

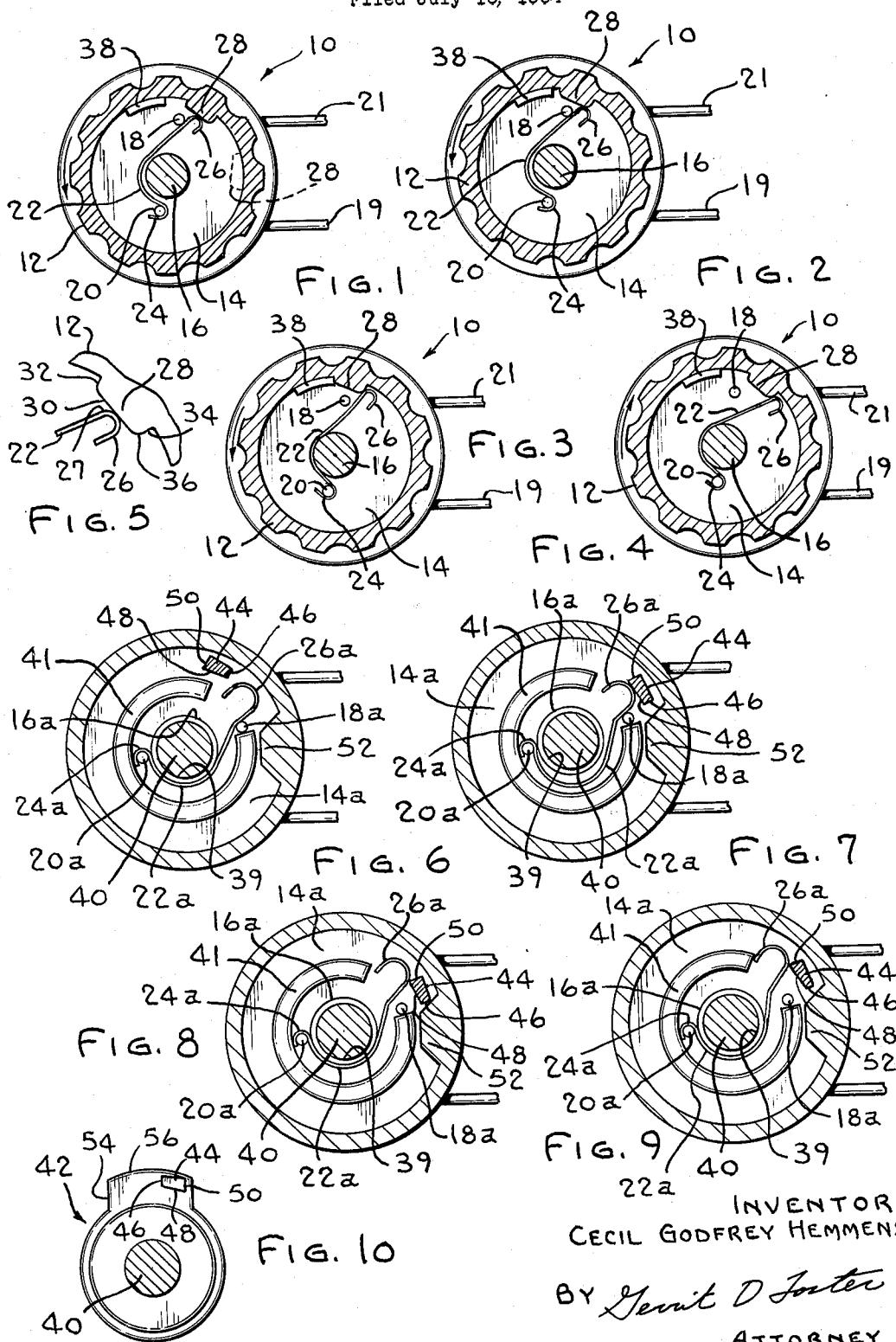
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C. G. HEMMENS

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SNAP ACTION SWITCH DEVICES

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INVENTOR
CECIL GODFREY HEMMENS

BY *Lewitt D. Foster*
ATTORNEY

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SNAP ACTION SWITCH DEVICES

Cecil Godfrey Hemmens, Purton, England, assignor to Plessey-UK Limited, Essex, England, a British company

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This invention relates to snap action switch mechanisms and, more particularly, to a switch adapted to energize and de-energize an electrical circuit control device, e.g. a potentiometer, in response to control movement of the control device.

Accordingly, a general object of this invention is to provide a snap action switch assembly which energizes and de-energizes an electrical control device in response to control movement of the device and, in its more specific aspects, to achieve such operation while maintaining a switch construction which is simple, economical and readily assembled.

For the achievement of these and other objects, this invention contemplates a switch mechanism having a conductive contact spring extending between first and second stationary contacts which are suitably connected in the circuit of an electrical circuit control device. The contact spring is suitably anchored at the first contact and has a free end biased into engagement with and free for movement with respect to the second contact. The contact spring is so mounted as to be capable of flexing on itself as well as being movable into and out of engagement with the second contact. To achieve movement of the contact spring with respect to the second contact, and also flexing of the spring on itself, the free end of the spring is positioned in the path of a movable cam member. Upon engagement of the cam member with the spring and subsequent relative movement therebetween, the spring is flexed inwardly toward the first contact. The cam eventually releases the spring for movement toward its unflexed position and the spring is simultaneously cammed away from the second contact to open the switch circuit. A suitable stop member is provided to limit the relative movement of the cam in one direction with respect to the contact spring and the position of the stop member with respect to the first contact and the contact spring is such that the spring is held out of engagement with the first contact to hold the switch circuit open after cam movement has been interrupted.

Other objects and advantages will be pointed out in, or be apparent from, the description and claims, as will obvious modifications of the embodiments shown in the drawing, in which:

FIG. 1 is an axial view illustrating the switch in closed circuit position with the contact spring partially flexed;

FIG. 2 is a similar view illustrating the switch just prior to release of the contact spring;

FIG. 3 is a similar view illustrating the switch after release of the spring and with the switch in its open circuit position;

FIG. 4 is a similar view illustrating the switch after initial movement from its "off" position (open circuit) toward its "on" position (closed circuit);

FIG. 5 is an enlarged view of the cam and the free end of the contact spring;

FIG. 6 is an axial view of an alternative embodiment illustrating the switch in its closed circuit position prior to engagement between the contact spring and cam;

FIG. 7 is a similar view of the alternative embodiment illustrating the switch after partial flexing of the contact spring and while still in a closed circuit position;

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FIG. 8 is a similar view of the alternative embodiment illustrating the switch in its open circuit position;

FIG. 9 is a similar view of the alternative embodiment illustrating the switch during initial movement from its "off" position to its "on" position; and

FIG. 10 is an axial view of a rotor construction which can be used in the alternative embodiment.

The switch mechanism of this invention is adapted for use with any one of a number of electrical circuit control devices, such as a potentiometer. The details of the circuit control device are not necessary to a proper understanding of this invention and for that reason it has neither been illustrated in the drawing nor will it be specifically described.

FIGS. 1-5 illustrate a switch embodying this invention and used in combination with a rim actuated control device 10 wherein actuating rim 12 is supported for rotation about fixed base plate 14. Boss 16 extends axially from base plate 14 and is preferably arranged coaxially with rim 12. Switch contacts 18 and 20 also extend axially of base plate 14 and are suitably connected in circuit with control device terminals 19 and 21 to control electrical energization and de-energization of the control device. Contact spring 22 extends between the stationary contacts to complete an electrical circuit through the switch. End 24 of the contact spring is turned back on itself to loop over contact 20 and opposite end 26 of the contact spring is also turned back on itself to provide a rounded end for a purpose which will become apparent as this description proceeds.

Preferably, contacts 18 and 20 are positioned on opposite sides of boss 16 with the circumference of the boss extending to a point offset laterally from an axially extending plane including contacts 18 and 20 or, in other words, offset from a plane including the contacts and extending normal to the base plate or the plane of the drawing. Contact spring 22 is assembled by fitting end 24 over contact 20 and flexing the contact spring around boss 16, this flexing causes the spring to bow intermediate its ends and produces a biasing force urging the contact spring into engagement with both contacts 18 and 20 thereby maintaining electrical engagement therebetween and without unduly high contact resistance.

With contact spring 22 so mounted, its end 26 can be moved clockwise about boss 16 to open the electrical circuit and, being flexed intermediate its ends, the contact spring will readily flex inwardly toward contact 20 in response to a force generally parallel to its extension between the stationary contacts or in a radial direction in the illustrated embodiment. To move spring 22 from its closed circuit position of FIG. 1 to its open circuit position of FIG. 3, rim 12 is provided with cam 28 which projects radially inwardly toward boss 16 and the contact spring with end 26 of the contact spring positioned in the path of rotation of the cam. Stop 38, preferably fixed on base plate 14, is also positioned in the path of movement of the cam to determine the "off" position of the switch as will be described more completely hereinafter.

During the major portion of rim movement, cam 28 is out of engagement with spring end 26 so that the contact spring bridges between contacts 18 and 20 and the switch circuit is closed. In moving in a counterclockwise direction, preferably from a maximum-voltage position to a minimum-voltage position where control device 10 is a potentiometer, cam 28 will move into engagement with end 26 of the contact spring. Cam 28 includes camming surface 30 extending angularly inwardly from leading edge 32 and falls off sharply at trailing edge 34 with the transition from camming surface 30 to trailing edge 34 being through radius 36. Trailing edge 34 and radius 36 provide a camming surface which extends angularly from

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camming surface 30 toward the rim. As rim 12 is rotated counterclockwise or in the direction of the arrow in FIGS. 1-3, leading edge 32 engages contact spring end 26 and continued cam movement flexes the contact spring on itself and about boss 16, however, due to the angle of surface 30 (the inward radial extension thereof increases from the leading to the trailing edge) the tendency is to hold end 26 in engagement with contact 18. Inward flexing of the contact spring continues until end 26 of the contact spring is transferred from surface 30 to radius 36 whereupon interaction between arcuate surface 27 of the spring end and radius 36, coupled with the energy stored in the contact spring due to its having been flexed, snaps end 26 toward the inner rim periphery and into engagement with trailing edge 34.

Stop member 38 is arranged for engagement by cam leading edge 32 to terminate rim movement in a counterclockwise direction and to determine the "off" position for the control device. Cam 28 is preferably constructed so that the angular distance between its leading edge and trailing edge is greater than the angular distance between stop 38 and the point of engagement between contact spring end 26 and contact 18 so that when the cam is in engagement with stop 28 contact spring end 26 is held away from contact 18 to thereby maintain the switch in an open circuit condition.

With these structural details in mind, the operation of the switch device will now be described. Assuming rim 12 to be initially in a position wherein cam 28 is spaced from the contact spring, e.g. the dotted line showing of cam 28 in FIG. 1, the control device can be adjusted without affecting the closed circuit position of the switch. As rim 12 is rotated counterclockwise toward the "off" position determined by stop 38, cam leading edge 32 engages free end 26 of the contact spring and, since the spring cannot rotate with cam 28, end 26 is moved radially inwardly toward contact 20 causing the contact spring to flex on itself in the direction of its extension between contacts 18 and 20. Continued movement of cam surface 30 with respect to the contact spring (FIG. 1) increases the inward flexing of the contact spring until spring end 26 reaches radius 36, see FIG. 2. As surface 27 of the contact spring end engages radius 36 the biasing force stored in the contact spring during the inward flexing, together with the interaction of radius 36 and surface 27, causes surface 27 to move over radius 36 freeing the spring for movement toward its unflexed position while also camming spring end 26 in a clockwise direction with a snap action away from contact 18 to establish the open circuit condition of the switch with end 26 in engagement with trailing edge 34 as illustrated in FIG. 3. When cam leading edge 32 strikes stop 38, illustrated in FIG. 3, the contact spring remains in engagement with trailing edge 34 and, since the arcuate extension between the leading and trailing edge is greater than the arcuate distance between the stop and the point of engagement between the contact and the spring, the contact spring is held away from contact 18 to maintain an open circuit position. In effect cam 28 includes two camming surfaces, surface 30 the radial inward extension of which increases from the leading to trailing edge so as to slope toward the contacts and contact spring and that formed by surfaces 34 and 36 which slopes away from the contacts and contact spring. In the illustrated embodiment these surfaces are oppositely angled with respect to a radial line from the axis of rim rotation and this in combination with the configuration of the spring end produces the necessary camming action to achieve desired switch opening. Preferably spring end 26 has a generally arcuate surface so as to present an angular face to radius 36 to cam the spring end in a clockwise direction. It will be appreciated that the engagement of the radius and spring end occurs prior to the cam engaging stop 38 so that the spring end follows the cam for a small angular distance but an amount insufficient to reclose the contact spring on contact 18. Other configura-

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tions can be used to cam the contact spring away from contact 18, e.g. end 26 could be V-shaped, it could have one angular surface which engages the cam trailing edge before the cam reaches the stop or, conceivably, contact spring end 26 could be flat and merely the trailing edged surface angled to rely on the interaction of the angled surface and stored spring force to achieve the camming action.

Should it now be desired to switch the control device from its "off" condition of FIG. 3 to its "on" condition, rim 12 is rotated clockwise. During initial clockwise rotation from the position of FIG. 3, spring end 26 moves with cam 28 away from contact pin 18 and also decreases the radial extension of the contact spring toward the rim (see FIG. 4). Upon continued clockwise rotation of the rim, spring end 26 eventually passes over radius 36 freeing the spring for return movement of the spring into engagement with contact 18. This return movement of the spring into engagement with contact 18 is influenced by the initial resiliency in the spring due to flexing over boss 16 and also the stress created in the spring during its rotation away from stop 38. Re-engagement with contact 18 restores the closed circuit position with a snap action and energizes the control device. During further movement of rim 12, the closed circuit condition remains undisturbed until the rim is again rotated toward engagement with stop 38 whereupon the control device is turned "off" in the manner described above.

FIGS. 6-10 illustrate an alternative embodiment of this invention which illustrates that the invention is not limited to use in rim actuated control devices nor to the particular cam configuration of FIGS. 1-5. The construction and arrangement of the stationary contacts, the contact spring and boss are identical to that of the switch arrangement described and illustrated in FIGS. 1-5 in that contact spring 22a has one end 24a looped on contact 20a and has its free end 26a turned back on itself and engaging contact 18a under the influence of the biasing force built up in the contact spring as a result of being bowed around boss 16a which, in this embodiment, includes an axial bore 39 for receipt of rotatable control shaft 40. In this embodiment, contact spring 22a is partially disposed in a groove defined between C-shaped ridge 41 and boss 41a and actuating rotor 42 carries cam 44. The rotor is suitably connected for rotation with shaft 40 to move cam 44 into and out of engagement with end 26a of the contact spring to effect switch operation in a manner similar to that described above in relation to FIGS. 1-5.

More particularly, cam 44 includes leading edge 46 and camming surface 48 which extends from the leading edge generally transversely of the direction of extension of contact spring 22a between the stationary contacts. In this instance, the extension of the contact spring is in a generally radial direction and camming surface 48, similar to camming surface 30, is sloped so that its radial inward extension increases from its leading edge to its trailing edge 50. Trailing edge 50 is radially aligned with the axis of rotation but, if desired, could be disposed at an angle to a radial line in the same directions as or oppositely from camming surface 48. The arcuate distance between stop 52 and the point of contact between end 26a and contact 18a is less than the arcuate extension between the leading and trailing edges of cam 48 so that when the cam engages the stop the contact spring is held out of engagement with upper contact 18a.

The operation of this embodiment is identical to that described above in that as shaft 40 is rotated counterclockwise cam 44 moves toward engagement with contact spring end 26a. The contact spring is initially engaged by leading edge 46 and is transferred onto cam surface 48 whereupon the contact spring flexes inwardly on itself with further movement of the cam. Inward flexing continues and end 26 is eventually transferred from surface 48 to trailing edge 50 whereupon, under the influence of its own resiliency, it is snapped into engage-

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ment with the trailing edge and is moved out of engagement with contact 18a. With this arrangement stop 52 can be engaged by cam leading edge 46 or, if desired, by edge 54 of the cam carrying rotor extension 56. In either instance, the open circuit condition of the switch is maintained by the angular extension between stop 52 and cam trailing edge 50 being greater than the angular extension between the stop and contact 18a.

Although this invention has been illustrated and described in connection with embodiments achieving control on the basis of rotating movement it will be appreciated that it could be used equally as well in controls using other types of movement, such as linear control movement. Therefore, it will be apparent to those skilled in the art that this and various other changes and modifications may be made without departing from the spirit of the invention or from the scope of the appended claims.

What I claim is:

1. A switch for use in combination with rotary electrical control devices having a rotatable control member, said switch comprising, in combination,

a circular base plate,

first and second fixed contacts relatively spaced on said base plate,

a fixed boss extending axially from said base plate and positioned intermediate said first and second contacts, said boss including a portion disposed laterally of an axially extending plane passing through said first and second contacts,

a resilient electrically conductive contact spring having opposite ends, one end of said contact spring anchored to said first contact, the opposite end releasably engaging said second contact and said contact spring engaging the laterally disposed portion of said boss intermediate said ends, said contact spring being flexed intermediate its ends by engagement with said boss and biased into engagement with said second contact,

cam means connected to and rotatable with said control member relative to said contacts and contact spring,

said opposite end of said contact spring extending into the path of movement of said cam means and said cam means characterized by having a first surface of predetermined angular extension projecting toward said contacts to flex said contact spring toward said first contact upon engagement therewith, said cam means also including a trailing edge surface disposed at an angle to said first surface and extending away from said contacts permitting expansion of said contact spring and cooperating to cam said opposite contact spring end away from said second contact,

and stop means fixed on said base plate and disposed in the path of movement of said cam means to limit movement of said cam means relative to said contacts, said stop means angularly spaced from said second contact a distance less than the angular extension of said cam means and said cam means trailing edge holding said contact spring out of engagement with said second contact when said cam means is in engagement with said stop member.

2. The switch of claim 1 wherein said contact pins are spaced apart in a radial direction on said base plate and said boss is generally cylindrical and is intersected by said axially extending plane.

3. The switch of claim 2 wherein said contact spring ends engage said contact pins to one side of said plane and said contact spring engages said boss on an opposite side thereof so that said contact spring is urged into engagement with said contacts by the resiliency of said contact spring.

4. The switch of claim 3 wherein said cam means includes a leading edge and wherein said first surface has an increasing inward radial projection from said leading edge to said trailing edge.

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5. The switch of claim 4 wherein said opposite spring end has a generally arcuate configuration.

6. The switch of claim 5 wherein said trailing edge extends from said first surface in a direction away from said contacts and is oppositely angled with respect to a radial line and as compared to said first surface.

7. The switch of claim 4 wherein said rotatable control member includes a rim rotatable about the periphery of said base plate and wherein said cam means is carried on said rim and projects inwardly thereof.

8. A snap action switch for use in combination with electrical control devices having a movable control member, said switch comprising, in combination,

a base plate,

first and second fixed contacts relatively spaced on said base plate,

a boss extending laterally from said base plate and positioned intermediate said first and second contacts, said boss including a portion disposed laterally of a plane extending laterally of said base plate and including said first and second contacts,

a resilient electrically conductive contact spring having opposite ends, one end of said contact spring anchored to said first contact, the opposite end releasably engaging said second contact, and said contact spring engaging the laterally disposed portion of said boss intermediate said opposite ends, said contact spring being flexed intermediate its ends by engagement with said boss and biased into engagement with said second contact,

cam means connected to and movable with said control member relative to said contacts and contact spring,

said opposite end of said contact spring extending into the path of movement of said cam means and said cam means characterized by having a first surface of predetermined extension projecting toward said contacts to flex said contact spring toward said first contact upon engagement therewith, said cam means including a trailing edge disposed at an angle to said first surface and extending away from said contacts permitting expansion of said contact spring and cooperating to cam said opposite contact spring end away from said second contact,

and stop means fixed on said base plate and disposed in the path of movement of said cam means to limit the movement of said cam means relative to said contact pins and spaced from said second contact in the direction of movement of said cam means a distance less than said predetermined extension of said cam means and said cam means trailing edge holding said contact spring out of engagement with said second contact when said cam means is in engagement with said stop member.

9. The switch of claim 8 wherein said contact spring ends engage said contacts to one side of said plane and said contact spring engages said boss on an opposite side thereof so that said contact spring is urged into engagement with said contacts by the resiliency of said contact spring.

10. The switch of claim 8 wherein said opposite spring end includes at least one angular surface engageable with said trailing edge and cooperating therewith to cam said opposite spring end away from said second contact.

11. The switch of claim 10 wherein said cam means includes a leading edge and the projection of said cam means toward said contacts increases from said leading edge to said trailing edge, and wherein said trailing edge extends away from said contacts and is oppositely angled with respect to the direction of extension of said contact spring and as compared to said first surface.

12. A switch comprising, in combination, a resilient contact spring having first and second ends, first and second relatively spaced fixed electrical contacts,

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said first contact spring end anchored on said first contact and said second end thereof releasably engaging said second contact,

means defining a surface spaced laterally from a line extending between said contacts and engaging said contact spring intermediate its ends, said contact spring being flexed intermediate its ends and biased toward said second contact,

cam means,

means supporting said cam means for movement relative to said contacts and in a direction transversely of said line extending between said contacts,

said second contact spring end disposed in the path of movement of said cam means and said cam means including an angular cam surface arranged transversely of said line for engagement with said second contact spring end to flex said contact spring along said line toward said first contact as said cam means moves relative to said contacts, said angular surface having a predetermined extension to a trailing edge and said trailing edge extending at an angle from said angular surface and away from said contacts, and means fixed relative to said contacts for limiting travel of said cam means relative to said contacts and spaced from said second contact a distance less than said predetermined extension to said trailing edge so that said contact spring is flexed toward said first contact during engagement with said angular cam surface and expands along said trailing edge away from said second contact upon engagement with said trailing edge.

13. A switch comprising, in combination, first and second relatively spaced terminal means, a resilient electrically conductive contact spring extending between said terminal means and having a free end and a relatively fixed end,

anchor means for said fixed contact spring end including said first terminal means,

actuating means for moving said free end of said contact spring into and out of engagement with said second terminal means and including cam means engageable with said free end, said cam means arranged to extend generally transversely of a line between said terminal means and flexing said contact spring inwardly toward its fixed end as cam means moves relative to said contact spring, said cam means further operative to permit said contact spring to expand outwardly of its fixed end and away from said second terminal means after a predetermined amount of movement of said cam means relative to said contact spring,

and means engageable with said actuating means for limiting movement of said cam means relative to said contact means to stop said cam means after it has moved said predetermined amount and operative to hold said contact spring out of engagement with said second terminal means.

14. The switch of claim 13 wherein said anchor means also includes a surface spaced laterally of a line between said terminal means and engaging said contact spring intermediate its ends to flex said contact spring and bias said free end of said contact spring into engagement with said second terminal means.

15. The switch of claim 13 wherein said cam means includes a trailing edge extending in a direction away from said terminal means and wherein said free end of said contact spring has at least one angular surface engageable with said trailing edge to cooperate in camming said contact spring away from said second terminal means as said contact spring expands outwardly.

16. A switch for use in combination with rotary electrical control devices having a rotatable control member, said switch comprising, in combination, a circular base plate,

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first and second fixed contacts relatively spaced on said base plate,

a boss extending axially from said base plate and positioned intermediate said first and second contacts, said boss including a portion disposed laterally of an axially extending plane passing through said first and second contacts,

a resilient electrically conductive contact spring having opposite ends, one end of said contact spring anchored to said first contact, the opposite end releasably engaging said second contact and said laterally disposed portion of said boss engaging said contact spring intermediate its ends, said contact spring being flexed intermediate its ends by engagement with said boss and biased into engagement with said second contact,

a shaft for rotating said control member, an actuator connected to and rotatable with said shaft, said actuator including cam means arranged for movement into and out of engagement with said opposite end of said contact spring and supported radially outwardly of said second contact, said cam means characterized by having a first surface of predetermined angular extension projecting toward said contacts to flex said contact spring toward said first contact upon engagement therewith, said cam means also including a trailing edge disposed at an angle to said first surface and extending away from said contacts permitting expansion of said contact spring and cooperating to cam said opposite contact spring end away from said second contacts,

and stop means fixed on said base plate and disposed in the path of movement of said cam means to limit the movement of said cam means relative to said contacts, said stop means angularly spaced from said second contact a distance less than the angular extension of said cam means and said cam means trailing edge holding said contact spring out of engagement with said second contact when said actuator is in engagement with said stop member.

17. A switch comprising, in combination, first and second relatively spaced terminal means, a resilient electrically conductive contact spring extending between said terminal means and having a free end and a relatively fixed end,

anchor means for said fixed contact spring end including said first terminal means,

actuating means for moving said free end of said contact spring into and out of engagement with said second terminal means and including cam means engageable with said free end, said cam means arranged to extend generally transversely of a line between said terminal means and flexing said contact spring inwardly toward its fixed end as cam means moves relative to said contact spring, said cam means further operative to permit said contact spring to expand outwardly of its fixed end and away from said second terminal means after a predetermined amount of movement of said cam means relative to said contact spring,

means engageable with said actuating means for limiting movement of said cam means relative to said contact means to stop said cam means after it has moved said predetermined amount and operative to hold said contact spring out of engagement with said second terminal means,

and means intermediate said contact spring ends and in contact therewith adapted normally flex said spring free end toward said second terminal means.

No references cited.

KATHLEEN H. CLAFFY, *Primary Examiner*.

75 D. SMITH, JR., *Assistant Examiner*.