Feb. 16, 1954

C. BRADLEY

2,669,618

SNAP-ACTION DEVICE

Filed March 4, 1950

Fig. 1.

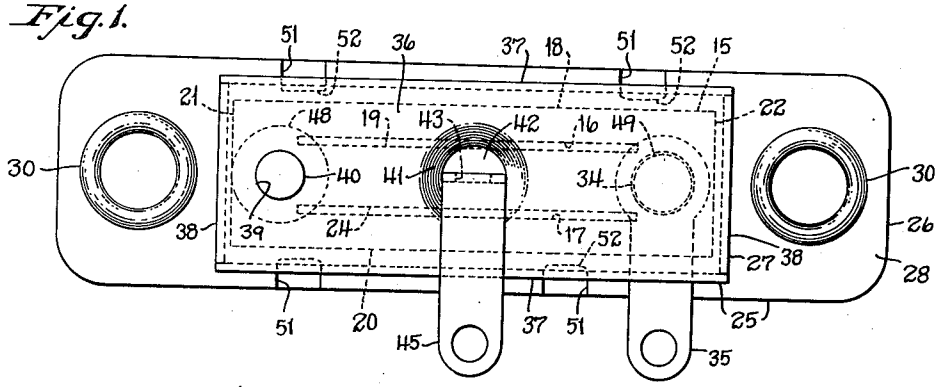


Fig. 2.

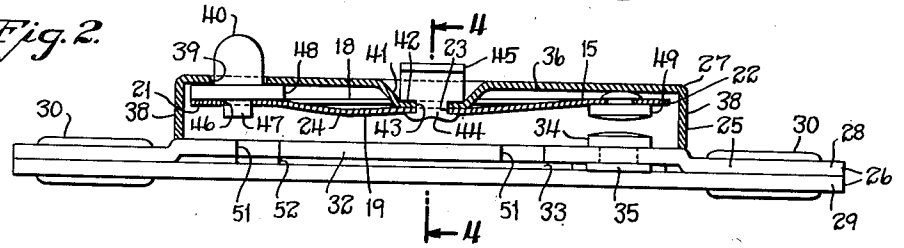


Fig. 3.

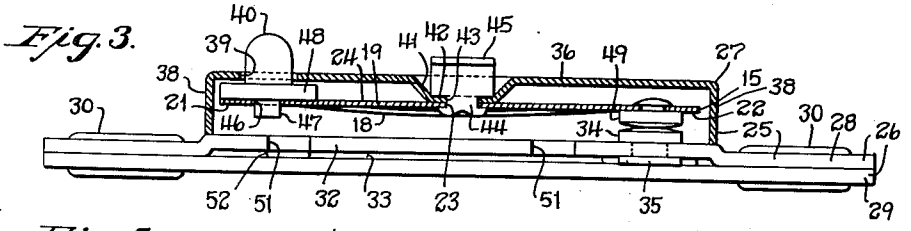


Fig. 5.

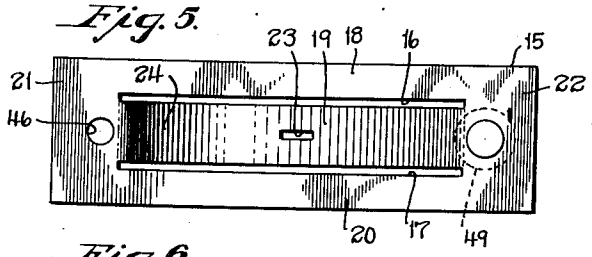


Fig. 4.

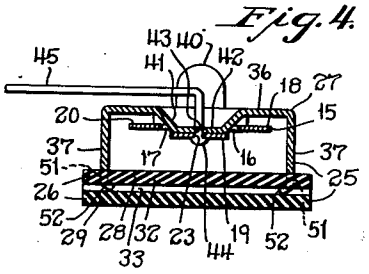


Fig. 6.

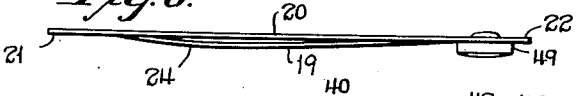


Fig. 7.

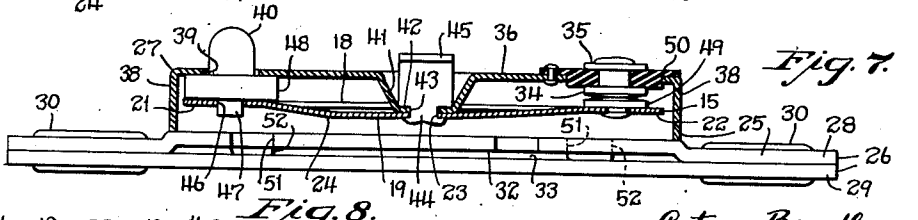


Fig. 8.

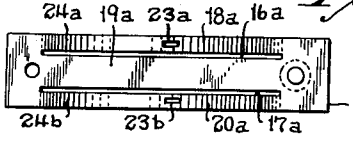
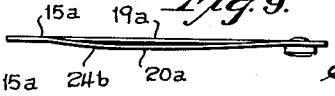


Fig. 9.



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SNAP-ACTION DEVICE

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Application March 4, 1950, Serial No. 147,605

10 Claims. (Cl. 200—67)

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The present invention relates in general to snap-action devices and in particular to an improved switch-arm for a snap-action switch of the miniature type adapted especially for uses calling for minuteness of movement of the switch-actuating means, and a capacity for interrupting relatively-high currents at normal voltage ratings.

An object of the invention is to provide a superior snap-action device.

A further object of the invention is to provide a superior snap-action switch of the miniature type characterized by a relatively-thin and substantially-flat casing.

A still further object of the invention is to provide a miniature-type snap-action switch of simple, durable and economical construction and capable of interrupting relatively-high currents.

A still further object of the invention is to provide a miniature-type snap-action switch with a superior switch-arm having structural characteristics such that relatively-small movement of one end of the switch-arm will impart relatively-large movement to the opposite end thereof.

A still further object of the invention is to provide a highly-sensitive snap-action device having a supporting-portion provided with a pre-set curvature eccentric to the center thereof, whereby minute movement of one end of the snap-action device imparts a disproportionately-large movement to the opposite end of the device.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a plan view of the snap-action switch embodying the novel switch-arm of this invention;

Fig. 2 is a front elevation partly in section of the snap-action switch of Fig. 1 showing the switch-contacts open;

Fig. 3 is a view similar to Fig. 2 but showing the position the parts assume when the switch-contacts are closed;

Fig. 4 is an end elevation in section of the switch on line 4—4 of Fig. 2;

Fig. 5 is a plan view of the novel snap-action device or switch-arm used in the snap-action switch;

Fig. 6 is a side elevation of the snap-action device of Fig. 4;

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Fig. 7 is a side elevation in section of a modification of the snap-action switch in which the contacts of the switch are normally closed and adapted to be opened by actuation of the switch-arm;

Fig. 8 is an enlarged plan view of a modification of the snap-action device of Fig. 5;

Fig. 9 is an enlarged side elevation of the snap-action device of Fig. 8.

The showing of Figs. 1 through 6

The snap-action device of this invention is described and illustrated as being an element, and in particular the switch-arm, of a miniature-type switch, and while it is especially suitable for this use, it may be modified for other uses wherein the basic principle of operation of the snap-action device is applicable. In this connection, the snap-action device is constructed so as to be responsive to a minimum actuating force and yet have relatively-large movement so as to incorporate good current interrupting capacity when used in a switch. To these ends, the snap-action device comprises a thin strip of spring material indicated generally at 15 which, in effect, is a thin metal leaf spring formed preferably of a phosphorous bronze alloy, although beryllium copper and equivalent metal alloys may be used. This spring-strip 15 is provided with two slots 16 and 17 extending longitudinally of the strip and in laterally-spaced, substantially parallel relationship so as to divide the strip 15 into three reaches 18, 19, and 20, each reach being joined integrally at its opposite ends to the corresponding ends 21 and 22 respectively of the spring-strip 15. The center reach 19 of the spring-strip is, in the present embodiment, slightly wider than the two side reaches 18 and 20 and is formed at a point substantially intermediate its opposite ends with a fastening-element constituting a vertical substantially rectangular aperture or slot 23.

Referring especially to Fig. 6, it will be seen that the center reach 19 of the spring-strip is provided with a pre-set curvature which is offset from the plane of the spring-strip, the offset of the curvature of the center reach 19 being downwardly of the plane of the spring-strip. It will be noted, moreover, that the pre-set curvature of the center reach 19 is not of uniform radius but embodies a section 24 of minimum radius which is eccentric to the center of the spring-strip, that is to say, the section 24 of minimum radius is nearer one end of the center reach 19 than its opposite end. This novel construction of the spring-strip provides a stiffness

factor which contributes directly to the effectiveness of the snap-action device as the switch-arm of a snap-action switch.

It has been discovered that a strip of spring metal constructed in the manner described above and supporting it by fastening-means at the center of its curved reach, will be actuated by depressing that end of the spring-strip which is adjacent the section 24 of the curved center reach, and which is hereinafter referred to as the actuating-end of the spring-strip, that is to say, the opposite end of the spring-strip will be deflected downwardly, and will snap back to its original position upon release of the actuating-end of the spring-strip. Moreover, the amount of force applied to the actuating-end of the spring-strip and the consequent movement of the said actuating-end thereof are extremely small. By way of example, the energy required to operate a spring-strip of the proportions illustrated herein is of the order of fifteen-thousandths inch-ounces, and the amount of movement of the actuating-end of the spring-strip is in a range of from one-thousandth to five-thousandths of an inch, the resulting movement of the opposite end of the spring-strip being substantially ten times that of its actuating-end. This characteristic of the spring-action device adapts it particularly to snap-action switches of the miniature type in that the relatively-large movement of one end of the snap-action device, in response to relatively-minute movement of its opposite actuating-end permits the use of the snap-action device as a switch-arm, having capacity for interrupting relatively-large currents at normal voltage ratings.

Figs. 1, 2, 3 and 4 illustrate a miniature-type snap-action switch, identified in general by the numeral 25, and embodying a switch-arm of the type disclosed in Figs. 5 and 6 and hereinabove described. The snap-action switch 25 comprises a composite base-member, indicated generally at 26, and a cover-member 27 within which the switch-arm 15 is supported in vertically-spaced relationship with respect to the composite base-member, in the manner described below. The composite base-member 26 comprises upper and lower laminae of substantially-identical dimensions and consisting of relatively-thin insulation material, the upper lamina 28 being preferably cardboard or fabric impregnated with a suitable plastic material, the lower lamina 29 being preferably Bakelite or the equivalent. The opposite ends of the upper and lower laminae are secured together by eyelet-grommets 30—30, while the central portion of the upper lamina 28 is provided with an embossed or raised portion 32 substantially equivalent in length to the length of the cover-member 27, thereby to provide a clearance-space 33 between the underside of the embossment 32 of the upper lamina and the upper side of the lower lamina, for accommodating one of the contact terminals of the switch in the manner hereinafter described.

The upper lamina 28 is provided with a contact 34 formed of a good conducting material such as silver or copper, the said contact 34 being located on the upper face of the upper lamina 28. The contact 34 projects down through the upper lamina 28, and mounts on the lower end thereof a contact terminal or blade 35, the inner end of which is secured to the contact 34. As so assembled on the base, the blade 35 is accommodated in the clearance-recess 33 between the upper and lower laminae of the base and projects outwardly at substantially right angles thereto.

The cover-member 27 of the switch is formed of metal such as thin sheet brass, and comprises a flat rectangular top 36 and side and end walls 37 and 38 respectively bent down at substantially right angles to the top 36. In the present embodiment, the combined height of the cover and the thickness of the composite base is substantially equal to one-sixth the over-all length of the switch, that is to say, a switch substantially one and one-half inches long would be approximately one-quarter of an inch thick. It will be appreciated, however, that these dimensions are not limiting on the invention, but serve merely to illustrate the relative proportions thereof and to indicate the minuteness of the assembled switch.

Formed at the left-hand end of the cover-member, as seen in Figs. 1 and 2, is a vertical aperture 39 which is adapted to accommodate a push button 40, the upper end of which projects up through the aperture in the top of the cover-member for manually operating the switch-arm, in the manner hereinafter described.

Formed at the center of the top 36 of the cover-member is a generally circular indenture 41 having a bottom wall 42 provided with a rectangular slot 43 in which is secured the lower reduced end 44 of a second contact terminal 45. The latter constitutes a blade-like member which is held from passing down through the slot in the bottom wall of the indenture by engagement of the shoulders of its reduced end with the bottom wall of the indenture. The terminal 45 may project upwardly substantially vertically from the top of the cover, but is preferably bent over at substantially right angles to extend outwardly from the side of the switch in the direction of the lower terminal or blade 35.

The reduced end 44 of the blade 45 projects down through the bottom wall 42 of the indenture, and constitutes fastening-means, both for securing the blade 45 in the indenture of the cover and for securing the switch-arm 15 rigidly to the underside of the bottom wall of the indenture. To these ends, the reduced end 44 of the blade 45 extends through the aforesaid slot 23 in the center reach 19 of the switch-arm 15 and is swaged over on the underside thereof, as shown especially well in Fig. 2. In this connection, it will be noted that the width of the indenture 41 is no greater than the width of the center reach 19 of the switch-arm, and hence, its side reaches 18 and 20 have clearance for extending on opposite sides respectively of the indenture, as shown in Fig. 4. Moreover, since the center reach 19 is below the plane of the side reaches 18 and 20, the latter will be supported in a substantially common horizontal plane slightly above the bottom wall 42 of the indenture.

Thus, with the switch-arm fixedly secured at its center only to the underside of the cover, the opposite ends of the switch-arm are free and unsupported. The end of the switch-arm which is adjacent the section 24 of minimum radius of the center reach 19 and which corresponds to the left-hand end of the switch-arm, as seen in Fig. 2, is provided with a vertical aperture 46 arranged to accommodate the reduced end 47 of the aforesaid push button 40, the latter being formed with an annular flange 48 intermediate its opposite ends which seats on the apertured end of the switch-arm and serves to hold the push button thereon with its reduced end 47 projecting down through the aperture 46 and constituting a stop-finger en-

gageable with the embossment 32, to limit the downward deflection of this end of the switch-arm. The annular flange 48 also serves to engage against the underside of the cover to limit the upward movement of the corresponding end of the spring-arm and also to hold the push button from rising up out of the aperture 39 in the cover. By means of this arrangement the amount of pre-travel and over-travel of the push button can be held to a minimum just sufficient to enable actuation of the switch-arm to be effected.

The opposite or right-hand end of the switch-arm is provided on its underside with a contact 49 which is preferably formed of a good conducting metal such as silver, copper, or the like, and located substantially opposite the contact 34 and secured to the switch-arm by swaging over the upwardly-projecting end of the rivet-shank on the top side of the switch-arm. The swaged-over portion of the contact 49 constitutes an abutment adapted to engage the underside of the cover and to limit the upward movement of the corresponding end of the switch-arm. This arrangement also serves to reduce to a minimum the amount of pre-travel of the push button necessary to effect actuation of the switch.

To assemble the cover-member 27 and its attached switch-arm 15 on the base-member 26, the embossment of the latter is provided with a pair of indentures 51 in opposite edges thereof respectively, arranged to accommodate metal tongues 52 which are formed integrally with and extend down from the bottom edges of the respective sides 37 of the cover-member, the metal tongues 52 being adapted to be turned under beneath the edges of the embossment 32 of the upper lamina 28 of the base-member to secure the cover-member thereto, as shown especially well in Fig. 4.

Operation of the showing of Figs. 1 through 6 inclusive

Normally, the push button 40 is supported by the left-hand end of the switch-arm in its uppermost position relative to the cover of the switch, the contact 49 at the opposite end of the switch-arm being in vertically-spaced relationship with respect to the contact 34 of the base-member. By reason of the abutment of the upper face of annular flange 48 on push button 40 against the under face of cover member 27, and also because of the abutment of the swaged-over portion of contact 49 against the under surface of the cover, as mentioned previously, a major portion of the pre-travel of the push button necessary before actuation of the switch is effected is eliminated. It will be noted that in this condition, the central reach 19 to which blade 45 is connected is substantially flat throughout its length except for that portion at one end which is provided with the aforesaid pre-set curvature. Now, when the push button 40 is pushed down, it travels initially the distance necessary to take up whatever small amount of pre-travel remains before actuation of the switch occurs. Thereafter, further deflection of the corresponding end of the switch-arm serves to deflect the opposite end of the switch-arm downwardly to bring its contact 49 in engagement with the contact 34. Due to the pre-set curvature of the center reach 19 of the switch-arm and, in particular, the section 24 of minimum radius thereof, the movement of the contact 49 is relatively large in comparison with the total movement of the push button 40 less its pre-travel. In the particular

embodiment of the invention shown herein, the actual movement of the contact 49 is of the order of ten times the total movement of the push button less its pre-travel and, consequently, due to the relatively-wide spacing of the contact 49 and the contact 34, the switch is capable of interrupting currents, which for a miniature switch of this type are relatively heavy.

The showing of Fig. 7

The snap-action switch shown in Figs. 1 through 6 inclusive is of the type wherein the contacts are normally open and are closed by depressing and releasing the push button of the switch. It will be appreciated, however, that the switch may be modified so that normally the switch will maintain a circuit closed and will open the circuit by depressing the push button. To this end, the contact 34 is shown mounted in the cover-member of the switch and insulated therefrom by an insulating grommet 50, the contact 49 in the corresponding end of the switch-arm 15 being mounted on the upper face thereof so that it is adapted normally to engage the contact 34.

Thus, normally, engagement of the contact 49 with the contact 34 will maintain a circuit closed, the circuit being opened whenever the push button 40 is depressed.

The showing of Figs. 8 and 9

Figs. 8 and 9 show a modification of a snap-action device for use with a switch. In its modified form, the snap-action device 15*a* comprises a thin strip of spring metal similar in form and material to the snap-action device 15 hereinabove described and illustrated in Figs. 1 through 6, the modified snap-action device 15*a* differing therefrom in the structure and function of the side reaches and central reach of the spring-strip. Thus, in the spring-strip 15*a*, the slots 16*a* and 17*a* which extend longitudinally thereof in straight substantially-parallel relationship, divide the spring-strip into side reaches 18*a* and 20*a* and a center reach 19*a*. The latter is substantially flat and imperforate, whereas the side reaches 18*a* and 20*a* respectively are formed with pre-set curvatures offset below the plane of the center reach 19*a* and having sections 24*a* and 24*b* respectively of minimum radius eccentric to the centers of the side reaches. In this connection, the centers of the side reaches are provided with substantially rectangular slots 23*a* and 23*b* respectively which serve as fastening-elements for securing the spring-strip to the underside of the cover of a snap-switch in the manner hereinafter described.

The modified switch-arm 15*a* will be assembled in the cover-member of the switch in the manner hereinabove described for the switch-arm 15 except that the switch-arm 15*a* will be fixedly secured to the underside of the cover-member by a pair of fastening-means engaged in the aforesaid slots 23*a* and 23*b* of the switch-arm, the action of the assembled switch-arm 15*a* being substantially identical to the action of the snap-switch hereinabove described.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equiv-

alency range of the appended claims are intended to be embraced therein.

I claim:

1. A snap-action device comprising a strip of spring material slotted longitudinally to form a plurality of laterally-spaced reaches joined integrally at their opposite ends to the corresponding ends of the strip, one of said reaches being substantially flat throughout a major portion of its length and having a single pre-set curvature offset from the plane of said strip and eccentric to a point substantially intermediate the opposite ends thereof; and mounting means to which said strip is secured at a point substantially intermediate its opposite ends to cause said ends to project outwardly in opposite directions in unsupported condition from such point, whereby snap-action movement of one of said unsupported ends is effected in a direction substantially perpendicular to the plane of said strip by the application of a force at the opposite unsupported end of said strip in the direction of said offset and substantially perpendicular to the plane of said strip.

2. A switch-arm construction for a snap-action switch comprising: a strip of spring material slotted longitudinally to form a plurality of laterally-spaced reaches joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, one of said reaches being substantially flat throughout a major portion of its length and having a single pre-set curvature offset from the plane of said strip and longitudinally from the center of said reach; mounting means to which said strip is secured at a point substantially intermediate its opposite ends to cause said ends to project outwardly in opposite directions in unsupported condition from such point; and a contact carried by one of said unsupported ends for snap-action movement in a direction substantially perpendicular to the plane of said strip by the application of a force at the opposite end of said strip in the direction of said offset and substantially perpendicular to the plane of said strip.

3. A switch-arm construction for a snap-action switch as defined in claim 2, wherein said strip of spring material is slotted to provide an inner central reach and a pair of outer reaches, said inner central reach having said pre-set curvature, said strip being supported solely by attachment of said central reach to said mounting means.

4. A switch-arm construction for a snap-action switch as defined in claim 3, wherein said central reach is provided with an aperture and said mounting means is provided with a lug which engages in said aperture for securing said strip to said mounting means.

5. A switch-arm for a snap-action switch having two contacts and contact terminals therefor, said switch-arm comprising: a strip of spring material slotted longitudinally to form a plurality of laterally-spaced reaches joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, one of said reaches being substantially flat throughout a major portion of its length and having fastening-means substantially intermediate its opposite ends for connecting said strip to one of said contact terminals with the opposite ends of said strip unsupported, and a pre-set curvature in said one reach, said pre-set curvature being offset from the plane of said strip and having a section of minimum radius eccentric to the center of said one reach; one of said contacts being secured to that end of said strip which is farthest from the said section of minimum radius of the curved reach, said contact being arranged to be moved relative to the second contact of said switch by relatively minute movement of that end of said strip which is adjacent the section of minimum radius of said curved reach.

6. A snap-action switch comprising a base-member having a contact and contact terminal therefor; a cover-member on said base-member; a second contact and contact terminal, said second contact terminal being mounted on said cover-member; a switch-arm adapted to be supported within said cover-member above said base-member, said switch-arm comprising a strip of spring material slotted longitudinally to form a plurality of laterally-spaced reaches joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, one of said reaches being substantially flat throughout a major portion of its length and having fastening-means substantially intermediate its opposite ends arranged to connect said strip to the terminal in said cover-member thereby to support said strip with its opposite ends free, and a pre-set curvature in said one reach offset from the plane of said strip and from the center of said one reach; said second contact being secured to one free end of said strip substantially opposite the contact in the base-member of said switch, said second contact being arranged to be snapped into and from engagement with the contact in said base-member by actuation of the opposite free end of said strip; and actuating-means mounted in said cover arranged to engage the aforesaid opposite free end of said strip for actuating the latter.

7. A snap-action switch comprising a base-member having a contact and contact terminal therefor; a cover-member on said base-member; a second contact and contact terminal, said second contact terminal being mounted on said cover-member; a switch-arm adapted to be supported within said cover-member above said base-member, said switch-arm comprising a strip of spring material slotted longitudinally to form two side reaches and a center reach, said reaches being joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, said center reach being substantially flat throughout a major portion of its length and having fastening-means substantially intermediate its opposite ends arranged to connect said strip to the terminal of said cover-member thereby to support said strip with its opposite ends free, and a pre-set curvature in said center reach offset from the plane of said strip and from the center of said center reach; said second contact being secured to one free end of said strip substantially opposite the contact in the base-member of said switch, said second contact being arranged to be snapped into and from engagement with the contact in said base-member by actuation of the opposite free end of said strip; and actuating-means mounted in said cover arranged to engage the aforesaid opposite free end of said strip for actuating the latter.

8. A snap-action switch comprising a base-member having a contact and contact terminal therefor; a cover-member on said base-member; a second contact and contact terminal, said sec-

ond contact terminal being mounted on said cover-member; a switch-arm adapted to be supported within said cover-member above said base-member, said switch-arm comprising a strip of spring material slotted longitudinally to form two side reaches and a center reach, said reaches being joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, said center reach being substantially flat throughout a major portion of its length and having fastening-means substantially intermediate its opposite ends arranged to connect said strip to the terminal of said cover-member thereby to support said strip with its opposite ends free, and a pre-set curvature in said center reach offset from the plane of said strip, said pre-set curvature having a section of minimum radius eccentric to the center of said strip; said second contact being secured to one free end of said strip substantially opposite the contact in the base-member of said switch, said second contact being arranged to be snapped into and from engagement with the contact in said base-member by actuation of the opposite free end of said strip; and actuating-means mounted in said cover arranged to engage the aforesaid opposite free end of said strip for actuating the latter.

9. A snap-action switch comprising a base-member having a contact and contact terminal therefor; a cover-member on said base-member; a second contact and contact terminal, said second contact terminal being mounted on said cover-member; a switch-arm adapted to be supported within said cover-member above said base-member, said switch-arm comprising a strip of spring material slotted longitudinally to form two side reaches and a center reach, said reaches being joined integrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, said center reach being substantially flat throughout a major portion of its length and having an aperture substantially intermediate its opposite ends; fastening-means arranged to engage in the said aperture of said center reach to connect said strip to the terminal of said cover-member thereby to support said strip with its opposite ends free, and a pre-set curvature in said center reach offset from the plane of said strip, said pre-set curvature having a section of minimum radius eccentric to the center of said strip; said second contact being secured to one free end of said strip

substantially opposite the contact in the base-member of said switch, said second contact being arranged to be snapped into and from engagement with the contact in said base-member by actuation of the opposite free end of said strip; and a push button supported on the aforesaid opposite free end of said strip and arranged to project through said cover for actuating said strip.

10. A snap-action switch comprising vertically-spaced supporting members; a contact and contact terminal associated with each of said supporting members; a switch-arm adapted to be supported by one of said supporting members in vertically-spaced relationship to the other of said supporting members, said switch-arm comprising a strip of spring metal slotted longitudinally to form a plurality of laterally-spaced reaches joined intergrally at their opposite ends to the corresponding ends of the strip and extending continuously therebetween, one of said reaches being substantially flat throughout the major portion of its length and having fastening means substantially intermediate its opposite ends arranged to connect said strip to the terminal of its respective supporting member thereby to support said strip with its opposite ends free, and a pre-set curvature in said one reach offset from the plane of said strip and from the center of said one reach; one of said contacts being secured to one free end of said strip substantially opposite the contact of the said other supporting member of said switch, said contact on said strip being arranged to be snapped into and from engagement with the contact of the said other supporting member by actuation of the opposite free end of said strip; and actuating means mounted in the said one supporting member arranged to engage the aforesaid opposite free end of said strip for actuating the latter.

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