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SNAP SWITCH

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Fig. 1.

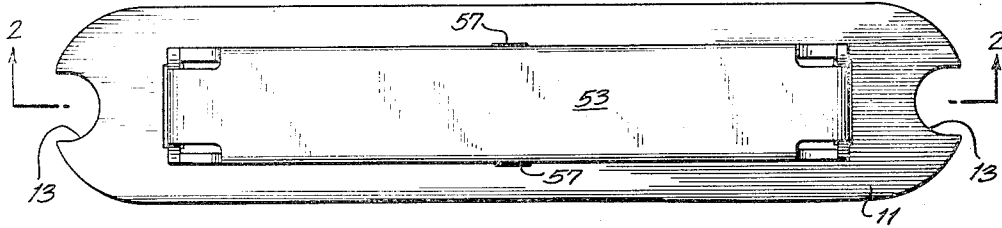


Fig. 2.

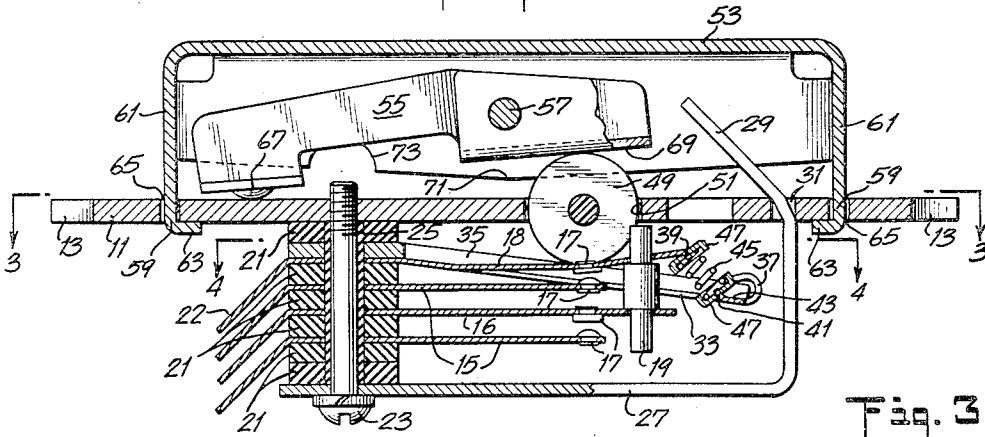


Fig. 3.

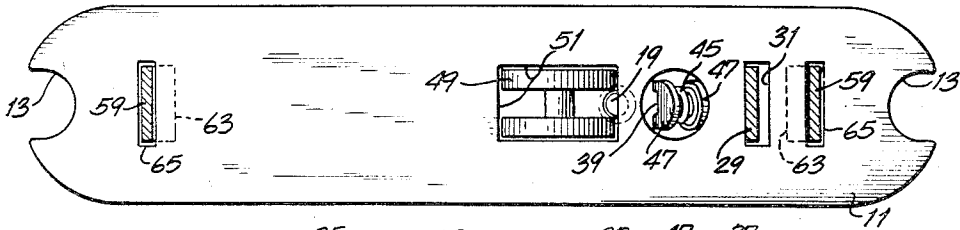


Fig. 4.

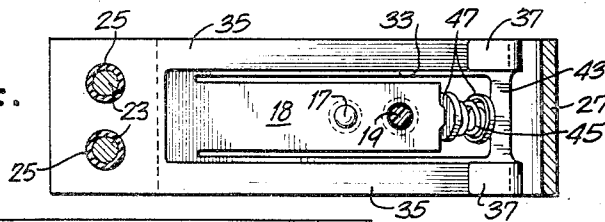
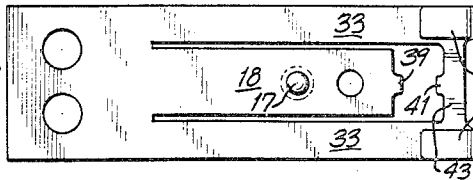


Fig. 5.



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SNAP SWITCH

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This invention is concerned with a snap switch. Certain features of the invention relate to a snap switch actuable by depressing any point along an elongated bar. Other features are of more general utility.

In snap action switches, it is required that the moving contact or contacts travel through substantial distances at high speeds in making and breaking, in order to minimize arcing at the contacts. Where the contacts are supported on flexible spring elements, this requirement for rapid motion through a substantial distance indicates the desirability of using light springs having a low spring rate.

Another requirement of switches generally, including snap action switches, is that the contacts be held together with substantial forces, in order to secure low contact resistance. Where the contacts are supported on flexible spring elements, this requirement indicates the desirability of using heavy springs having high spring rates.

These two opposing requirements commonly lead to a compromise in the design of a conventional snap switch, with some reduction in the speed and distance of the contact travel, and some increase in the weight of the spring, in order to secure optimum results. The working life of a heavy spring which is repeatedly flexed is somewhat lower than the life of a light spring similarly flexed. Consequently, the compromise design adversely affects the working life of the switch.

It is an object of this invention to provide a superior snap switch having a combination of light and heavy springs acting together and so arranged that the heavy spring provides most of the working force while most of the travel is performed by the light spring so that the flexing of the heavier spring is kept to a minimum and the working life of the switch is greatly prolonged.

Another object of this invention is to provide a snap switch having the long-life characteristics indicated above while at the same time maintaining a superior current-carrying path within the elements of the switch.

Another object of this invention is to provide a relatively small size snap switch having a cylindrical actuator that is translated laterally to actuate the switch and is rotated a small amount each time the switch is actuated so that the actuator is given an even wear over its entire periphery, thereby greatly prolonging the life of the switch.

Another object of this invention is to provide improved switch actuating mechanism including an elongated bar spring biased to an extended position and means effective to actuate the switch upon depression of any point along the bar.

Briefly, the snap switch according to this invention comprises a main support member, a relatively light spring, a relatively heavy spring located adjacent to said light spring, means for mounting said springs on said support member, resilient means operatively connecting flexible portions of the two springs in order to cause a snap action when the flexible portions are translated relatively to one another so as to cause a reversal of this relative position,

and contact means located for actuation by one of said springs so as to produce a snap-type of circuit-making and breaking action. The switch also includes a cylindrical actuator which is translated laterally to actuate said switch and means for rotating said actuator through a small angle each time the switch is actuated in order to create even wear of the actuator periphery and long life of the switch.

One embodiment of the invention is set forth below and includes the various elements illustrated in the drawings by way of example. Like reference numbers refer to like parts in the various figures.

Referring to the drawings:

Fig. 1 is a plan view of the entire switch as assembled;

Fig. 2 is a cross-sectional elevation, taken along the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is another cross-sectional view taken along the line 4—4 of Fig. 2; and

Fig. 5 is a plan view of the topmost compound spring element of the switch.

The snap switch according to this invention is of a simple and yet rugged construction and various metals or other materials may be employed in the construction of the various elements thereof. However, it is preferred to use simple steel stampings for many of the elements. The current-carrying members are constructed of Phosphor bronze, tempered copper, or the like. The contacts are of any satisfactory metal, such as silver. A main support plate, or body portion 11, may be constructed of various metals or other materials but is preferably stamped from a relatively heavy gauge ferrous metal. This body member 11 may take any desired shape but is illustrated as being an elongated strip having rounded ends with semi-circular indentation 13 for mounting the switch. Attached to the body member 11 there is a stack of contact-carrying springs 15, 16 and 18 which may be constructed of copper or the like material having sufficient temper to provide the necessary spring action. Contact studs 17 are attached in the usual manner, as by riveting, welding or brazing near the extremities of the springs. In the illustrated switch there are two springs 15, a middle spring 16 and an upper spring 18 (Figs. 2, 4 and 5). The upper spring 18 is the center tongue of a compound part as will appear in more detail below. The springs 15, 16 and 18 together go to make up a pair of switches that are actuated simultaneously by means of a spacer 19 which is inserted through holes in the spring 18 and the spring 16 located near the free ends thereof. Spacer 19 may be of any desirable insulating material.

Although only two pairs of contact studs 17 have been illustrated, it will be clear that any desired number of additional pairs of springs and accompanying contacts might be mounted in the stack, physically parallel with those springs illustrated. Of course, only a single pair might be employed if desired.

The switch illustrated provides single-throw action. To secure double-throw action, additional contacts (not shown) might be located for cooperation with the movable studs 17 in order to have contacts closed when the elements are in the upper position as illustrated, which contacts would be open when the illustrated contacts are closed. As before, an arrangement might be had whereby a single pole, double-throw switch is obtained.

The springs 15, 16 and 18 are supported in a spaced-apart manner by insulating blocks 21 which are secured in a stack to the support member 11 by means of a pair of machine screws 23. Screws 23 are threaded into the support member 11 and have insulating sleeves 25 surrounding them. Below and to the right of the springs 15 and

contact studs 17, as the parts appear in the drawing, there is a protective strip 27 bent into a right angle shape and having a narrow tongue 29 at one end thereof, which tongue is inserted through a rectangular slot 31 in the support plate 11, for a purpose to be described below. At the other extremity of the strip 27 there are a pair of holes to receive the machine screws 23. The stack of insulating blocks 21 are interleaved with the springs 15, 16 and 18 and assembled together with the protective strip 27 by the machine screws 23, and the whole group is held securely in place on the body 11 by the screws 23.

The upper spring or tongue 18 is part of a compound structure as will be observed by reference to Fig. 5. This structure also includes a portion 33 having the general form of a hollow rectangle. The tongue 18 projects inwardly from the left-hand side (as it appears in the drawings) of the hollow rectangular portion 33. This portion 33 is backed up, except at its right-hand end, by a relatively heavy gauge bifurcated spring element 35 (see Fig. 4). Intimate contact is maintained between the free ends of heavy spring 35 and hollow rectangular portion 33 of the compound element, by a pair of curved tips 37, formed on the right-hand end of portion 33, that clip over the ends of heavy spring 35.

A pair of projections 39 and 41 are located respectively at the free end of the upper spring 18 and on the inside of a bridging section 43 of the hollow rectangular portion 33. These projections 39 and 41 cooperate with a pair of spring retaining collars 47 having narrow slots therein of a size to receive the projections 39 and 41. A spring 45 is retained between the collars 47.

It should be noted that the entire compound spring structure, including tongue 18, the hollow rectangular portion 33, and the heavy spring 35, cooperate in carrying electric current to the contact button 17 on tongue 18. Specifically, current entering this structure through button 17 may flow inwardly along the tongue 18 to the left-hand end of the hollow rectangular portion 33 and thence to the terminal 22 attached to its base, or it may flow outwardly along tongue 18, through retainers 47 and spring 45 to bridging section 43, and thence along the sides of the hollow rectangular portion 33 to the terminal 22. Wherever the heavy spring member 35 contacts hollow rectangular portion 33, that heavy spring member provides a parallel current path. Consequently, the resistance of the current path is substantially lower than in prior art structures.

A generally cylindrical actuator 49 engages the upper surface of the tongue 18 and is restrained against lateral movement by being loosely received in an opening 51 in the plate 11. The actuator 49 is vertically movable downward to shift the parts from the open contact position shown to a closed contact position in which the respective pairs of studs 17 are in engagement. In the construction shown, the central portion of the actuator 49 is cut away to clear the upper contact stud 17 and the upper end of spacer 19, so that the actuator 49 is spool-shaped. The configuration of the actuator 49 may take other forms, e. g., it might be spherical.

The actuator 49 is biased upwardly by the sum of two spring forces, both of which are transmitted to the actuator through the leaf spring 18. One of the two forces is supplied by the leaf spring 16, acting through the spacer 19 upwardly on spring 18. The other, and larger of the two forces is supplied by the heavy leaf spring 35 and the cooperating hollow rectangular leaf spring portion 33. This force acts upwardly through coil spring 45 at the end of leaf spring 18. These forces act upwardly on the cylindrical actuator 49, tending to move it through the hole 51.

These upwardly acting forces are restrained from moving the actuator 49 upward by cooperating actuating mechanism located above the plate 11. This mechanism includes an elongated hollow actuator bar 53, and a lever 55 pivoted on a shaft 57 extending transversely of the

hollow bar 55 substantially at its center. The left-hand end of lever 55, as it appears in the drawing, is provided on its lower surface with a button 67 which rides on the surface of plate 11. The right-hand end of lever 55 is provided on its lower face with a flat plane surface 69, which engages the upper portion of the periphery of actuator 49.

The upward forces acting on actuator 49 tend to rotate lever 55 counter-clockwise about shaft 57, thereby forcing button 67 against plate 11, and also tending to lift lever 55 and bar 53 bodily upwards. This upward movement of the parts is limited by a pair of extensions 59 on the ends of the bar 53, which extensions project downwardly through apertures 65 in the plate 11, and are provided with bent-over tips 63 which engage the under side of plate 11 and prevent upward movement of the bar 53 beyond the position shown in the drawing. The tongue 29 on the end of protective strip 27 projects within the hollow bar 53 and aids the extensions 59 and apertures 65 in guiding the bar against lateral tilting when it is depressed from the position shown.

When the bar 53 is depressed at any point along its length, the shaft 57 is moved downwardly. If one end of the bar is depressed, it pivots about the other end. If the middle of the bar is depressed, the whole bar may move bodily downward. In any event, shaft 57 moves downward, rotating lever 55 clockwise about the shaft 57 (while button 67 slides on the surface of plate 11), and driving actuator 49 downward. As this movement takes place, actuator 49 rolls a short distance along the plane surface 69, thereby changing its angular position and its points of contact with plane 69 and leaf spring 18. During the return or upward movement of the bar 53, the forces holding spring 18 in contact with actuator 49 and the actuator 49 in contact with plane 69 are reduced, so that the same rolling movement does not take place. Consequently, upon repeated actuations of the switch, the cylindrical actuator 49 is gradually rotated, continually advancing in one direction. The wear on the actuator is thereby distributed about its periphery, promoting long life of the actuator.

It is to be noted that the bar 53 may be constructed of various materials, but it is preferred to use a suitable gauge steel or the like material which may be stamped out flat and then bent into the shape illustrated. The bar 53 is preferably coated, as by plating, to protect it against undesirable corroding. The bar 53 has the lower edges of its sides shaped so as to form a shallow V having a lowest point 71 centrally located with respect to the length of the bar 53. There is a semicircular cut-out section 73 in each of the sides to provide ample clearance for the ends of the machine screws 23. The sides form a protective enclosure for avoiding any fouling of the actuation parts of the switch.

When the actuator 49 is moved downwardly upon depression of bar 53, it forces downwardly the free end of spring 18 and, through spacer 19, the free end of spring 16. As the spring 18 moves downwardly, coil spring 45 is compressed and the angle of its axis changes toward the horizontal. As that angle changes as described, the force components acting through coil spring 45, downwardly on the free end of heavy spring 35, and upwardly on the free end of spring 18, are reduced. If the switch-actuating force is constant or substantially so, then the actuator 49 and spring 18 move faster and faster as this opposing force is progressively reduced. At the same time, the free end of heavy spring 35 moves upwardly until it reaches substantially its unstressed position when the axis of coil spring 45 is horizontal. When the end of spring 18 passes the horizontal level of the free end of heavy spring 35, then the force of coil spring 45 begins to act downwardly on the end of leaf spring 18, and upwardly on the free end of heavy spring 35. The switch actuating force is now aided by the coil spring,

5

and by the force of heavy spring 35 acting through the coil spring, and the springs 18 and 16 move even faster, completing their stroke with a snap and closing their contacts with an impact.

When the bar 53 is released, the leaf springs 16 and 18 move back toward the positions shown. At first, they move under their own force and are opposed by coil spring 45. After the spring 45 passes its horizontal position, it aids the upward movement of springs 16 and 18, being then backed up by the force of heavy spring 35.

From the foregoing, it may be observed that the moving contacts 17 are supported on light, readily flexible leaf springs which are capable of rapid movement and which move through substantial distances. On the other hand, most of the force for movement of the contacts into engagement and for holding them in engagement is derived from the heavy spring 35, which travels only a short distance during operation of the switch and which is therefore flexed only slightly, so that the working life of the switch is prolonged.

An advantage of using the hollow construction of the bar 53 in conjunction with the lever 55 and the broad flat surface 69 thereof, is that the switch may be employed for foot operation or other uses such that rough usage is to be expected. In such case the bar 53 may become deformed, as by being racked under side forces etc., without substantially changing the height of the operative surface of the lever 55 above the surface of the body or support member 11. This is most particularly true where the actuator 49 is spherical in configuration. Consequently the operation of the switch will not be impaired as a result of such rough usage.

Various modifications of the structure shown may be employed within the scope of the invention. For example, although it is usually preferred to actuate the switch by moving the lighter spring member, as shown, it may in some cases be desirable to actuate it by moving the heavier spring member. In that event, a shorter travel of the switch actuator may be utilized to produce the same contact travel, but a greater actuating force is required. As another alternative, the inner spring member, such as tongue 18, may be made heavier, while the outer spring member, such as rectangular portion 33, is made lighter. It is always best in either case, to mount the contact button on the lighter spring, since it travels farthest. While some of the benefits of the invention may be secured in a structure where both the inner and outer spring members are of the same strength, and thickness, such an arrangement is not preferred in the usual case.

The actuator 49 may be constructed of any material having satisfactory strength and wearing qualities. It has been found that the use of nylon for this element (actuator 49) is highly satisfactory since this material has a desirable resilience as well as long wearing properties and adequate strength.

It may be observed that the switch according to this invention is simple in construction while at the same time being rugged and long lasting. Furthermore, the parts are largely such that they may be formed from simple stampings and consequently the construction costs may be maintained at a minimum.

While there has been illustrated a specific embodiment of this invention in accordance with the applicable statutes, this is not to be taken in any way as limiting the invention, but merely as illustrative thereof.

What is claimed is:

1. Switch actuating means comprising a frame member, an elongated bar supported on said frame member for movement toward and away from the frame member, a lever mounted on said bar for pivotal movement about an axis extending transversely of the bar substantially at its center, said lever having two opposed arms, a switch, an actuator for said switch mounted on said frame member in alignment with one arm of said lever and movable

6

toward and away from said one arm of the lever; means biasing said actuator into engagement with the lever and tending to rotate the lever about said axis to bring its other arm into engagement with the frame member and thereafter to rotate said lever about the point of engagement of the other arm and the frame member as a fulcrum and thereby to move said bar bodily away from the frame member, means limiting the movement of the bar away from the frame member, said bar and lever cooperating upon movement of any point along said bar toward said frame member to move said actuator against said biasing means.

2. Switch actuating means comprising a frame member, a round actuator mounted for rotation and translation along a line transverse to its axis of rotation in said frame member, a driving member movably mounted on said frame member and aligned with said actuator, a switch, including a movable element aligned with said actuator on the opposite side thereof from the driving member, means biasing said element into engagement with the actuator and tending to hold the actuator in engagement with the driving member, said driving member being movable toward the actuator to translate said actuator and said element and thereby to actuate the switch, and means including said driving member for advancing said actuator angularly on its axis in a predetermined direction upon each actuation of the switch, so that the wear on said actuator during successive actuations is distributed about its periphery.

3. A snap-acting switch comprising a relatively light leaf spring member, means fixedly supporting one end of said spring member, said spring member comprising three parallel spring fingers projecting from said one end, the middle one of the three fingers being shorter than the two outer fingers, a relatively heavy leaf spring member mounted at one end on said supporting means adjacent said light spring member, said heavy spring member comprising two parallel spring fingers having flat sides abutting against flat sides of said two outer fingers of the light spring member, a bridge connecting the free ends of said outer fingers and of said heavy fingers for concurrent movement, a coil spring, and means retaining said coil spring between said bridge and the free end of said middle finger, said coil spring being effective as an over-center spring to bias said middle finger to either of two positions on opposite sides of said outer fingers said spring members and said coil spring cooperating to move by snap action between first positions wherein the middle finger is on one side of the plane of the outer fingers and second positions wherein the middle finger is on the opposite side of the plane of the outer finger, said middle finger having a travel between its first and second positions substantially greater than the travel of the outer fingers between their first and second positions, a first contact carried by said middle finger and moved thereby between two positions, and a second contact positioned to be engaged by said first contact in one only of its two positions.

4. A snap-acting switch as defined in claim 3, in which said spring members and said coil spring are self-biased to said first positions, and including an actuator to move said middle finger to its second position and thereby to move said outer fingers to their second positions.

5. A snap-acting switch as defined in claim 4, in which said actuator comprises a cylinder, a plate-like frame member having a thickness substantially less than the diameter of the cylinder and having an aperture dimensioned to receive the cylinder loosely with its axis generally parallel to said plate-like member, said cylinder being rotatable on its axis and translatable through said aperture, a driving member movably mounted on the frame member and aligned with the cylinder, said middle finger being aligned with the cylinder on the opposite side thereof from the driving member and engaging said cylinder, said driving member and said middle finger cooperating

7

to retain said cylinder in said aperture, said driving member being movable toward the cylinder to translate said cylinder and said middle finger and thereby to actuate the switch, and means including said driving member for advancing said cylinder angularly on its axis in a predetermined direction on each actuation of the switch, so that the wear on said cylinder during successive actuations is distributed about its periphery.

6. A snap-acting switch as defined in claim 5, in which said driving member comprises a lever, an elongated bar supported on said frame member for movement toward and away from the frame member, said bar normally extending parallel to said frame member, means pivotally connecting said lever to said bar substantially at the center of the bar, said lever having two opposed arms, one aligned with said cylinder and movable toward and away from said cylinder, said springs being effective to bias said cylinder into engagement with said one arm of the lever and tending to rotate the lever about its pivotal connection to bring its other arm into engagement with the frame member and thereafter to rotate said lever about the point of engagement of said other arm with the frame member as a fulcrum and thereby to move said bar bodily away from the frame member, means limiting the movement of the bar away from the frame member, said bar and lever cooperating upon movement of any point along the bar toward said frame member to move said actuator and operate the switch.

7. Switch actuating means comprising a frame member, an elongated bar extending generally parallel to said frame member and supported thereon for movement toward and away from the frame member, a lever mounted on the bar for pivotal movement about an axis

8

extending transversely of the bar substantially at its center, said lever having two opposed arms, a switch, an actuator for said switch comprising a cylinder mounted in said frame member for rotation about its axis and translation in a direction transverse to its axis of rotation, said cylinder being aligned with one arm of said lever, said one arm having a substantially plane surface for rollingly or slidingly contacting said cylinder, said switch including means biasing said cylinder into engagement with said one lever arm and tending to rotate the lever about said axis to bring its other arm into engagement with the frame member and thereafter to rotate the said lever about the point of engagement of the other arm with the frame member as a fulcrum and thereby to move said bar bodily away from said frame member, means limiting the movement of the bar away from the frame member, said bar and lever cooperating upon movement of any point along the bar to move the cylinder against the biasing means, said lever being then effective to translate the cylinder and the switch and thereby to actuate the switch, said lever being effective to rotate the cylinder during translation thereof in one direction by an amount greater than the rotation thereof during translation in the opposite direction, whereby the actuator is advanced angularly in a predetermined direction upon each actuation of the switch, so that wear on the actuator during succeeding actuations is distributed about its periphery.

References Cited in the file of this patent

UNITED STATES PATENTS

2,402,838	Obszarny	June 25, 1946
2,470,613	Gaynor	May 17, 1949
2,507,065	Trautmann	May 9, 1950