Feb. 1, 1944. K. RATH 2,340,615

SNAP ACTION DEVICE

Filed March 20, 1942

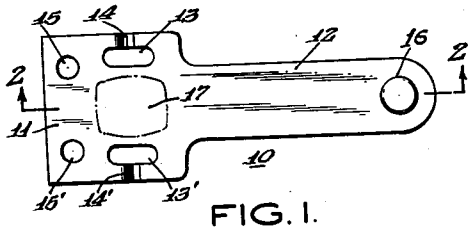


FIG. 1.

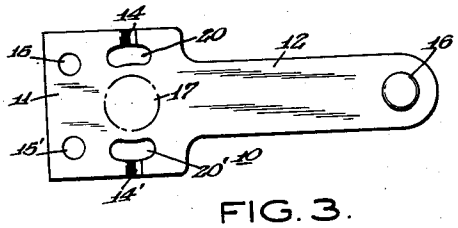


FIG. 3.

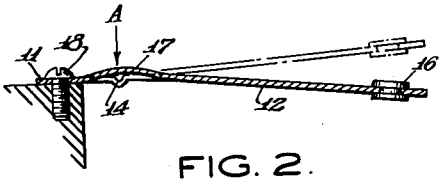


FIG. 2.

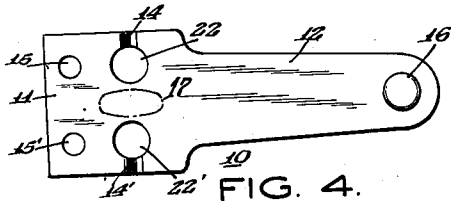


FIG. 4.

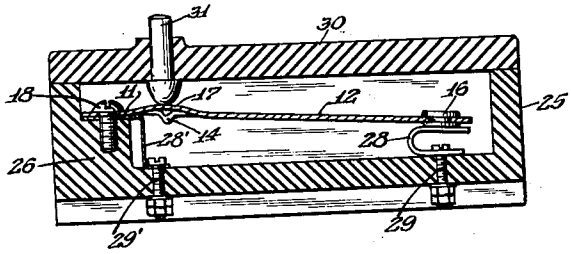


FIG. 5.

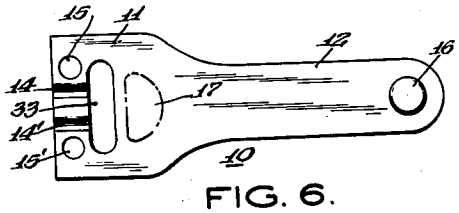


FIG. 6.

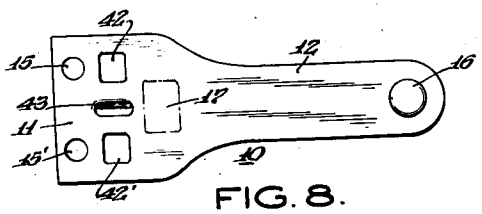


FIG. 8.

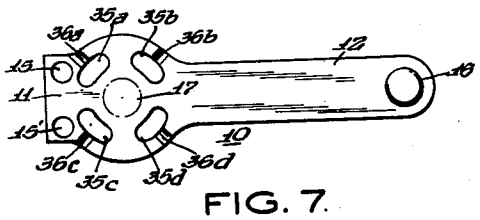


FIG. 7.

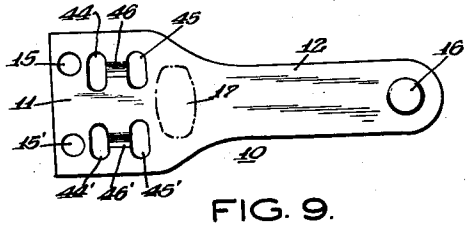


FIG. 9.

INVENTOR.

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UNITED STATES PATENT OFFICE

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SNAP ACTION DEVICE

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Application March 20, 1942, Serial No. 435,520

7 Claims. (Cl. 74—100)

My invention relates to improvements in and a method of making snap action devices which serve for producing a quick and jerky motion of an organ by means of a relatively slow driving force such as used in electric switches for making and breaking an electrical circuit.

An object of the invention is the provision of an electrical snap switch which is adapted to interrupt substantially large currents upon relatively small physical application of pressure or displacement.

More particularly, the invention is concerned with the type of snap action switch comprising essentially a flat leaf spring fixedly mounted at one end cantilever fashion and having a cupped or bulged region to give a material displacement of the free end thereof with a jerk or snap action upon application of a relatively small physical force or displacement to the bulge.

The various types of snap action switches which have become known in the past may be divided into the two following basic categories.

The first type, referred to as the arched spring or toggle action type and exemplified by U. S. Patent 1,215,665 to H. Landis, comprises a flat spring arranged between two rigid bearings or abutments. The distance between said abutments is less than the length of the spring in its flat plane condition whereby the spring will assume a curved or arched shape on either side of the central plane between said abutments. In such a position the spring is held under tension and may be shifted by a comparatively small force to the central or neutral position from which, owing to its elasticity, it will proceed with a jerk or snap movement to a position of opposite curvature substantially in the manner of a toggle mechanism.

An inherent disadvantage of snap action devices of this character is the fact that the distance between the abutments must be carefully adjusted to insure anything like consistent results and uniformity in the manufacture of switches of like size and characteristics. Moreover, the displacement in the transverse direction of a contact piece preferably secured to the center of the spring is limited by the construction and size of the switch as is readily understood.

These advantages are not overcome to any satisfactory degree by a simplified method of constructing switches of this type comprising an arched spring described in U. S. Patent 1,668,974 to A. J. Mottlau. The latter utilizes for this purpose a flat spring having a pair of longitudinal parallel slots separated from each other by a bridging member which serves as the actuating spring organ and is caused to become curved or arched by deforming the outer spring portions, thereby providing the equivalent of an arched spring supported between two abutments spaced at a lesser distance than the spring length.

Numerous snap action constructions of the above general type have become known and used in the art, all comprising essentially a longitudinal confined spring normally bowed or arched in its entirety towards one or the other side of its dead center or flat plane condition and adapted to be thrown against the dead center to a position of opposite curvature by a suitable pressure applying element such as a plunger, push button, thermal expansion device, or directly by an internally produced displacement force caused by heat if the spring is made of bi- or multi-sheet metal responsive to temperature change.

The second basic type of snap switch, referred to as cantilever type and exemplified by U. S. Patents 1,448,240 to J. A. Spencer, 1,780,758 to H. G. Leupold, and 1,849,481 to P. De Langie, et al., comprises a leaf spring secured at one end only cantilever fashion so as to allow its opposite end to move freely between two positions of equilibrium with a snap action. To this end, the spring is caused to become internally biased or bulged in such a manner that application of a small pressure or displacement either externally or internally will cause the bulge to be reversed, thereby moving the free end of the spring over a comparatively large distance with a sudden or snap action from one to the other position of equilibrium.

One way of producing a biased spring of the latter type consists in shaping or cupping a metal plate and thereafter subjecting it to a tempering operation to provide the required springiness or resiliency.

Another method forming the subject of Patent 1,780,758 consists in the provision of a central lengthwise slot extending to the free end of a rectangular spring plate and means, such as a bridging member or contact piece, secured to the free ends of the legs or prongs thus obtained for holding the latter in a position slightly bowed or forced towards each other in such a manner as to result in a distorted or biased condition of the spring.

A major disadvantage of the aforementioned construction and method of producing snap

switch spring devices is due to the fact that great difficulties are experienced in the production of the switches in large quantities due to the excessive number of rejections and defective units, despite the employment of special assembly tools and precision methods. The amount of deformation or displacement in most cases is so small and critical as to cause essential variations of the characteristics in the final units that is required minimum pressure to initiate the switch operation, the contact pressure, etc., resulting in a considerable number of rejects which are either completely useless or outside the tolerances required in practice.

Accordingly, a further object of my invention is to provide a novel leaf spring type snap action device which is both simple in design and easy to manufacture and which is characterized by high uniformity in quantity production as well as reliability in operation.

A more specific object is to provide a cantilever type snap action spring the biased region of which or bulge near its mounted end may be produced in a most simple and efficient manner substantially independently of the remaining portion which serves solely as a lever or actuating element designed to give a material movement upon relatively slight physical displacement of said bulge.

Another object is the provision of a snap action spring of the above type which can be produced by a simple crimping or deforming operation of a flat leaf spring stamping which may have been fully or partly tempered to provide a required springiness or resilience.

The above and further objects and novel aspects 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 top view of a snap action spring element embodying the principles of the invention; Figure 2 is a cross-sectional view taken on line 2—2 of Figure 1; Figures 3 and 4 illustrate modifications of springs constructed according to the invention; Figure 5 is a vertical cross-sectional view of a simple electric switch construction embodying an actuating spring device according to the invention; and Figures 6 to 9 illustrate further modifications of snap action spring elements constructed in accordance with the invention.

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

Referring more particularly to Figures 1 and 2, there is shown a flat spring 10 for use as a snap action organ comprising a fixedly mounted enlarged end portion 11 substantially square-shaped and biased or bulged to provide a snap action in the manner to be described presently and a narrow or lug-shaped, substantially straight or undistorted actuating portion 12 preferably integral with and extending from portion 11. Portion 12 which serves as the actuating member proper such as for making or breaking an electrical contact is made of adequate length to provide a sufficient leverage effect so as to give a material displacement of its outer free end or efficient contact pressure if used for operating an electrical switch upon relatively slight physical application of force or displacement to the biased or bulged region of the portion 11.

In the embodiment of the invention according to Figure 1, the cupping or bulge of portion 11 is obtained by the provision of oblong slots 13 and 13' spaced from the outer ends of portion 11 and being parallel to the longitudinal axis of the spring. The sections between the slots 13 and 13' and the adjacent outer edges of portion 11 are distorted or shortened by the provision of transverse grooves or crimps 14 and 14', respectively, resulting in slight bulging or cupping of the region between the slots as indicated in dotted lines at 17. In this manner, the spring will assume a position or shape as indicated in Figure 2 on a somewhat exaggerated scale for better illustration.

The spring is secured to a support in any suitable manner such as by means of rivets or screws 18 passing through mounting holes 15 and 15'. Upon application of a slight pressure or displacement to the buckled region 17 in the direction of the arrow A as shown in Figure 2, the bulge will instantly assume a position of opposite curvature with respect to the neutral or flat plane condition of the spring with a jerk or snap action, thus causing a material displacement of the free end of the lever or actuating portion 12 to which may be secured an electrical contact piece 16. This position is shown in the drawing in dotted lines. Due to the leverage effect of portion 12, a relatively slight bulge of portion 11 will give a material displacement which in turn will enable the use of a relatively strong spring to insure high accuracy of response combined with efficient contact pressure in an electric switch.

There is thus provided by the invention an improved and efficient snap action device which can be manufactured by a simple stamping and crimping or pressing operation and wherein the bulged or biased region 17 for producing the snap action may be designed and produced independently of the actuating member 12 serving solely to provide a sufficient leverage to insure high sensitivity and efficient contact pressure and other advantages well understood by those skilled in the art.

Figure 3 shows a modification of a snap spring device differing from Figure 1 by the provision of a pair of arc-shaped slots 20 and 20' concave and located symmetrically with respect to the longitudinal axis of spring 10 in place of the straight slots shown in Figure 1 and resulting in a more or less circular cupping or bulge 17 between the slots.

Figure 4 shows another modification wherein the slots take the form of circular holes or perforations 22 and 22', respectively, and the portion 12 tapers towards portion 11.

Referring to Figure 5, I have shown a cross-section through an electrical switch of simplified construction embodying a snap action spring according to the invention. The spring and contacts are mounted in a rectangular casing 25 of insulating material such as ceramic, a phenolic condensation product, or other composition material or the like. A raised portion 26 at one end of the inside of casing 25 supports the mounted end of the snap spring 10 which may be of any of the types shown in the other figures and a suitable contact element 28 is secured at the other end of housing 25 by a rivet or bolt 29 passing through the bottom wall of the casing and serving as one of the electric terminals of the switch. A similar terminal 29' connects with the spring 10 through a metal lead or connecting strip 28'.

Casing 25 is closed by a cover 30 through which passes an actuating member such as a push-button or plunger 31 having a lower rounded end en-

gaging the biased or buckled region 17 of the snap spring. Upon slight application of pressure to the outer end of button 31, the bulge 17 will be reversed and the spring snap to a position of opposite curvature resulting in a separation of the contacts 16 and 26. While the switch shown is of the normally closed type it may be converted into one of the normally open type by arranging the contact 28 on the apposite side of the spring. Alternatively, a pair of contacts may be provided one on each side of the spring to obtain a double action switch in a manner well understood.

Figures 6 to 9 show further modifications of slot and groove arrangements to produce a cupped or buckled region of a snap action spring according to the invention.

In Figure 6 the portion 11 of the spring is provided with a single slot 33 near the mounted end, said slot being transverse to the longitudinal axis of the spring. The section between slot 33 and the adjacent edge of the spring is deformed by the provision of a pair of spaced crimps or grooves 14 and 14' located near the outer edges of the slot 33 and being substantially parallel to the axis of the spring, thereby causing a bulge or biased region 17 on the opposite side of slot 33.

In Figure 7 the portion 11 of spring 10 is partly of circular or arc-shaped contour and provided with a plurality, in the example shown four, arc-shaped spaced concentric slots 35*a*, 35*b*, 35*c*, and 35*d* located upon the same circle and radial grooves or crimps 36*a*, 36*b*, 36*c*, and 36*d* extending from the slots to the outer edge as shown to produce a substantially circular cupping 17 in the center.

In all the previous constructions the grooves or crimps extend from the slots or openings to the outer edge of the spring to cause the desired bulging or distortion required for the snap action operation. In the embodiment shown in Figure 8 the crimp or groove is separated from the slots or holes and so spaced therefrom and located as to obtain a desired bulge or cupping effect.

Thus, in Figure 8 a crimp or groove 43 is formed between the slots or openings 42 and 42' corresponding to and arranged in the manner of the slots 13 and 13' of Figure 1. Due to the distortion caused by the crimp 43 the distance between the slots 42 and 42' will be shortened resulting in a vaulting or cupping of the adjacent area as shown at 17.

In Figure 9 there is shown another slot and crimping arrangement comprising two pairs of parallel slots 44—45 and 44'—45' transverse to and provided on opposite sides of the longitudinal axis of the spring. The bridging sections between each pair of said slots are deformed by the grooves 46 and 46', respectively, substantially parallel to the spring axis to cause a bulged or cupped region 17 in the manner similar to that obtained in Figure 8.

While the operation of the novel snap action device according to the invention has been shown in Figure 5 with reference to an externally applied pressure to or displacement of the bulged or biased region 17, it is understood that the operating force or displacement may be produced in any other suitable manner to move the spring from one to the other position of equilibrium. Thus, a snap action device described by the invention may be constructed of bi- or multi-metal sheet to act as a thermostat by causing a displacement of the biased region by internal heat action in a manner well understood by those skilled in the art.

While I have shown and described a few desirable embodiments of the invention, it is understood that this disclosure is for the purpose of illustration and that various changes in shape, proportion, and arrangement of parts as well as the substitution of equivalent elements for those herein shown and described may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length, means for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with at least one aperture and a crimp adjacent to said aperture to cause a central region of said first section to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force applied thereto while leaving said second section in substantially flat condition, whereby to cause a material displacement of the free end of said second section.

2. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length, means for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with at least one aperture and at least one transverse crimp extending from said aperture to an outer edge of the section to cause a central region of said first section to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon while leaving said second section in substantially flat condition, whereby to cause a material displacement of the free end of said second section.

3. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length, means for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with a pair of apertures symmetrical to the longitudinal axis of the spring and transverse groove-like crimps extending from said apertures to the outer adjacent edges of the section, to cause the region between said openings to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon while leaving said second section in substantially flat condition, whereby to cause a material displacement of the free end of said second section.

4. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length extending from said first section, means

for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with a pair of oblong slots parallel and symmetrical to the longitudinal axis of the spring, and transverse groove-like crimps extending from said slots to the adjacent outer edges of the section, to cause the region between said slots to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon, while leaving said second section in substantially flat condition, whereby to cause a material displacement of the free end of said second section.

5. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length extending from said first section, means for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion said first section being provided with a plurality of arcuate slots located upon the same circumference, and transverse groove-like crimps extending radially from said slots to the adjacent outer edges of the section to cause the central region between said slots to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon while leaving said second section in substantially flat condition, whereby to effect a material displacement of the free end of said second section.

6. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length extending from said first section, means for fixedly securing the end of said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with a pair of arcuate slots concave and symmetrical to the longitudinal axis of the spring, and transverse groove-like crimps extending radially from said slots to the adjacent outer edges of the section to cause the region between said slots to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon, while leaving said second section in substantially flat condition, whereby to effect a material displacement of the free end of said second section.

7. A snap action device for operating switch contacts and the like comprising a normally flat oblong leaf spring having a first wider section at one end thereof of relatively short length and a second narrow section of relatively greater length extending from said first section, means for fixedly securing said first section, whereby to freely support said spring comprising both said first and second sections canti-lever fashion, said first section being provided with a plurality of apertures arranged symmetrically about the longitudinal axis of said spring, and transverse groove-live crimps extending radially from said apertures to the adjacent outer edges of the section, to cause the central region between said apertures to assume a position slightly bulged from its initial flat condition and adapted to reverse the bulge with a snap action by a slight displacement force exerted thereon, while leaving said second section in substantially flat condition, whereby to effect a material displacement of the free end of said section.

KARL RATH.