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ELECTRIC SWITCH

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FIG. 1

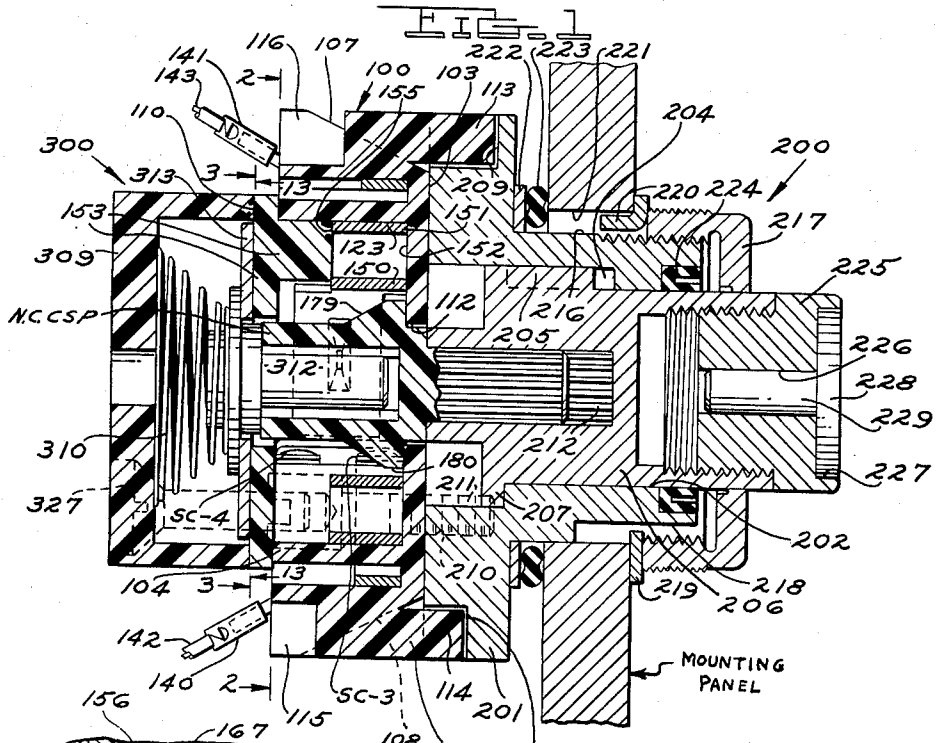


FIG. 5

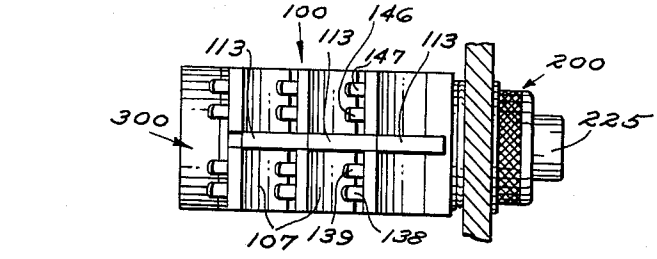


FIG. 5A

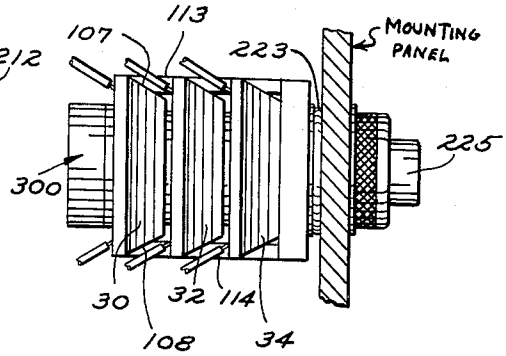


FIG. 6

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ELECTRIC SWITCH

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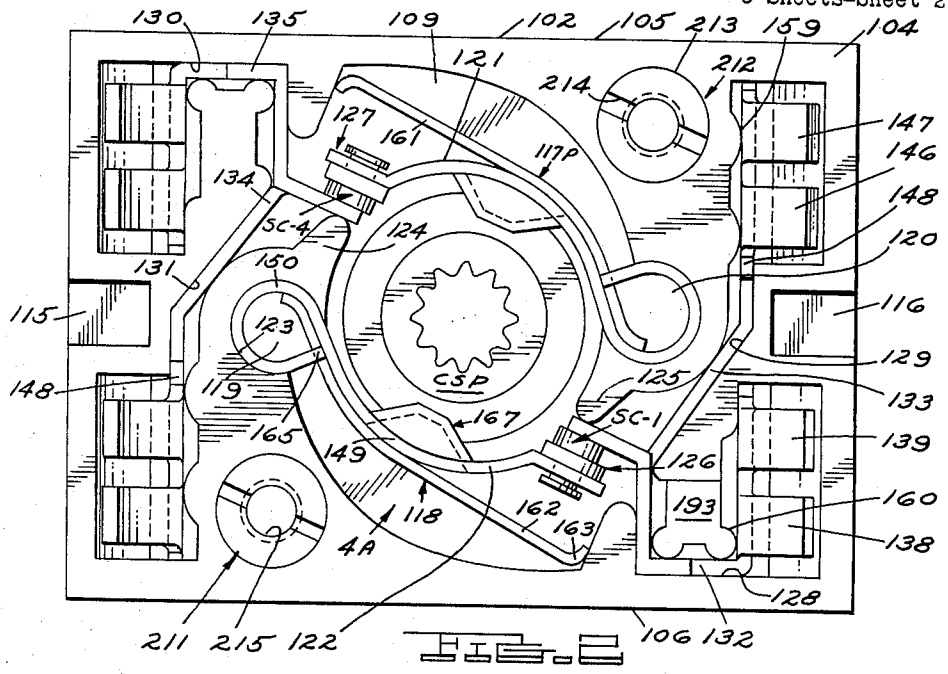


FIG. 2

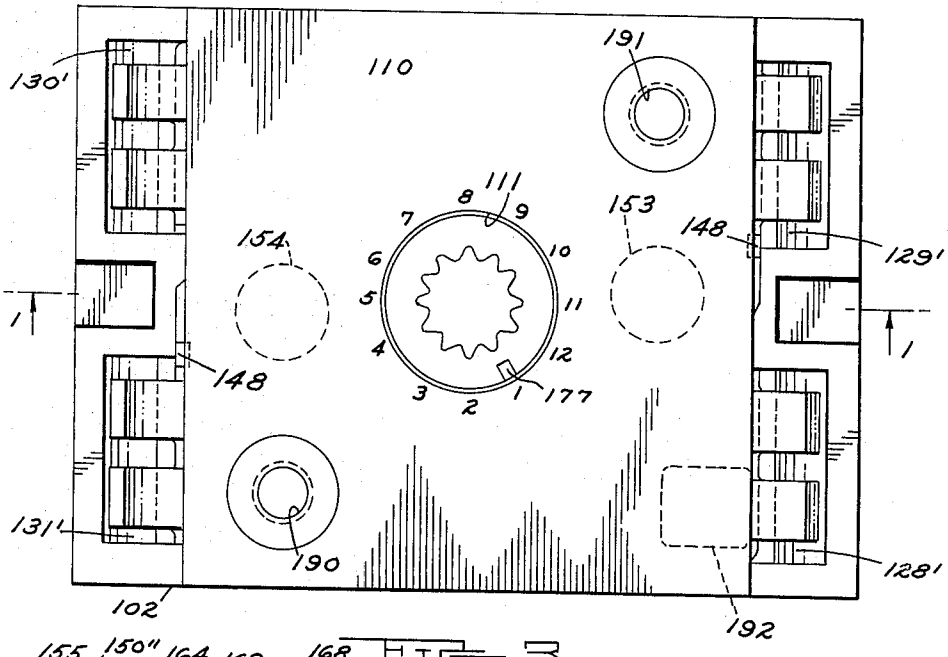


FIG. 3

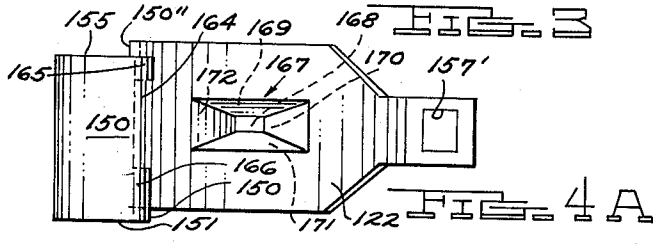


FIG. 4A

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ELECTRIC SWITCH

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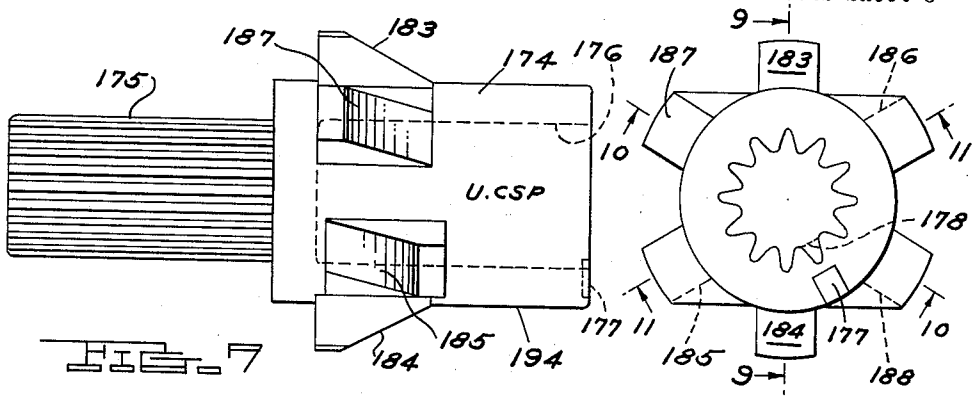


FIG. 7

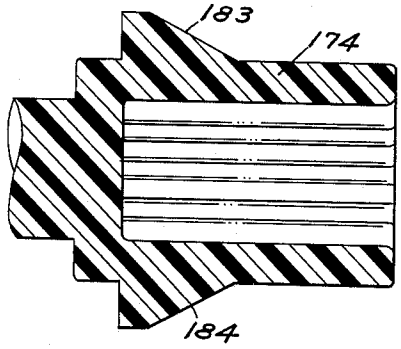


FIG. 9

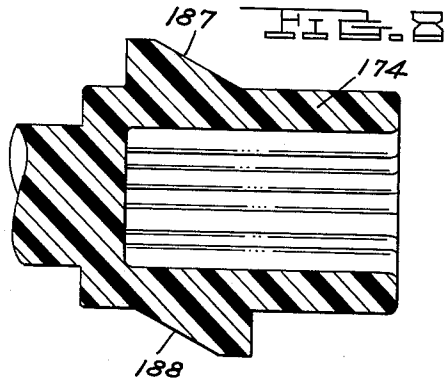


FIG. 8

FIG. 10

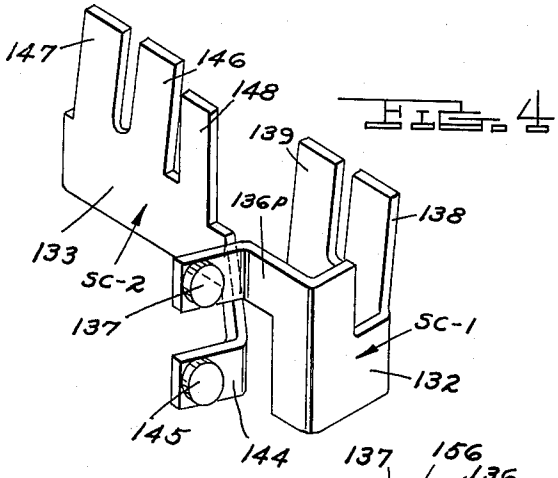


FIG. 4

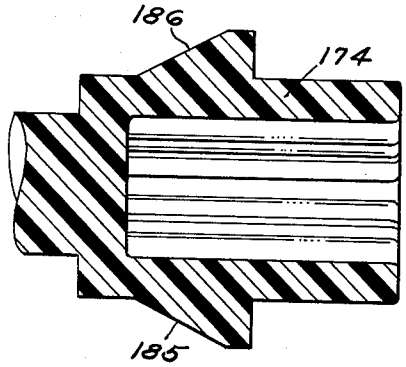


FIG. 11

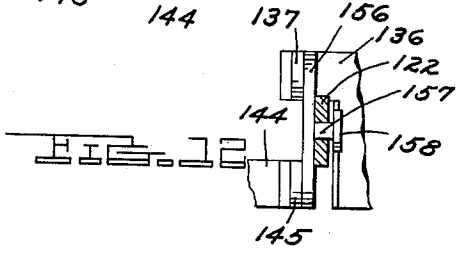


FIG. 12

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ELECTRIC SWITCH

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FIG. 13

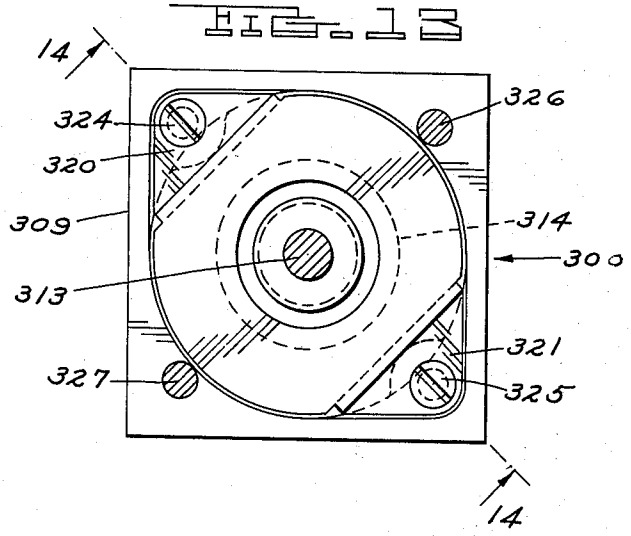
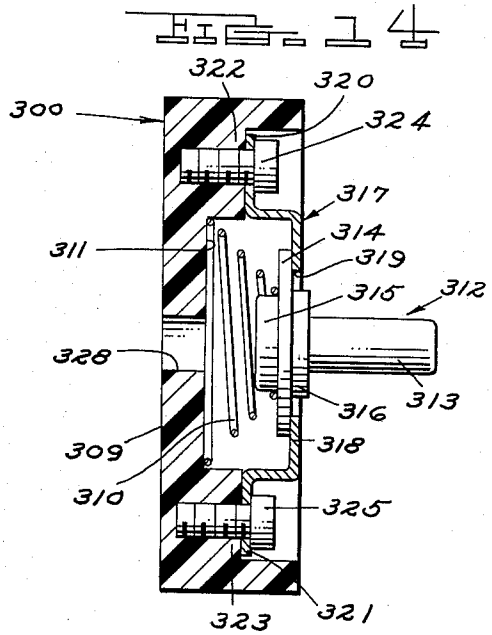


FIG. 14



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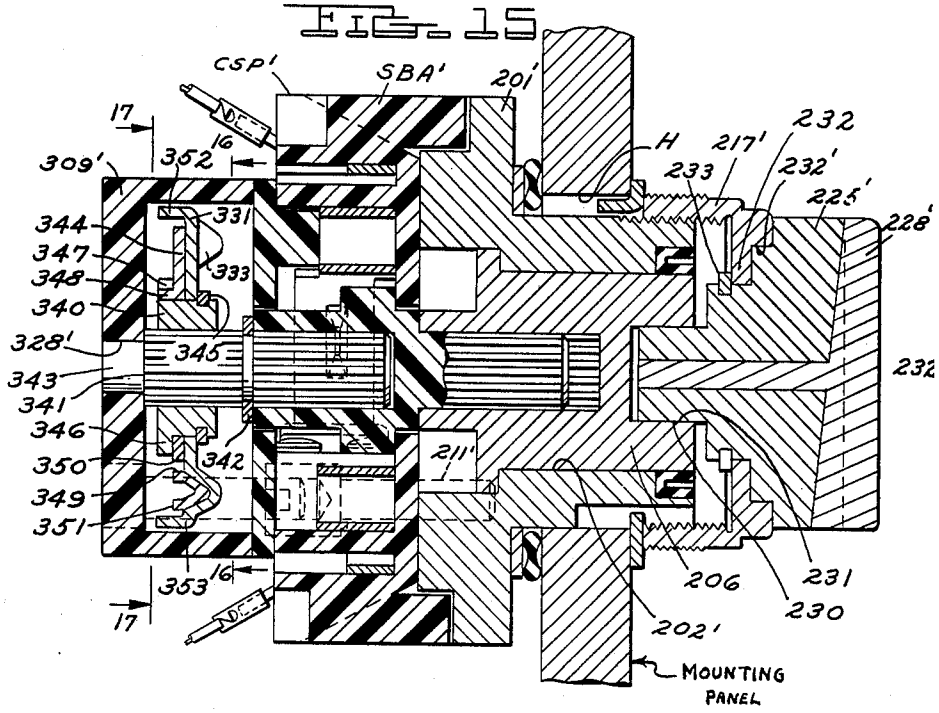
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FIG. 15



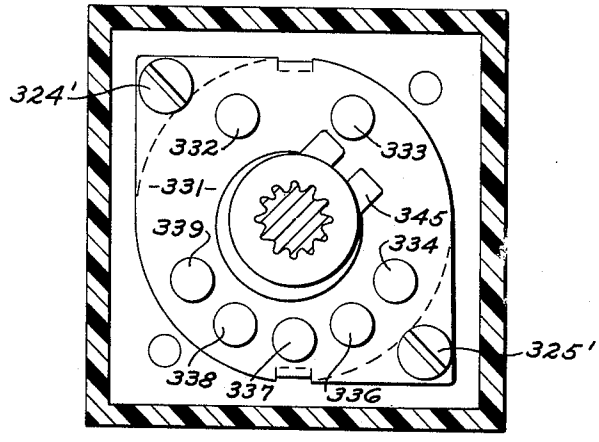


FIG. 16

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ELECTRIC SWITCH

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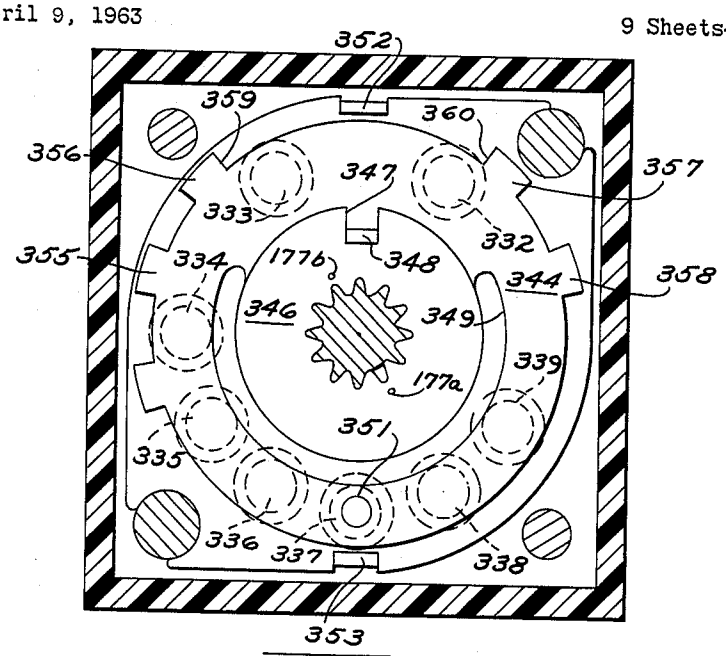


FIG. 17

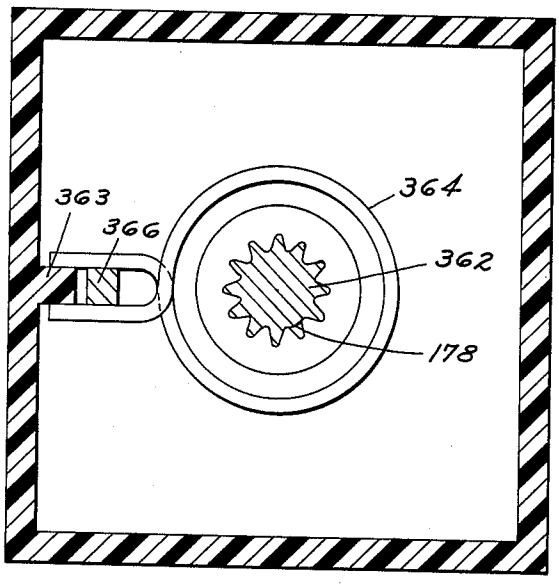


FIG. 23

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ELECTRIC SWITCH

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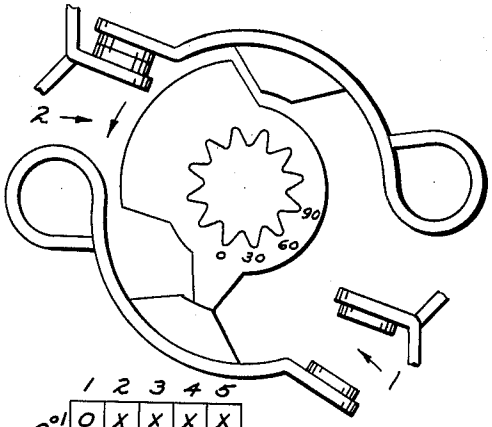


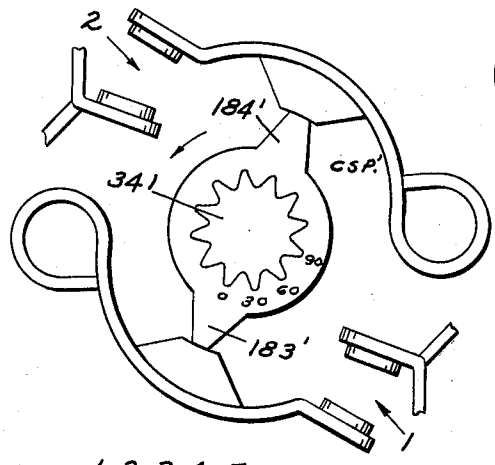
FIG. 18

	1	2	3	4	5
0° 1	O	X	X	X	X
2	X	O	O	O	O

30° 1	X	X	X	X	X
2	O	O	O	O	X

60° 1	X	X	X	X	X
2	O	O	O	X	O

FIG. 19

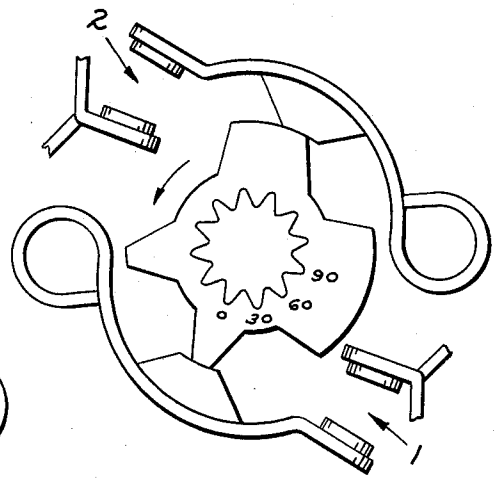


	1	2	3	4	5	
0° 1	O	X	X	X	X	20a
2	O	X	X	X	X	

30° 1	X	X	X	X	X	20b
2	X	X	X	X	X	

60° 1	X	X	X	X	O	20c
2	X	X	X	X	O	

FIG. 20



	1	2	3	4	5
0° 1	O	X	O	O	O
2	O	O	X	X	O

30° 1	X	O	O	O	X
2	O	X	X	O	X

60° 1	O	O	O	X	O
2	X	X	O	X	O

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ELECTRIC SWITCH

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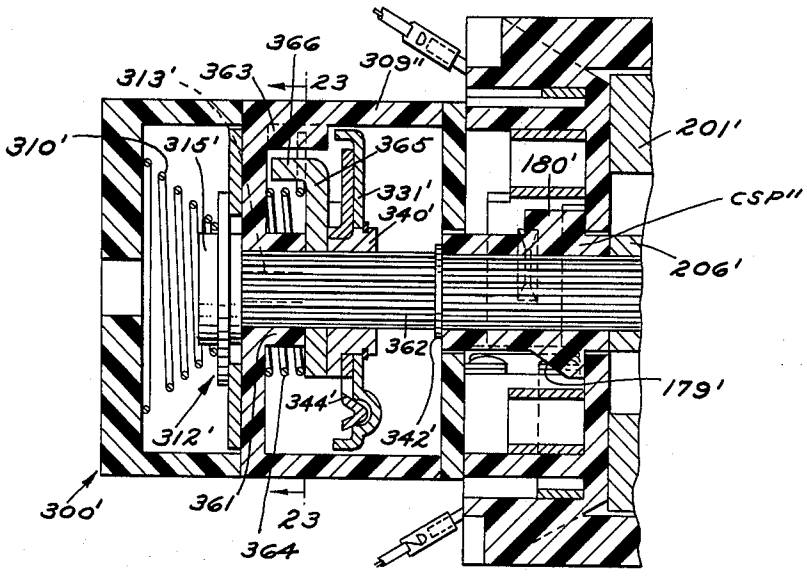


FIG. 21

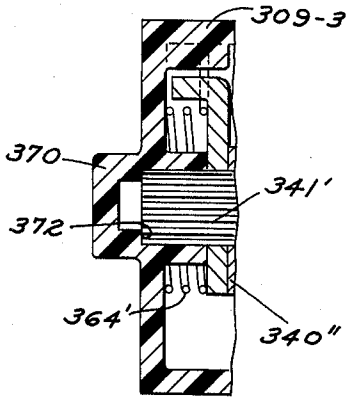


FIG. 24

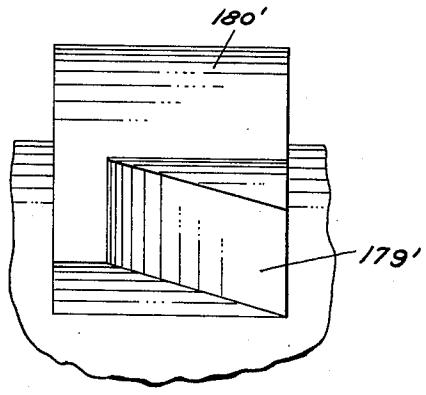


FIG. 22

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ELECTRIC SWITCH

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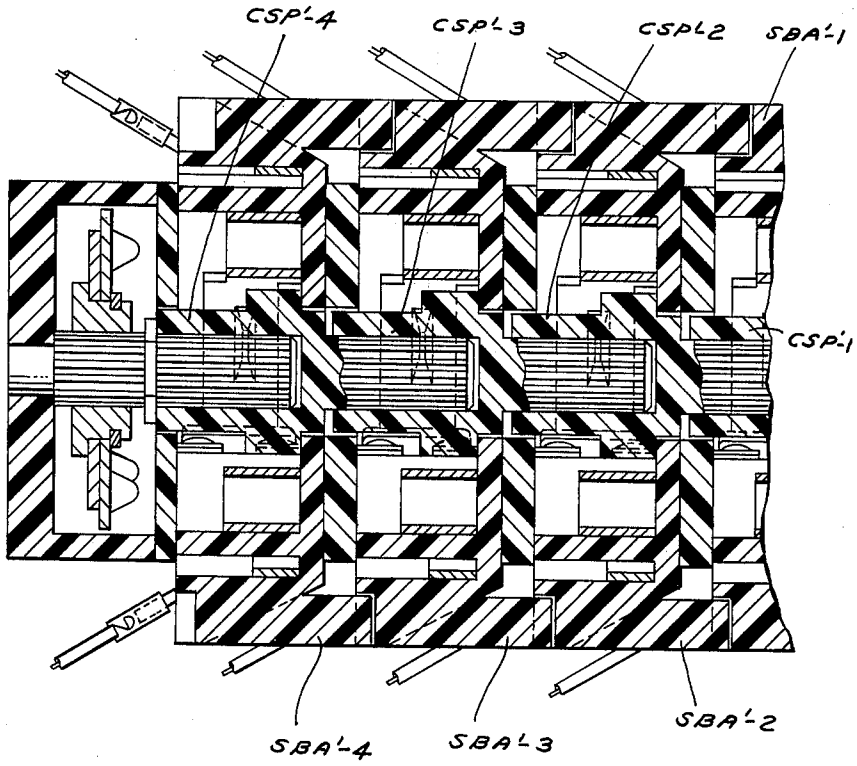


FIG. 25

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United States Patent Office

3,251,956
Patented May 17, 1966

3,251,956

ELECTRIC SWITCH

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Filed Apr. 9, 1963, Ser. No. 271,760
34 Claims. (Cl. 200—14)

This invention relates to electric switches generally characterized as rotary switches (sometimes also referred to as selector switches), pushbutton switches, and combination rotary and pushbutton switches, and to modular switch assemblies of the foregoing types. A rotary switch is one in which switch contacts are opened or closed upon rotation of the switch actuator; a pushbutton switch is one in which contacts are opened or closed by pushing the actuator; a combination rotary and pushbutton switch is one in which the contacts are opened or closed by a combined pushing and rotation of the actuator.

The subject matter herein disclosed is based upon certain fundamental concepts some of which are: to provide a line of pushbutton, rotary, and combination pushbutton-rotary switches which utilize to a great extent similar parts and subassemblies; the design of the switches is such that the number of contacts can be readily increased by adding standardized subassemblies thereby avoiding the necessity of providing different switch designs for different numbers of contacts; the design of the switches is such that the normal condition of the contacts, i.e., open or closed, can be readily altered whereby a user having a switch whose normal contact condition is, for example, normally closed, can readily alter the switch to provide a normally open contact condition without the purchase of any new parts or a totally new switch; the design of the switches is such that they are highly compact and externally of such shape and dimensions as to allow an efficient design of control panels or boxes on or in which the switches are to be mounted; the switches are provided with terminals to which conductors may be readily connected without interference with other terminals, likelihood of accidental short-circuiting, or confusion as to which terminals are the proper ones for connection of conductors to obtain the desired circuit control; and finally the line of switches are subject to manufacture and sale at competitively attractive prices.

A primary object of this invention is the provision of a switch body assembly for the aforementioned types of switches, which comprises cooperating stationary and movable contacts and a contact shifting part, all so designed, supported, and arranged that the same assembly may be used in either a rotary, a pushbutton, or a combination rotary and pushbutton switch, without any change except in the shape of the contact shifting surface of the contact shifting part.

Another object of the invention is provision of a modular switch made up of a tandem or stacked arrangement of removably connected individually complete switch body assemblies with mechanism connected to opposite ends of the switch for controllably actuating the individual switch body assemblies. By varying the number of stacked switch body assemblies in a given switch, the total number of available switch contacts may be similarly varied.

Another object of the invention is the provision of each of the aforementioned three types of switches made up of three removably connected assemblies; an actuator assembly, a switch body assembly and a positioning assembly. The actuator assembly may be either the pushbutton, rotary, or combination pushbutton and rotary type; the switch body assembly may be for either a rotary, a pushbutton, or a combination rotary and pushbutton type switch; and the positioning assembly may be either for a detent type rotary switch, or for a spring-return rotary type switch either with or without detent means, or for a pushbutton spring-return type switch, or for a combination pushbutton-rotary type switch.

Another object of the invention is the provision of a switch having a switch body assembly which may be opened and the contact shifting part repositioned to give a different contact opening or closing sequence from that theretofore existing. For example, a pushbutton switch having what we term a universal contact shifting part, may be readily converted from one in which the contacts are normally closed, to one in which one contact is normally closed and another normally open, or in which the contacts are normally open simply by repositioning in the switch body assembly the contact shifting part. With a suitably shaped contact shifting part, the switch body assembly of a rotary type switch may be opened and the contact shifting part repositioned to provide a different sequence of contact operation. By utilization of differently shaped contact shifting parts any desired sequence of contact operation may be provided in a rotary switch of the character herein disclosed.

Another object of the invention is the provision of a switch body assembly as constructed that a plurality of such assemblies may be connected in stacked or tandem relation, with the terminals for the contacts therewithin while exposed for connection of wires thereto do not interfere with adjacent assemblies and are substantially protected from accidental short-circuiting by bare wires lying adjacent the switch.

Another object of the invention is the provision of a housing for a switch body assembly which is provided with independent chambers for each movable contact and each set of stationary contacts electrically insulating the contacts against unintended short-circuiting therebetween.

Another object of the invention is the provision of a detent mechanism for a rotary type selector switch which may be readily altered to provide a greater or lesser number of contact control positions and allow for different degrees of rotation of the switch actuator.

Other objects, advantages, and meritorious features will more fully appear from the specification, claims, and accompanying drawings, wherein:

FIG. 1 (Sheet 1) is a cross-sectional view through a pushbutton switch embodying the invention showing the pushbutton assembly, switch body assembly and pushbutton spring-return assembly taken along the axis of the switch on line 1—1 of FIG. 3 and utilizing a cam causing the switch contacts to be normally closed;

FIG. 2 (Sheet 2) is a view inside the switch body assembly of FIG. 1 taken along line 2—2 thereof, it being noted that for economy in the drawings, FIG. 2 has been rotated 90 degrees;

FIG. 3 (Sheet 2) is similar to FIG. 2 but with the switch body cover in place, taken along line 3—3 of FIG. 1;

FIG. 4 (Sheet 3) is a perspective view of a stationary contact assembly;

FIG. 4A (Sheet 2) is a side elevation of a movable contact arm looking in the direction of arrow 4A in FIG. 2;

FIG. 5 (Sheet 1) is a fragmentary cross-sectional view through a pushbutton switch body assembly but in which a cam is utilized causing the switch contacts to be normally open;

FIG. 6 (Sheet 1) is a side view of a pushbutton switch having a plurality of stacked or tandemly arranged switch body assemblies;

FIG. 6A (Sheet 1) is a top view of a pushbutton switch having a plurality of stacked or tandemly arranged switch body assemblies;

FIG. 7 (Sheet 3) is an elevation of what may be termed a universal pushbutton cam;

FIG. 8 (Sheet 3) is a right-hand end view of the cam of FIG. 7 showing the six cam lobes;

FIG. 9 (Sheet 3) is a cross-sectional view taken on line 9—9 of FIG. 8;

FIG. 10 (Sheet 3) is a cross-sectional view taken on line 10—10 of FIG. 8;

FIG. 11 (Sheet 3) is a cross-sectional view taken on line 11—11 of FIG. 8;

FIG. 12 (Sheet 3) is a fragmentary detail of the floating connection between the movable contact and the cam follower arm;

FIG. 13 (Sheet 4) is a cross-sectional view taken on line 13—13 of FIG. 1 showing the positioning assembly;

FIG. 14 (Sheet 4) is a cross-sectional view taken on line 14—14 of FIG. 13;

FIG. 15 (Sheet 5) is a cross-sectional view through a rotary switch embodying the invention taken along the axis of the switch and showing the rotary knob assembly, switch body assembly, and detent positioning assembly;

FIG. 16 (Sheet 5) is a cross-sectional view through the detent positioning assembly of the FIG. 15 switch taken along the line 16—16 thereof;

FIG. 17 (Sheet 6) is a cross-sectional view through the detent positioning assembly of the FIG. 16 switch taken along the line 17—17 thereof;

FIGS. 18, 19 and 20 (Sheet 7) show three different rotary cam configurations each in association with a pair of movable contacts;

FIG. 21 (Sheet 8) is a fragmentary cross-sectional view through a combination rotary pushbutton spring-return switch showing the switch body assembly, detent positioning and spring-return mechanisms;

FIG. 22 (Sheet 8) is a fragmentary view of an elevation of a cam for use in the switch body assembly of FIG. 21;

FIG. 23 (Sheet 6) is a cross-sectional view taken along the line 23—23 of FIG. 21;

FIG. 24 (Sheet 8) is a fragmentary cross-sectional view through a spring-return mechanism for a rotary switch; and

FIG. 25 (Sheet 9) is a cross-sectional view through a plurality of rotary switch body assemblies connected together in tandem or stacked relation.

In FIG. 1 and those figures ancillary thereto, the invention is shown embodied in a pushbutton type switch. In FIG. 15 and those figures ancillary thereto, the invention is shown embodied in a rotary or selector type switch. In FIG. 21 and those figures ancillary thereto, a combination pushbutton-selector switch is shown. With each of these three types of switches there are three common assemblies, namely a switch body assembly and mechanism connected thereto for controllably actuating it comprising an actuator assembly and a positioning assembly. For convenience, reference numerals in the 100 Series refer to parts of a switch body assembly, those of the 200 Series refer to parts of an actuator assembly, and those of the 300 Series to parts of a positioning assembly.

Except for the contact shifting part the switch body assembly is of identical construction whether used in the pushbutton, selector switch, or combination pushbutton-selector switch. The actuator and positioning assemblies differ somewhat as between the pushbutton, selector, or combination pushbutton and selector switches.

Pushbutton switch

As shown in FIG. 1 this switch essentially comprises a switch body assembly, hereinafter referred to as SBA100 and mechanism connected thereto for controllably actuating it comprising an actuator assembly 200 and a positioning assembly 300. While it will be apparent hereinafter to those skilled in the art that assembly 300 might be combined with assembly 200 in a single mechanism, and other parts of SBA100 changed correspondingly to provide for operation using such a single assembly control mechanism, in the instant and preferred embodiment such mechanism comprises the above mentioned individual assemblies 200 and 300. A number of advantages, features, and various inventive aspects of the subject matter disclosed herein require that the control mechanism be separated in individual assemblies as aforesaid, though certain other inventive concepts in the switch may not require such individualization of the assemblies.

The SBA is best shown in FIGS. 1 and 5 on sheet one, FIGS. 2 and 3 on sheet two, and in various figures of sheet three. It preferably comprises a dielectric housing 102 composed of a plastic having electrically non-tracking and arc-quenching characteristics. One such plastic that has been found particularly suitable is made by the Rostone Corporation, Lafayette, Indiana, under the trademark Rosite 3250. It is a hot molded (thermosetting) material made up of mineral fibers bonded together with a polyester resin. It has a high dielectric characteristic and good impact resistance. The SBA housing is essentially a block of this or similar dielectric material formed in rectangular shape, as viewed in FIGS. 1 and 2, having opposite parallel planar front and rear faces, respectively 103 and 104. Opposite side edges 105 and 106 are perpendicular to the front and rear faces while top and bottom edges 107 and 108 taper inwardly from the rear to the front face as shown best in FIGS. 1 and 6.

The block 102 comprising the switch housing has a central recess 109 (FIG. 2) therein opening outwardly through the rear face of the block to be substantially closed by cover 110 having a central opening 111 therethrough. Such central recess also opens outwardly at 112 through the front face of the block in axial alignment with opening 111 on what might be considered the axis of the housing. Extending forwardly of the front face 103 at the top and bottom edges are SBA positioning and aligning lugs or ears 113 and 114, the former being larger than the latter, and at the rear face of the SBA block are complementary ear-receiving sockets 115 and 116. These ears of one SBA are adapted to fit into the complementary sockets at the rear of another SBA to position the assemblies in proper axial and angular alignment as shown in FIGS. 6 and 25 where SBA30, 32 and 34 are shown with their respective ears and sockets in interfitted engagement.

Recess 109 is adapted to receive and house the switch contacts as well as the contact shifting part. The contact shifting part or cam CSP is disposed on the axis of the housing and on opposite sides of this part and adjacent thereto are the movable contacts generally indicated at 117 and 118. It will be noted that the central recess is arranged symmetrically with respect to the axis of the housing. The walls of such recess are provided at opposite sides of the axis of the housing with a pair of sockets 119 and 120 opening through the rear face of the block to receive and rotatably support for pivotal movement one end of each of the movable contact lever arms 121 and 122. For this purpose each socket is provided with a cylindrical inner wall 123 with the axis of the socket par-

alleling the axis of the housing and the axis of the contact shifting part CSP.

It will be noted that the wall of the central recess is also shaped to provide extending fingers **124** and **125** at opposite sides of the axis of the housing which are adapted to back up the inner ends of stationary contact means. Such contact means are disposed on opposite sides of the central recess and have terminal connectors exposed outwardly of the housing for connecting the contacts of the SBA in an electric circuit as hereinafter explained. Such stationary contact means comprise stationary contacts generally indicated in FIG. 2 at SC–1 and SC–4, and, while hidden in FIG. 2, other stationary contacts SC–2 and SC–3 are disposed directly in front of SC–1 and SC–2. The stationary contacts are arranged in pairs, to wit SC–1 and SC–2 comprising one pair and SC–3 and SC–4 comprising the other pair, with each pair adapted to be bridged by a floating contact part at the free end of each movable contact lever arm, to complete a circuit between the stationary contacts of each pair through the associated floating contact part. The stationary contacts SC–1 and SC–2 are adapted to be engaged and bridged by the movable contact part **126** floatingly carried at the free end of lever arm **122**, while stationary contacts SC–3 and SC–4 are adapted to be engaged by the movable contact part **127** floatingly carried at the free end of the lever arm **121**.

The stationary, or sometimes referred to as fixed contacts, are disposed in the aforementioned pairs at common locations at opposite sides of the central recess and adjacent the sockets **119** and **120** which bearingly receive and support the movable contact lever arms. It will be noted that intervening portions **124** and **125** of the block separate the sockets **119** and **120** from the adjacent pair of stationary contacts. The arrangement of sockets and pairs of stationary contacts is such that with the contact lever arms pivotally supported in the sockets, the arms extend across the central recess, alongside opposite sides of the contact shifting part, and terminate adjacent each such common location where the pairs of contacts are disposed.

The central recess **116** is provided with a plurality of contact conductor-strip receiving and supporting branch passageways disposed in spaced apart relation and electrically insulated from one another by intervening portions of the block. These branch recesses or passageways open outwardly through the rear face of the block so that with the cover of the housing removed, the passageways are exposed as shown in FIG. 2.

Four such passageways are shown at **128**, **129**, **130** and **131**. The passageways may be grouped in pairs in the sense that two of them, i.e. **128** and **129**, open into the central recess at a common location at one side of the recess while another pair, i.e. **130** and **131**, open into the central recess at another and common location at the opposite side of the recess. With the cover **110** in place as shown in FIG. 3, the outer ends **128'**, **129'**, **130'** and **131'** of the passageways are exposed in the rear face of the block **102**. Each passageway is adapted to receive in a press fit through the rear face of the block (when the cover is removed) one of the stationary contacts to support the same in fixed position in the block.

Each stationary contact comprises a contact conductor strip the inner end of which is exposed to the central recess at one of the aforementioned common locations and exhibits thereat a contact button, and the outer end of which is exposed through the rear face of the block for connection to an electric circuit. The conductor strips are indicated at **132**, **133**, **134** and **135** for contacts SC–1, SC–2, SC–3 and SC–4 respectively. Strips **132** and **135** are identical as are strips **133** and **134**. A description of **132** and **133** will therefore suffice for the others. The strips **132** and **133** are shown in perspective in FIG. 4 (Sheet 3) in their proper relative positions as they would appear in the SBA.

Strip **132** has at the inner end an extension arm **136** to which a contact button **137** is secured as shown. This strip, like the others, is formed of a suitably electrically conductive metal stamping such as medium hard brass with the button composed of nickel-silver alloy or any other well-known electrically and mechanically suitable metal, secured to the strip as by riveting, brazing or the like. The outer end of the strip is provided with means for connecting it to conductors of an electric circuit, and for this purpose a pair of laterally spaced apart connecting tabs or lugs **138** and **139** are provided which are inclined with respect to the remainder of the strip to extend angularly out of the rear face of the SBA as shown in FIGS. 1, 2 and 6. A conductor provided with a female connector complementing the size and shape of the tabs, such as is schematically shown in FIG. 1 at **140** or **141**, may be slipped grippingly over the tabs to connect conductors such as **142** and **143** to the stationary contacts.

The strip **133** is provided with an extension arm **144** which is disposed at its inner end in spaced relation beneath the inner end of arm **136** as shown in FIG. 4 and a contact button **145** is mounted thereon. The outer end of strip **133** is provided with a pair of laterally spaced-apart connecting tabs or lugs **146** and **147** which are inclined similarly to tabs **138** and **139**, to extend angularly out of the rear face of the SBA. An upstanding lug **148** is adapted to underlie cover **110** of the SBA to hold strip **133** from shifting upon withdrawal of connectors from tabs **146** or **147**.

Buttons **137** and **145** of the stationary contacts SC–1 and SC–2 face the companion floating contact part **126** of movable contact **118** to be bridged thereby to complete a circuit between the conductor strips **132** and **133**. It will be noted from FIG. 2 that the pairs of connecting tabs **138** and **139** for strip **132** are disposed spaced from the pair of connecting tabs **146** and **147** for strip **133** with a portion of the housing **102** disposed therebetween. When a plurality of switch body assemblies are secured together in stacked relation as shown in FIGS. 6 and 6A (Sheet 1) the pairs of tabs and connectors received over them are even more positively separated by the interposition of the aligning lugs **113** and **114** therebetween and such tabs are substantially protected from all sides by their own SBA and the SBA juxtaposing it, from unintended engagement by loose conductors.

To facilitate insertion and support of the conductor strips in the passageways, rounded protuberances **159** and **160** of the walls of the passageways bear against the sides of the strips urging them toward the opposed side walls of the passageways.

The movable contacts **117** and **118** are of identical construction and are best shown in FIGS. 2 and 4A on Sheet 2. A description of one will suffice for both. Movable contact **118** comprises a lever arm **122** which may be formed of medium hard brass or any other suitable material, including a dielectric material, having an intermediate portion **149** transversely curved on a radius whose center is measured from the axis of the SBA. One end of such intermediate portion terminates in a cylindric bearing portion comprising a curled or substantially closed loop end **150** having an external cylindric surface mating with the cylindrical surface **123** of the socket **119** such that the lever arm is carried for closely guided swingable or pivotal movement by the socket with such movement being in a plane substantially perpendicular to the axis of the socket. Such closed loop end or bearing end **150** of the lever arm is offset from the remainder of the arm as shown at **150'** and **150''** in FIGS. 1 and 4A such that with the edge **151** resting or riding against the bottom **152** of the socket, the remainder of the lever arm is supported spaced from the bottom of the central recess as shown in FIG. 1.

The dielectric cover 110 which closes the rear face of the SBA is provided with a pair of integral lugs 153 and 154 (FIGS. 1 and 3) aligned with the sockets 119 and 120 and projecting thereinto to lightly bear against the edge 155 of the curled end of each of the contact lever arms in the sockets, thereby preventing axial shifting of the arms in the sockets.

The floating part 126 at the free end of the lever arm has an elongated plate 156 (FIGS. 5 and 12) of a length sufficient to span the distance between and substantially cover in mating engagement the stationary contact buttons 137 and 145. The back of the plate is provided with a shank 157 of square cross-section which extends in a loose fit through a square hole 157' (FIG. 4A) in the end of the lever arm. A head 158 on the shank, formed as by mushrooming the latter after insertion through the hole in the arm, serves to anchor the parts loosely together. The cross-sectional shapes of the shank and hole prevent any substantial rotation of the plate relative to the lever arm. By virtue of this floating connection, any misalignment of the buttons 137 and 145 with the plate is compensated for, the plate being capable of sufficient rocking or tilting to insure proper full face-to-face contact with the buttons. The plate 156 is of course formed of a suitably electrically conductive metal for completing a circuit between the buttons of the stationary contacts.

The movable contacts are yieldingly biased toward and against the stationary contacts, and for this purpose each movable contact includes spring means in the form of a leaf spring sprung in place between the lever arm and the wall of the central recess to urge the lever arm toward the stationary contacts and toward the CSP. The leaf spring comprises a spring steel leaf 161 for arm 121 and leaf 162 for arm 122, one end of which is secured to the lever arm by insertion into the bearing end 150 of the lever arm between the end of the loop and the opposing surface of the lever arm. The opposite end of the arm is bent as at 163 to provide a rounded surface for bearing against the side wall of the central recess. Intermediate opposite ends the leaf abuts the convex surface of the lever arm to urge the arm inwardly toward the stationary contacts. The end of loop 150 is provided with a shallow spring-receiving notch 164 (FIG. 4A) through which the leaf spring extends with portions 165 and 166 of the end of the loop at opposite sides of the notch serving to position the spring and prevent shifting thereof axially of the loop. The depth of notch 164 is slightly less than the thickness of the leaf 162 such that with the loop tightly closed with portions 165 and 166 bearing against the opposed surface of the lever arm, the leaf is sufficiently tightly gripped in the notch so that it will not work out of the loop or shift appreciably transversely of the plane of movement of the arm 122.

Intermediate opposite ends of the lever arm and on the concave side thereof it is provided with a cam follower 167, the rear side of which is seen in FIG. 4A. The follower may be formed of a separate piece welded, brazed or otherwise secured to the arm or it may be formed integrally with the arm, as shown in FIGS. 2 and 4A, by suitably stamping the arm during its fabrication. In either form the cam follower is pyramidally shaped on a rectangular base whose major dimension extends lengthwise of the arm, and with the apex being omitted to form a flat face 168 bounded by four angularly related faces 169, 170, 172 and 173 (FIG. 4A) meeting each other and the face 168 along lines of intersection which have been radiused slightly to eliminate sharp corners. Each of these faces may at one time or another, depending upon the shape of the camming surface of the CSP and/or the type of switch in which the SBA is utilized, act as a cam follower surface. This cam follower is a universal follower because it will properly function to shift the lever arm away from the stationary contacts or allow the lever arm to approach the contacts under the bias of the leaf spring with any of the wide variety of shapes of camming surfaces that may be formed on the CSP and despite the fact that the CSP may be shifted axially and/or rotated to effect shifting of the movable contacts.

The CSP for the pushbutton switch as well as for the other switches comprises the same basic structure and need differ only in the shape of the camming surface to effect various opening and closing sequences of the contacts whether the CSP be shifted axially or rotated.

Essentially the CSP comprises a cam supported for movement on the axis of the housing, the movement being either along the axis of the SBA and/or rotatable thereabout. In effect the cam is moved on its own axis, which is coincident with the axis of the SBA, either reciprocably or rotatably, and in the case of the combination pushbutton-selector switch both movements of the cam are involved. The cam is removably supported in the housing. It includes coaxially extending means at opposite ends for removably connecting it to the mechanism at either side of the SBA for controllably actuating it as in the case of FIGS. 1 or 15, and/or to the cams of adjacent switch body assemblies when a plurality of such assemblies are stacked as in FIGS. 6 or 25.

The CSP in every case includes a body 174, see Sheet 3, of cylindrical form having coaxial means on opposite ends for slidably connecting the cam to adjacent cams and/or mechanism for controllably shifting the cam. Such means comprise complementary projection and socket means 175 and 176 which may be provided with complementary splines. While for merely a pushbutton type switch such splines may be unnecessary in some cases, the splines are preferably provided to simplify production of cam blanks thereby avoiding the necessity of distinguishing between blanks suitable for use in pushbutton switch body assemblies not requiring splines and other cases requiring splines.

In any event the splines are a preferable means of allowing telescopic connection of adjacent cams or mechanism and preventing relative rotation therebetween. The socket 176 is sufficiently deep so that projection 175 of another cam may extend thereinto without bottoming when switch body assemblies are juxtaposed as in FIGS. 6 and 25. The socket and projection of each CSP should be so sized relative to each other that there is no relative rotation between adjacent telescopically connected cams, and the telescopic connection should be a push fit.

The CSP may be and preferably is formed of a material having a low coefficient of friction and adequate structural strength, such as nylon, Delrin or Teflon, the latter two being trademarks of E. I. du Pont de Nemours respectively for its tetrafloro etheylene resins and its acetyl resins. The CSP is preferably formed by injection molding using Delrin. The CSP shown in the drawings has twelve equally spaced spline grooves in the socket 176, and eleven spline teeth on the projection 175, with the teeth of projection 175 aligned with the grooves of the socket. While twelve spline teeth might be provided on projection 175, the omission of one tooth conveniently serves an index function as later explained. The portion of projection 175 at which the tooth has been omitted is indicated at 178. The body is provided with an index mark 177 radially opposite one of the grooves of the socket and the omitted tooth 178 of the projection 175 whereby two cams may be readily telescoped together in preselected rotatably oriented positions.

The cam shown in the switch of FIG. 1 allows the switch contacts to be normally closed and is therefore identified as N.C. CSP while the CSP of FIG. 5 maintains the contacts normally open and is therefore identified as N.O. CSP. Both cams are provided with an annular camming surface having a high lobe surface extending parallel to the axis of the cam and an inclined surface extending axially of the cam. In the case of

N.C. CSP the inclined surface **179** is conical and slopes inwardly toward the rear end (socket opening end) of the cam and the high lobe portion **180** is cylindrical and disposed at the "base" of the conical surface. In the case of N.O. CSP the camming surface is just reversed, i.e., surface **181** is conical but slopes inwardly toward the front end (projection **175** end) of the cam, and the high lobe portion **182** is cylindrical at the "base" of the cone.

Upon axially shifting N.C. CSP inwardly or toward the rear of the switch (toward the left as viewed in FIG. 1) the cam followers **167** of each movable contact lever arm will ride the conical surface **179** causing the movable contacts to be shifted away from the stationary contacts opening the circuits between the contacts of each pair of stationary contacts. When the N.C. CSP reaches the limit of its inward travel the high lobe surface **180** will underlie the cam follower **167** of the movable contact arms, holding the movable contacts at their wide open positions. Upon axial shifting of N.C. CSP outwardly (toward the right in FIG. 1) the cam followers of arms **121** and **122** will ride down the conical surface allowing the movable contacts under the tension of the leaf springs to reseat against the stationary contacts to re-establish the circuit therebetween. By virtue of the spring **310** of the positioning assembly, hereinafter more fully described, the normal position of N.C. CSP is outwardly and in the position shown in FIG. 1. In this position the contacts are normally closed.

Just the reverse of the foregoing operation obtains for N.O. CSP shown in FIG. 5. Here it will be observed the contacts are normally open as the high lobe surface **182** underlies the cam follower **167** of each movable contact lever arm with the cam in its outward position. Upon axial shifting of the cam inwardly the cam followers ride down the inclined surface **181** allowing the contacts to close. When N.O. CSP axially shifts in the opposite direction the contacts are again opened.

The cam shown in FIGS. 7–11 is what may be termed a universal cam and is therefore designated as U. CSP. Its purpose is to allow both pairs of stationary contacts to be normally closed, or both pairs normally open, or one pair normally closed and the other normally open, depending upon the rotatably oriented position in which it is inserted in the switch body assembly. The pushbutton actuator **206** of the actuator assembly, hereinafter more fully described, is supported for axial shifting but held against rotation, and therefore with the spline projection **175** of the cam received in a complementary spline socket **212** of the actuator, rotation of the cam is prevented.

U. CSP is provided with a plurality of oppositely axially inclined camming surfaces arranged about the cam at equal angularly spaced-apart locations. Diametrically opposite camming surfaces may be conveniently grouped in pairs as follows: rearwardly inclined surfaces **183** and **184**; forwardly inclined surfaces **185** and **186**; and oppositely inclined surfaces **187** and **188**.

By inserting U. CSP in the SBA in one rotatably oriented position, with the spline projection **175** in the spline socket **212** of the pushbutton actuator, such that the camming surfaces **183** and **184** are adapted to engage the cam followers **167** of the movable contact lever arms, the contacts will be normally open, and the cam will appear in cross-section taken along **9—9** of FIG. 8 with the cam in a SBA, similar to N.O. CSP in FIG. 5. Upon depression of the actuator button the contacts will be closed, while a return movement to the right under influence of the return spring **310** will cause the contacts to reopen.

By withdrawing U. CSP from the SBA and reinserting it in another rotatably oriented position such that the camming surfaces **185** and **186** are adapted to engage the cam followers **167** of the movable contact arms, the contacts will be normally closed, and the cam will appear in cross-section taken along line **11—11** of FIG. 8 like N.C. CSP of FIG. 1 and will function similarly.

On the other hand U. CSP may be inserted in the SBA in either of two other rotatably oriented positions, to wit: such that surface **187** is adapted to ride the cam follower of arm **121** and surface **188** is adapted to ride the cam follower of arm **122**, or vice versa. In the first of these rotatably oriented positions, contacts SC–3 and SC–4 will be normally closed while contacts SC–1 and SC–2 will be normally open, and in the second rotatably oriented position contacts SC–3 and SC–4 will be normally open and contacts SC–1 and SC–2 will be normally closed.

The mechanism for controllably actuating the switch body assembly of the pushbutton switch shown in FIG. 1 also serves to support the switch in a mounting panel. Such mechanism includes the actuator assembly **200**, which extends through a suitably provided circular hole H (having a notch **221**) in the mounting panel, and the positioning assembly **300** which cooperably with the actuator assembly **200** serves to effect shifting of the CSP.

Assembly **200** includes an actuator body or mounting body **201** having a cylindrical bore **202** and a counterbore **203** within which is slidably received a cylindrical actuator **206**. A guideway slot **204** in the bore **202** is adapted to slidingly receive a corresponding rib **205** of the actuator **206**. The rib extends forwardly along the actuator parallel its axis from a head portion **207** at the inner end of the actuator. The interfitting rib **205** in slot **204** prevents relative rotation between the actuator and mounting body **201** while allowing axial reciprocation of the actuator. The head **207** is adapted to abut the bottom of the counterbore **203** to limit outward movement of the actuator. The sliding fit of the actuator **206** in the bores **202** and **203** is sufficiently close so that it is supported for closely guided but free travel in the mounting body **201**.

The rear end and face of the mounting body **201** complements the front face of a juxtaposed switch body assembly, being provided with sockets **208** and **209** to receive the aligning lugs **113** and **114** to properly rotatably orient the SBA on the rear face of the mounting body. A pair of threaded openings, only one of which is shown at **210** in FIG. 1, are adapted to receive SBA retaining screws **211** and **212** to secure the SBA to the mounting body in flush mating juxtaposition. Each screw extends through a hole in the SBA housing **102** and is provided with an enlarged head **213** having a screwdriver slot **214** therein and a coaxial threaded socket **215** in the head for receiving similar screws of another SBA to secure the switch body assemblies in tandem or stacked relation as shown in FIG. 6.

The mounting body has a cylindrical bushing portion **216** threaded at its outer end to receive an externally knurled or the like nut **217**. The bushing may be flatted as at **218** to receive and position a legend plate or locking ring **219** thereon, such plate having an inturned portion **220** which fits into slot **221** in the hole H through the mounting panel. A spacer **222** and dust seal **223** encircles the bushing at the back of the mounting plate. Tightening of nut **217** draws the mounting body tightly against the panel fixedly securing it thereto. Another seal **224** set in an annular recess in the front of the mounting body cooperates with the actuator to seal against the entry of foreign matter therealong into the bore **202**.

A pushbutton **225** is threadedly received in the outer end of the actuator **206** and is provided with a bore **226** and a counterbore **227** opening through the rear face of the button to removably receive in a push fit a color code plate **228** having a shank **229**.

The positioning assembly **300** for the pushbutton switch of FIG. 1 is adapted to urge the CSP and actuator **206** outwardly or to the right as viewed in FIG. 1. Such assembly includes, as shown in FIGS. 1, 13 and 14 (Sheet

4) a cup-shaped houisng 309 preferably formed of a dielectric material such as the same material from which the SBA housing is formed. Disposed within this housing is a helical compression spring 310 the larger end of which is seated against the bottom wall 311 of the housing, and the smaller end of which is seated against the head of a guide pin 312. The head of the pin which is integral with its shank 313 includes a wide flange 314 having a centrally disposed nose 315. The flange 314 is circular. A shoulder 316 underlies the flange. Spring 310 is held under compression by a pin-retaining plate 317 shown in plan view in FIG. 13. The plate is generally circular but includes a pair of ear portions bent out of the plane of a central portion 318 which has a central aperture 319 therethrough. The ears, which are indicated at 320 and 321, abut shoulders 322 and 323 at opposite inside corners of the cup-shaped housing, to be secured thereto by screws 324 and 325.

The shank 313 is unsplined and has a diameter that closely fits the crests of the splines within the socket 176 of the CSP. Shoulder 316 is adapted to abut the end of the CSP surrounding the socket opening.

Spring 310 is so sized that while it will allow axial shifting toward the left, as viewed in FIG. 1, of the CSP under finger pressure against button 225 of the actuator mechanism, it will return the CSP and button outwardly, to the right as viewed in FIG. 1, when operator's finger is removed, and will thereby cause the contacts to shift as the contact followers follow the inclined surface of the contact shifting part.

Adjacent the corners of housing 309 opposite the screws 324 and 325 there are screw-receiving apertures extending through the housing each having a beveled countersink in the rear face of the housing to receive therethrough screws 326 and 327 which are threadedly received within the threaded socket 215 of the screws 211 and 212 for holding the positioning assembly removably at the rear end of the SBA. The screws 326 and 327 of course extend through the openings 190 and 191 in the SBA cover 110 shown in FIG. 3. If desired the bottom of the housing 309 may be provided with a central aperture 328 to allow the insertion therethrough of a member to push the CSP and pushbutton assembly to the right. However such aperture 328 is not likely to be used for this purpose as spring 310 is intended to return the CSP and pushbutton to the right under normal circumstances. Aperture 328 finds its particular utility in connection with switches hereinafter described wherein the same housing 309 is utilized, but without the spring 310, pin 312, and retainer plate 317.

The inside of cover 110 is provided with a lug or shoulder 192, as shown in FIG. 3, which registers with a relieved area 193 of the block, so that the cover 110 can only be secured to the block in one rotatably oriented position. This insures that the index markings surrounding aperture 111 through the cover plate are in the properly oriented position on each SBA with which the cover plate may be assembled. For example, when using the universal cam U, CSP shown in FIG. 7, the index mark 177 is exposed through the cover as shown in FIG. 3, and by providing instructions to the installer of the switch, the manufacturer can indicate, for example, that with the index mark set at the number one index position shown on the cover plate, switch contacts will be normally closed. On the other hand with the index mark set at another specific position as indicated by the cover plate, the contacts might be normally open, or one might be normally open and the other normally closed. This is of course even more important where there is a stacked assembly of SBA's and one wishes to check the stack to see what the contact sequence is, merely by removing the positioning assembly and successive SBA's, the installer can tell at a glance at the cover plate what the particular cam is set for.

The CSP is supported in the SBA for movement on the axis thereof as aforesaid, by a close fit between the cylindrical surface 194 thereof and the edge of the hole 112 through the bottom of the SBA housing and the edge of the aperture 111 through the cover. The CSP is further supported by the push fit of its projecting end 175 within the spline socket 212 of the actuator 206. In a stack of SBA's in a pushbutton switch, the splined projecting end 175 of each CSP is carried by the spline socket 176 of the adjacent CSP such that the successive cams are closely supported for movement on the axis of the stacked assembly.

Selector switch

This switch is shown in FIGS. 15–20 and as hereinafter pointed out utilizes many parts identical to those heretofore described. The SBA′ is identical to the SBA of FIG. 1 except the camming surface of the CSP′ is different because the CSP′ rotates to effect opening and closing of the contacts instead of shifting axially as with the FIG. 1 structure. In addition, it is possible to provide for a variety of contact conditions at different positions of rotatable movement of the CSP′, up to six different successive control positions being shown, as distinguished from the two control positions possible with the pushbutton switch. The body 201′ is identical to body 201 heretofore described. The actuator 206′ has no longitudinal rib corresponding to rib 206 of FIG. 1 so that it is free to rotate in the body 201′. Instead of a pushbutton 225, a selector knob 225′ having a color code plate 228′ is provided which may be of any suitable configuration to enable ready turning by an operator. Preferably the knob has a polygonal shank portion 230 slidably, nonrotatably received in a correspondingly shaped socket 231 in the actuator 206′. A nut 217′ somewhat similar to nut 217 is threaded onto the body 201′ to secure the latter to the mounting panel. The nut includes an inwardly extending annular lip 232 and shoulder 232′ which support the knob for rotation. A snap ring 233 received in a suitably provided groove in the knob locks the knob in the nut 217′ against outward movement relative thereto making the knob and nut an individual assembly.

The positioning assembly has a housing 309′ which is identical to housing 309 heretofore described. However the mechanism inside the housing 309′ differs from that within housing 309. Within 309′ is a detent mechanism whose function is to position and hold the CSP′ and knob at the position to which they are manually rotated by the operator. In the simplest form of selector switch operation, the knob is rotated between only two positions. At one position the contacts in the SBA′ are in one condition, for example, normally closed, while at the other position they might be, for example, normally open. The detent mechanism is provided with stop means limiting the rotation of the knob and CSP′ to these two positions with a spring detent for releasably holding the CSP′ and knob at either of these positions. However the detent mechanism may be repositioned in the housing 309′ to give an additional position of rotation thereby providing three possible contact conditions, for example, at one position both contacts may be closed, at another position both may be open, and at the third position one contact may be closed and the other open. By slight modifications of the detent assembly still further rotatable positions of the CSP′ may be obtained to provide for additional contact conditions.

The detent mechanism includes a detent plate 331 secured in housing 309′ by screws 324′ and 325′. The plate is provided with a pair of dimples 332 and 333 which extend forwardly as shown in FIGS. 15 and 16 and which are disposed 60 degrees from each other about the center of the plate, and equidistant from the vertical center line of the plate. Opposite these dimples are six additional dimples of similar size 334, 335, 336, 337,

338 and 339, spaced equidistantly apart at 30 degree intervals from each other, with dimple 339 at 90 degrees from dimple 332. The pair of dimples 332 and 333 are utilized when the switch is to be a two-position selector switch and serve to position the CSP' and selector knob at either of two positions to which the knob may be rotated. The remaining dimples are utilized when the selector switch is to have more than two positions.

Plate 331 is mounted on a hub 340 for rotation of the hub within the plate, the plate serving to support the hub in housing 309' and in turn a spline shaft 341 which extends into the CSP' for rotation therewith. The shaft is provided with a flange 342 which abuts the rear face of the CSP' to prevent rearward axial shifting of the CSP', the rear end of the shaft having a reduced diameter cylindrical bearing end 343 which fits hole 328' in the bottom of housing 309'. One tooth of the splined shaft may be omitted to serve as an index for rotatable orientation of the shaft with respect to a CSP'. Hub 340 is splined to mesh with the splines of shaft 341 in a push fit.

Fixed on hub 340 for rotation therewith is a locking plate 344 juxtaposing the detent plate 331 with the latter being held thereagainst by a snap ring or the like 345 which is received in a groove in the hub as shown in FIGS. 15 and 16. The hub has a shoulder 346 provided with a notch 347 into which an ear 348 of the locking plate extends to hold the plate against rotation relative to the hub. The locking plate is spring-tensioned against the detent plate by virtue of a slot 349 in the locking plate which extends for approximately 240 degrees around the plate to form a spring tab 350 at the center of the plate. This tab, in the manufacture of the locking plate, is bent angularly out of the plane of the plate such that when the locking plate and detent plate are juxtaposed on the hub as shown in FIG. 15, a dimple 351 on the locking plate is yieldingly tensioned against the detent plate and into a dimple of the latter when the same is aligned with dimple 351. By turning the selector knob 225' the locking plate is caused to turn relative to the detent plate, the peripheral portion of the latter yielding or shifting away from the locking plate to allow dimple 351 to ride out of the dimple in the detent plate and traverse the angular distance to the next adjacent dimple in the detent plate at which dimple 351 will spring thereinto and the operator will immediately again sense an increased resistance to turning of the selector. Each point during rotatable movement of the knob 225' at which the operator encounters marked resistance to further turning will indicate a location at which the switch contacts are at a control position. At each such position the nesting dimples of the respective locking and detent plates will hold the CSP' and knob against further unintended rotation.

To limit rotation of the CSP' and knob 225' the detent plate 331 is provided with a pair of diametrically opposite stop ears 352 and 353 which extend rearwardly and overhang the peripheral edge of the locking plate 344. Plate 344 has a plurality of peripheral outwardly extending frangible stops or lugs 354, 355, 356, 357 and 358 disposed in angularly spaced-apart relations and defining therebetween different degrees of allowable angular travel of the locking plate.

Stops 356 and 357 are disposed at their edges 359 and 360, 60 degrees apart and will will limit, by virtue of the interposition of stopping ear 352, rotation of the locking plate, and hence the CSP', to 60 degrees of angular travel. When the locking plate is disposed within the housing as shown in FIG. 17, angular travel of the CSP' will be limited to 60 degrees and three control positions will be effective, namely, when dimples 335, 336 and 337 are successively engaged by dimple 351 of the locking plate. If stop 357 is removed then another 30 degrees of rotation of the locking plate will be afforded, with the consequent provision of four control positions for the CSP'. If stop 356 is removed then an additional 30 degrees of rotation is allowed, and five control positions for the CSP' are provided. If stop 355 is removed, then still another 30 degrees, altogether now 150 degrees, of rotation is allowed, and six control positions for the CSP' are provided, each position 30 degrees from the next adjacent position.

If none of the stops are removed from the locking plate, but instead it is removed from the hub (of course first removing snap ring and detent plate) and replaced therein at 180 degrees from the position shown in FIG. 17, then stops 356 and 357 will cooperate with ear 353 of the detent plate limiting rotation to 60 degrees, but also providing for nesting of dimple 351 in either dimple 332 or 333 of the detent plate, to provide two control positions 60 degrees apart for the CSP'.

The locking plate and detent plate are formed of any suitable sufficiently spring-like and wear-resistant material, and either medium brass or beryllium copper are satisfactory. The housing 309' is secured to the SBA' in the same fashion as is housing 309 secured to the SBA of FIG. 1. The splined shaft 341 is inserted in the hub 340 such that the omitted tooth of the splines is disposed opposite either one of two index marks 177*a* or 177*b* of the locking plate.

By the proper selection or design of the CSP' a wide variety of possible contact conditions may be obtained with the selector switch. Also, the rotatably oriented position in which the CSP' and shaft 341 are telescoped together will determine the sequence of operation of the contacts.

FIGS. 18, 19 and 20 show three possible configurations of the CSP' looking at the rear end of the CSP', for example, along line 18—18 of FIG. 15. A number of different configurations are possible and the three shown are merely examples. The rear face of the cam carries one or more degree index marks. With the shaft 341 telescoped in the cam of FIG. 20 such that the omitted tooth portion of the shaft is opposite the Zero degree index mark of the cam and the index mark 177*a* of locking plate 344, the contacts 1 (SC–1 and SC–2) and 2 (SC–2 and SC–3) will be open when the lug 360 of the locking plate abuts stop ear 352 (dimple 351 nests in dimple 388), and will be closed when the selector knob and cam are rotated in the direction of the arrow of FIG. 20 to nest dimple 351 in dimple 337, 336, 335, or 334. Of course to rotate the cam to positions in which dimple 351 will nest in dimple 335 or 334 of the detent plate, ears 355 and 356 must be removed.

In table 20*a* the sequence of contact positions is shown when the shaft 341 is telescoped in the cam and the cam rotated as above described. Numerals 1 and 2 at the left end of the table correspond to contacts 1 and 2 schematically shown in FIG. 20, the "O" marks in the table indicating "open" contact and the "X" marks indicating "closed" contact. The numerals 1, 2, 3, 4, 5 at the top of the table indicate the successive control positions of the cam as represented by the dimple 351 nesting respectively in detent plate dimples 338, 337, 336, 335 and 334.

In table 20*b* the contact conditions are shown when the shaft 341 is telescoped into the cam of FIG. 20 such that the omitted tooth portion of the shaft is opposite index 30 on the cam. In this instance, at each of the five rotated positions of the cam, the contacts are closed. In table 20*c* the contact conditions are shown during the same sequence of cam rotation as with tables 20*a* and 20*b*, and here the shaft 341 and the cam are telescoped together such that the omitted tooth portion is opposite index mark 60 of the cam. It will be appreciated that with the elimination of lug 375 a six position sequence may be provided.

FIGS. 18 and 19, each with their accompanying tables, show contact conditions arising from the shape of the cams and the rotatably oriented position of telescoping

together shaft 341 with the respective cams. It is apparent that depending on the shape of the cam and the rotatably oriented position of cam and detent shaft, an extremely wide variety of sequential contact conditions may be obtained, and that with any given cam a number of different sequences of contact opening or closing is possible.

Cams of different shapes to give rise to varying sequential orders of contact opening and closing while of value in a switch utilizing only one SBA' as shown in FIG. 15, are also of value in a stacked arrangement of switch body assemblies when used in a selector switch such as shown in FIG. 25. In this figure a plurality of switch body assemblies are connected together in tandem to be conjointly operated upon rotation of the selector knob, not shown. With CSP'–1, CSP'–2, CSP'–3 and CSP'–4 of FIG. 27 each having suitable index marks at the rear face similar to the cams of FIGS. 18, 19 and 20, and with the spline projection of each having a tooth omitted or some other index indicia, and with the cams of any desired camming surface configuration and rotatable orientation relative to each other for telescopic connection, any desired sequence of contact operation may be provided for the selector switch assembly. For example, at one rotated position of the selector knob the contacts of SBA'–1 may be closed, those of SBA'–2 may be open, one pair of contacts may be open and the other closed in SBA'–3, and in SBA'–4 both contacts may be closed, while at another rotated position a different series of contact conditions may obtain. By disconnecting the four switch body assemblies and rotatably reorienting the cams relative to each other a different sequence of contact operation for the entire assembly may be obtained. It has been found that by utilizing different rotatably oriented positions of telescopic connection of a series of cams, a large number of combinations of contact operation and sequences of operation are possible with only a few different cam shapes. Through the preparation of suitable tables for each of the different cam shapes and combinations of such shapes in various rotatably oriented positions of telescopic connection, the various combinations of contact conditions and sequence of contact operation may be readily determined. As a consequence, a switch manufacturer constructing a line of selector switches following the teachings of this disclosure may provide for any variety of combination of contact conditions and sequence of contact operation likely to be required by a customer with the only difference in parts being the shape of the camming surface of the cam. With a number of differently shaped cams in stock, the customer requirements may be satisfied by the proper selection of cams and proper rotatably oriented connection thereof together, which may be determined from the previously prepared tables showing the possible combinations and sequence of contact operation. Similarly, a user of the selector switch may, by changing the rotatable orientation of the CSP' relative to the detent shaft or relative to another CSP' where more than one SBA' is utilized in the switch, alter the contact position of the switch or sequence of contact operation.

It is apparent from the foregoing that the telescopic connection of the CSP' with the detent shaft through the use of a splined socket, and the telescopic connection of cams having corresponding splined sockets and projections leads to a simple, readily alterable assembly which can provide an unlimited variety of possible contact conditions and sequence of contact operation. It is also apparent that because the only difference between switch body assemblies for selector switches which give rise to different contact conditions and sequence of operation is in the shape of the camming surface of the cams or the rotatable orientation of the cams and detent shaft at the time of their telescopic connection, substantial savings in cost are possible. Even the cam blanks may be and preferably are of identical shape, only the shaping of the camming surfaces requiring different manufacturing operations.

In the FIG. 25 assembly the switch bodies SBA'–1, SBA'–2, etc. are, of course, identical in structure to the SBA' of FIG. 15 differing only in the particular CSP' that may be utilized. The switch bodies are removably secured together by screws (not shown) similar to screws 211 and 212 of the pushbutton switch with the screws of SBA'–2, for example, threading into the head-end of corresponding screws of the SBA'–1. As the various contact shifting parts or cams CSP'–1, CSP'–2, etc. are telescoped together in splined interfitting relation, a single mounting body such as 201' is utilized which supports the stacked arrangement of switch body assemblies from a panel. A single positioning assembly of a construction identical to that shown in FIGS. 15, 16 and 17 may be utilized.

Pushbutton-selector switch

In FIG. 21 a combination pushbutton-selector switch with a spring return is shown. In such a switch a mounting body and selector knob of the type generally shown in FIG. 15 is utilized as well as a similar SBA', it being of course obvious that the selector knob must be axially displaceable inwardly as well as rotatable. The CSP'' has a differently shaped camming surface than any heretofore mentioned because the switch contacts are to be actuated by a combination of axial shifting and rotation of the cam. For example, the cam may have a camming surface configured such that one of the movable contact lever arms is shifted when the selector button pushed and the other contact lever arm is only shifted when the selector button is thereafter rotated while held depressed. A different camming surface configuration might require a depression and rotation of the selector knob while held depressed to effect any shifting of either or both of the lever arms. Other configurations of the camming surface may give rise to other forms of contact operation with this type switch.

To limit rotation of the cam a hub 340', detent plate 331' and locking plate 344' of the type described in connection with FIGS. 15, 16 and 17 are utilized in the FIG. 21 construction. The housing 309'' is similar to housing 309 except as heremention ed. It is of a somewhat greater axial length than housing 309 and has a central internal boss 361 with an unsplined aperture therethrough sized to rotatably support the splined shaft 362 and is further provided with a rib 363, see FIG. 23. The detent plate is secured to the bottom or rear of the housing by screws similar to screws 324' and 325' of FIG. 16. Rib 363 cooperates with a torsion or return spring 364 which serves to rotatably reposition the cam upon release of the selector knob by the operator. The spring encircles the boss 361 and its opposite ends are bent to extend radially outwardly of the spring axis and sprung into embracing relation over the rib as shown in FIG. 23. Mounted in splined connection on shaft 362 is a return finger having a shaft embracing plate portion 365 and a laterally bent finger part 366 interposed between the ends of the torsion spring as shown in FIG. 23. Upon rotation of the shaft 362 in either direction upon rotation of the selector knob and contact shifting part, one end of spring 364 will move with the finger portion 366 to return the shaft to its initial position upon release of the knob. Where the detent plate and locking plate are assembled to allow shaft rotation in either direction from its initial position, the spring acts as a centering spring.

In the FIG. 21 construction the hub 340' and return finger are a slip, though splined, fit on the shaft, whereby the shaft may shift axially through them upon depression of the selector knob. Secured to the rear face of housing 309'' is a positioning assembly 300' similar to the assembly 300 of FIGS. 1, 13 and 14. It differs therefrom only in that the shank 313' of guide pin 312' is of a smaller diameter than shank 313 as it must fit a smaller socket (unnumbered) in the left end of shaft 362.

Spring 310' serves to return the shaft and CSP" to the right following axial shifting to the left under depression of the actuator. The fit of shank 313' in the socket at the left end of shaft 362 and the encirclement of the small end of spring 310' about nose 315' is sufficiently loose so that the shaft may rotate without appreciable resistance being offered by spring 310'.

In the FIG. 21 embodiment shaft 362 is shown as extending completely through the CSP" and into the actuator 206', the CSP" having a splined bore therethrough with which the shaft meshes. A shoulder 342' on the shaft, which may be a snap ring received in a suitably provided groove in the shaft, abuts the CSP" to hold it against the actuator 206'. It will be apparent, however, that the CSP" may be similar to the cams heretofore described in having a splined socket at one end and a splined projection at the other end with shaft 362 being shorter and telescoped into the socket and the splined projection of the cam projecting into the actuator. Such latter construction is preferred, the one shown being an alternative.

The camming surface of CSP" shown in FIGS. 21 and 22 is merely one example of many possible configurations. Such cam has an axially inclined surface 179' and a radially tapering or eccentric cam lobe 180', each of which occupies but a portion of the total circumference of the cam. It will be noted from FIG. 21 that the relative axial position of the cam followers (one of which is shown in phantom) and surface 179' is such that merely rotation of the cam without axial depression will not cause a cam follower to ride up surface 179'. Also, the normal rotatably oriented position of the cam is such in relation to the cam followers that an axial shifting of the cam alone will not serve to shift a contact lever arm. However by rotating the cam, lobe 180' rides against one of the cam followers to shift the associated lever arm away from its companion stationary contacts, and then while holding the cam in such rotated position if the actuator is depressed, surface 170' will ride beneath the cam follower of the other lever arm shifting it away from its companion stationary contacts. The switch of FIG. 21 having a cam of the configuration described therefor has both contacts normally closed, one set being opened upon rotation of the cam and the other set upon axial depression while the cam is held in its rotated position.

As will be apparent different cam configurations will give rise to different contact conditions and sequences of contact operation. It is also apparent that by stacking similar switch body assemblies a greater number of contacts may be provided, and that by proper design of cams for a stacked assembly a wide variety of contact conditions and sequence of contact operation for the switch may be attained.

Self-returning selector switch

In FIG. 24 a self-return mechanism for a selector switch is shown. The housing 309–3 is similar to housing 309" except that the bottom wall instead of having an aperture completely therethrough is closed as at 370 and a shoulder 372 is provided against which the end of shaft 341' bears. Shaft 341' is similar to shaft 341 of FIG. 15, and a spring-return mechanism of the character disclosed in FIG. 21 is fitted on the shaft just behind hub 340". With the positioning mechanism of the FIG. 15 switch modified as shown in FIG. 24, rotation of the actuator will be counter the bias of the return spring 364' and upon release of the actuator the spring will return the shaft, cam and actuator to their original positions.

What is claimed is:

1. An electric switch comprising: a housing, a stationary contact in the housing, a movable contact supported in the housing for movement toward and away from the stationary contact and yieldingly biased theretoward to make a circuit therewith, a contact shifting part supported for movement in the housing and having an inclined camming surface cooperable with the movable contact to shift the same away from the stationary contact upon movement of the cam, and mechanism for controllably shifting said part disposed externally at opposite sides of and removably secured to the housing and having portions telescopically removably connected with opposite ends of the contact shifting part.

2. The invention as defined in claim 1 characterized in that said part is provided at opposite ends with coaxial and complementary splined projection and socket means and said mechanism includes a rotary knob at one side of the housing slidably interconnected with a spline of one of said means, and said mechanism further includes a rotary positioning device at the opposite side of the housing slidably interconnected with a spline of the other of said means.

3. The invention as defined in claim 2 characterized in that said rotary positioning device includes a return spring yieldingly biasing said cam counter rotation of said knob.

4. An electric switch comprising: a housing, a stationary contact in the housing, a movable contact supported in the housing for movement toward and away from the stationary contact and yieldingly biased theretoward to make a circuit therewith, a cam supported for movement in the housing on a fixed axis and having a camming surface tapering axially of the cam, said movable contact pivotally supported upon an axis extending substantially parallel to the fixed axis of the cam, and mechanism for shifting the cam axially disposed externally at opposite sides of and removably secured to the housing with portions removably mechanically connected with opposite ends of the cam.

5. In a switch: a housing, a pair of fixed contacts in the housing, an arm in the housing, means in the housing for supporting the arm at one end for pivotal movement toward and away from the fixed contacts, means for biasing the arm toward the fixed contacts, a bridging contact on the other end of the arm with means floatingly mounting the bridging contact on such end of the arm to engage the fixed contacts and make a circuit therebetween, a cam supported for movement in the housing adjacent said arm and having an inclined camming surface engaging said arm to pivot the same away from the stationary contacts upon movement of the cam, and terminal means supported in the housing and connected to the fixed contacts for connecting the same to an external electric circuit.

6. An electric switch comprising: a housing, a stationary contact in the housing, a movable contact supported in the housing for movement toward and away from the stationary contact and yieldingly biased theretoward to make a circuit therewith, a cam supported for movement along a fixed axis in the housing and having an inclined camming surface cooperable with the movable contact to shift the same away from the stationary contact upon movement of the cam, actuator mechanism removably secured externally to one side of the housing and having an axially shiftable button removably mechanically connected with one end of said cam, and cam positioning mechanism removably secured externally to an opposite side of the housing and having a spring loaded part mechanically connected with the opposite end of the cam and yieldingly biasing the cam axially toward the button.

7. An electric switch comprising: a housing, a stationary contact in the housing, a movable contact supported in the housing for movement toward and away from the stationary contact and yieldingly biased theretoward to make a circuit therewith, a cam supported for movement in the housing along a fixed axis and cooperable with the movable contact to shift the same, said cam having at one end a coaxial splined connecting portion, cam actuating

mechanism removably secured externally to one side of the housing in coaxial alignment with the cam and having an axially shiftable part fixed against rotation and provided with a splined portion removably interfitting with the splined portion at the end of the cam, cam positioning mechanism removably secured externally to an opposite side of the housing and having a spring loaded part connected with the other end of the cam and yieldingly biasing the cam axially toward the actuator mechanism, and said cam including a plurality of angularly spaced apart camming surfaces one of which is operable to shift the movable contact away from the stationary contact upon depression of said part axially against said spring bias, and another of which is operable when the cam is connected to said part at a different rotatably oriented position, to shift the movable contact toward the stationary contact upon depression of said part against said spring bias.

8. In an electric switch assembly: a switch housing comprising a block of dielectric material having a central recess therein opening outwardly through a face of the block, said block provided with a plurality of conductor strip receiving and positioning recesses disposed in spaced apart relation and electrically insulated from one another by intervening portions of the block and opening outwardly through a face of the block, said block provided with a terminal conductor strip receiving passageway for each terminal recess extending between its terminal recess and the central recess with pairs of passageways opening into the central recess, a terminal in each terminal-receiving recess having a conductor strip extending through the associated passageway to the central recess, a stationary contact on each strip exposed to the central recess, said central recess having wall portions shaped to pivotally support one end of a movable contact lever arm, a movable contact lever arm in the central recess pivotally supported at one end by said wall portions and provided at the opposite end with a bridging contact for bridging a pair of stationary contacts when the arm swings theretoward, said housing provided with an aperture opening through the bottom of the central recess outwardly of the opposite face of the housing, a cam in the central recess having a camming surface cooperable with the movable contact lever arm to swing the same upon shifting of the cam, mechanism for shifting the cam secured to the outside of the housing at said opposite face thereof, means extending through said aperture connecting the cam to said mechanism, and cover means extending over the open ends of the recesses.

9. In an electric switch assembly: a block of dielectric material having a central recess opening outwardly through a face of the block, a cam in said recess, said block provided with a plurality of terminal-connecting conductor strip receiving and supporting passageways opening laterally outwardly through such face of the block and disposed in spaced apart relation and communicating in pairs with a central recess at a plurality of spaced apart common locations, a rigid terminal-connecting conductor strip laterally slidably received and supported in each of said passageways and provided at the inner end with a fixed contact disposed in spaced apart adjacency with a companion fixed contact of another strip at the said common locations about the central recess with the strip having at its other end a terminal-connecting portion exposed through such face of the block for connection with a conductor thereto, said block shaped at spaced apart locations about the recess to provide a plurality of individual means for pivotally supporting a plurality of movable contact lever arms with one such means for each such arm, at least one such lever arm disposed in the recess and supported at one end by said means and extending across the recess alongside the cam and terminating at its free end adjacent one of said locations, a bridging contact on the free end of the arm for engaging and bridging the fixed contacts at said location, said arm provided with a portion for riding a camming surface of the cam, and spring means in the central recess yieldingly biasing the lever arm toward the cam.

10. In an electric switch: a housing, a cam supported for movement on a fixed axis in the housing, a plurality of pairs of fixed contacts in the housing arranged about the axis of movement of the cam in radially spaced position from the cam, a plurality of operably independent movable contact lever arms each swingably supported at one end in the housing for movement about an axis substantially paralleling the axis of the cam with the arms extending along opposite sides of the cam and each terminating at its free end adjacent a pair of the fixed contacts, a bridging contact on the free end of each arm for bridgingly engaging a pair of the fixed contacts to complete a circuit therebetween, each arm having a cam follower portion intermediate opposite ends for riding a camming surface of the cam, said cam having a radially outwardly facing camming surface radially opposed to the arms and operable to shift the arms radially upon movement of the cam, spring means in the housing for yieldingly biasing each arm independently inwardly toward the cam, and each of said fixed contacts having terminal-connecting portions extending outwardly of the housing for connection of the fixed contacts in an electric circuit.

11. The invention as defined in claim 10 characterized in that said cam is axially shiftable in the housing and spring means are provided for yieldingly biasing the cam toward a first axially displaced position and actuator means are provided for axially shifting the cam counter said spring means to a second axially displaced position, and said camming surface tapers axially of the cam to shift the arms radially of the cam during axial shifting thereof.

12. The invention as defined in claim 10 characterized in that one portion of the camming surface opposite a cam follower of one arm tapers axially inwardly from one end of the cam toward the other end while another portion of the camming surface opposite a cam follower of another arm tapers axially outwardly from said one end of the cam toward the other end whereby axial shifting of the cam simultaneously shifts one arm radially outwardly and another arm radially inwardly.

13. A switch body assembly comprising: a dielectric housing having a recess therein opening outwardly through a face thereof, a cam supported for movement centrally in the recess, a pair of arms in the recess on opposite sides of the cam and each supported at one end for swingable movement in a plane substantially perpendicular to the axis of movement of the cam, each arm having a cam follower portion intermediate the ends of the arm confronting the cam, and a pair of fixed contacts for each arm disposed in the recess to be engaged and bridged by the free end of each arm, and spring biasing means in the recess for each arm yieldingly and urging the free end of the arm toward its associated pair of fixed contacts.

14. A modular switch body assembly for stacking in axial alignment with corresponding assemblies comprising: a block of dielectric material having opposite parallel faces for facial juxtaposition in a stack with corresponding blocks, said block having a central recess therein opening outwardly through such faces for alignment with corresponding recesses of adjacent blocks in a stack, a cam supported in the recess for movement on an axis extending perpendicular to said faces and having coaxially arranged portions at opposite ends for engaging corresponding portions of cams of corresponding assemblies disposed in stacked relation at opposite faces of the block, two pairs of fixed contacts disposed in the recess at opposite sides thereof, a pair of arms in the recess on opposite sides of the cam with each arm swingably supported at one end in a wall of the recess adjacent one pair of fixed contacts and electrically insulated therefrom by an intervening portion of the block and extending

across the recess along side the cam and terminating at its free end adjacent the opposite pair of fixed contacts, means at the free end of each arm for bridgingly engaging the fixed contacts adjacent such end of the arm, each arm having a cam follower portion intermediate its opposite ends for riding a camming surface of the cam, spring means in the recess yieldingly biasing the free ends of the arms toward the fixed contacts, and terminal connectors extending outwardly of the block and connected at their inner ends to the fixed contacts.

15. An electric switch comprising: a switch body assembly having a dielectric housing containing a pair of stationary contacts and a cooperating movable contact arranged to make and break a circuit between the stationary contacts, a cam cooperable with the movable contact to shift the same, an actuator assembly having a housing removably secured to one side of the switch body assembly housing and supporting mechanism cooperating with the cam to shift the same, and a cam positioning assembly having a housing removably secured to the opposite side of the switch body assembly housing and containing mechanism cooperable with the cam to position it.

16. A modular stack switch comprising: a plurality of substantially closed individual switch housings removably secured together in aligned front-to-rear facial juxtaposition, a cam in each housing supported for movement on an axis of the assembly with the cams removably mechanically connected for conjoint dependent shifting, mechanism secured to one end of the assembly and connected to the cam of the adjacent switch housing for shifting it and in turn the cams in the other housings, cooperating stationary and movable contacts in each housing with terminal connectors exposed outwardly of the housing for connecting the contacts in an electric circuit, said movable contacts including spring means yieldingly biasing the movable contacts toward the stationary contacts, and each movable contact disposed adjacent a cam and disconnectably engaged therewith to be shifted thereby counter the spring bias out of engagement with an associated stationary contact upon movement of the cam.

17. A modular stack switch comprising: a stacked plurality of individual corresponding switch body assemblies removably secured together in aligned front-to-rear facial juxtaposition, a cam in each body assembly supported in axial alignment with the cams in the other assemblies, means connecting together the cams of adjacent assemblies for conjoint dependent movement, companion stationary and movable contacts in the assemblies with the movable contacts cooperating with the cams to be shifted thereby toward and away from the stationary contacts, actuator mechanism connected in axial alignment to one end of the aligned stack of assemblies and having an actuating part connected to the cam of the adjacent assembly for shifting it and in turn the cams of the other assemblies, and cam-positioning mechanism secured to the opposite end of the aligned stack of assemblies and having a cam-positioning part connected to the cam of the adjacent assembly to position it and in turn the cams of the other assemblies.

18. A switch housing for a modular stack-type electric switch comprising: a block of dielectric material having opposite front and rear faces with the front face having a greater transverse dimension than the rear face such that when corresponding blocks are stacked in aligned front-to-rear facial juxtaposition the front face of one has face portions exposed beyond the edge of the juxtaposed rear face of the other, and said block internally recessed to receive and support switch mechanism and terminal connecting lugs with such internal recessing opening through said front face portions to expose terminal connecting lugs supported in such internal recessing for attachment of terminals thereto when a plurality of such blocks are in the aforesaid stacked relation.

19. The invention as defined in claim 18 characterized in that said block is provided with corresponding lug and socket portions for establishing proper juxtaposed alignment with a corresponding block.

20. The invention as defined in claim 18 characterized in that said block has a side edge tapering inwardly from the front face to the rear face to overhang in spaced partially covering relation the said front face portions of a corresponding block when the blocks are in the aforesaid stacked relation.

21. A switch housing for an electric switch comprising: a block of dielectric material having a central recess opening outwardly through a face of the block, said block provided with a plurality of terminal-connecting conductor strip-receiving passageways disposed in spaced-apart relation and electrically insulated from one another by intervening portions of the block and opening outwardly of the block in such spaced-apart relation and opening inwardly in pairs at a plurality of spaced-apart common locations into said central recess whereby when terminal-connecting conductor strips are disposed in such passageways they are exposed in pairs to said central recess at such spaced-apart locations, said block shaped at spaced-apart locations about said central recess to provide a plurality of individual means for pivotally supporting a plurality of movable contact lever arms with one such means for each such arm, each such means being disposed on an opposite side of the recess from one of said common locations whereby a movable contact lever arm when supported thereby may extend across the recess toward such common location.

22. The invention as defined in claim 21 characterized in that said passageways open outwardly through the same face of the block as the central recess spaced laterally from the central recess, and a dielectric cover closes the central recess at such face of the block.

23. The invention as defined in claim 21 characterized in that said face of the block is the front face and the block is provided with a parallel rear face of lesser transverse dimension than the front face such that a corresponding block may be stacked in front-to-rear facial juxtaposition with portions of the front face of the block exposed beyond the edge of the juxtaposed rear face of the other block, and said passageways in the block open outwardly through said exposed portions of the front face to expose for connection terminal-connecting conductor strips disposed therein.

24. A switch housing for an electric switch comprising: a block of dielectric material having a central recess opening outwardly through a face of the block, said block provided with a terminal-connecting conductor strip-receiving passageway opening outwardly of the block and inwardly into said central recess, said block shaped at said central recess to provide a cylindrical socket opening laterally into the central recess for receiving and pivotally supporting the cylindrical end portion of a movable contact lever arm, said cylindrical socket disposed at an opposite side of the central recess from the point at which said passageway opens into the central recess such that a lever arm when pivotally supported in the socket will extend across the recess to the opening of said passageway, and a closure adapted to cover said central recess.

25. In an electric switch; a pair of stationary contact means, a pair of movable contacts supported in opposition to the stationary contact means for independent movement toward and away from the pair of stationary contact means and biased theretoward, a contact shifting part supported adjacent the pair of movable contacts for axial shifting in opposite directions, means for holding said part in either of two rotatably oriented positions during axial shifting, said part having a plurality of circumaxially arranged inclined camming surfaces cooperable with the movable contacts to shift them counter said bias away from the stationary contact means, said surfaces arranged in two pairs with the surfaces of one pair

being inclined in one direction for shifting the movable contacts away from the stationary contact means upon axial shifting of the part in one direction while disposed in one of said rotatably oriented positions, and the camming surfaces of the other pair inclined in the opposite direction for shifting the movable contacts away from the stationary contact means upon axial shifting of said part in the opposite direction while disposed in the other of said rotatably oriented positions.

26. In an electric switch: a pair of stationary contact means, a pair of movable contacts supported in opposition to the stationary contact means for independent movement toward and away from the pair of stationary contact means and biased theretoward, a contact shifting part supported adjacent the pair of movable contacts for axial shifting in opposite directions, means for holding said part in either one of at least three rotatably oriented positions during axial shifting, said part having a plurality of circumaxially arranged inclined camming surfaces cooperable with the movable contacts to shift them counter their bias away from the stationary contact means, said surfaces arranged in three pairs with the surfaces of one pair inclined in one direction for shifting the movable contacts away from the stationary contact means upon axial shifting of the part in one direction while in one of said rotatably oriented positions, and the camming surfaces of the other pair inclined in the opposite direction for shifting the movable contacts away from the stationary contact means upon axial shifting of said part in the opposite direction while in another of said rotatably oriented positions, and the camming surfaces of the third pair inclined in opposite directions for shifting one movable contact away from and the other movable contact toward their respective stationary contact means during axial shifting of said part in one direction while in a third rotatably oriented position.

27. A modular stack switch comprising: a stacked plurality of individual corresponding switch body assemblies removably secured together in aligned front-to-rear facial juxtaposition, a cam in each body assembly supported in axial alignment with the cams in the other assemblies each cam having a coaxial splined projection at one end telescoped into a complementary splined coaxial socket of an adjacent cam for conjoint dependent shifting of the cams, companion stationary and movable contacts in the switch body assemblies with the movable contacts cooperating with the cams to be shifted thereby toward and away from the stationary contacts, said splined sockets and projections of adjacent cams telescopically connectible at a plurality of relatively rotated oriented positions of the cams, and mechanism for controllably shifting the cams removably connected to opposite ends of the stacked plurality of switch body assemblies and having splined portions telescopically engaged with the splined projection and socket portions of the cams of the end switch body assemblies.

28. In an electric switch: a stationary contact and a cooperating movable contact arranged to make and break a circuit with the stationary contact, a rotatable cam cooperable with the movable contact to shift the same toward and away from the stationary contact upon rotatable movement of the cam, mechanism for controllably shifting the cam releasably connected thereto and including a rotatable knob and a detent assembly, said assembly including a detent plate disposed transversely of the rotatable axis of the cam and provided with a circumaxial arrangement of angularly spaced-apart recesses, a locking plate disposed transversely of the rotatable axis of the cam and juxtaposing in coaxial alignment the detent plate for rotation relative thereto and provided with a protuberance tensioned axially toward the detent plate for successively nesting in the recesses thereof upon relative rotation of the plates, one of said plates rotatable with the cam and the other plate fixed against rotation, said recesses and protuberance rotatably oriented relative to the camming surface of the cam and the movable contact to provide successive determined conditions of the contacts at each nested position of the protuberance in the recesses during rotation of the cam.

29. The invention as defined in claim 28 characterized in that one of said plates includes a plurality of peripheral radially extending angularly spaced-apart frangible stops and the other plate includes a peripheral ear extending between said stops to abut the same and limit relative rotation of the plates.

30. The invention as defined in claim 28 characterized in that one of said plates is mounted for rotatable orientation relative to the other plate and the cam in at least two positions, and one of said plates provided with a pair of angularly spaced-apart peripheral stops and another pair of angularly spaced-apart stops spaced apart a greater distance than the spacing of the first pair and the other plate provided with a peripheral finger disposed to extend between either pair of stops, and said rotatably oriented plate being selectively shiftable to interpose said finger between one or the other pair of stops to alter the angular movement of the cam.

31. A combination pushbutton-selector switch comprising: a housing, a pair of stationary contacts in the housing each having a cooperable movable contact with the movable contacts being independently operable, a cam in the housing for shifting the contacts and having a first cam surface operable to shift one of the movable contacts upon rotation of the cam and having another camming surface operable to shift the other movable contact upon axial displacement of the cam, and mechanism for controllably shifting the cam secured to the housing and including a part connected to the cam and supported for axial and rotatable displacement to shift the cam correspondingly and including spring means operably coupled to said part and biased counter rotatable and axial movement thereof to return said cam to its initial position following shifting thereof by said part.

32. The invention as defined in claim 31 characterized in that one of said camming surfaces of the cam is disposed when the cam is at its initial position in axially spaced relation from a position of operable engagement with at least one of the movable contacts.

33. In an electric switch: a housing, a pair of independently movable contacts supported in the housing for movement toward and away from complementary stationary contact means to make and break a circuit therewith, means for biasing the movable contacts toward the stationary contact means, a contact shifting part in the housing supported adjacent the movable contacts for axial shifting in opposite directions in any one of a plurality of rotatably oriented positions, means for holding said contact shifting part against rotation in any one of said rotatably oriented positions, said part provided with oppositely inclined camming surfaces arranged in three pairs with one pair adapted to shift the movable contacts during axial shifting of said part at each rotatably oriented position thereof, one pair of camming surfaces being inclined in one direction axially of the part while another pair of camming surfaces are inclined in the opposite direction axially of such part, and the third pair of camming surfaces being inclined in opposite directions axially of said part.

34. In an electric switch: a dielectric housing, a cam supported for reciprocation in the housing, a pair of arms in the housing on opposite sides of the path of reciprocation of the cam and each supported at one end for swingable movement in a plane substantially perpendicular to the path of reciprocation of the cam, each arm having a cam follower portion intermediate the ends of the arm confronting the cam, a pair of fixed contacts for each arm disposed to be engaged and bridged by the free end of each arm, spring means for biasing each arm to urge the free end of the arm toward its associated pair of fixed contacts, a plurality of angularly

spaced apart cam surfaces on the cam operable to shift the arms counter the spring bias upon reciprocation of the cam, means for releasably holding the cam in the housing against rotation in a plurality of rotatably oriented positions relative to the arms whereby predetermined cam surfaces will engage the cam followers to effect selected movement of the arms upon reciprocation of the cam dependent upon the rotatably oriented position of the cam.

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