United States Patent [19]

Roeser

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[45] **Oct. 9, 1973**

[54] **ELECTRICAL SWITCH**

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[21] Appl. No.: **197,412**

[52] **U.S. Cl.** ..... **200/68,** 200/159 A

[51] **Int. Cl.** **H01h 21/40**

[58] **Field of Search** ..... 200/76, 78, 77, 68, 200/153 LA, 159 R, 159 A, 167 A

[56] **References Cited**

UNITED STATES PATENTS

2,295,301	9/1942	Smith	200/167 A
3,604,878	9/1971	Amis, Jr. et al.	200/159 R
2,668,200	2/1954	Glaze	200/167 A
3,253,111	5/1966	Winter et al.	200/167 A

FOREIGN PATENTS OR APPLICATIONS

590,975	4/1959	Italy	200/159 A

Primary Examiner—David Smith, Jr.
Attorney—Robert D. Silver

[57] **ABSTRACT**

A multi-position electrical switch is provided in which the position of the switch can be determined by tactile sensation or pressure feel. The switch includes an actuating push button which is engageable with an actuating cam. The button and cam are slidably disposed on a central detent rod provided with a plurality of radially inwardly extending detent grooves and camming surfaces which determine the various positions of the switch and which provide tactile information regarding the position of the switch. Balls which are positioned between the button and the cam are receivable successively in the grooves as the switch is moved from one position to another. A coil spring resiliently biases the cam and push button against movement in one direction, and a second preloaded coil spring can be provided for providing additional biasing force on the cam and push button when the push button is depressed to a predetermined extent, thereby providing further tactile information regarding the position of the switch. Longitudinally extending contact legs are mounted within the casing, and each contact leg is provided with a camming surface to permit the cam to urge the contact leg outwardly into contact with a terminal when the cam is in one of the switch positions. The specific embodiment described and illustrated is a three position switch having two poles in which one contact leg of each pole is made and the other not made in the first position, the contacts of the first pole are reversed while the contacts of the second pole remain unchanged when the switch is moved to the second position, and the contacts of the second pole are changed while the contacts of the first pole remain unchanged when the switch is moved from the second to the third position.

19 Claims, 20 Drawing Figures

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[11] **3,764,762**
[45] **Oct. 9, 1973**

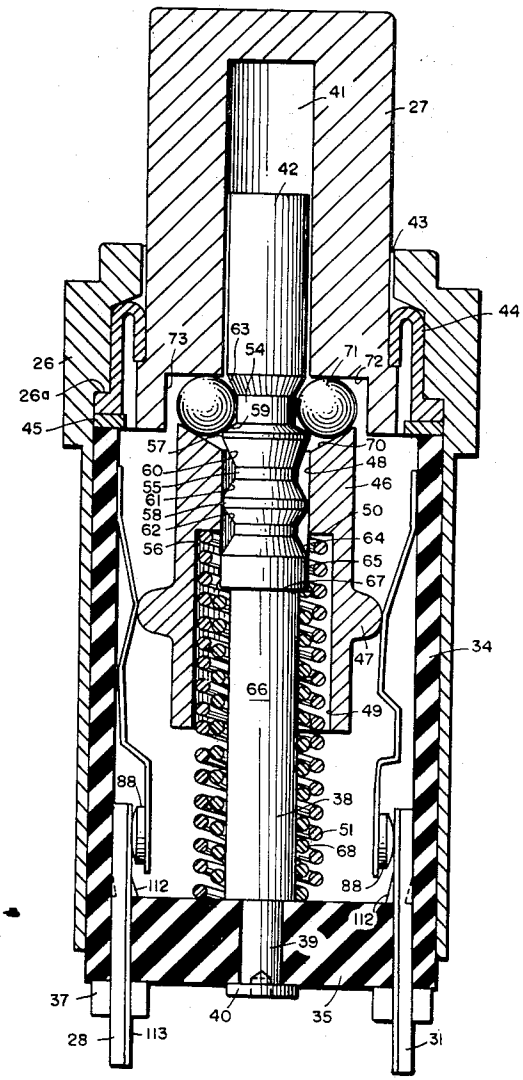


FIG. 1

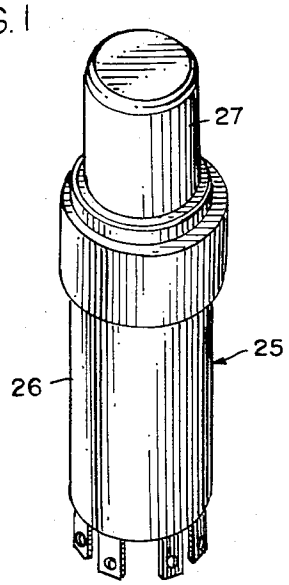


FIG. 2

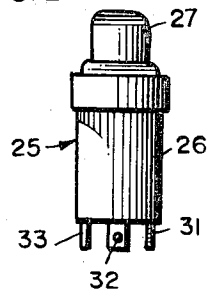


FIG. 3

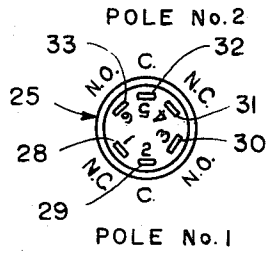


FIG. 5

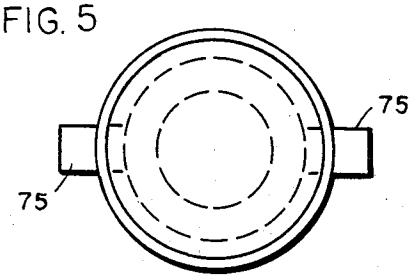


FIG. 7

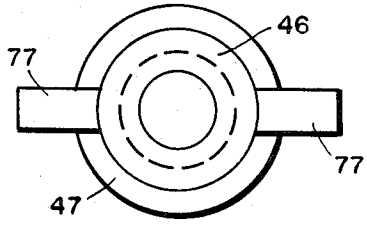


FIG. 6

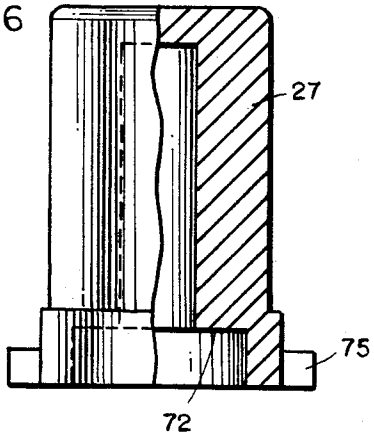


FIG. 8

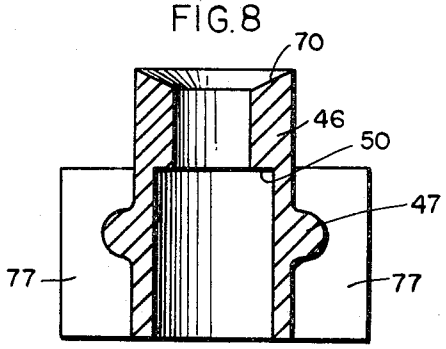


FIG. 4

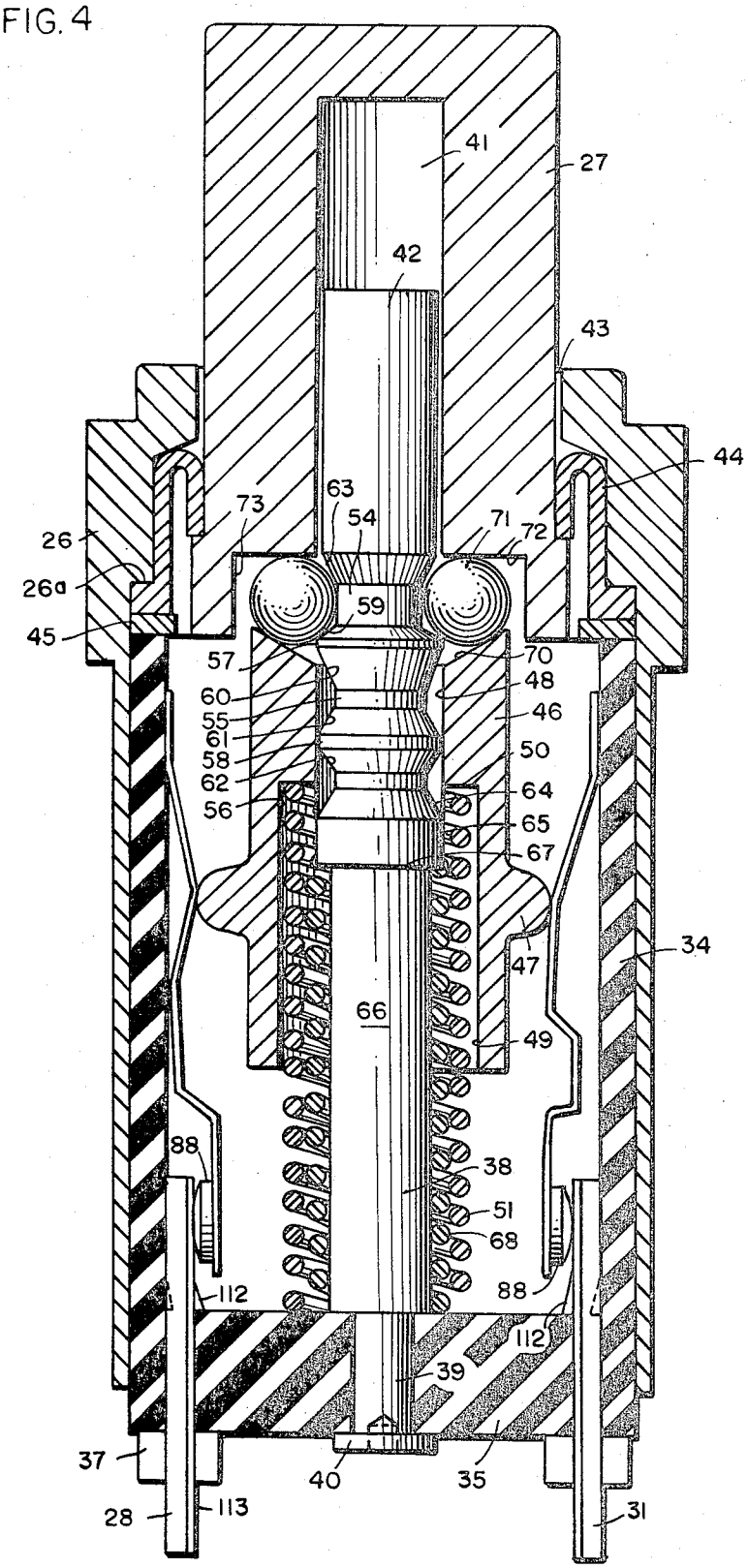

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FIG. 9

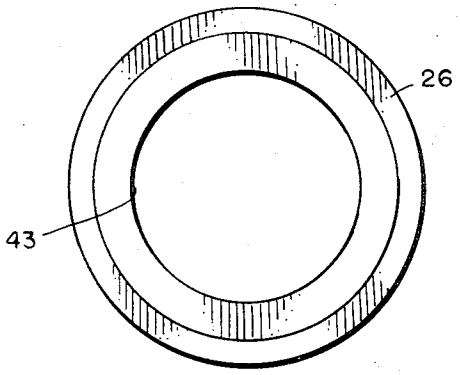


FIG. 11

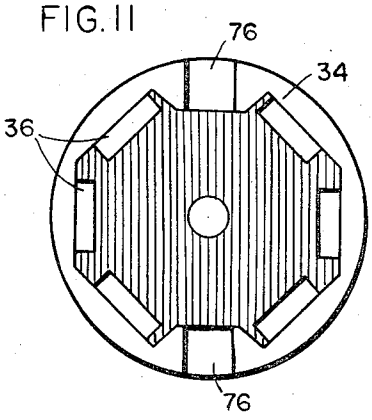


FIG. 10

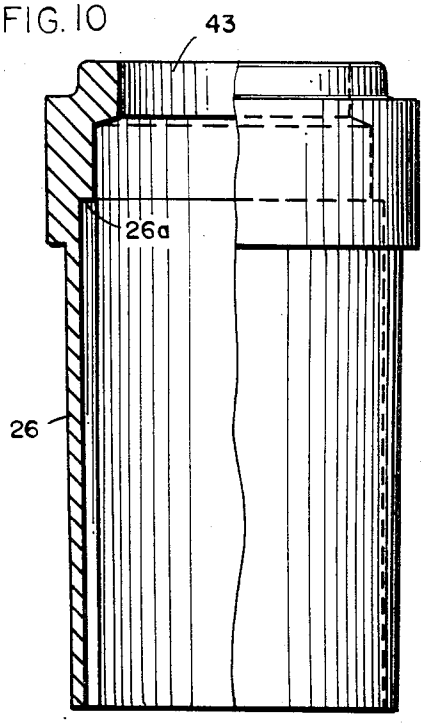


FIG. 12

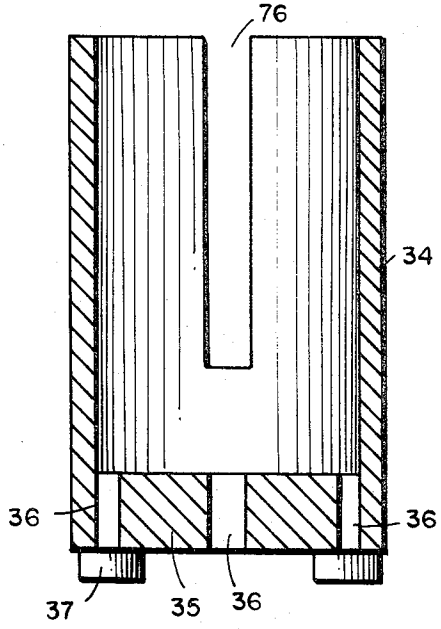


FIG. 13

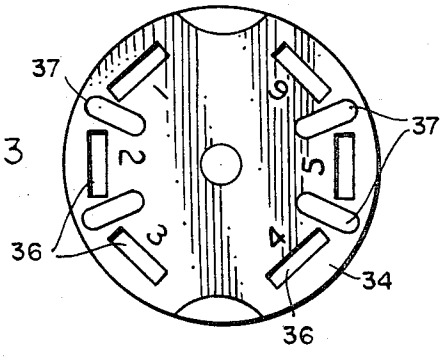


FIG. 14

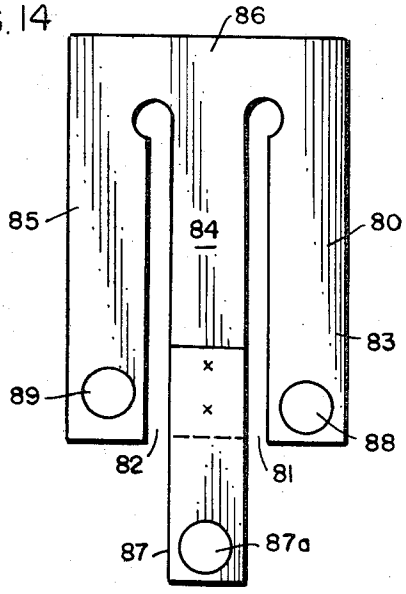


FIG. 15

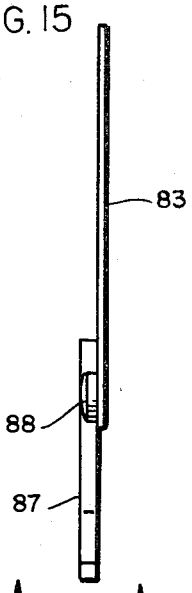
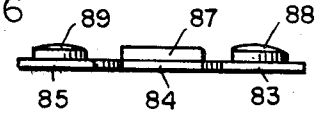


FIG. 16



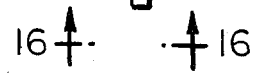


FIG. 17

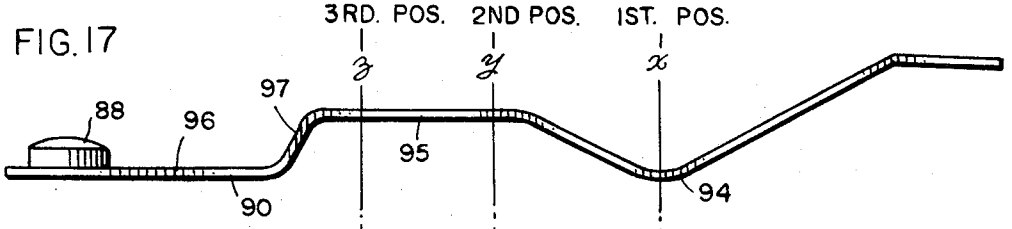


FIG. 18

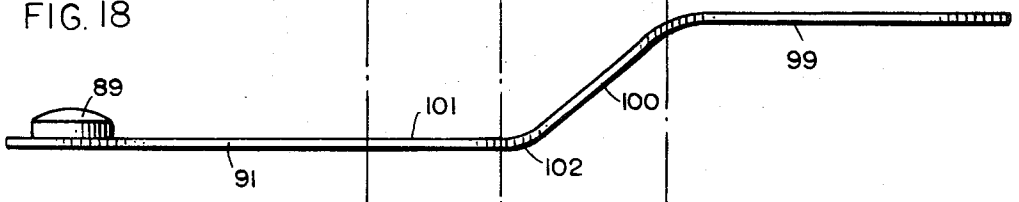


FIG. 19

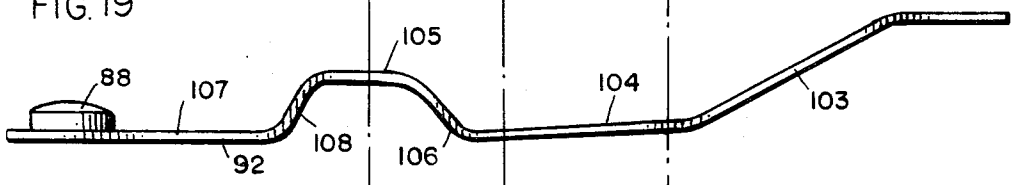
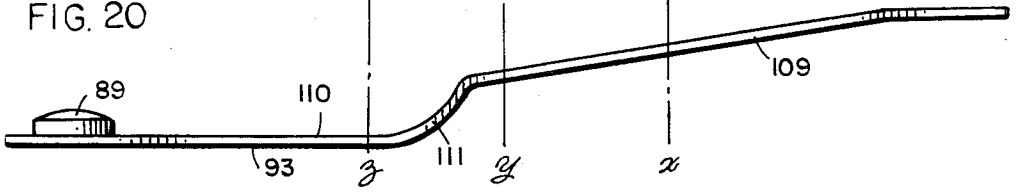


FIG. 20



ELECTRICAL SWITCH

BACKGROUND AND SUMMARY

This invention relates to a multi-position switch, and, more particularly, to a switch which provides readily sensible tactile evidence of changes in position. The switch is particularly useful in applications in which it is desirable to determine the position of a switch by pressure feel and in applications requiring three modes of operation such as off-high-low, off-slow-fast, stop-fine-coarse, etc.

The movement of the detent balls into and out of the grooves of the detent rod can be easily felt, and the camming surfaces along the detent rod can be varied to provide a different feel as the switch is moved from one position to another. A preloaded spring is engageable by the actuating means when the actuating means reaches a certain position to provide further tactile evidence of the position of the switch. Each contact leg of the switch is provided with a camming surface of a desired length so that each contact is either made or not made by the cam as desired when the switch is in a particular position. The camming configurations of the contacts can be selected as desired to provide a plurality of different switching combinations in which one or more contacts are either made or not made in each switch position, and the camming configurations can be chosen to provide either make before break action or break before make action. The detent and switching structures are relatively uncomplicated and extremely durable to provide reliable results over a prolonged period.

DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawing, in which --

FIG. 1 is a perspective view of a three position push button switch made in accordance with the invention;

FIG. 2 is a reduced side elevational view of the switch of FIG. 1;

FIG. 3 is a bottom plan view of the switch of FIG. 2;

FIG. 4 is an enlarged longitudinal cross sectional view of the switch;

FIG. 5 is a top plan view of the push button;

FIG. 6 is an elevational view, partially broken away, of the push button;

FIG. 7 is a top plan view of the cam sleeve;

FIG. 8 is an elevational view, partially broken away of the cam sleeve;

FIG. 9 is a top plan view of the outer case of of the switch;

FIG. 10 is an elevational view, partially broken away, of the outer case;

FIG. 11 is a top plan view of the base;

FIG. 12 is a longitudinal sectional view of the base;

FIG. 13 is a bottom plan view of the base;

FIG. 14 is a plan view of one of the blades which provide the contact legs;

FIG. 15 is a side elevational view of the blade of FIG. 14;

FIG. 16 is a view taken along the line 16—16 of FIG. 15:

FIG. 17 is an enlarged side elvational view of the contact leng which is engageable with terminal No. 1 of pole No. 1;

FIG. 18 is an enlarged side elevational view of the contact leng which is engageable with terminal No. 3 of pole No. 1;

FIG. 19 is an enlarged side elevational view of the contact leng which is engageable with terminal No. 4 of pole No. 2; and

FIG. 20 is an enlarged side elevational view of the contact leg which is engageable with terminal No. 6 of pole No. 2.

DESCRIPTION OF SPECIFIC EMBODIMENT

Referring to FIGS. 1–3, the numeral 25 designates generally a push button switch which includes a generally cylindrical outer case 26 and a push button 27 which can be depressed into the outer case. Terminals 28, 29, 30, 31, 32 and 33 extend longitudinally outwardly from the other end of the switch, and the terminals can be provided openings in the outer ends thereof to facilitate electrical connection to various electrical components or circuits as desired.

The specific switch illustrated is a double pole switch in which the terminals 28-30 form pole No. 1 and the terminals 31–33 form pole No. 2. The terminals 29 and 32 are designated in FIG. 3 as common terminals, the terminals 28 and 31 are designated as normally closed terminals, and the terminals 30 and 33 are designated as normally open terminals.

Referring now to FIG. 4, the cylindrical outer case 26 is seen to be ensleeved over a generally cylindrical base 34 formed of insulating material (see also FIGS. 11–13) which is provided with a transversely extending end wall 35. The end wall 35 is provided with six rectangular slots 36 (FIGS. 11–13) through which the terminals 28–31 extend, and a central opening 36. If desired, barrier or locating embossments 37 can be provided on the end wall between adjacent terminal slots.

An elongated detent rod 38 extends axially through the enclosure formed by the outer case 26 and base 34, and a radially reduced end portion 39 of the detent rod extends through the central opening 36 in the end wall of the base and is secured therein by peening or deforming the end thereof over the end wall as at 40. The push button 27 is provided with a central bore 41 which receives the cylindrical upper end 42 of the detent rod. The upper end of the detent rod terminates below the upper end of the bore 41 of the push button, and the push button can be depressed downwardly through the circular opening 43 in the upper end of the outer case 26. A cup or hat shaped sealing bottom maintains a sealing engagement between the outer case and the push button as the push button moves axially relative to the case and prevents dust and other foreign material from entering the interior of the switch. The boot 44 is positioned above an annular washer 45, and the boot and washer are retained between the top of the base 34 and an annular shoulder 26a on the case 26.

A generally cylindrical cam sleeve 46 formed of insulating material is also slidably received on the detent rod for axial sliding movement and includes a circumferential radially outward extending camming rib or flange 47. The sleeve 46 is provided with a first cylindrical inner wall 48 and a second cylindrical inner wall 49 of larger diameter which is joined to the cylindrical wall 49 by the radially extending shoulder 50. A helical or spirally wound coil spring 51 is retained between the end wall 35 of the base and the shoulder 50 of the cam-

ming sleeve and resiliently biases the camming sleeve upwardly.

The central portion of the detent rod **38** is provided with three radially inwardly extending annular grooves **54, 55,** and **56** and intermediate portions **57** and **58.** Each of the intermediate portions **57** and **58** are seen to be generally V-shaped in longitudinal cross section to provide a pair of frusto-conical converging camming surfaces. The intermediate portion **57** includes an outwardly and downwardly inclined camming surface **59** and an inwardly and downwardly camming surface **60,** and the intermediate portion **58** includes an outwardly and downwardly camming surface **61** and an inwardly and downwardly camming surface **62.** If desired, the uppermost annular groove **54** may terminate in an inclined surface **63,** and the lowermost annular groove **56** may terminate in an inclined surface **64.** A cylindrical portion **65** extends downwardly from the lowermost groove and is joined to a radially reduced cylindrical portion **66** by a shoulder **67.**

The maximum diameter of the intermediate portions **57** and **58** and the diameter of the cylindrical portion **65** is preferably just slightly less than the diameter of the cylindrical surface **48** of the camming sleeve so that the camming sleeve is supported relatively firmly and substantially coaxially on the detent rod. A second helical coil spring **68** is disposed concentrically within the first spring **51** and is retained between the end wall **35** of the base and the shoulder **67** on the detent rod.

The upper end of the camming sleeve **46** terminates in an inwardly and downwardly inclined frusto-conical surface **70,** and a plurality, five in the embodiment illustrated, of hard metal balls **71** are interposed between the frusto-conical wall **70** and a radially extending shoulder **72** on the push button. The spring **51** urges the camming sleeve into engagement with the balls and the balls into engagement with the push button, and the frusto-conical surface **70** acts as a camming surface to urge the balls radially inwardly against the detent rod. The push button terminates in a downwardly extending annular wall **73** to prevent the balls from escaping from between the camming sleeve and the push button.

Referring now to FIGS. **5** and **6,** the push button **27** is seen to include a pair of radially outwardly extending locating lugs **75** at the bottom thereof which are slidably received in a pair of diametrically opposed longitudinally extending slots **76** (FIG. **12**) in the wall of the base **34.** Similarly, the camming sleeve **46** includes a pair of radially outwardly extending locating lugs **77** (FIGS. **7** and **8**) which are also slidably received by the slots **76.** The locating lugs **75** are engageable with the washer **45** at the top of the base to provide an upper stop for the push button and to retain the push button and the cam sleeve against the force exerted by the spring **51.** The lugs **77** of the cam sleeve are engageable with the bottom of the slots **76** to provide a lower stop for the cam sleeve and push button.

Each of the poles of the double pole switch illustrated are formed from a three legged blade **80** shown in FIGS. **14–16.** The blade **80** is originally formed from a flat metal sheet which is provided with a pair of slits **81** and **82** to define legs **83, 84** and **85** which are joined by an end piece **86.** An extension strip **87** is secured to the end portion of the middle strip **84,** as by welding, and provides the middle or common terminal for the pole formed by the blade **80.** Metallic contact elements **88** and **89** are secured to the strips **83** and **85,** respectively, and the contact elements are advantageously formed of a metal having good electrical conductivity such as silver.

After the terminal strip **87** and the contacts **88** and **89** are secured to the blade, the blade is formed to provide a curvature to the connecting portion **86** corresponding to the curvature of the inside surface of the base **34** and to provide the desired camming configurations to the legs **83** and **85.** Four specific configurations for the four outside legs of the two blades **80** utilized in the double pole switch **25** are illustrated in FIGS. **17–20.** The contact legs **90** and **91** illustrated in FIGS. **17** and **18** correspond to the outside legs **83** and **85** of one of the blades, and the contact legs **92** and **93** illustrated in FIGS. **19** and **20** correspond to the outside legs **83** and **85** of the other blade used in the double pole switch.

Referring first to FIG. **17,** the contact leg **90** is formed to provide a generally V-shaped camming portion **94,** a relatively straight portion **95** which is offset from the camming portion and which is joined to a relatively straight contact-supporting portion **96** by a connecting portion **97.**

The contact leg **91** in FIG. **18** is formed to provide a straight portion **99,** an inclined portion **100,** and a relatively straight camming and contact-supporting portion **101.**

The contact leg **92** in FIG. **19** includes an inclined portion **103** which merges smoothly with a slight inclined camming portion **104,** and an offset portion **105** which is joined to the camming portion **104** by an arcuate portion **106** and which is joined to a relatively straight contact-supporting portion **107** by a connecting portion **108.**

The contact leg **93** of FIG. **20** includes a slightly inclined portion **109** which is joined to a relatively straight camming and contact-supporting portion **110** by an arcuate portion **111.**

After each blade is formed to provide the desired configuration to the contact legs and the desired curvature to the connecting portion **86,** the blade is heat treated to provide the contact legs with sufficient resilience to return to their original positions after being engaged by the cam **47** as will be described in detail hereinafter. I have had good results in forming the blades from a beryllium copper alloy **25** which provides relatively good electrical conductivity and good resilience.

Referring now to FIGS. **12** and **13,** the blade which includes the contact legs **90** and **91** is inserted in the base **34** so that the terminal extension **87** on the middle leg of the blade extends through the slot **36** in the end wall of the base which is indicated by the number **2** embossed on the end wall. This terminal will provide the common terminal for pole No. **1.** The contact legs **90** and **91** will be aligned with the slots in the end wall which are indicated by the numbers **1** and **3,** respectively, on the end wall, but these contact legs will terminate above the end wall as shown in FIG. **4.** Terminals **28** and **30** are received by the slots **36** indicated by the numerals **1** and **3,** and these terminals can be secured by staking a portion of the terminal as at **112** in FIG. **4** so that it engages the end wall. Each terminal is also formed of material having good electrical conductivity, and I have had good results with a brass strip which is provided with an **8** mil coating **113** of silver on the side of the terminal facing the contact leg.

The blade which includes the contact legs **92** and **93** is similarly positioned within the base by inserting the terminal strip on the middle leg through the slot **36** in the end wall which is indicated by the number **5** in FIG. **13.** The contact legs **92** and **93** are then aligned with the slots indicated by the numbers **4** and **6,** respectively, and terminals **31** and **33** are received by these slots and secured therein.

The springs **51** and **68** and the detent rod **38** can then be positioned within the casing and the detent rod secured by peening the end of the reduced portion. The cam sleeve **46,** balls **71,** and push button **27** are slidably received in the slots **76** in the wall of the base, and the washer **45** and boot **44** are positioned over the button. The outer case **26** may then be moved downwardly over the push button and outer case and suitably secured in the position illustrated in FIG. **4.**

The switch is illustrated in its first position in FIG. **4** in which the balls **71** are received in the first annular groove **54** of the detent rod and the cam sleeve and push button are held against the upward force exerted by the spring **51** by the engagement of the locating lugs **75** of the push button with the washer **45.** When the cam sleeve is in the position illustrated, the cam **47** is in engagement with the camming portion **94** of the contact leg **90** to force this leg outwardly so that the contact **88** thereon engages the terminal **28** which is secured within the slot indicated by the number **1** in FIG. **13.** Similarly, the cam **47** engages the camming portion **104** of the contact leg **92** to force this leg outwardly so that the contact **88** thereon engages the terminal **32** positioned within the slot indicated by the number **4** (in FIG. **13**).

Referring to FIGS. **17–20,** the line *x—x* indicates the position of the cam relative to the contact legs when the cam sleeve is in the first position illustrated in FIG. **4.** It is thus apparent that the contact legs **91** and **93,** which are not shown in FIG. **4,** are not engaged by the cam in the first position, and the contacts thereon are therefore out of engagement with the terminals **30** and **33** in the slots indicated by the numbers **3** and **6,** respectively, in FIG. **13.** Accordingly, when the push button and cam sleeve are in the first position, terminal **28** is electrically connected by means of the blade **80** of pole No. **1** to terminal **29** which is secured to the blade, and terminal **31** is electrically connected by means of the blade of pole No. **2** to terminal **32** which is connected to the blade.

The switch can be moved to the second position by depressing the push button **27** to force the balls **71** and cam sleeve **46** downwardly against the bias of the spring **51** until the balls are received in the second annular groove **55.** Since the balls **71** are cammed outwardly by the camming surface **59** of the detent rod against the inward bias provided by the frusto-conical camming surface **70** of the cam sleeve and the spring **51** as the button is depressed, the operator can readily feel the movement of the switch from the first position to the second position. When the balls contact the camming surface **60** of the detent rod, they begin to return radially inwardly until the balls reach the surface of the second annular groove **55.** The radially inward movement of the balls and the seating of the balls in the second annular groove between the camming surfaces **60** and **61** can also be readily felt by the operator.

Referring to FIGS. **17–20,** the line *y—y* indicates the position of the cam **47** when the switch is in the second position. In this position, the cam **47** has moved out of engagement with the camming portion **94** of the contact leg **90,** and the resilient contact leg has moved away from terminal **28** to break the electrical contact between that leg and the terminal. However, the cam **47** has engaged the camming surface **101** of the other contact leg of pole No. **1,** leg **91,** to force the contact thereon into engagement with terminal **30** in slot number three to electrically connect terminals **29** and **30.**

The contacts of pole number two remain unchanged as the switch is moved from the first to the second position. The cam **47** still engages the camming portion **104** of the contact leg **92,** and the cam has not yet reached the camming surface **110** of the contact leg **93.**

The switch can be moved from the second to the third position by further depressing the push button to move the balls **71** out of the second annular groove **55** and into the third annular groove **56.** As described hereinbefore, the movement of the balls from one annular groove to the next can be felt by the operator so that the position of the switch is tactilely evident. Further, the spring **68,** which is held in a pre-load compressed condition by the shoulder **67** of the detent rod engages the shoulder **50** of the cam sleeve as the sleeve moves from the second to the third position to provide an additional biasing force against movement of the cam sleeve to the third position. This additional biasing force provides further tactile evidence of the position of the switch. As can be seen in FIG. **4,** the upper turn of the spring **68** is provided with a flattened surface which engages the shoulder **67** and which extends radially outwardly therefrom so that it will engage the shoulder **50** of the cam sleeve.

Referring again to FIGS. **17–20,** the contacts of pole No. **1** remain unchanged as the switch moves from the second to the third position, indicated by the line *z—z.* Referring to the contact leg **90** of FIG. **17,** the cam **47** moves adjacent but out of engagement with the offset portion **96** so that this contact leg remains out of engagement with terminal **28.** Similarly, the cam remains in engagement with the elongated camming portion **101** of the contact leg **91** so that this contact leg remains in electrical engagement with terminal **30.**

However, the contacts of pole No. **2** are changed when the switch moves from the second to the third position. Referring to the contact leg **92** of FIG. **19,** the cam **47** will move beyond the camming portion **104** into the pocket defined by the offset portion **105** so that this resilient contact leg will move out of engagement with terminal **31.** The contact leg **93** of FIG. **20** will be moved into engagement with the terminal **33** as the cam **47** engages the camming portion **110** of this contact leg.

The switch can be returned from the third to the second position or from the second to the first position by reducing the force exerted on the push button. The spring **51** exerts a sufficient force to urge the balls **71** outwardly along the camming surfaces **62** and **60** of the detent rod, and the return force provided by the spring **68** will no longer act upon the cam sleeve when the switch reaches the second position. Accordingly, tactile evidence of the position of the switch is provided by the spring **68** whether the switch is being moved in one direction or the other.

Although the contact legs of the blades are resiliently biased inwardly toward the detent rod and away from the terminals, I have found that it is advantageous if the

material and resilience of the contact legs is such that the camming surfaces of these legs do not provide sufficient resistance to movement of the cam **47** in either direction. In other words, the feel or tactile evidence of the switch position is provided by the camming surfaces of the detent rod and the springs **51** and **68** rather than by the camming surfaces of the contact legs.

The angles of the camming surfaces **59–62** of the detent rod can be selected to provide a desired sensible detent force as the switch moves from one position to another. In the particular embodiment illustrated, the caming surfaces **59** and **61** have angles relative to the axis of the detent rod of 45° and 30°, respectively, to provide a different feel as the switch moves from the first to the second position and from the second to the third position, and the detent surfaces **62** and **60** have angles of 40° and 20°, respectively, to provide a different feel as the switch returns from the third to the second position and from the second to the first position.

In one specific embodiment the force needed to move the switch from the first position to the second position was about 3 pounds, and the force needed to move the switch from the second to the third position was about 5 pounds. The release forces, i.e., the maximum forces that could be exerted on the button while permitting the button to move upwardly, were about 1.6 pounds for movement from the third to the second positions and about 1.1 pounds for movement from the second to the first positions.

The particular embodiment illustrated is a double pole single throw switch in which the positions of the contacts of pole No. **1** are changed as the switch moves from the first to the second position while the positions of the contacts of pole No. **2** remain unchanged, and the positions of the contacts of pole No. **2** change as the switch moves from the second to the third position while the contacts of pole No. **1** remain unchanged. However, it will be readily understood that different switching combinations can be provided by selecting different camming configurations for the contact legs. For example, both poles could change as the switch moves from one position to another, and one or both of the poles could again change as the switch moves to the next position. Also, the location and configuration of the camming surfaces can be selected so that the switch will either break before make or make before break, i.e., one contact will move out of engagement with a terminal before another contact moves into engagement with a terminal or one contact will move into engagement with a terminal before another contact moves out of engagement with a terminal.

Other modifications of the invention will be readily apparent. For example, the detent rod can be modified to provide a two position switch by providing only two annular grooves with suitable stop means for the actuating means, i.e., the cam sleeve and the push button, or additional grooves can be provided to provide additional switch positions. In all cases, the camming configurations of the contact legs can be seoected as desired to provide the desired switching action.

Although the contact legs shown are formed from a sheet of metal which provides two contact legs and one terminal, the contact legs could be formed separately and electrically connected in some other way. The circuits of the two poles are independent, and a wide variety of connection possibilities and contact arrangements are available. Further, the switch could be provided in single pole form in which only one blade **80** is used.

While in the foregoing specification, detailed descriptions of specific embodiments of the invention were set forth for the purpose of illustration, it is to be understood that many of the details hereingiven may be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. An electrical switch comprising elongated casing means, a pair of terminals mounted in the casing means and extending therefrom, a pair of longitudinally extending contact legs within the casing means, each of the contact legs being provided with a camming surface, the camming surfaces of the contact legs being longitudinally spaced, actuating means including a cam movably mounted within the casing means for longitudinal movement between first and second positions, the cam engaging the camming surfaces of one of the contact legs to force said one contact leg into engagement with one of the terminals when the actuating means is in the first position, the cam engaging the camming surface of the other contact leg to force the other contact leg into engagement with the other terminal when the actuating means is in the second position, detent means within the casing means engageable with the actuating means for resisting movement of the actuating means from one position to another, and spring means within the casing engaging the actuating means for resiliently biasing the actuating means against movement from the first to the second positions, the detent means including a longitudinally extending generally cylindrical detent rod mounted within the casing means and having longitudinally spaced radially inwardly extending annular grooves formed therein, the portion of the rod between adjacent grooves being generally V-shaped in longitudinal cross section to provide a pair of camming surfaces, a ball engageable with the actuating means and receivable successively in each of the annular grooves as the actuating means moves from the first to the second positions, the ball being cammed outwardly by one of the camming surfaces as the actuating means is moved between two adjacent positions.

2. The switch of claim **1** in which the detent rod is provided with three of said inwardly extending annular grooves, the actuating means being movable between first, second and third positions, the ball being receivable successively in each of the grooves as the actuating means moves from the first to the third positions.

3. The switch of claim **1** in which the actuating means includes a sleeve and an actuating button slidably disposed and longitudinally spaced along the detent rod, the cam extending radially outwardly from the sleeve, the spring means urging the sleeve toward the actuating button, the end of the sleeve adjacent the actuating button having a camming surface extending longitudinally away from the button and radially inwardly, the ball being positioned between the camming surface of the sleeve and the button and being urged radially inwardly against the detent rod by the camming surface of the sleeve.

4. The switch of claim **2** in which the spring means includes a first coil spring engaging the actuating means as the actuating means moves between the first and third positions and a second coil spring concentric with the first spring and being engageable with the actuating means when the actuating means moves between the

second and third positions whereby a greater biasing force acts on the actuating means when the actuating means moves between the second and third positions than when the actuating means moves betwen the first and second positions.

5. The switch of claim **1** in which the camming surface of the detent rod engaged by the ball as it moves from the first annular groove to the second annular groove has a different inclination than the camming surface of the detent rod engaged by the ball as it moves from the second annular groove to the third annular groove.

6. The switch of claim **2** in which the camming surface of the detent rod engaged by the ball as it moves from the third annular groove to the second annular groove has a different inclination than the camming surface of the detent rod engaged by the ball as it moves from the second annular groove to the first annular groove.

7. An electrical switch comprising elongated casing means, a plurality of terminals mounted in the casing means and extending therefrom, a plurality of longitudinally extending contact legs within the casing means, each of the contact legs being provided with a camming surface and being resiliently biased away from an associated terminal, a longitudinally extending detent rod mounted within the casing means and having three longitudinally spaced transversely inwardly extending recesses formed therein, actuating means including a cam mounted for longitudinal movement along the detent rod between first, second and third positions, a detent member engageable with the actuating means and receivable in the recesses of the detent rod as the actuating means moves from one position to another, spring means within the casing means engaging the actuating means for resiliently biasing the actuating means against movement from the first to the second positions and from the second to the third positions, the cam being engageable with the camming surface of each of the contact legs as the actuating means moves longitudinally along the detent rod, each contact leg being forced into engagement with one of the terminals when the cam engages the camming surface of that contact leg and being out of engagement with a terminal when the cam is out of engagement with the camming surface of that contact leg.

8. The switch of claim **7** in which the detent rod is generally cylindrical and the recesses are radially inwardly extending annular grooves formed in the rod, the portions of the rod between adjacent grooves being generally V-shaped in longitudinal cross section to provide a pair of camming surfaces, the detent member being a ball engageable with the actuating means and receivable successively in each of the grooves as the actuating means moves from the first to the third position, the ball being cammed outwardly by one of the camming surfaces as the actuating means is moved between two adjacent positions.

9. The switch of claim **8** in which one pair of the contact legs is electrically connected to one of the terminals and another pair of contact legs is electrically connected to another terminal to provide a double pole switch.

10. The switch of claim **8** in which the camming surface of the detent rod engaged by the ball as it moves from the first annular groove to the second annular groove has a different inclination than the camming surface of the detent rod engaged by the ball as it moves from the second annular groove to the third annular groove.

11. The switch of claim **8** in which the camming surface of the detent rod engaged by the ball as it moves from the third annular groove to the second annular groove has a different inclination than the camming surface of the detent rod engaged by the ball as it moves from the second annular groove to the first annular groove.

12. The switch of claim **7** in which the actuating means includes a sleeve and an actuating button slidably disposed and longitudinally spaced along the detent rod, the cam extending radially outwardly from the sleeve, the spring means urging the sleeve toward the actuating button, the end of the sleeve adjacent the actuating button having a camming surface extending longitudinally away from the button and radially inwardly, the ball being positioned between the camming surface of the sleeve and the button and being urged radially inwardly against the detent rod by the camming surface of the sleeve.

13. The switch of claim **7** in which the spring means includes a first coil spring engaging the actuating means as the actuating means moves between the first and third positions and a second coil spring concentric with the first spring and being engageable with the actuating means when the actuating means moves between the second and third positions whereby a greater biasing force acts on the actuating means when the actuating means moves between the second and third positions than when the actuating means moves between the first and second positions.

14. The switch of claim **7** in which the casing means is provided with a longitudinally extending slot and the actuating means includes a transversely extending lug slidably received in the slot, abutment means on the casing means engageable with the lug to provide a limit stop for the actuating means.

15. The switch of claim **14** in which the slot is terminated by an end wall which provides the abutment means.

16. The switch of claim **14** in which the abutment means is provided by a closure member for the slot which prevents the lug from being withdrawn from the slot.

17. An electrical switch comprising elongated casing means, at least a pair of terminals mounted in the casing means and extending therefrom, at least a pair of longitudinally extending contact legs within the casing means, each of the contact legs being provided with a camming surface, actuating means including a cam movably mounted within the casing means for longitudinal movement between at least two positions, the cam having a transversely outwardly extending projection thereon at a single longitudinal position of the cam, the camming surface of each contact leg having a different configuration, the camming surface of one of the contact legs being engageable with the projection of the cam when the cam is in both of the two cam positions and forced thereby into engagement with one of the terminals, the camming surface of the other contact leg being engageable with the projection of the cam when the cam is in only one of the two cam positions and forced thereby into engagement with the other of the terminals.

18. The switch of claim 17 in which the switch is a double pole switch and includes four of said terminals mounted within the casing means and extending therefrom and first and second pairs of said contact legs, the first pair of contact legs providing one pole and the second pair of contact legs providing the other pole, the actuating means and the cam being movable between first, second and third positions, the camming surfaces of the contact legs being shaped so that one of the contact legs of the first pair is engageable by the projection on the cam when the cam is in one of the cam positions but is not so engageable when the cam is in the other two cam positions, the other contact leg of the first pair being engageable when the cam is in said other two cam positions but is not so engageable when the cam is in said one cam position, one of the contact legs of the second pair being engageable by the projection on the cam when the cam is in two of the cam positions but not so engageable when the cam is in the third cam position, the other contact leg of the second pair being engageable by the projection on the cam when the cam is in said third cam position but not so engageable when the cam is in said two cam positions whereby one and only one of the contact legs of each pole is engaged by the projection of the cam and forced thereby into engagement with one of the terminals in each of the three cam positions.

19. The switch of claim 17 in which the contact legs are electrically connected to a third terminal extending from the casing means whereby said one terminal is electrically connected to the thrid terminal when the actuating means is in the first position and said other terminal is electrically connected to the third terminal when the actuating means is in the second position.

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