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W. J. KELLEIGH

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SNAP SWITCH

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2 Sheets-Sheet 2

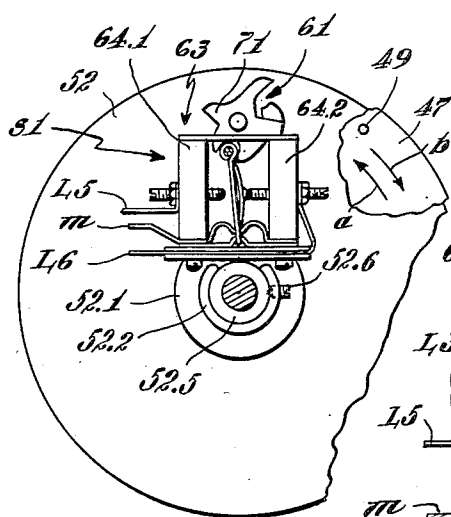


Fig. 11

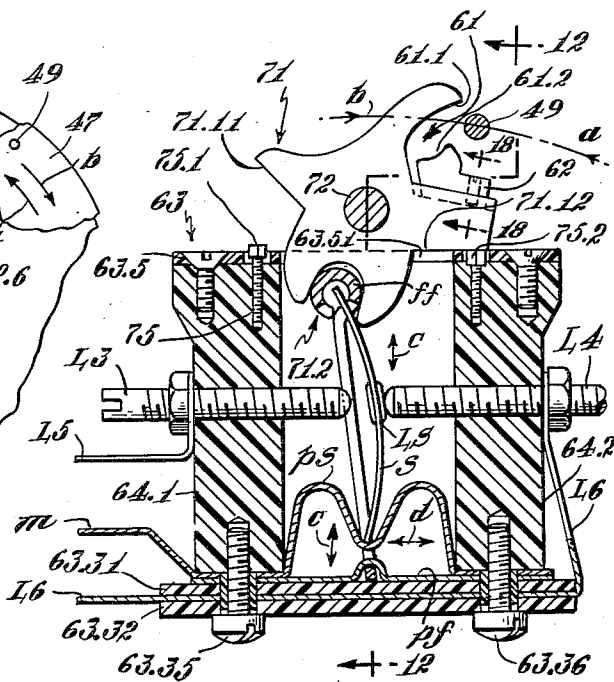


Fig. 13

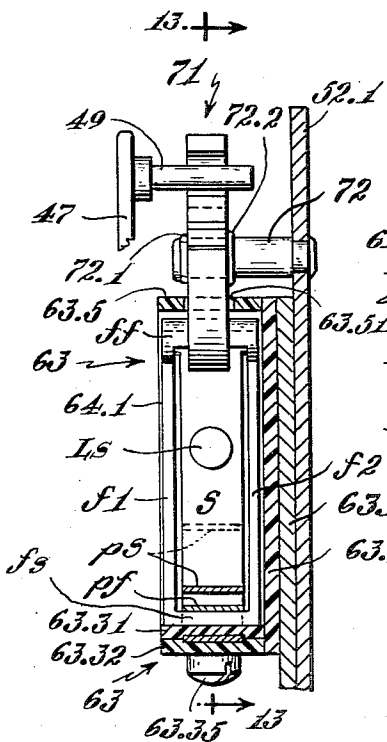


Fig. 12

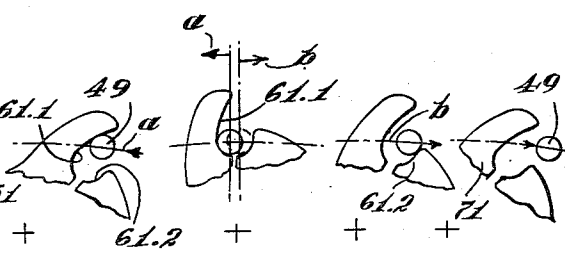


Fig. 14 Fig. 15 Fig. 16 Fig. 17

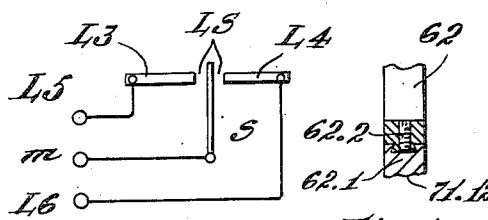


Fig. 18 Fig. 19

Inventor:
Waldo J. Kelleigh
by Robert, Cushman & Grover,
Attorneys.

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2,825,779

SNAP SWITCH

Waldo J. Kelleigh, Wayland, Mass., assignor to Electrical Apparatus Company, Inc., Boston, Mass., a corporation of Massachusetts

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18 Claims. (Cl. 200—67)

This invention relates to electrical switches of the snap action type and to devices for actuating such switches, and incorporates the snap switch construction which is disclosed in my copending application Serial No. 365,855, filed July 3, 1953, of which this is a continuation-in-part.

It is one of the principal objects of the invention to provide switching apparatus of the above type which provides increased wiping action and increased contact pressure just prior to the snap action, and an especially effective wiping action during the contact making period—which provides particularly fast, energetic, and adjustably delayed snap action—and which provides switching apparatus of this general type which is suited for use in a variety of applications requiring compact, light and durable construction that can be easily accommodated in housings that are suitable for switches of various types—these improvements of operation being accomplished by simple, inexpensive and easily adjusted and assembled components.

Another object of the invention is to provide a mechanism for actuating a switch of this type which can be in its turn actuated by mechanism movable relative thereto such as for example a rotating pin of a timing device, and which then permits exact and easy adjustment for setting the click point indicating that contact transfer has taken place, to occur at an exact timer pin position—to provide an adjustable time delay between two actuations corresponding to a forward and a return motion of actuators such as the above mentioned pin—to provide for time delay which permits one timer to reset and start a consecutive timer in a chain of such devices, giving the timer solenoids the needed time to pull in—and to provide for easier and yet exact adjustment of the above mentioned and of analogous functions.

The following summary of its nature and substance for attaining the above objects, characterizes the invention in one of its main aspects as the combination, with a quick action switch having fixed contact means on a base, a movable tensioned contact member and a movable compressed spring contact member which movable contact members have adjacent pivot ends for support on the base, whereas these two movable contact members are pivoted on each other at their other ends, subtending different radii at the base pivot ends so that rotation on these base pivots will cause increased compression of the spring member—of a pivot spring member inserted between the base and an adjacent end of one or both movable contact members, near the pivot portion of the base. These spring pivot members can assume various shapes such as M-shaped strips fastened at both legs with the intermediate depression constituting the pivot for a respective contact member, or the pivot spring or springs can be leaf springs fastened on one side to the base. In an important embodiment, an M-shaped pivot spring is symmetrical with respect to its supports on the base and to its central depression that serves as pivot for a contact member.

In another important aspect of the invention, a snap

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action switch is combined with two stationary contact members extending from the base means towards the approximate center of the contact members and with cam means pivoted on the base adjacent to the outer free ends of the movable contact members, which cam means have a notch for engaging these outer ends and a cam recess for engagement with an actuating means such as the above mentioned timer pin. According to a further practically important aspect of the invention, the notch position as well as the cams of the recess can be adjusted for purposes of more exact and versatile control of the fast action switch.

These and other objects and aspects of novelty will appear from the herein presented outline of its principles, its mode of operation and its practical possibilities together with a description of several typical embodiments illustrating its novel characteristics. These refer to drawings in which

Fig. 1 is an axonometric diagram illustrating the general principles of snap switches according to the invention;

Figs. 2 and 3 are longitudinal sections through a switch housing containing a reset type snap action switch according to the invention, in two positions;

Fig. 4 is a section similar to those of Figs. 2 and 3 but containing a snap action switch of the spring return type, shown in normal position;

Fig. 5 is a section similar to Fig. 4 but with the switch in intermediate position;

Fig. 6 is a plan view of a snap spring element of the general type indicated in Fig. 1 and used in Figs. 2 to 5;

Fig. 7 is a view of an actuating button such as used in apparatus according to Figs. 2 to 5, showing a possibility of conspicuously marking such an element to indicate the contact condition;

Figs. 8, 9 and 10 are diagrammatic sections through a switch according to Figs. 1 to 6, showing the contact springs in two resting and one intermediate position;

Fig. 11 is the side elevation of that portion of a known timer device which includes a rotating disc with an actuating pin and a switch according to the invention mounted for actuation by the pin;

Fig. 12 is an enlarged section on lines 12—12 of Fig. 13;

Fig. 13 is a section on lines 13—13 of Fig. 12;

Figs. 14 to 17 are diagrams illustrating the operation of the switch cam by the timer pin;

Fig. 18 is a detail section on lines 18—18 of Fig. 13; and

Fig. 19 is a diagram indicating the electrical connection of the switch contacts.

In Fig. 1, a frame member F constitutes the above mentioned tensioned movable contact member. It has two side arms *f1*, *f2*, a spring pivot bar *fs* and a frame pivot bar *ff*. The bar *ff* can consist, as shown, of a bent over and cut out portion of a one piece frame. The above mentioned compressed movable spring member is indicated at S. It rests with one end in a recess of the pivot spring *ps* and with the other end in the pivot bar *ff* of the tensioned contact member F. The spring pivot bar *fs* of the frame F rests in notches of the frame pivot springs *pf*. The pivot springs *ps* and *pf*, either of which can be omitted, may assume various forms as will appear hereinbelow.

As indicated in Figs. 8 to 10, the spring members *pf* and *ps* are fastened to a base member B, and the movable contact members F and S swing with their pivot bar *ff* between two stops or limiters L1, L2 and L3, L4, which can constitute actuating means or stop means or contact means, as will be described more in detail hereinbelow.

Assuming for example that L1 and L2 are actuating means and L3, L4 contact means then, if L1 of Fig. 8

is moved towards the right, the spring contact member will move from contact L4 towards contact L3 into the position shown in Fig. 9, finally resting according to Fig. 10, with the pivot contact bar *ff* on actuator L2 and with the compression spring member *S* on contact L3. As indicated with arrows *c1*, *c2* in Fig. 9, the springs *ps* and *pf* will yield during the passage of the contact members through the intermediate position of Fig. 9, bending in the sense that the notched pivot spring portions approach each other as shown in Fig. 9. This spring action assists considerably in the movement of the switch structure and the snap action. The spring contact member *S* is not necessarily fully straight in an intermediate position such as shown in Fig. 9, but it might go through various shapes. The mechanically and electrically beneficial characteristics of this movement will be described somewhat more in detail below, with reference to these figures as well as to Fig. 13.

Figs. 2 to 6 indicate a particularly practical way of mounting a switch of the above described type, in a housing especially suited for that purpose.

In Figs. 2 to 6, the switch assembly 30 is shown as having an essentially parallelepipedal housing 31 made of moldable insulating material with a bottom part or base 32 and a top part or cover 33.

The outer surface of the bottom part 32 is essentially smooth with the exception of two ribs or barriers 35, 36 on the outside of the bottom wall. The inside of the bottom part has four levels relatively to the circumferential rim 40 which fits the corresponding rim 80 of the top part 33. The highest and next to highest levels are formed by the extensions 41 and 42 which are higher than 40 (Figs. 2 to 5), and the two lower levels are formed by surfaces 43 and 45. At a level intermediate of 43 and 45 is provided a three sided recess 44 in surface 43.

The bottom part or base 32 has three transverse perforations 61, 62, 63 and two lateral perforations 65, 66.

The top part or cover 33 of the housing 31 has a groove 81 running the entire length, and on the inside (Fig. 2) it has two ledges defining three symmetrical levels indicated at 85, 86, 87, 88, 89. The top 33 also has two transverse holes 91, 92 corresponding to and having the same diameter as holes 61 and 62 of the bottom part 32.

The top part 33 has also a center hole 93 for the shank of an operator 311 to be described hereinbelow.

The switch is assembled by means of special rivets 150 as shown in Figs. 2 to 5. Prior to assembly, such a rivet has a tubular shank 150.1, a flange 150.2, and two lugs (not shown) which fit recesses in the housing wall. It also has an inside thread 150.3. Upon assembly, the end 150.5 is spun or otherwise expanded over the housing surface which is opposite the flange or head 150.2, as indicated in Figs. 2 to 5.

Various screws, bolts or other threaded fastening members can be used for assembling the switch or for fastening it to other construction components. As indicated in Figs. 2 to 5, screws 161 and 162 can be used to fasten the top part 32 to the bottom part 32. If desired, these can be used for holding terminal strips. Screws 171 and 172 can be used for fastening terminal lugs or strips to the base portion 32. In either case, the hollow rivets establish electric connections between the switch contacts and the terminals. If only base terminals are used, insulating such as nylon screws can be used at 161, 162, providing a fully insulated cover.

Referring now to Figs. 2, 3 and 6, a snap action switch of the present type is mounted within the housing 32, 33 by means of rivets 150, 151 and 152. The movable contact element 30 of this snap switch consists of a frame member 301 and a spring member 302, corresponding to members *F* and *S* of Fig. 1, and also shown in Fig. 6. Spring and frame are pivoted on two compensating pivot springs 305 and 306 corresponding to members *ps* and *pf*

of Fig. 1 with hooks 307, 308, respectively. The stationary contact springs 111 and 112 are fastened between the housing and flanges of their rivets 150 and 151. Two actuators 311 and 312 are provided, each having a push-button portion 314 and 315 respectively. The snap switch operating points 317 and 318 contact the spring member 302 in one or the other position as shown in Figs. 2 and 3, respectively. With the snap switch in the position of Fig. 2, if the actuator 311 is depressed the spring 302 will be bent downwardly and the frame snaps upwardly just as soon as the spring bow passes the pivot line defined by the pivot points of hooks 307 and 308. The spring switch thus snaps into the position shown in Fig. 3, and actuator point 318 then rests on the downwardly bent spring member 302. For returning the switch into the previous position, button 312 is pressed and the spring snaps back into the position of Fig. 2.

Figs. 4 and 5 show a spring return snap-action switch. This embodiment is exactly similar to that shown in Figs. 2, 3 and 6, with the exception that a somewhat different pivot spring arrangement is used, and the actuator 312 is replaced by a resilient stop member such as button 321 suitably fixed to the rivet 151. When the actuator 311 is depressed from the position of Fig. 4, the spring 302 bending downwardly contacts the button 321 which bounces it into the position shown in Fig. 5 whence it returns automatically into the initial position according to Fig. 4. Thus one actuating operation of push-button 311 causes the making of momentary contact at 112 and then returns the snap element into contact with stationary contact 111.

In the embodiment according to Figs. 4 and 5, only a single pivot spring 305.1 is used, whereas the hooked strip 306.1 is practically rigid. This embodiment provides the above discussed improved functions, such as better wiping, to a degree that is satisfactory for many purposes. Since compensation for the elongation of the spring member 302 is one of these improved functions, the single spring pivot member is preferably applied to the spring member 302, although it might sometimes be used with the frame member 301.

The actuating members of switches of this type can be provided with tell-tale marks such as indicated at 311.5 of Fig. 4 and at 311.6 of Fig. 7. These marks consist conveniently of recessed or set-off portions of the push button pin, to which colored, such as red, paint or other material is applied.

Figs. 11 and 12 show a snap action spring according to the present invention, incorporated in a timing device according to my Patent No. 2,542,085 of February 20, 1951. This timer incorporates a disc 52 carrying a switch *s1* and a disc 47 carrying an actuator pin 49. In the present embodiment, the switch *s1* is mounted on a plate 52.1 having a collar 52.2 around a hub 52.5 of the disc 52, such that, by means of a set screw 52.6 the switch can be rotatably adjusted. The finger or pin 49 of the rotating disc 47 extends between discs 47 and 52. Fig. 11 shows the flush end of the pin where it is fastened to the disc 47. The operation of the timer apparatus is irrelevant for present purposes, excepting the fact that the pin 49 moves towards and into the cam recess 61 in the direction of arrow *a*, rotating the switch actuator in the manner to be described below, and then retracts in the direction of arrow *b*.

Referring now also to Figs. 13 to 18, the construction of another embodiment of the snap switch according to the invention, here serving as switch *s1* of the timer, is as follows. Fastened by conventional means to the plate 52.1 is a frame 63 made of insulating material and having a liner 63.1, a back-plate 63.2, baseplates 63.31 and 63.32, two columns 64.1 and 64.2, and a top plate 63.5. The baseplates 63.3 are joined to the respective columns 64.1 and 64.2 by screws 63.35 and 63.36. The baseplates confine between them a conductor L6 in the man-

ner to be described hereinbelow. The pivot springs *ps* and *pf* (compare Fig. 1) are fastened between the baseplate 63.31 and the columns 64. The top piece 63.5 has an opening 63.51, for the actuator 71 now to be described.

A pivot pin 72 is riveted to the plate 52.1 and rotatably supports at its other end, between two flanges 72.1, 72.2 a cam piece 71 made of insulating material. As shown in Fig. 13, the cam piece has two stop faces 71.11 and 71.12, a notch 71.2 for actuating the switch cross bar *ff* (compare Fig. 1), and the above mentioned adjustable cam recess 61. This cam recess has two sides, namely a fixed side or face 61.1 and an adjustable side or face 61.2. The later is part of a slide piece 62 (Figs. 13 and 18) which, by means of a dovetail groove and key 62.1 and a set screw 62.2, is adjustable on the stop extension 71.12 of the cam piece proper 71, in a direction that is essentially parallel to the path of the pin 49.

The snap switch proper *s1* is constructed according to the principles pointed out with reference to Fig. 1 but it will be noted that both ends of each pivot spring are clamped between the baseplate 63.31 and the columns 63.4. In this manner the bar spring *pf* permits a slight upward movement whereas the M-shaped spring *ps* permits considerable movement in both horizontal and vertical direction as indicated by arrows *c* and *d*. Two adjustable contact pins L3 and L4 (compare Figs. 8 to 10) are fastened in the columns 64.1 and 64.2 respectively, making contact with the spring contact member *S* at contact points LS. Terminal strips L5 and L6 are attached to the fixed contacts L3 and L4 respectively, and the spring *ps* has a tail strip *m*. These members constitute a single pole, double throw switch as indicated in Fig. 19.

In order to adjust the swing of the cam piece 71, stop members such as two set screws 75.1 and 75.2 are provided in columns 64.1, 64.2 with their heads countersunk into the top plate 63.5 when in their deepest position. These stop members or adjusting screws contact the faces 71.11 and 71.12 and limit the movement of the cam piece, as clearly indicated in Fig. 13.

It will be observed that in the embodiment according to Figs. 11 to 18, the lower pivot spring *pf* moves mainly in the vertical direction *c* whereas the upper spring *ps* moves vertically in *c* as well as horizontally in *d*. This not only increases the contact pressure and contributes to the wipe action, but provides also for clearance of the actuating notch 71.2; accidental contact at the region where the top of the cross piece *ff* approaches the bottom of the notch 71.2 is alleviated by the give of the spring *ps*.

The operation of switches built according to Figs. 1 to 10 having been described above, there remains to be described the operation of the embodiment according to Figs. 11 to 19, as follows.

The main purpose of the cam arrangement according to these figures is to provide in a given control installation sufficient time for a timer to reset the next timer in a chain of timers, whose solenoids require a certain time to pull in, or for similar functions.

Since the switches necessarily vary somewhat with respect to their exact snap points, the angular position of the switch *s1* relatively to the timer as a whole is first adjusted with the aid of the set screw 52.6, as explained above with reference to Fig. 11, rotating the switch sleeve 52.1 on its hub until the click point for a given disc position is attained.

As clearly indicated in the series of schematical representations, Figs. 14 to 17, a mechanical time delay is introduced by way of the configuration of the cam recess 61 that engages the pin 49. The cam recess is effective in both directions of the pin travel, with face 61.1 on the forward and with face 61.2 on the return travel. However a delay is effected between the forward and back stroke, as indicated in Fig. 15 by the difference be-

tween the two pin positions indicated by the center lines with arrows *a* and *b* respectively. These arrows correspond to arrows *a* and *b* of Fig. 11. There is thus a positive delaying travel introduced before the second click, on the return stroke. The gap of 61 can be adjusted by means of the above described movable jaw 61.2 of slide piece 62, and it will now be evident that the period between the first click, corresponding to arrow *a* of Fig. 15 and the second click corresponding to the position of the arrow *b* can be conveniently adjusted. It will be noted that in this instance the switching takes place similarly to that of the switch described with reference to Figs. 2 and 3, one actuation corresponding to each transfer of contacts, where of course the actuation takes place by means of members such as L1 and L2 of Figs. 8 to 10, here the sides of the notch 71.2. The delay between the forward and back strokes can thus be individually and positively controlled within the cycle of operation of the timer by means of the adjustable faces 71.11 and 71.12. In addition, the timing can be controlled by adjusting the swing of the cam notch 61, so that more than the usually available mechanical delay is provided for the safe pull-in of solenoids, or for similar purposes. A still further time delay is introduced by the movable pivot point of the contact *F* which moves down when the force of the actuator cam 71 begins to act, and thus introduces a small time delay by way of this shift of effective pivot.

It will be observed that this function is made possible through the use of a switch action according to Figs. 2 and 3, with an actuation for each contact transfer—but could not be carried out with an action according to Figs. 4 and 5.

Common to the operation of all embodiments of the invention are the following beneficial effects.

First of all, the spring pivots *pf* and/or *ps* introduce a wiping action, as indicated at *c* of Fig. 13, which is superior to any such action heretofore possible, since it is due not merely to an eccentricity but to actual longitudinal movement of the contact spring in the direction *c*.

The lateral movement such as indicated at *d* of Fig. 13 increases the snap action by a certain kick-out in the indicated direction, which assists the horizontal component of the snap frame and spring contact construction as a whole.

Furthermore, the contact pressure increases just prior to the snap action due to the fact that the pivot springs are at the instance at maximum deflection and therefore exert the highest pressure, indirectly applied at the point of contact.

Still further, the action of the new snap switch is faster since the pivot springs can provide a give by way of two elements instead of one that is, if both movable contact members *F* and *S* are provided with pivot springs, both the frame as well as the spring will give from the first moment when the swinging action is initiated.

The slight time delay that is introduced by the pivot springs is discussed above with reference to the use of such switches in timers.

It will be evident that the above described snap spring construction can be used with actuators in the position of components L3, L4 of Figs. 8 to 10, such as used in Figs. 2 to 5—that instead these components can be fixed as at L3 and L4 of Fig. 13—that the electrical contacts and terminals can be arranged accordingly, and that M-shaped pivot springs such as shown in Figs. 1, 11, 12 and 13, can be used instead of the springs illustrated in Figs. 2 to 10.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A quick action switch comprising: a mounting base

having pivot support means, fixed contact means, and two stop means opposite each other; a first snap member having an essentially rigid frame which has a pivot end adjacent to said pivot support means and a swinging end with frame pivot means, and which extends into the space between said stop means; a second member having a spring and extending from adjacent to said pivot end to said frame pivot means, for quickly moving said snap members between said stop members; movable contact means carried on at least one of said snap members for contacting with said fixed contact means of the mounting base; and pivot spring means on said pivot support means for pivoting with longitudinal yield at least that one of said snap members which carries said movable contact means; whereby said pivot spring means assist in said quick movement, impart to at least one of the snap members a wiping movement, and permit increased contact pressure and a delayed quick movement.

2. A switch according to claim 1 further comprising two actuator means mounted on said base on either side of said members, whereby deflection of said members by one of the actuator means propels it towards the other actuator means with the assistance of said pivot spring means.

3. Switch assembly according to claim 1 wherein a switch actuator member extends from one side of said base towards said members.

4. Switch assembly according to claim 1 further comprising a resilient stop means and an actuator means opposite said stop means with said members extending between said actuator means and said resilient stop means, whereby deflection of said members by the actuator means propels it towards the stop means which propels it back towards the actuator means.

5. A quick action switch of the type having a base, fixed contact means on the base, pivot mounting means on the base, a movable tensioned contact member, and a movable compressed spring contact member, one of said contact members being arranged for making contact at one of said fixed contact means on the base, said contact members having adjacent pivot ends located for pivoted support on distinct pivot points near said pivot mounting means on the base and said contact members being pivoted on each other at their other ends for rotation on said pivot points to cause varying tension of said spring contact member, combined with pivot spring means inserted between said pivot mounting means and the pivot point of that contact member which is arranged for making contact at one of said fixed contact members on the base, whereby said spring supported pivot point is free to change its position during said rotation, said pivot spring means assumes part of the compression of said spring contact member, and the respective contact member is enabled to move longitudinally with wiping contact relatively to the fixed contact means on the base.

6. Switch according to claim 5 wherein said pivot spring means is M-shaped with the ends of the legs mounted on said base and with the intermediate depression constituting the pivot for its contact member, deformation of said pivot spring means causing longitudinal as well as transverse variation of the distance between the base and the contact member that is pivoted on said pivot spring means.

7. Switch according to claim 5 wherein said pivot spring means is a leaf mounted on one side on said base and having on the other side a depression constituting the pivot for its contact member, bending of the leaf varying the distance between the base and the contact member that is pivoted on said pivot spring means.

8. Switch according to claim 5 wherein said pivot spring means is a curved band extending from the base towards its contact member in the general direction of said contact member, its deformation varying the distance between base and said contact member.

9. Switch according to claim 5 wherein said base has two spring mounting means on respective sides of said movable contact members, wherein said compressed spring contact member is pivoted on an M-shaped pivot spring member extending transversely between said spring mounting means, and said tensioned contact member is pivoted on a bar-shaped pivot spring member extending between said mounting means.

10. Switch according to claim 9 wherein said M-shaped as well as said bar-shaped pivot spring members are symmetrical to said base and to said points.

11. Switch according to claim 5 further combined with two stationary contact members extending from said base towards the approximate center of said contact members; and with cam means pivoted on said base adjacent to said other ends of said contact members, said cam means having a notch for engaging said other ends, and a cam recess for engagement with an actuating means.

12. Switch according to claim 11 further comprising stop members on said base adjacent said cam means, and corresponding stop faces on said cam means, whereby the movement of said other ends by said notch is limited by said stop members and stop faces.

13. Switch according to claim 12 wherein said stop members and stop faces are relatively adjustable whereby the travel of said cam means and hence the actuation of the switch can be varied.

14. Switch according to claim 11 wherein said cam recess has two faces for contacting a pin-shaped actuating means, with clearance between said faces for providing a time lag upon return movement of said actuating means.

15. Switch according to claim 14 further including means for adjusting said clearance, whereby said time lag is adjustable.

16. Switch according to claim 5, wherein said pivot spring means includes means for yielding in the general direction of said contact members as well as in a direction obliquely thereto, both directions being generally in the plane of rotation of said movable contact members, whereby wiping movement and snap action of said movable contact members are promoted.

17. A device for actuating a quick action switch, comprising: base means for mounting said switch; an actuating pin mounted on said base means for movement relatively thereto; stop members fixed relatively to said base means; cam means pivotally mounted on said base means and including an actuating notch for engaging a movable contact means of said switch, stop faces on said cam means for contacting one or the other of said stop members so as to limit the angle of rotation of said cam means, and a cam recess having two cam sides such that one of said cam sides is in the path of said pin when a stop face rests on one of said stop members and that the other cam side is in the path of said pin when a stop face rests on the other stop member; whereby the distance of said cam sides determines a time delay between advance and return movements of said pin.

18. Device according to claim 17 further comprising means for adjusting one of said cam sides on said cam means.

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