Feb. 15, 1944. W. DUBILIER 2,341,858

SNAP SWITCH

Filed Jan. 7, 1942

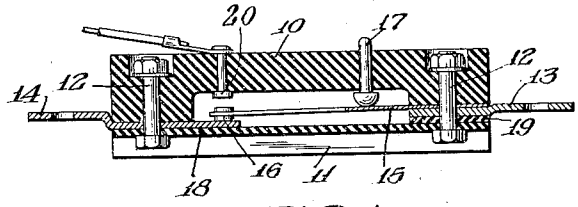


FIG. 1.

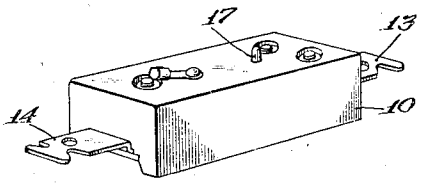


FIG. 2.

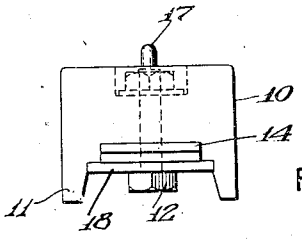


FIG. 3.

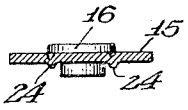


FIG. 7.

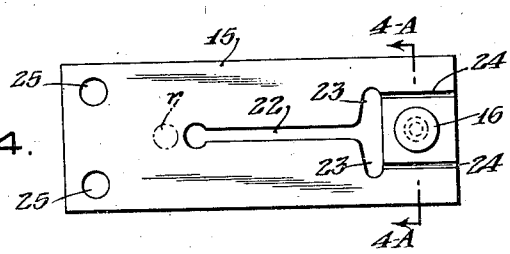


FIG. 4.

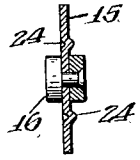


FIG. 4-A.

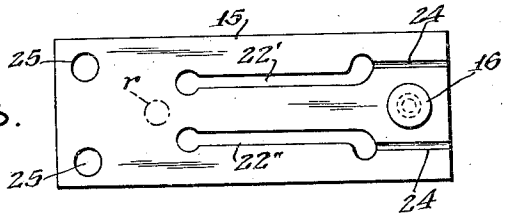


FIG. 5.

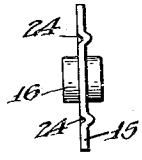


FIG. 5-A.

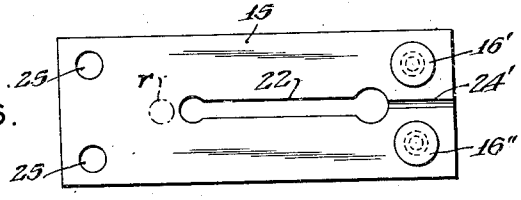


FIG. 6.

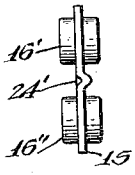


FIG. 6-A.

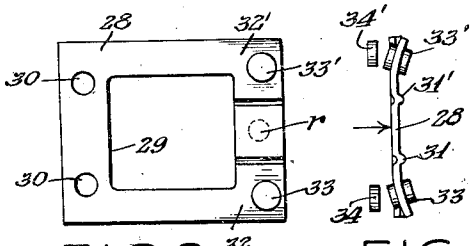


FIG. 8.

FIG. 9.

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SNAP SWITCH

William Dubilier, New Rochelle, N. Y.

Application January 7, 1942, Serial No. 425,831

8 Claims. (Cl. 74—97)

The present invention relates to electrical switches of the snap-action type which are adapted to interrupt substantially large currents upon relatively minute physical application of pressure or displacement. More particularly, the invention is concerned with switches of the type comprising essentially a flat leaf spring which has a region adjacent to a fixedly mounted end thereof biased or strained internally to give a material displacement of the opposite free end of the spring with a jerk or snap action upon application of a relatively small movement or pressure to said strained region.

Various types of snap-action switches have been known in the past all of which are defective and have disadvantages in one or the other respect. Thus, one basic construction, as exemplified by U. S. Patent 1,215,665 to H. Landis, comprises a flat spring arranged between two rigid bearings or abutments in such a manner as to assume a curved or arched position. In such a position the spring is held under tension and may be shifted in the manner of a toggle by a comparatively small force to a neutral position from whence, owing to its elasticity, it will proceed by a jerk or snap movement to a position of opposite curvature in the manner of a toggle.

Another construction, as exemplified by U. S. Patent 1,089,167 to G. W. Wacker, comprises a spring blade provided with a longitudinal slot, the portion on one side of the slot being secured rigidly and the portion on the other side of the slot being bent at its opposite ends so as to assume a curved position from which it may be displaced by the application of a small force to a position of reversed curvature with a snap action in a manner similar to that according to the first-mentioned patent.

A method of constructing a switch of the first-mentioned type utilizing a curved or arced spring secured or supported at its opposite ends is disclosed in Patent 1,668,974 to A. J. Mottlau. The latter utilizes a double-slotted flat spring to provide a bridging member between the slots which serves as the actuating spring member, being curved or arched by deformation by the outer spring portions.

Numerous other snap switches have become known in the past consisting essentially of a longitudinally confined spring normally bowed or arched on one side or the other of its dead center and adapted to be thrown against its dead center by means of a suitable connection with a pressure applying element such as an actuating plunger or thermal expansion device or directly by internal strain or displacement caused by heat when using a spring of bi- or multi-sheet metal responsive to temperature changes.

A basically different type of snap-action device to which the present application has specific reference, as exemplified by U. S. Patent 1,448,240 to J. A. Spencer; 1,780,758 to H. G. Leupold; 1,849,481 to P. De Langie et al., comprises a leaf spring or blade secured at one end cantilever fashion so as to allow its opposite end to move freely between two positions of equilibrium with a snap action. To this end, a limited portion or region of the spring near the pivoted end thereof, that is, at the side opposite to the freely movable end, is caused to become internally biased or slightly buckled in such a manner that application of a small force to said biased region will cause the free end of the spring to move over a relatively large distance with a sudden or snap action from one to an opposite position of equilibrium.

In the construction shown by U. S. Patent 1,780,758 the spring is biased by using a blade which is slit for a considerable part of its length with the sections or legs thereof being slightly bowed or forced towards each other and secured in this position by a contact serving as a bridging member.

A major disadvantage of all snap switches of the above described and similar types, especially the construction according to U. S. Patent 1,780,758, is the fact that great difficulties are experienced in the quantity production thereof due to the large number of rejections and despite the use of special assembly tools and other precautions taken. In particular, in the case of the last mentioned pivoted type of switch having a limited sensitive or biased region next the pivot point, the degree of bowing or forcing together the free ends of the spring blade is so minute as to cause substantial variations in the final units and a considerable number of defective units which are either completely unusable or not in compliance with the required tolerance range.

Accordingly, it is an object of the present invention to provide a novel snap-action device which is both simple in construction and easy to manufacture while, at the same time, insuring high uniformity in quantity production and accuracy and reliability in operation.

A specific object is to provide a switch of the above character which, while being highly sensitive and accurate in operation, is of an extremely low weight, especially as regards the movable element or contact so as to substantially prevent

accidental operation due to shock or other mechanical forces effecting the same.

These and further objects and advantages of the invention will become more apparent from the following detailed description taken with reference to the accompanying drawing forming part of this specification and wherein:

Figure 1 is a longitudinal cross-section through a switch embodying the principles of the invention; Figure 2 is a perspective view and Figure 3 a side view of the switch shown in Figure 1; Figure 4 is a top view showing one form of construction of the spring actuating member for use in a switch according to the invention; Figure 4—A is section taken on line 4A—4A of Figure 4; Figures 5 and 5—A are top and side views, respectively, of a modification of an actuating spring according to the invention; Figures 6 and 6—A are top and side views, respectively, of another modified actuating spring construction; Figure 7 is a cross-sectional view of an actuating spring showing a modification of the contact element; and Figures 8 and 9 are top and side views, respectively, of still a different type of switch construction in accordance with the invention.

Like reference numerals identify like parts in the different views of the drawing.

Referring to Figures 1 to 3, the switch shown comprises essentially a cast or molded insulating housing or support 10 which may be of any suitable material such as ceramic, Bakelite or similar insulating composition material. Support 10 has a cavity for containing the switch parts and is formed with opposed longitudinal legs 11 for supporting or mounting the unit upon a base. Suitable fastening means such as rivets or screws 12 are arranged to secure the switch parts against the housing 10. A first contact lug 13 overlying one end of the actuating leaf spring 15 is clamped against the support 10 by means of a pair of screws 12 passing through holes in lug 13 and spring 15, thus firmly supporting and securing one end of the spring member 15 cantilever fashion and effecting electrical connection between the spring member and the terminal lug projecting from one side of the housing. A second lug 14 is similarly clamped against the opposite end of support 10 by a third screw 12 and serves both as a cooperating contact for the spring contact 16 and as a connecting terminal element projecting from the opposite side of the housing 10. The actuating spring member 15 is properly internally strained or biased in the manner to be described presently to provide a sensitive region adjacent to its pivoted end cooperating with a push button 17 or the like slidably mounted in and projecting above the top face of the housing and serving to actuate the contact 16 into material displacement with a snap action upon application of a slight mechanical pressure upon button 17. An insulating plate of cardboard, Bakelite or the like is secured with screws 12 to provide a bottom protective covering for the switch elements. The spacer 19 interposed between lug 13 and plate 18 insures proper alignment and firm connection between the elements.

The switch shown may be used both as a make and break type. In the former case the cooperating contact is the inner end of lug 14 and in the latter case a further contact 20 provided with a suitable soldering terminal or the like may be arranged on the opposite side of contact 16, as shown in the drawing.

Referring now to the switching spring member proper, more particularly to the construction shown in Figures 4 and 4—A, the same comprises essentially a leaf spring or blade of suitable material such as spring steel, copper or beryllium bronze or the like provided with a T-shaped aperture comprising a central longitudinal slot 22 having one end terminating in two transverse slots 23. The portion of the blade between the transverse slots 23 and the adjacent edge is deformed by the provision of a pair of crimps or grooves 24 substantially parallel to the slot 22 and located near the outer ends of the slots 23 in such a manner as to provide a slightly buckled or internally biased region near the opposite pivoted end of the blade as indicated at r. The latter, if slightly depressed by means of push button 17 or the like as shown in Figure 1, will cause the free end of the spring carrying the contact 16 riveted or otherwise connected thereto to move suddenly from one position to another position of equilibrium with a snap action. Mounting holes 25 serve for securing the spring blade to the support or housing by rivets or screws as shown in Figure 1 or in any other suitable manner. In the drawing, the thickness of leaf spring 15 and contact 16 has been exaggerated for clearness and ease of illustration.

Among the advantages of a snap-action spring member of the afore-described type is the reduction of parts by the use of a single integral slotted spring element which is biased by a simple crimping or deforming operation and the resultant increased uniformity of the completed elements, resulting in considerable reduction of the number of rejections or defective units. Another advantage is the fact that the contact 16, which is of a different metal from the spring 15 such as silver-clad copper, may be limited to a size required by purely electrical considerations, thus not only reducing its weight but preventing impairment of the internal tension or bias of the spring member due to the different thermal expansion co-efficient of the spring and contact, respectively, as has been found to be the case in prior art constructions wherein the contact serves as a bridging member to hold the legs of the spring in bowed position. Consequently, the characteristics of a switch spring constructed in accordance with the invention will vary little within a wide range of ambient temperature changes or due to heat caused by the sparking and arcing between the contacts, thus insuring high operational stability and increased life of the switch.

In the construction according to U. S. Patent 1,780,758, on the other hand, a relatively heavy bar or strip is secured across to two legs of the slotted spring which not only acts as a contact piece but serves to hold the legs of the spring together under tension to produce a biased region at the opposite supported end of the spring. For practical reasons this bar is bent around the spring, thus making its weight still heavier. Hence, a heavy weight of this type carried by the free end of the spring is easily affected by vibrations or outside forces such as a sudden acceleration or deceleration when the switch is used on an aircraft or other vehicle, resulting in undesirable operations of the switch and other drawbacks and defects. Moreover, since this bar is usually of a metal different from the spring metal, the different thermal co-efficients of expansion and contraction will affect the joint between the bar and the spring resulting not only in loosening or deterioration of the electrical

contact but seriously affecting the tension or bias of the spring, thereby destroying or materially impairing its operating characteristics.

All the aforementioned defects and drawbacks are overcome by the novel method and construction according to the present invention wherein the weight of the contact piece, which does not have to hold any parts or determine the spring tension or bias condition, may be reduced to a minimum while the tension or bias of the sensitive region is affected simply and solely by the groove-like crimp or equivalent deformation of the free end of the spring in the manner described hereinabove. In this connection, it will be further evident that with the prior art structure it will be extremely difficult to obtain a uniform bias or tension and operating spring pressure due to the relatively small force and displacement involved in drawing together the legs of the spring, whereas in the case of the invention, due to the considerably simplified construction and method of producing the spring tension, the tension or bias may be effected with considerably increased consistency and uniformity for the reasons that will be obvious from the foregoing.

The reduction of the contact weight has the further advantage that the switch will be less sensitive to external shock or other mechanical forces liable to cause accidental operations. This is of special importance when the switch is used on moving vehicles, such as airplanes, in which case shocks or a sudden acceleration or deceleration may result in unauthorized operation of the switch contacts due to excessive weight or inertia.

Referring to Figures 5 and 5—A, there is shown a modified actuating spring constructed in accordance with the principles of the invention. In this case, the blade 15 has a pair of parallel slots 22' and 22'' terminating in enlarged portions. The grooves or crimps 24 are arranged between the enlarged portions of the slots and the edge of the blade, as shown. In a construction of this type a pair of sensitive regions will be produced near the opposite ends of the slots having an overlapping area r of increased sensitivity engaged by a push button or other actuating element.

Referring to Figures 6 and 6—A, there is shown a modification similar to Figure 4 having but a single central crimp or groove 24', arranged between the slightly enlarged portion of the slot 22 and the edge of blade 15. A construction of this type is especially suited for the provision of a pair of contacts 16' and 16'' on the opposite sides of the crimp 24'. Contacts 16' and 16'' may either be used for simultaneously controlling two electrical circuits or the contacts may be connected in series for single circuit operation to reduce sparking and arcing.

If due to the grooves or crimps 24 and 24' the end of the leaf spring becomes slightly curved, a contact 16 extending over a larger surface of the spring having downturned edges engaging said grooves may be provided, as shown in Figure 7 to hold the spring in straight or flat position. Alternatively, a contact strip may be used extending over the entire width of the spring if the weight of the contact is of no consequence. This contact strip of relatively stiff metal may be bent around the end of the spring as will be readily understood.

Spring 15 may be constructed of resilient bi- or multi-metallic sheet, whereby the switch will be displaceable by temperature change rather than by pressure application. In this case, the pin or button 17 is omitted, the actuating pressure or displacement being produced by internal strain of the bi- or multi-metallic sheet due to the different thermal expansion of the components thereof in a manner well understood. The thermostatic metal used may be a standard conventional bi-metallic combination. The metal is properly tempered to insure sufficient springiness for member 15. Upon a predetermined temperature rise, the thermostatic metal of the switch causes a distortion and internal pressure or strain in the body thereof to flip the switch to its opposite or "heated" position.

In Figures 8 and 9 there is shown another switch construction according to the invention comprising a flat spring 28 having an aperture 29 to form a frame mounted in fixed position at one side in any suitable manner such as by means of screw bolts or rivets passing through mounting holes 30. The portion of the frame opposite to its supported side is provided with a pair of transverse grooves or crimps 31 and 31' causing the outer free regions 32 and 32' to assume a curved or bent shape towards one side from which they may be displaced to a position of opposite curvature with a snap action by a slight pressure application or thermally produced slight displacement of the central region r between the crimps 31 and 31' in a manner readily understood from the foregoing. Contacts 33 and 33' are secured to the outer free ends of the spring member and cooperate with one or more stationary contacts 34 and 34'.

It will be evident from the foregoing that the invention is not limited to the specific construction and details described and disclosed for illustration and that the underlying novel principle of the invention will be susceptible of numerous variations and modifications coming within the broader scope and spirit thereof as defined in the appended claims. The specification and drawing are, accordingly, to be regarded in an illustrative rather than in a limiting sense.

I claim:

1. In a snap action device, a body member, an actuating member constituted by a flat rectangular leaf spring of substantially even thickness throughout and provided with at least one longitudinal slot and having one of its short ends fixedly secured to said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between the outer end of said slot and the adjacent free end of said spring being crimped to produce a biased region near the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance by comparatively small displacement of said biased region.

2. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with at least one longitudinal slot and having one end fixedly secured to said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between the outer end of said slot and the adjacent free end of said spring being deformed by at least one groove-like crimp substantially parallel to said slot to produce a biased region near the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action upon com-

paratively small displacement of said biased region.

3. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with at least one narrow slot terminating in an enlarged aperture and having its end opposite to said aperture fixedly secured to said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between said aperture and the free end of said spring being deformed by at least one groove-like crimp substantially parallel to said slot to produce a biased region near the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance by comparatively small displacement of said biased region.

4. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with at least one longitudinal slot terminating in an enlarged aperture spaced from an edge of said spring, said spring having its end opposite to said aperture fixedly secured to said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between said aperture and the adjacent free edge of said spring being deformed by at least one groove-like crimp substantially parallel to and in line with said slot to produce a biased region adjacent to the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance upon a relatively small displacement of said biased region.

5. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with at least one longitudinal slot terminating in an enlarged aperture spaced from the adjacent edge of said spring, said spring having its end opposite to said aperture fixedly secured upon said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between said aperture and the outer free edge of said spring being provided with a pair of groove-like crimps located symmetrically and substantially parallel to said slot to produce a biased region near the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance by comparatively small displacement of said biased region.

6. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with a T-shaped aperture comprising a longitudinal slot extending over a substantial length of said spring and terminating in a transverse slot, means for fixedly securing the end of said spring opposite to said transverse slot to said body member, the portion of said spring adjacent to said slot being substantially flat and the portion between said transverse slot and the adjacent free end of said spring being deformed by a pair of groove-like crimps arranged symmetrically and substantially parallel to said longitudinal slot to produce a biased region near the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance by comparatively small displacement of said biased region.

7. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with a pair of parallel longitudinal slots, means for fixedly securing one end of said spring to said body member cantilever fashion, the portion of said spring adjacent to said slots being substantially flat and the portion between the outer ends of said slots and the free end of said spring being deformed by groove-like crimps substantially parallel to said slots to produce a biased region adjacent to the fixed end of said spring, whereby the free end of said spring will move from one to another position with a snap action over a relatively large distance by comparatively small displacement of said biased region.

8. In a snap action device, a body member, an actuating member constituted by a flat leaf spring of substantially even thickness throughout and provided with a longitudinal slot extending over a considerable length thereof, means for fixedly securing one end of said spring to said body member cantilever fashion, the portion of said spring adjacent to said slot being substantially flat and the portion between the outer end of said slot and the free end of said spring being deformed by at least one groove-like crimp substantially in line with said slot to produce a biased region near the fixed end of said spring, whereby relatively small displacement of said biased region causes a comparatively large displacement of the free end of said spring between two positions with a snap action.

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