

Jan. 28, 1958

H. Y. FISHER

2,821,588

SNAP ACTING ELECTRIC SWITCH

Filed April 29, 1955

2 Sheets-Sheet 1

Fig. 1.

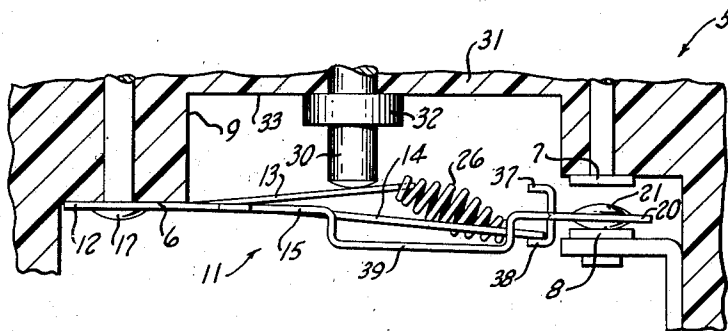


Fig. 2.

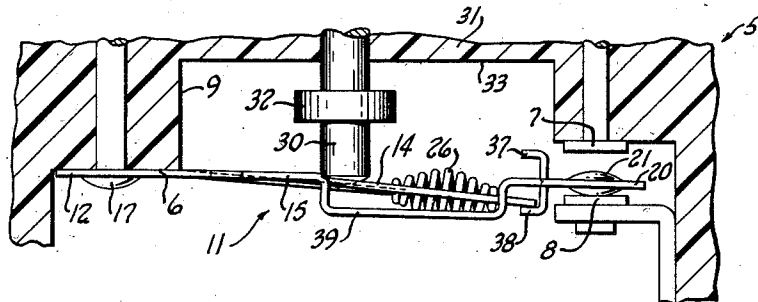


Fig. 3.

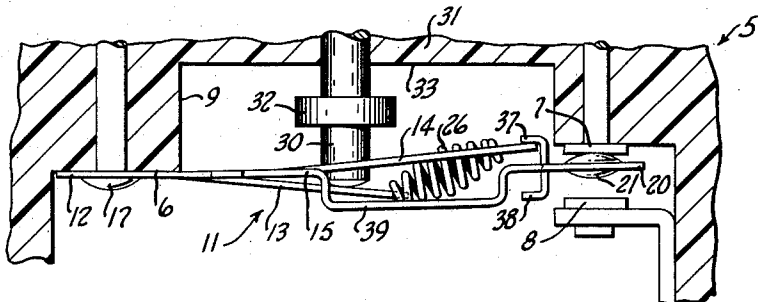
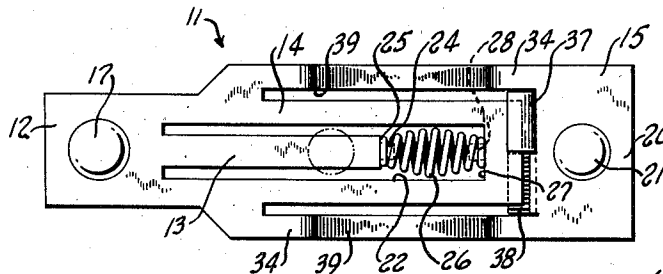


Fig. 4.



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2 Sheets-Sheet 2

Fig. 5.

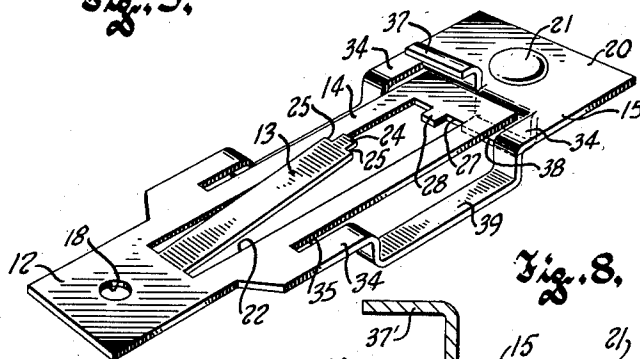


Fig. 8.

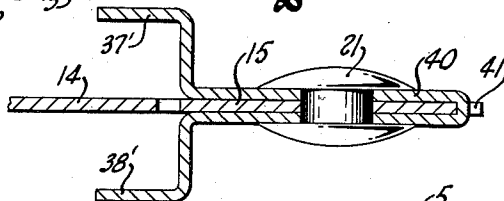


Fig. 6.

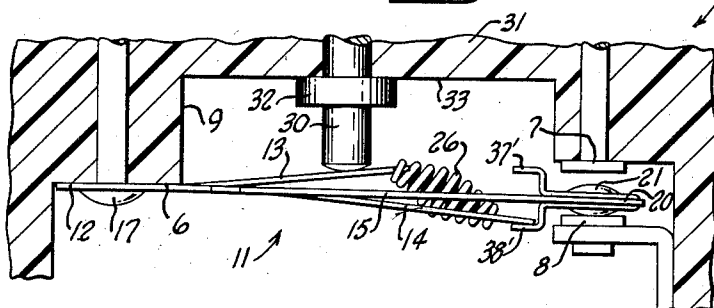
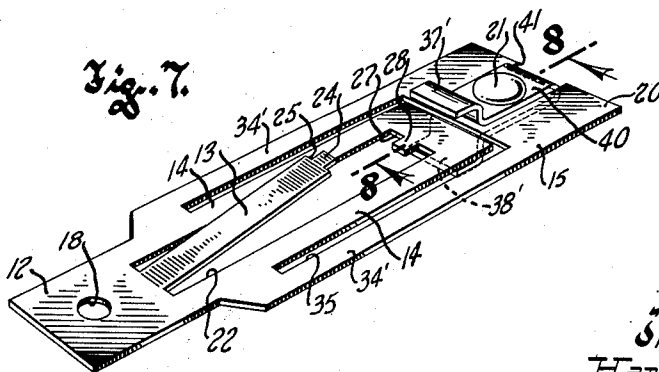


Fig. 7.



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2,821,588

SNAP ACTING ELECTRIC SWITCH

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Application April 29, 1955, Serial No. 504,967

10 Claims. (Cl. 200—67)

This invention relates to electric switches and has more particular reference to improvements in snap acting electric switches of the type wherein snap actuation of a movable switch member in one direction is effected as a consequence of movement of an actuating member in the opposite direction, through the medium of a spring maintained under stress between said members and connected in overcenter relation therewith. In most switches of this type, the member to be snap actuated from one position to another comprises the contactor of the switch, and the overcenter spring was heretofore connected directly between the contactor and the movable actuator.

In all such snap acting electric switches employing an overcenter spring, the contactor is snap actuated from one position to another as a consequence of shifting of the overcenter spring by the actuator from one position of reduced stress through a critical position of maximum stress toward an opposite position of reduced stress. Normally, the overcenter spring exerts a force acting in one direction upon the contactor to hold it engaged under pressure with a stationary contact. During actuation of the switch, however, the spring is moved through its critical position of maximum stress, at which time the direction of the force which the spring exerts upon the contactor is suddenly reversed to cause the contactor to be propelled with a snap action to its other position.

It will be appreciated, therefore, that the force imposed upon the contactor by the overcenter spring and relied upon for maintenance of good contact pressure, diminishes from maximum at either position of reduced stress of the spring, to zero as the overcenter spring closely approaches or occupies its critical position of maximum stress. This critical position of the overcenter spring, when it is under maximum stress, is commonly referred to as the dead center position of the switch.

Ordinarily, when the application of force to the actuating member of the switch carries the overcenter spring uninterruptedly past its position of maximum stress in one continuous motion, that is, without delay, the operation of the switch is quite satisfactory. Serious problems of fluttering and arcing of the switch contacts result, however, if the overcenter spring is caused to very slowly approach its dead center position of maximum stress, for the spring may then hang up at the dead center position for long periods of time, exerting little or no pressure upon the movable contactor. This is especially true when the actuating member of the switch is moved by means of a thermally responsive device or by a float in a large vessel containing liquid. Even though constructed with the utmost precision, it was next to impossible to eliminate fluttering of the movable contactor of the switch and arcing of the switch contacts under such conditions of use of snap switches of the type here in question.

The primary purpose of this invention is to provide a snap acting electric switch of the type embodying an overcenter spring wherein means is provided to assure

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adequate contact pressure to prevent fluttering of the movable contactor of the switch, even though the overcenter spring may be held at, or close to, its position of maximum stress for protracted periods of time.

More specifically, it is a purpose of this invention to provide a snap acting electric switch having an overcenter spring operatively connected between first and second movable switch members in the manner described, and wherein the contactor of the switch comprises a third movable switch member so related to said other switch members that a part of the force applied to the actuating member to shift the overcenter spring from one position of reduced stress toward its critical position of maximum stress is imposed upon the contactor to hold it firmly engaged with a cooperating stationary contact, even though the spring may remain at or close to its dead center position of maximum stress for a protracted period of time.

Still another purpose of this invention resides in the provision of a snap acting switch of the character described, featuring an assembly of three independently flexible resilient blades of different lengths, stamped and formed from a single sheet of metal, and all of said blades extending in the same direction from a common base at one end of the assembly. In this assembly, the longest of said blades is provided with a contact portion at its outer end, the shortest of said blades comprises a movable actuator and the intermediate blade is operatively connectable in overcenter relation with the actuating blade by the overcenter spring and is also resiliently connected with the contact blade so that flexure of said intermediate blade imposes a force on the longest blade.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate two complete examples of the physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which;

Figure 1 is a side view of the snap acting electric switch of this invention shown installed in an insulative housing, and with the overcenter spring in one of its two positions of reduced stress;

Figure 2 is a view similar to Figure 1 but showing the overcenter spring substantially at its critical position of maximum stress;

Figure 3 is a view similar to Figures 1 and 2 but showing the positions of the switch parts following snap actuation of the switch;

Figure 4 is a bottom view of the switch;

Figure 5 is a perspective view of the blade assembly per se;

Figure 6 is a view similar to Figure 1 but illustrating a slightly modified embodiment of the invention;

Figure 7 is a perspective view of the blade assembly shown in Figure 6, and

Figure 8 is an enlarged fragmentary cross sectional view taken through Figure 7 along the line 8—8.

Referring now more particularly to the accompanying drawings in which like reference characters indicate like parts throughout the several views, the numeral 5 generally designates the switch housing, only a portion of which is shown. The housing is preferably made of insulative material and is provided with a flat downwardly facing support 6 near one end, and upper and lower sta-

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tionary contacts 7 and 8, respectively, at its other end, spaced substantially equal distances to opposite sides of the plane of the supporting surface 6. The housing is further provided with a relatively large recess or well 9 intermediate the supporting surface 6 and the stationary contacts, with the mouth of the well opening downwardly.

The snap switch mechanism of this invention comprises a blade assembly 11 stamped and formed from a single sheet of resilient metal to provide a flat base 12 at one end of the assembly and three resilient blades 13, 14 and 15 all integrally joined to one edge of the base and projecting outwardly in the same direction therefrom. These blades are generally edgewise adjacent to one another and they are individually flexible flatwise in opposite directions substantially perpendicular to the plane of the base 12.

The blade assembly is secured in the switch housing with the base 12 flatwise seated on the support 6, by means of a rivet 17 passing through a suitable hole 18 in the base and through the upper portion of the switch housing 5, to also provide one of the terminals (not shown) of the switch. The blades of course, project lengthwise toward the opposite end of the switch housing and a contact portion 20 on the free end of the longest blade 15 projects between the upper and lower stationary contacts 7 and 8 for cooperation therewith. The contact portion 20 of the longest blade 15 may bear directly upon either of the stationary contacts but, if desired, a rivet 21 secured in the contact portion may serve as a contact point having convex surfaces at both sides of the blade for engagement with the upper and lower stationary contacts.

The shortest blade 13, which is also the narrowest, projects from the base 12 medially of the opposite side edges thereof, and provides a movable actuating member extending about one-half the distance from the base to the outer end of the longest blade. The blade 13 is flatwise flexible up and down through an opening in the intermediate blade 14, the opening being defined by a substantially U-shaped cutout 22 in the intermediate blade.

At its outer or free end, the actuating blade 13 is provided with a reduced tongue or projection 24, and the shoulders 25 which flank the projection provide a seat for one end of a helically coiled spring 26 which is confined under compression between the outer end of the actuating blade 13 and an abutment 27 on the intermediate blade defined by the bight of the U-shaped cutout therein. A similar tongue 28 on the intermediate blade projecting inwardly from the abutment 27 thereon toward the outer end of the actuating blade 13, cooperates with the projection or tongue 24 on the actuating blade to retain the coiled compression spring 26 operatively connected between the actuating and intermediate blades with these blades in overcenter relation to one another. It will be understood, of course, that the tongues 24 and 28 enter the end convolutions of the spring to prevent displacement of the spring from the blades.

It will be seen from the description thus far, that the actuating and intermediate blades 13 and 14, respectively, are similar to the actuating and contact blades of conventional snap acting switches of the type employing an overcenter spring. Thus the overcenter spring 26 tends to hold the actuating and intermediate blades flatwise separated and in their positions seen in Figure 1, wherein the actuating blade is shown flexed upwardly into engagement with the lower end of an operating button 30 mounted in the top wall 31 of the switch housing, and with the intermediate blade 14 flexed downwardly. The spring 26, of course, also forces the actuating button upwardly, which motion is limited by the engagement of an enlargement 32 on the button with the bottom 33 of the recess 9 in the switch housing.

Figure 1, therefore, shows the overcenter spring 26 in one of its two positions of reduced stress. Figure 3 shows

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the spring in its opposite position of reduced stress; while in Figure 2, the spring is shown substantially in its dead center position of maximum stress.

The operating button 30 may be depressed by any of a number of different mechanisms, or even manually, to cause snap actuation of the switch as a result of downward flexure of the operating blade 13 and consequent shifting of the overcenter spring from its first position of reduced stress shown in Figure 1, toward and past its position of maximum stress, or dead center, as shown in Figure 2. As soon as the actuating blade carries the overcenter spring past its position of maximum stress, the spring acts upon the intermediate blade 14 in the opposite direction to snap the same upwardly with a sudden motion.

The snap switch of this invention departs from conventional mainly by reason of the fact that the longer blade 15, rather than the intermediate blade, comprises the contact blade of the switch.

As stated hereinbefore, the longer blade has a contact portion 20 on its outer end portion, adjacent to the outer end of the intermediate blade. The contact portion 20 is connected to the opposite side edges of the intermediate blade, near its junction with the base, by means of a pair of opposite resilient arms 34. It will be understood, of course, that since the blade assembly is stamped from one sheet of spring metal, the contactor or longer blade 15 and the intermediate blade 14 are defined by a substantially U-shaped cutout 35 similar to the cutout 22 in the intermediate blade, so that the latter is free to flex up and down in the centrally disposed opening provided by the cutout in the longest blade.

It will be apparent, therefore, that the contact portion 20 of the blade 15 is resiliently connected with the intermediate blade at a location remote from the outer or free end of the intermediate blade, so that flatwise flexing motion imparted to the intermediate blade in one direction is also imparted to the contact blade 15 in the same direction.

Thus, with the position of the parts shown in Figure 1 wherein the intermediate blade is flexed downwardly under the force of the compression spring 26, the contact blade 15 is also flexed downwardly by reason of its resilient connection with the intermediate blade provided by the opposite arms 34. Hence, the contact portion 20, or, more particularly, the contact point 21 thereon, will be held in pressure engagement with the lower stationary contact 8 of the switch.

This resilient connection between the contact and intermediate blades is of the essence of this invention, for it assures that the contactor 15 will be forcibly held down against its stationary contact 8 as long as the intermediate blade 14 is similarly flexed downwardly, as seen in Figures 1 and 2. Thus, the force exerted upon the operating button 30 and imposed upon the intermediate blade 14 through the actuating blade 13 and spring 26 at the time the spring closely approaches or is in its dead center position of maximum stress is translated, at least in part, to a similar downward force acting upon the contact blade 15 to hold it engaged with the lower stationary contact 8.

This force urging the contactor blade downwardly to its lower position of engagement with stationary contact 8 will be maintained no matter how long the overcenter spring 26 is caused to remain close to, or at, its critical position of maximum stress, during which time the spring itself exerts practically no downward force upon the intermediate blade 14.

As soon as the overcenter spring passes the critical position of maximum stress indicated in Figure 2, it quickly snaps the intermediate blade upwardly to the position seen in Figure 3 to suddenly release the downward force acting upon the contact blade and to free it for upward travel with the intermediate blade, by reason of its resilient connection therewith, into engagement with the upper stationary contact 7.

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Thus it will be seen that in the operation of the switch of this invention, there is no possibility that the contact blade will flutter back and forth on its stationary contact 8 in the manner which previously caused objectionable arcing of the contacts during the time the overcenter spring closely approached, or was at, its dead center position of maximum stress and little or no contact pressure was exerted on the contact blade thereby. Instead, the contactor of the switch of this invention will be quickly snapped upwardly as soon as the overcenter spring reaches a critical position at which the intermediate blade 14 begins its snap movement in the upward direction.

With the switch described thus far, the contact blade 15 may complete a circuit in either position thereof defined by its engagement with one or the other of the stationary contacts 7 and 8, and in either position of the contactor, sufficient force is made available by the intermediate blade to hold the contacts engaged under pressure during the time the overcenter spring crosses its dead center position of maximum stress. It will be apparent, however, that for some uses only one stationary contact may be required. Therefore, the lower stationary contact 8 might suffice where only one circuit is to be controlled by the switch, while the upper stationary contact could be supplanted by an insulating surface on the switch housing. Ordinarily, however, it is customary to provide two such stationary contacts and where only one circuit is to be controlled, no lead is connected to the terminal of the upper contact 7, for instance.

If desired, the contactor blade 15 may be caused to return automatically to its lower position of engagement with the stationary contact 8 upon release of the force on the operating button 30. For this purpose, the actuating blade 13 of the switch may be biased upwardly, as shown best in Figures 5 and 7, it being understood that the upward bias must be sufficient to overcome the force of the overcenter spring 26 to carry the same from its second position of reduced stress, seen in Figure 3, to its first position of reduced stress shown in Figure 1.

Also, if desired, a lost motion driving connection may be provided between the intermediate blade 14 and the contact blade 15, so that a greater proportion of the expansive force of the overcenter spring will be imposed upon the contact blade in either of its two positions to hold it firmly engaged with one or the other of its cooperating stationary contacts. This lost motion connection may be afforded by a pair of spaced upper and lower abutments 37 and 38, respectively, on the contact blade spaced substantially equal distances to opposite sides of the contact portion 20 thereon and overlying opposite faces of the outer end portion of the intermediate blade 14. In Figures 1 to 5, inclusive, the abutments 37 and 38 are shown formed integral with the contact portion 20 of the contact blade, being bent up from the edge portion thereon which opposes the outer end of the intermediate blade 14.

Obviously, the contact blade is considerably longer than shown at the time the blades are stamped from a sheet metal blank in order to provide sufficient stock at the bight of the U-shaped cutout 35 in the contact blade to enable the abutments 37 and 38 to be bent up from the contact portion of the blade. When the abutments are bent up as described, the opposite resilient arms 34 of the contact blade are crimped as indicated at 39, to foreshorten the blade the distance necessary to assure engagement of the outer end portion of the intermediate blade with one or the other of the abutments 37 and 38 as the intermediate blade is snapped back and forth during operation of the switch.

With the position of the parts shown in Figure 1, therefore, the intermediate blade 14 engages the lower abutment 38, nearly the entire force of the overcenter spring 26 is imposed upon the contact blade to hold it firmly engaged with the lower stationary contact 8.

While the expansive force of the overcenter spring

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26 acting upon the intermediate blade in the Figure 2 position of maximum stress of the spring may be said to be substantially zero, nevertheless adequate contact pressure will be maintained as a result of the downward force imposed upon the contact blade by the intermediate blade 14 due to the downwardly flexed condition thereof.

As soon as the actuating blade 13 carries the overcenter spring past the dead center position of maximum stress thereof, and as soon as the intermediate blade begins to travel upwardly as a result of the reversed angle at which force is applied thereto by the overcenter spring, the intermediate blade is quickly snapped upwardly. While the intermediate blade is capable of effecting engagement under pressure between the contact portion of the contact blade and the upper stationary contact without the necessity of the upper abutment 37 on the contact blade, it is advantageous to provide for transient driving engagement of the outer end portion of the intermediate blade with the upper abutment 37 during upward snap movement of the intermediate blade in order to assure quick and positive engagement of the contact blade with its upper stationary contact.

It will also be appreciated that the abutments 37 and 38 act as stops for limiting the travel of the intermediate blade, both upwardly and downwardly in the opposite positions of minimum stress of the overcenter spring.

In the modified embodiment of the invention illustrated in Figures 6, 7 and 8, the abutments 37' and 38', though fixedly attached to the contact portion 20 of the contact blade, are not formed integrally with the blade. Instead, these abutments are formed as upwardly and inwardly extending legs on a U-shaped clip 40 clinched around the outer end of the contact blade with the bight of the clip received in an outwardly opening notch 41 in the blade. This clip may be permanently secured to the contact portion 20 by the rivet 21 which provides the contact point on the contact blade. In this case, of course, the arms 34' of the contact blade may be formed straight.

It will also be understood that, if desired, the abutments providing the lost motion driving connection between the contact and intermediate blades may be formed integral with the outer end portion of the intermediate blade 14, or by securing a clip thereto, similar to the clip 40.

From the foregoing description, taken together with the accompanying drawings, it will be readily apparent to those skilled in the art, that the switch of this invention has the highly desirable advantage of eliminating fluttering of the switch contactor and arcing of the switch contacts at such times as the overcenter spring is in, or closely approaches, its dead center position of maximum stress, no matter how slowly the spring is moved through said position of maximum stress.

What I claim as my invention is:

1. In an electric switch of the type wherein an overcenter spring effects snap actuation of a contact member in one direction from one position to another as a consequence of movement of an actuating member in the opposite direction to shift the spring to and slightly beyond a critical position of maximum stress: characterized by the provision of a third switch member having a portion movable back and forth in the same directions as said actuating and contact members; and further characterized by the fact that said spring is operatively connected in overcenter relation between said actuating member and the third switch member to snap the latter from one position to another during operation of the switch, and by means providing a motion transmitting connection between said third member and the contact member whereby snap actuation of the former from one position to the other will contact the latter and cause snap action thereof from one position to another.

2. In a snap acting electric switch, the combination of: first and second movable switch members and a spring

confined under compression between said members and connected in overcenter relationship therewith, so that movement of said first member in one direction relative to the second member to shift said spring to and slightly beyond a critical position of maximum stress effects snap actuation of said second member in the opposite direction from one position to another under the action of said spring; a movable contactor having a lost motion connection with said second member providing for a degree of relative motion therebetween during travel of said second member between said positions thereof, but by which the contactor is directly contacted by said second member and driven thereby with a snap motion in one direction, from one position to another, as a consequence of snap actuation of said second member in the same direction; and resilient means connecting the contactor with said second member and stressed by said second member when the latter is in said one position thereof, to impose a force on the contactor in a direction to restrain it against movement out of said one position thereof, until said second member begins its snap movement toward said other position thereof.

3. In a snap acting electric switch of the type wherein a spring confined under compression between first and second movable switch members and connected in overcenter relationship therewith, effects snap actuation of said second switch member in one direction, from one position to another, as a consequence of movement of said first switch member in the opposite direction to move said spring from one position of reduced stress through a position of maximum stress toward an opposite position of reduced stress: a third movable switch member providing a contactor; means providing a lost motion driving connection between the contactor and said second switch member by which the latter is movable relative to the contactor during a portion of the travel of said second switch member between said positions thereof, but by which the contactor is directly contacted by said second switch member and driven thereby with a snap motion in one direction from one position to another as a consequence of snap actuation of said second switch member in the same direction; and resilient means connecting the contactor with said second switch member and stressed thereby when the latter is in one of said positions thereof, to impose a force on the contactor in a direction to hold it in one of said positions thereof during the time said overcenter spring closely approaches its position of maximum stress, as it is moved from one position of reduced stress to the other.

4. In a snap acting electric switch of the type wherein a spring confined under compression between first and second movable switch members and connected in overcenter relationship therewith, effects snap actuation of said second switch member in one direction from one position to another, in consequence of movement of said first switch member in the opposite direction to move said spring from one position of reduced stress through a critical position of maximum stress toward an opposite position of reduced stress: a third switch member providing a movable contactor; and means connecting the contactor with said second switch member so that snap actuation of the latter in said direction effects movement of the contactor in the same direction from one position to another, said means comprising resilient means stressed by said second switch member when the latter is in said one position thereof to impose a force on the contactor in a direction to hold it in said one position thereof during the time said overcenter spring closely approaches and/or occupies said critical position of maximum stress and further comprising spaced abutments on the contactor alternately engageable by said second switch member during snap actuation thereof in opposite directions to provide a lost motion driven connection between the contactor and said second switch member by which the contactor is propelled to one or the other of

the said positions thereof during snap actuation of said second switch member.

5. In a snap acting electric switch of the type wherein a spring confined under compression between first and second movable switch members and connected in overcenter relationship therewith effects snap actuation of said second switch member in one direction from one position to another, in consequence of movement of said first switch member in the opposite direction move said spring from one position of reduced stress through a critical position of maximum stress toward an opposite position of reduced stress: a third switch member providing a movable contactor; means providing a lost motion driving connection between said second and third switch members comprising spaced abutments carried by one of said last two designated members loosely embracing and engageable by a portion of the other thereof, whereby said second member may move relatively to the contactor during a portion of the travel of said second switch member between said positions thereof but by which the contactor is directly contacted by said second member and driven with a snap motion in one direction, from one position to another, as a consequence of snap actuation of said second switch member in the same direction; and resilient means connecting the contactor with said second switch member and stressed thereby when the latter is in one of said positions thereof to impose a force on the contactor in a direction to hold it in one of said positions thereof during the time said overcenter spring closely approaches and/or occupies its position of maximum stress.

6. A blade assembly for a snap acting electric switch characterized by the fact that said assembly is stamped and formed from a single sheet of spring metal and comprises: a base at one end of the assembly providing for securement thereof to a support, and three resilient blades projecting outwardly in the same direction from one edge of the base and each being flatwise flexible relative to the others in opposite directions substantially perpendicular to the base; a first one of said blades providing an actuator; a second one of said blades being longer than said actuator and having an end portion spaced from and opposing the outer end of said first blade; means on the opposing outer end portions of said first and second blades providing for connection of a compression spring thereto in overcenter relationship therewith; and the third blade comprising a contact portion outwardly of but adjacent to the outer end of said second blade and an elongated resilient arm joined to said second blade near the junction of the latter with the base, whereby flatwise flexure of said second blade in one direction imposes a force on said third blade to flex the same in the same direction through said resilient arm of the third blade; and lost motion means for causing direct contact of the outer end of the second blade and the third blade to impart a snap action to the third blade when the second blade snaps over center.

7. A blade assembly for a snap acting electric switch characterized by the fact that said assembly is stamped and formed from a single sheet of spring metal and comprises: a base at one end of the assembly providing for securement thereof to a support, and three resilient blades projecting outwardly in the same direction from one edge of the base and each being flatwise flexible relative to the others in opposite directions substantially perpendicular to the base; a first one of said blades providing an actuator; a second one of said blades being longer than said actuator and having an end portion spaced from and opposing the outer end of said first blade; means on the opposing outer end portions of said first and second blades providing for connection of a compression spring thereto in overcenter relationship therewith; the third blade comprising a contact portion outwardly of but adjacent to the outer end of said second blade and an elongated resilient arm joined to said second blade near

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the junction of the latter with the base, whereby flatwise flexure of said second blade in one direction imposes a force on said third blade to flex the same in the same direction through said resilient arm of the third blade; and lost motion means including spaced abutments fastened to said third blade for engaging the outer end of the second blade to impart a snap action to the third blade when the second blade snaps over center.

8. The blade assembly set forth in claim 7 wherein said spaced abutments on said third blade are formed integral with the outer end portion of said third blade.

9. The blade assembly set forth in claim 8 wherein said third blade is foreshortened by a deformation in the arm thereof, and wherein said abutments on the contact portion of the third blade are bent up from the edge of the contact portion which opposes the outer end of said second blade to overlie opposite faces of said outer end portion of the second blade.

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10. The blade assembly set forth in claim 7 wherein said spaced abutments comprise a clip embracing and secured to the contact portion of said third blade, said clips having offset legs spaced from one another and projecting inwardly over opposite faces of the outer end portion of said second blade to define the limits of movement of the latter relative to the contact portion of the third blade.

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