

3 S. GHAEM-MAGHAMI ET AL
MULTIPLE POSITION SWITCH HAVING MULTIPLE
SETS OF CONTACTS AND CAMS

2 Sheets-Sheet 1

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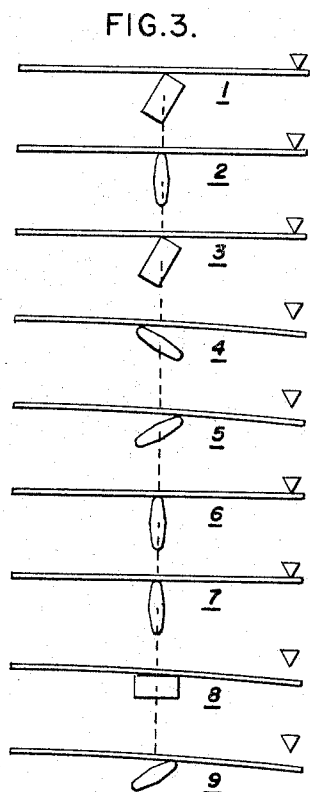
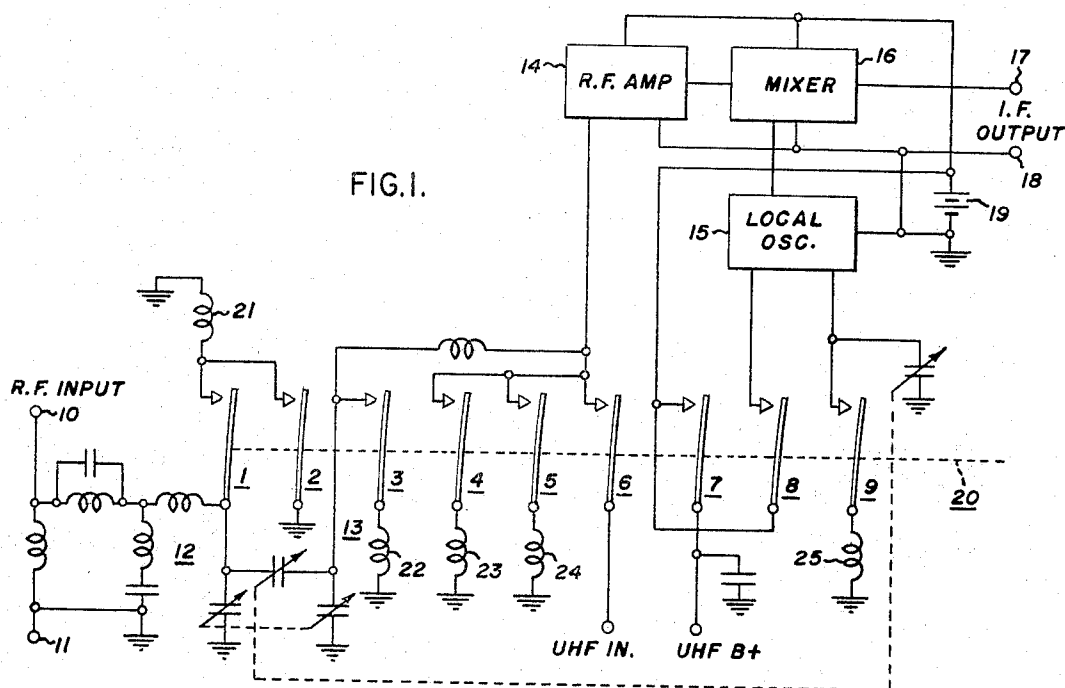


FIG.2.

CONTACT SETS	POS.A CH.1	POS.B CH.2-6	POS.C CH.7-13
1	C	0	C
2	C	0	0
3	C	0	C
4	0	C	0
5	0	0	C
6	C	0	0
7	C	0	0
8	0	C	C
9	0	0	C

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S. GHAEM-MAGHAMI ET AL
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3,373,252

Filed July 15, 1966

2 Sheets-Sheet 2

FIG. 4.

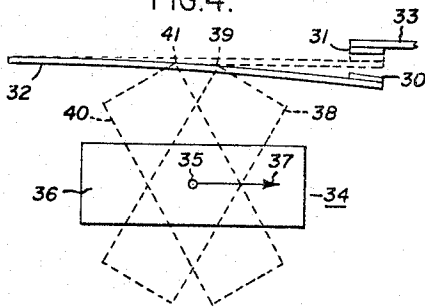


FIG. 5.

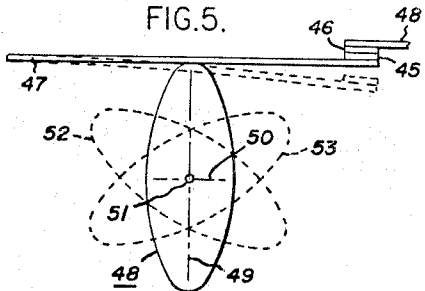


FIG. 7.

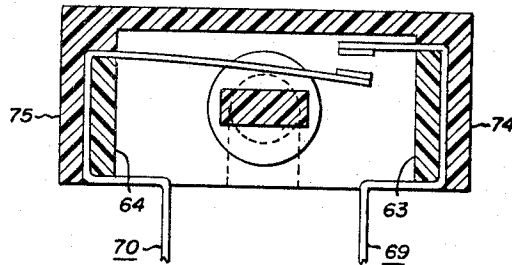


FIG. 8.

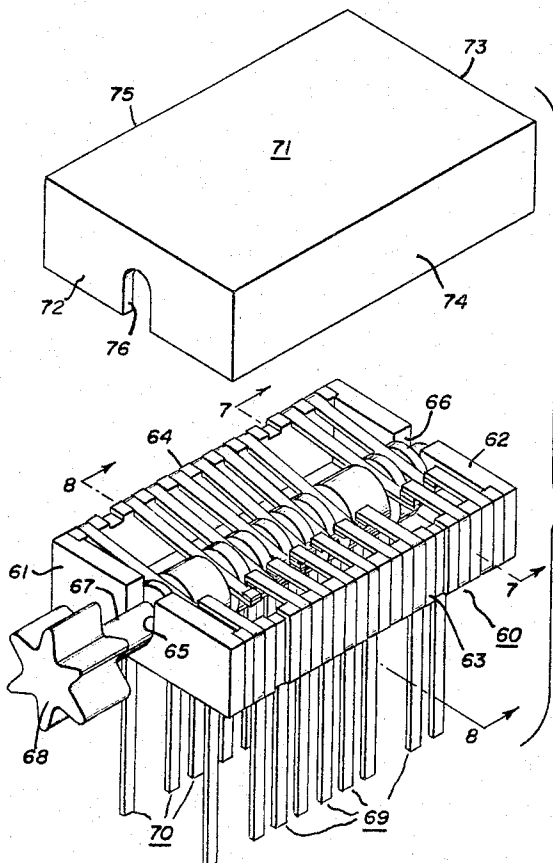
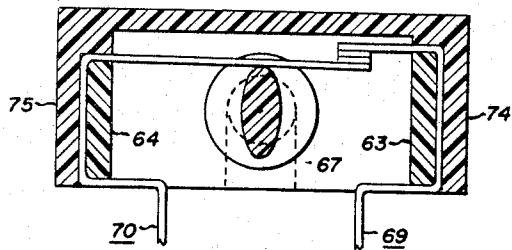


FIG. 9.

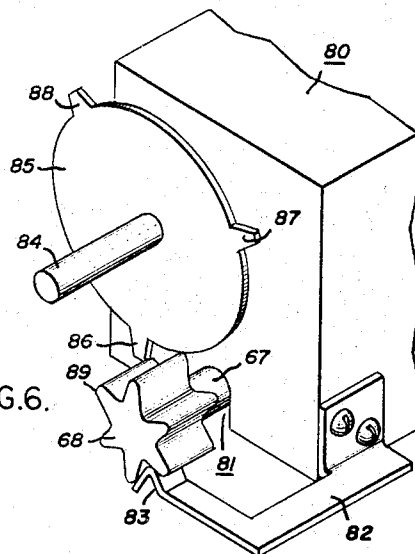


FIG. 6.

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1

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MULTIPLE POSITION SWITCH HAVING MULTIPLE SETS OF CONTACTS AND CAMS

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ABSTRACT OF THE DISCLOSURE

In a tuner, a first plurality of contacts engage a second plurality of contacts to form a plurality of contact pairs. Each of the pairs is individually controlled by individual cams mounted on a single shaft. The cams are of differing contours and mutually angularly displaced to effect a closing of different pairs in different positions of the shaft.

The present invention relates to a multiple position switch having multiple sets of contacts actuated in predetermined groups, each group corresponding to a respective position and more particularly to such a switch arrangement including means effecting the operation thereof through a common shaft.

In the television tuner art considerable switching is required in the R.F. (radio frequency) circuits to set them up for operation on the channels of transmission in the low and in the high VHF frequency ranges as well as to set up such circuits for operation over the UHF frequency range. For such application a three position switch is required wherein one position sets up circuit connections for UHF operation, another position sets up circuit connections for operation in the low range VHF channels, and a third position sets up circuit connections for operation in the high range VHF channels. In addition, it is desirable to be able to tune at least the channels in the low and high VHF ranges from a common shaft and for the switching to be accomplished coincidentally with motion of the shaft to the range desired. Preferably, in such circuits the tuning is accomplished by means of a variable capacitor or capacitors. One such circuit is disclosed and claimed in a copending application Ser. No. 595,569, filed July 15, 1966, and assigned to the assignee of the present invention. A particular multiple variable capacitor structure adapted for such usage is disclosed and claimed in a copending application Ser. No. 565,570, filed July 15, 1966, and assigned to the assignee of the present invention.

The present invention is directed to providing a simple, compact, easily constructed, yet highly reliable switch for switching a plurality of sets of contacts into desired open or closed position depending upon the position of an actuating shaft associated therewith.

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 shows a diagram partly in block form and partly in schematic form of the VHF tuner portion of a television receiver showing some of the tuned circuits thereof and sets of switching contacts therefor.

FIGURE 2 sets forth in tabular form the nine sets of

2

contacts of the switch of FIGURE 1 and the open or closed state of each contact set for three positions of the switch.

FIGURE 3 shows in schematic form the nine sets of contacts of FIGURE 1 set for the first position of operation and illustrates two kinds of mechanically actuating cams associated with a common actuating shaft for effecting opening and closing of the contacts of each set.

FIGURE 4 shows a set of contacts and an associated cam of one type in accordance with the present invention for achieving a three position switching sequence two positions of which produce a closure of the contacts.

FIGURE 5 shows a set of contacts and an associated cam of another type in accordance with the present invention two positions of which produce an opening of the contacts.

FIGURE 6 shows a perspective view of a switch construction in accordance with the present invention showing the nine sets of contacts and the associated cams thereof mounted on a common shaft adapted to be set in six positions, three of which repeat, and also shows a housing therefor.

FIGURE 7 is a sectional view of FIGURE 6 taken along section 7—7 showing a set of switching contacts with an associated cam of the one type.

FIGURE 8 is a sectional view of FIGURE 6 taken along section 8—8 showing a set of contacts with an associated cam of the other type.

FIGURE 9 shows a perspective view of the switching assembly of FIGURE 6 and a shaft of a tuning structure mounted on a common support member and integrated therewith, illustrating the manner in which the switching and tuning functions are accomplished by positioning of the switching and tuning shaft.

Referring now to the combination block and schematic diagram of FIGURE 1 there is shown a pair of television signal input terminals 10 and 11 to which is connected a primary tuned circuit 12. A secondary tuned circuit 13 is capacitively coupled to the primary tuned circuit and the output thereof is connected to an R.F. amplifier 14. The primary circuit and secondary tuned circuits shown are more fully described and claimed in the aforementioned patent application Ser. No. 595,569. The output of the R.F. amplifier 14 and the output of a local oscillator 15 are applied to a mixer 16 which converts frequencies selected by the tuned circuits to I.F. frequencies and which appear at the output terminals 17 and 18 of the mixer. A power source 19 is provided for energizing the R.F. amplifier 14, local oscillator 15 and mixer 16.

A multiple position switch 20 is also provided having nine sets of contacts all shown in open states. The switch has three positions conveniently designated positions A, B and C. Position A corresponds to channel 1 or UHF operation. Position B corresponds to low range VHF operation, channels 2 through 6. Position C corresponds to high range VHF operation, channels 7 through 13. The contact sets are mechanically linked with a shaft on which a plurality of cams are located to produce the proper state in the contact set, open or closed, as required for the mode of operation selected, as will be more fully described below.

In FIGURE 2 a table is shown setting forth the contact sets in one column, and in adjacent successive columns are set forth the state of each switch set for the

positions A, B, and C, respectively. Contact set 1 functions to switch an inductance coil 21 in shunt with the primary tuned circuit for high range VHF operation. Contact set 2 functions to ground the high potential side of the primary circuit 12 in UHF operation. Contact set 3 functions to connect a tuning inductance 22 in shunt with the secondary tuning capacitor on high range VHF operation. Contact set 4 functions to connect a tuning inductance 23 in parallel with the secondary tuning capacitance on low range VHF operation. Contact set 5 functions to parallel inductance 24 in shunt with the secondary tuning capacitance of the tuned circuit 13 on high channel VHF operation. Contact set 6 functions to connect the I.F. output from the UHF tuner (not shown) to the tuned circuit formed of the elements used in the secondary tuned circuit 13. Contact set 7 functions to connect B+ or the high potential of the energizing source 19 to the UHF tuner on UHF operation. Contact set 8 functions to connect B+ operating potential to the local oscillator 15 in VHF operation. Contact set 9 functions to connect a tuning inductance 25 in shunt with the tuned circuit of the local oscillator 15 on high range VHF operation.

The switching sets and cam arrangement for accomplishing the three position switching sequence for the nine sets of contacts are set forth in schematic form in FIGURE 3 in which the contact set corresponding to contact set of FIGURE 1 is designated by the same numeral and to which reference is now made. In this figure the cam positions and corresponding states of the contact sets are set for position A or UHF operation. The switching sequences of the nine sets fall into six categories, in three of which two closed states appear and one open state and in three of which two open states appear and one closed state. The former group of three categories is achieved by use of one type of cam referred to as type No. 1 cam, and the latter group of three categories is achieved by means of another type of cam referred to as type No. 2 cam. A set of contacts actuated by a type No. 1 cam is shown in FIGURE 4 and its operation will be more fully explained in connection therein.

In FIGURE 4 is shown a set of two contacts 30 and 31, each fastened to adjacent ends of respective ones of a pair of resilient arm members 32 and 33 suitably supported at their remote ends. A cam 34 is positioned on a shaft intermediate the support point and the contact 30 of the resilient member 32. The cam 34 is of generally rectangular outline and is adapted to be rotated about the center of symmetry or geometric center 35 of the cam. The cam 34 is proportioned such that when its longer dimension 36 is parallel to the direction of the member 32 indicated by the position of the cam shown in solid lines and further indicated by the arrow 37 extending from geometric center along the horizontal direction to the right. When the cam is moved counterclockwise 60 degrees from that position so that it assumes position shown in dotted outline 38, a corner 39 thereof engages the member 32 and presses it upward and producing engagement of contacts 30 and 31. When the cam is rotated an additional 60 degrees and assumes position indicated by dotted outline 40, the adjacent corner 41 of the cam engages the member 32 and maintains the set of contacts in closed position. When the cam is moved an additional 60 degrees beyond that position it again assumes the direction in which the long dimension thereof is parallel to the direction of the member 32 and does not engage it, enabling the contact set to be open. Two additional 60-degree movements of the cam would again produce two closed states in sequence in the contacts. Accordingly, starting with the position indicated, as the cam is moved at 60 degree intervals through a complete cycle the six positions or state of contacts are: open-closed-closed-open-closed-closed. From the six position sequence a three position sequence may be derived which has two closed positions thus enabling such a contact set and cam ar-

range to produce the switching functions required in the contact sets of FIGURE 3 requiring three positions, two of which are closed. The desired initial state in the contact set is set by orienting the cam with respect to the shaft to produce such initial state and also which gives the proper two subsequent states on counterclockwise motion of the cam.

In FIGURE 5 is shown a contact set and a cam arrangement referred to as a type No. 2 cam. Each of a pair of contacts 45 and 46 are mounted on adjacent ends of which are fixedly supported. A cam 48 of generally elliptical outline having major and minor axes 49 and 50 corresponding approximately to the long and short dimensions of the rectangular outline of the cam of type No. 1. The cam is shown mounted at its center 51, i.e., at the intersection of its major and minor axes and positioned such that the major axis 49 is perpendicular to the arm and so that the cam surface bears against the arm to produce engagement of the contacts 45 and 46. If the direction of the minor axis as shown is taken as zero reference, when the cam is moved counterclockwise to the position shown by dotted outlines 52, i.e., moved 60 degrees from the position shown in the solid line, the cam no longer engages the arm and an open state is produced in the contacts 45 and 46. When the cam is moved an additional 60 degrees as indicated by the dotted outline 53, the cam still avoids contacting the member 47 and an open position is maintained. As the cam is moved another 60 degrees the major axis 49 of the elliptical outline is now perpendicular to the arm again and bears up against it producing a closure of the contacts. Two further 60-degree movements would produce open conditions in the contacts 45 and 46. Accordingly, as the cam of the contact set is moved through six positions the contacts become successively closed-open-open-closed-open-open. Thus, it is apparent that the switching arrangement of FIGURE 5 can be used to produce a three position switching sequence in which the contacts for two of the positions are open. The desired initial switching state is set by appropriate orientation of the cam on the shaft, for example, for contact set 2, the cam would be oriented as shown in solid outline in FIGURE 5.

Referring now to FIGURE 6 there is shown a perspective view of the physical embodiment of the invention illustrated schematically in FIGURES 3, 4 and 5. In this figure is provided a generally rectangular frame member 60 having a pair of opposed end members 61 and 62 and a pair of opposed side members 63 and 64. The end members have a pair of recesses 65 and 66 in them adapted to receive a shaft 67 at one of which is located a wheel 68 with six protuberances or teeth on them spaced 60 degrees apart. Along the shaft are located cams of type No. 1 and type No. 2 oriented in the manner indicated in the table, FIGURE 2 such that for position A operation the respective contact sets 1 through 9 will have the condition set forth in the table of FIGURE 2. The opposed side members 63 and 64 have a plurality of grooves along the upper and outer surfaces thereof aligned in opposed relationship and of dimensions to receive a plurality of strips of resilient members. The strips of one type 69 with the contact on the under side thereof are placed along member 63. The strips of another type 70 with the contact on the upper surface thereof are placed along member 64. The strips are dimensioned so that the contacts of corresponding strips of opposite type are in registry and in the absence of a cam bearing against the strips, the contacts thereon are open or disengaged. A cover member 71 is provided for securing the shaft and the contact members in place as well as for protecting the contact elements and cam members from environmental influences. The cover member 71 is a parallelepiped form having two end members 72 and 73, two side members 75 and 76. Recesses, one of which is shown and designated 76, are provided in the sides of the cover member to receive the shaft 67.

FIGURE 7 shows a sectional view of FIGURE 6 taken along section 7—7 particularly illustrating the manner in which the conductive members of contact set 8 as well as the other sets are retained in position bearing against both the side members 63 and 64 and the cover member 71 and illustrating a type No. 1 cam.

FIGURE 8 is a sectional view of FIGURE 6 taken along section 8—8 showing the manner in which the contact members of switch 2 are retained in position between two members and particularly illustrating a type No. 2 cam member.

Referring now to FIGURE 9 there is shown a housing or support member 80 for supporting the switch assembly of FIGURE 6 and a variable impedance structure, for example a gang of variable capacitors (not shown). In this figure the switch assembly is generally designated as 81 and is supported at the base of the housing 80 and aligned so that the shaft 67 with the wheel 68 with teeth on the periphery thereof extends along the long dimension of assembly. On the front face housing 81 is mounted a resilient lock member 82 consisting of a strip of resilient material having one end rigidly secured to the housing and the other end of which has a detent 83 therein adapted to register with the depressions in the periphery wheel 68. The lock member 82 with the detent in it retains the shaft 67 in any of the six positions desired. The wheel is set in respect to the detent so that the position of the shaft 67 corresponds to one of the desired switch positions. Also mounted on the frame member is another shaft 84 supported in bearing surfaces in the front and rear facing of the housing 80 and rotatable therein. On the shaft is fixedly mounted another wheel 85 lying generally in the same plane as the six tooth wheel 68. On the periphery of the wheel 85 are located three protuberances or teeth 86, 87, and 88 each adapted to engage a tooth of the six tooth wheel 68 and advance it in one position as the protuberances of the wheels engage or mesh. In the position shown the tooth 86 has meshed with the tooth on the six position gear and advanced it one position. In the process the resilient member gives sufficiently to permit such advancement. This could correspond to switching of the shaft 67 from a position corresponding to switch position A to switch position B. As the shaft 84 is rotated clockwise to the tooth 87 would engage a corresponding tooth 89 on wheel 68 and advance it sixty degrees. This advancement could correspond to switching of the shaft from a position corresponding to switch position B to switch position C. The range of movement of the shaft 84 between teeth 88 and 86 when it is free of engagement with wheel 68 would correspond to the UHF tuning range. The range of movement of the shaft between teeth 86 and 87 would correspond to low range VHF tuning and the range of movement of the shaft 84 between teeth 87 and 88 would correspond to high range UHF tuning.

It will be appreciated that a single type of cam arrangement such as shown in either FIGURE 4 or FIGURE 5 could perform all of the three position contact sequences set forth in the table of FIGURE 2; however a modification would be required in the strips to which the contacts are connected. For example, in FIGURE 4, if strip 33 were placed underneath strip 32 with contacts thereon arranged to be engaged when the short dimension of the rectangle 34 is perpendicular to the direction of the arm 32 the open-closed-closed sequence illustrated would become closed-open-open. The assembly of FIGURE 5 may be similarly modified with similar results. With such modified arrangements while only one type of cam would be used for all contact sets, four different kinds of strip assemblies instead of two would be required to assemble a composite switch such as shown in FIGURE 6.

The foregoing is a description of illustrative embodiments of the invention, and it is applicants' intention in the appended claims to cover all forms which fall within the scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A switch comprising a support means,
a shaft mounted on said support means,
a plurality of arm members each mounted on said support means and adapted to be deflected about an axis substantially parallel to the axis of the shaft,
a plurality of contacts each mounted on a respective one of said arms,

another plurality of contacts each mounted in spaced relation with respect to a respective one of said first plurality of contacts,

- a plurality of cams of mutually differing contours mounted along the length of said shaft, each in engageable relationship with a respective one of said arms

so that over a cycle of revolution each of said arms is engaged to cause respective ones of said contacts on said arms to be brought into and out of engagement with respective ones of said second set of contacts at different times in the cycle of revolution.

2. The combination of claim 1 in which said support means comprises:

a generally rectangular frame member having a front and a rear member and a pair of opposed side members, said side members having a plurality of slots, each slot on one side member being aligned with a respective slot on the other side member, said arm members being in the form of strips each aligned in a respective slot in one of said side members, each of said other plurality of contacts being located on a respective one of another plurality of strip members, said strip members each being aligned in a respective one of said slots in other of said side members, and

a generally rectangular retaining member having inside dimensions equal to the outside dimensions of said frame member and adapted to fit thereover so as to secure said strip members in place between the sides of said side members and the sides of said rectangular retainer member,

said shaft member rotatably secured in the front and rear members of said frame member.

3. The combination of claim 1 in which each cam of said plurality of cams is located adjacent a respective arm member and adapted to be rotated about an axis substantially parallel to the axis of deflection of said arm member about the secured end thereof, the cross-section of said each cam being symmetrical about a pair of mutually perpendicular axes, one corresponding to the shortest dimension of said each cam through the axis of rotation, the axis of rotation of said each cam being positioned with respect to said arm member so that when said shortest dimension approaches parallel thereto the surface of said each cam bears against said arm member to deflect said arm member in said one direction to change said contacts from one of said two states to the other thereof.

4. The combination of claim 3 wherein the axes of one of said plurality of cams are mutually angularly displaced with respect to the axes of another of said plurality of cams.

5. The combination of claim 4 wherein said each cam is contoured so that six equally spaced positions of the shortest dimension of said each cam represent a complete revolution in which six distinct relations of said contacts are produced, two of which are of one of said two states and four of which are of the other of said two states.

6. The combination of claim 5 in which one of said plurality of cams is of generally elliptical outline and another is of generally rectangular outline.

7. The combination of claim 6 in which is provided means for positioning said shaft in six equally distant angular positions including a wheel member having six teeth, a resilient member for engagement with each of

7

said teeth in sequence for maintaining said shaft in said positions, each of said cams properly oriented with respect to the angular positions of said shaft as determined by the wheel means.

8. The combination of claim 6 in which is provided another wheel means of substantially larger radial dimension mounted on a shaft angularly aligned with respect to the first mentioned shaft and having three teeth thereon spaced about the periphery thereof whereby for a complete revolution of said second wheel when said first is advanced three positions.

8

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