it is unnecessary for the fingers 26a, 26b to extend inwardly toward each other since the keeper prevents upward movement of the drive actuator. An end portion 34a of the keeper 34 in spaced parallel relationship to the end 13c is provided with an opening 34b and receives the inner end 30b 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 13c 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 31a of the drive actuator 31 and the keeper 34. The drive actuator 31 is provided with an elongated slot 31c to provide clearance between the keeper 34 and the spring 36.

Assuming that the rotary switches 11a, 11b of the electrical component 10 are in the first switch position, that is, the position shown in FIGS. 1 and 4a 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 32a engages the corresponding finger 26b of the star cam 20. But as the shoulder 32a of the drive actuator 31 engages the finger 26a, and start rotation of the star cam 20 through the predetermined angle, the other shoulder 32b does not engage the other finger 26b but instead moves inside and beneath the finger 26b. 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 15a 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 15a, 15b. Upon releasing the force applied to the shaft 30, the compressed spring 36 biases the shaft outwardly, and the other shoulder 32b leaves the channel 27 with the star cam remaining in the position shown in FIG. 4b of the drawings. During the return action, the drive actuator 31 pivots slightly when the shoulder 32b engages the inner portion of the finger 26b. As soon as the shoulder 32b returns beyond the finger 26b, the drive actuator 31 again centers itself be-
between the two fingers 26a, 26b. A second push or subsequent axial force applied to the shaft results in the other shoulder 32b engaging finger 26b 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 11a, 11b, 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 operable 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 operable 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 operable 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 operable 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 operable 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 co可operable 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.