May 11, 1943. A. E. BAAK 2,318,734

SNAP ACTION SWITCH

Filed Dec. 7, 1939

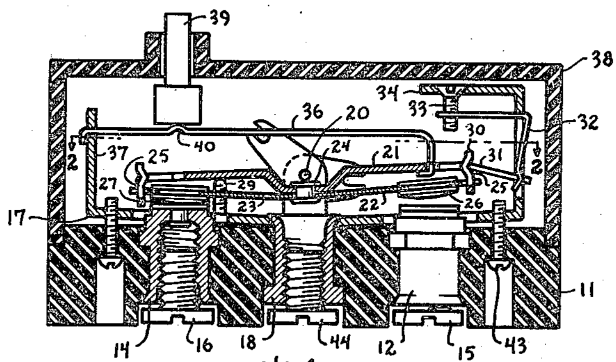

Fig.1

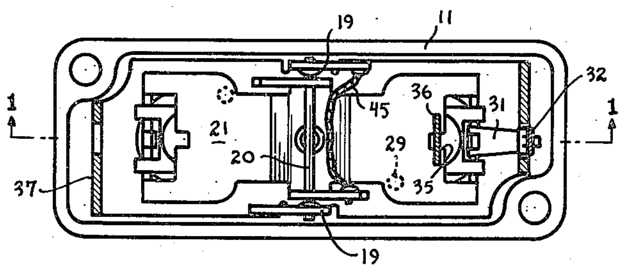

Fig.2

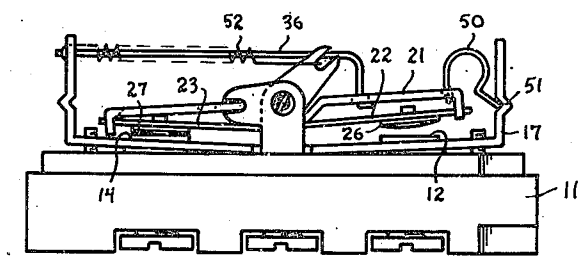

Fig.3

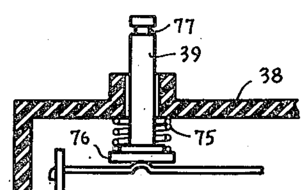

Fig.5

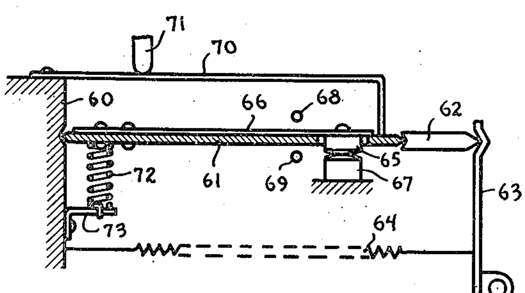

Fig.4

Inventor

Albert E. Baak

By George H Fisher

Attorney

Patented May 11, 1943

2,318,734

UNITED STATES PATENT OFFICE

2,318,734

SNAP ACTION SWITCH

Albert E. Baak, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application December 7, 1939, Serial No. 307,991

19 Claims. (Cl. 200—67)

This invention relates to switching devices which are actuated with a snap action.

One of the main objects of the present invention is to design a small, compact, and unitary snap action switch which is inexpensive to manufacture and efficient in operation.

A further object is to design a snap action switch of the self return type and completely enclose the structure in an insulating housing having an actuating pin extending therethrough.

Another object is to provide a simple method of changing this switch from a self return type to a push-pull type by inserting a small additional spring inside of the cover.

Another object is to provide an open contact switch lever which is rotated by means of a resilient actuating member and further to provide spring means acting on the lever for over-compensating the spring rate of the actuating member to produce a snap action. The lever may carry one or more movable contacts by means of press back blades and in this case the spring rates of the press back blades must also be over-compensated by the spring means.

Still another object is to provide a switch of the above type wherein means are provided for adjusting the angle at which the spring means exerts its force on the switch lever and also means for adjusting the force exerted by the spring means.

Another object is to provide a double throw switch having two press back blades normally having zero tension and so arranging them that on rotation of the lever one of the blades starts being pressed back just as all of the press back has been relieved from the other blade. Thus the two blades as a unit have a constant effective spring rate and the switch can be actuated with a smaller driving force.

These and other objects will readily become apparent as the following specification is read in the light of the accompanying drawing, in which

Figure 1 is a sectional view of a preferred embodiment of my invention, the section being taken along the line 1—1 of Figure 2.

Figure 2 is a plan view taken partly in section along the line 2—2 of Figure 1.

Figure 3 is an elevation of a modified form of my invention.

Figure 4 is a view of a further modification, and

Figure 5 is a detail view of a spring which may be added to each of the modifications disclosed in the first four figures.

Referring now to Figure 1 of the drawing, the reference numeral 11 indicates an insulating base in which are mounted a pair of stationary contacts 12 and 14 which are in the form of sleeves and have at their upper ends special contact surfaces. These sleeves screw threadedly receive terminal screws 15 and 16.

A metallic frame 17 is mounted on the base 11 and is retained thereon by means of the sleeve 18 which extends through a hole in the base and also through a hole in the frame 17 and which is turned over to secure the frame to the base member. The frame 17 is provided with a pair of arms 19 between which is mounted an axle 20. Lever 21 is pivotally mounted on the axle 20 and carries a pair of press back blades 22 and 23 by any suitable means such as the rivet 24. Each end of the lever 21 is provided with a turned down portion 25 provided with a hole through which the ends of the press back blades extend. The holes are of such size as to permit the ends of the blades a predetermined amount of movement relative to the lever and the blades are tensioned downwardly against the lower ends of the lever. The press back blade 22 carries a contact 26 which is adapted to cooperate with stationary contact 12 and the blade 23 carries contact 27 which is adapted to cooperate with the stationary contact 14. As seen in Figure 1 the contacts 14 and 27 are in engagement and the blade 23 has been pressed back. Contacts 26 and 12 are separated and the end of the press back blade is tensioned downwardly against the downwardly turned end 25 of the lever 21.

A stop 29 is mounted in the base for limiting the rotation of the lever 21 in a counter-clockwise direction as seen in Figure 1. Thus the lever 21 is not pressing on the movable contact 27 and the pressure between the contacts 27 and 14 is determined by the tension in the press back blade 23. A similar stop shown in dotted lines in Figure 2 limits the rotation of the lever 21 in a clockwise direction. If desired these stops may be eliminated so that the engagement of the lever with the contacts themselves limit the rotation of the lever. This provides for a greater contact pressure for a given switch actuating force but with this arrangement there is a greater tendency for the contacts to bounce as they come together. Therefore in the preferred embodiment of my invention I employ the stops 29 to limit the movement of the lever and reduce the tendency toward contact bounce.

The turned down end 25 of the lever is provided with a tongue 30 having a depression in which one end of a toggle 31 seats. It will be noted that the contact lever 21 is symmetrical about the axle 20. This is so the lever may be assembled on the base without regard to which end is which. The other end of the toggle 31 seats in a depression in an L shaped leaf spring 32, the other end of which is adjustably connected by means of the screw 33 with a horizontally extending portion 34 of the frame 17. The lower end of the leaf spring 32 in which the toggle 31 seats is biased toward the left as seen in Figure 1, and in this position of the parts it biases the lever 21 for rotation in a counter-clockwise direction thereby tending to hold the contacts 27 and 14 in engagement.

A resilient arm 36 is connected at one end to an arm 37 on the frame 17 and its other end is formed with a reduced portion which extends within the slot 35 in the end of lever 21. The reduced portion of arm 36 forms shoulders which bear on the surface of lever 21 to rotate the lever. A cover 38 seats on the base 11 and forms therewith a housing for the entire switch mechanism. A pin 39 extends through an opening in the cover 38 and seats on the rounded projection 40 on the resilient member 36.

When no external force is being applied to the pin 39 the parts will assume the positions shown in Figure 1. At this time the press back blade 23 is attempting to rotate the lever 21 in a clockwise direction but this tendency is overcome by the leaf spring 32 acting on the lever 21 through the toggle 31 and holding the lever in the position shown. In order to actuate the switch an external force is applied to the pin 39 pushing it downwardly. This force tends to bow the resilient member 36 and build up a force therein until it is sufficient to start the lever 21 rotating in a clockwise direction. As this rotation starts it will be noted that the angle between the toggle 31 and the lever 21 changes in such a manner that the effective force opposing rotation of the lever 21 and exerted by the leaf spring 32 is decreasing. The rate at which this force decreases must be so related to the spring rate of the resilient arm 36 that it decreases faster than the decrease in the force exerted by the resilient arm 36 as this arm rotates the lever 21. It will also be noted that as the lever 21 rotates, the press back blade 23 straightens out and the force exerted by this blade tending to rotate the lever 21 also decreases until the end of the press back blade engages the end of the lever 21 at which time this force suddenly becomes zero. As the lever 21 continues to rotate contacts 26 and 12 engage at which time the press back blade 22 is being flexed and this flexure further opposes rotation of the lever 21. Therefore, in order that the lever snap completely from one position to the other, the force exerted by leaf spring 32 which resists rotation of the lever 21 must decrease at a rate greater than the combined effect of the spring rate of the resilient arm 36 and the effect of the press back in blade 23 being relieved and the effect of picking up the press back blade 22. In other words, the spring rate of the resilient arm 36 must be such that when a force is stored in this arm sufficient to start the lever 21 to rotate in a clockwise direction it must decrease at a rate sufficiently low to continue to rotate the lever 21 to its other position. This can only be accomplished as long as the force exerted by the leaf spring 32 resisting rotation of the lever decreases at a sufficiently rapid rate to over-compensate the spring rate of the resilient arm 36, the press back blades 22 and 23 and to overcome the effect of the initial tension in each of the press back blades as the resisting force of blade 23 is reduced to zero and the resisting force of blade 22 is picked up and increased from zero to a value depending upon the initial tension of the blade.

As set forth above the stop 29 limits rotation of the lever 21 in a clockwise direction and at this time the lever 21 has not passed over center, or even up to dead center, with respect to the toggle 31. This being the case the leaf spring 32 is still tending to rotate the lever 21 in a counter-clockwise direction although with a much smaller force than it was before the lever 21 was rotated. At this time therefore there is still sufficient force being exerted by the resilient arm 36 to hold contacts 26 and 12 in engagement and to press back the blade 22. As the external force on the pin 39 is removed to a point where the resilient arm 36 cannot hold the lever 21 the lever will start to rotate in a counter-clockwise direction. As it does so the angle at which the toggle 31 presses against the lever 21 is changed to increase the rotative effect which the leaf spring 32 has on the lever 21 and here again this change must increase more rapidly than the increase in resistive force due to the spring rate of the resilient arm 36 and must also increase at a rate sufficiently great to over-compensate for the effect of the press back blades 22 and 23 so that once the lever 21 starts to rotate in a counter-clockwise direction the leaf spring 32 will continue that rotation until the lever has returned to its original position.

In order to properly adjust the switch a screw 43 is passed loosely through a hole in the base 11 and screw threadedly engages the frame 17 which is biased upwardly. Rotation of this screw will vary the position of the frame and hence the lower end of the leaf spring 32 thereby changing the angle at which the toggle 31 engages the lever 21. Also by rotating the screw 33 the force exerted by the leaf spring 32 may be adjusted. Adjustment of this force will of course vary the differential of the switch.

It will be noted that this switch is a single pole double throw switch having a common terminal screw 44. The electrical connection is from the terminal 44 through sleeve 18 to the frame 17, arm 19, and through parallel paths through the axle 20 or conductor 45 to the switch lever 21. As the switch is oscillated back and forth the electrical connection is therefore alternately from the terminal 44 to terminal 15 and from terminal 44 to the terminal 16.

Figure 3 shows a modification of the switch shown in Figure 1 in which the base 11, frame 17, switch lever 21 and resilient actuating arm 36 are substantially the same as in Figure 1. In Figure 3, however, a bowed leaf spring 50 takes the place of the leaf spring 32 and toggle 31. The spring 50 seats in a depression 51 in the frame 17 and its other end engages directly on the end of the lever 21. In this modification as the lever 21 is rotated in a clockwise direction it passes over-center with respect to the spring 50. Therefore a return spring 52 must be provided for returning the lever 21 to its original position. In this modification the press back blades 22 and 23 are under zero initial tension and furthermore, as the lever 21 is rotated, the press back in one blade is first gradually relieved and just as one contact is separating from its stationary contact the other contact is just engaging its stationary contact and the other press back blade is being tensioned. The resultant effect is that the two press black blades act as a unit and have an effective constant spring rate so that there is no sudden reducing of one force to zero and picking up a second force acting in the opposite direction as there is in the modification in Figure 1. As a result the spring 50 need not exert as great a force as the leaf spring 32 and the actuating force for the switch need not be as large.

Another difference between this modification and that of Figures 1 and 2 is that the lever is limited in its rotation only by its engagement with the movable contact after the press back blade has been tensioned its limit. In other words, in Figure 3 the contacts 27 and 14 are in engagement and the left-hand end of the lever 21 is resting on the upper part of the movable contact 27, so that all of the forces which went to produce the snap action are now taken up in forcing the contacts together. Furthermore, as the press back blade 23 is itself trying to rotate lever 21, the actual pressure between the contacts is greater than the external force required to actuate the switch.

It is intended that the base 11 in Figure 3 shall be provided with a cover and actuating pin the same as the switch in Figures 1 and 2. As an external force is applied to the pin an actuating force will be stored in the resilient arm 36 until the lever 21 starts to rotate in a clockwise direction. This rotation is of course initially opposed by the spring 50 but as the lever starts to rotate this opposing force decreases at a rate sufficient to over-compensate for the spring rates of the resilient arm 36, the return spring 52 and the press back blades 22 and 23. Spring 50 will tend to maintain the contacts 26 and 12 in engagement after the lever 21 has been rotated and therefore the return spring 52 must exert sufficient force to overcome the effect of the spring 50 when the tension in the resilient arm 36 has been removed. It will be understood that as the lever 21 starts to rotate in a counter-clockwise direction that the spring 50 will again over-compensate the spring rates of the resilient arm 36, return spring 52 and the two press back blades to snap the lever 21 in the opposite direction.

Figure 4 illustrates a third form of my invention and comprises a stationary support 60 with which the lever 61 has a knife edge engagement. The opposite end of the lever 61 is engaged by a toggle 62 which seats in a depression in a pivoted arm 63. The spring 64 biases arm 63 for rotation in a direction to place a longitudinal compressive force on the lever 61. The lever 61 carries a movable contact 65 by means of a press back blade 66, the contact 65 cooperating with a stationary contact 67. When the lever 61 and toggle 62 are aligned the contacts 65 and 67 are in engagement but the blade 66 has not been pressed back. This is actually an unstable position of the switch as the lever 61 is snapped between the two stops 68 and 69. The lever 61 is actuated by means of a resilient arm 70 which is engaged by an actuating pin 71 similar to the pin 39 shown in Figure 1.

Assuming the lever 61 to be engaging the stop 68 it will be seen that the effect of spring 64 through the lever 63 and toggle 62 is to oppose rotation of the lever 61. The application of an external force to the pin 71 therefore stores energy in the resilient arm 70 until it exerts a force sufficient to start the lever 61 to rotate in a clockwise direction. This rotation changes the angle at which the toggle 62 engages the lever 61 and this change in angle overcompensates the spring rate of the resilient arm 70, the spring 64 and the return spring 72 which is mounted on the bracket 73 connected to the stationary support 60. As the contacts 65 and 67 engage a further movement of the lever 61 presses back the blade 66 and therefore in order that the lever snap into engagement with the stop 69 the toggle 62 in conjunction with spring 64 and lever 63 must also compensate the spring rate of the press back blade 66.

At this time the effect of spring 64 is to tend to hold the lever 61 in engagement with the stop 69. Hence the return spring 72 must have sufficient strength to start the lever 61 rotating in the opposite direction against the force exerted by spring 64 when the pressure on the resilient arm 70 is relieved by the pin 71. As the lever 61 starts to rotate in a counter-clockwise direction the change in angle between the toggle 62 and lever 61 again over-compensates the various spring rates to cause the lever to snap into engagement with the stop 68 and separate contacts 65 and 67.

Figure 5 discloses a simple manner in which the snap switches of all three modifications described may be changed from switches of the self return type to switches of the push-pull type. In the modification shown in Figures 1 to 4 the switch is actuated in one direction when the pin 39 is depressed and in the opposite direction when the pin is released. In Figure 5 a coiled compression spring 75 has been placed around the pin 39 within the cover 38 and this spring seats on a flange 76 of the pin 39 at one end and against the underneath side of the cover 38 at the other end. The spring 75 is arranged to exert a force on the pin 39 sufficient to hold the lever 21 or 61 in its clockwise position once it has been actuated to this position. Therefore in order to return the lever to its original counter-clockwise position the pin 39 must be lifted by an external force to counteract the effect of the spring 75. Spring 75 however, does not exert a force sufficient to rotate the lever 21 in a counter-clockwise direction. In other words, this spring exerts a force sufficient to maintain the switch in its actuated position but is incapable of actuating the switch itself so that the pin 39 must be pushed to actuate the switch and pulled to return the switch. A notch 77 is shown in the outer end of the pin 39 so that it may be engaged by any suitable actuating member by which it may be both pushed and pulled.

Reference is made to the copending application of Carl G. Kronmiller Serial Number 308,005 filed December 7, 1939, which discloses a different application of the principle shown in Figure 5.

As various changes and modifications in this invention may occur to those who are skilled in the art I wish it to be understood that I intend to be limited only by the scope of the appended claims and not by the specific embodiments disclosed herein.

I claim as my invention:

1. In a device of the character described, a pivoted lever, a movable contact carried thereby, a stationary contact, spring means exerting a compressive force on said lever, the direction of said force being at an angle of less than 45° with respect to said lever and such as to tend to sepa-

rate said contacts, a resilient arm engaging said lever, means for building up a force in said arm, said last named force being of sufficient magnitude to rotate said lever against the action of said spring means and hence reduce the angle between the direction of said force and said lever, the reduction in the angle at which said spring means exerts its force over compensating the spring rate of said resilient arm, and means limiting the rotation of said lever to prevent the direction of application of force by said spring means ever being aligned with said lever whereby said spring means is operative to return said lever to its original position upon a reduction of the force applied to said arm.

2. In a device of the character described, a pivoted lever, a resilient blade mounted on said lever, a movable contact carried by the free end of said blade, a stationary contact mounted for cooperation with said movable contact, spring means exerting a compressive force on said lever, the direction of said force being at an angle of less than 45° with respect to said lever and such as to tend to separate said contacts, and a resilient member for rotating said lever against the action of said spring means and hence reduce the angle between the direction of said force and said lever, said rotation causing such a reduction in the angle at which said spring means exerts its force on said lever that the spring rates of both said resilient member and said blade are over compensated to cause said contacts to engage with a snap, said contacts acting to limit the rotation of said lever, said blade acting in a direction to reverse said lever.

3. In a device of the character described, a movable member, a resilient blade mounted thereon, a movable contact carried by the free end of said blade, a stationary contact, said contacts being in engagement at a first position of said movable member and separated at a second position of said member, biasing means applying a compressive force on said member, the direction of said force being at an angle of less than 45° with respect to said movable member, said force constantly tending to move said member to one of its positions throughout the entire movement of said member, and resilient means for moving said member against the force exerted by said biasing means and hence reducing the angle between the direction of said force and said movable member, said change in angle over compensating the spring rate of said resilient means and blade to cause said member to move from one position to another with a snap action.

4. In a device of the character described, a lever pivoted at a mid point, a movable contact carried by said lever on each side of said mid point, a pair of stationary contacts mounted for cooperation with said movable contacts, spring means exerting a compressive force on said lever at an angle of less than 45°, said force tending to close one pair of contacts and separate the other pair, and a resilient member for rotating said lever against the force exerted by said spring means, said rotation causing a reduction in the angle at which said spring means exerts its force on said lever whereby the spring rate of said resilient member is over compensated and the lever moves with a snap action to separate one pair of contacts and close the others, engagement of one or the other of said pairs of contacts limiting the rotation of said lever whereby substantially all of the force which causes the lever to snap, acts to hold the contacts in engagement.

5. In a device of the character described, a pivoted lever, a resilient blade mounted on said lever, a movable contact carried by the free end of said blade, a stationary contact mounted for cooperation wth said movable contact, spring means exerting a compressive force on said lever at an angle of less than 45°, said force tending to separate said contacts, a resilient member for rotating said lever against the action of said spring means, said rotation causing such a reduction in the angle at which said spring means exerts its force on said lever that the spring rates of both said resilient member and said blade are over compensated to cause said contacts to engage with a snap, said blade acting in a direction to reverse said lever, and stop means for limiting rotation of said lever whereby the pressure between the contacts is determined by the blade only.

6. In a device of the character described, a lever pivoted at a mid point, a pair of resilient blades mounted on said lever with their free ends on opposite sides of said mid point, movable contacts carried by the free ends of said blades, said resilient blades being so arranged that when said lever is rotated in one direction one of said blades is pressed back and therefore tensioned, and when the lever is rotated in the opposite direction the other blade is pressed back and tensioned, stationary contacts, spring means exerting a compressive force on said lever at an angle of less than 45° and such as to tend to hold one pair of contacts closed and the other pair open, and a resilient member for rotating the lever against the action of said spring means and hence reducing the angle between the direction of said force and said lever, the arrangement being such that just as the tension of one of said blades is relieved the tension of the other blade starts to become operative whereby the two blades as a whole have a substantially constant effective spring rate as said lever is rotated, rotation of said lever causing such a reduction in the angle at which said spring means exerts its force on said lever that the spring rates of said resilient member and said blades are over compensated.

7. In a device of the character described, a lever pivoted at a mid point, a pair of resilient blades mounted on said lever with their free ends on opposite sides of said mid point, movable contacts carried by the free ends of said blades, said resilient blades being so arranged that when said lever is rotated in one direction one of said blades is pressed back and therefore tensioned, and when the lever is rotated in the opposite direction the other blade is pressed back and tensioned, stationary contacts, spring means exerting a compressive force on said lever at an angle less than 45° and such as to tend to hold one pair of contacts closed and the other pair open, and a resilient member for rotating the lever against the action of said spring means, the arrangement being such that just as the tension of one of said blades is relieved the tension of the other blade starts to become operative whereby the two blades as a whole have a substantially constant effective spring rate as said lever is rotated, rotation of said lever causing such a reduction in the angle at which said spring means exerts its force on said lever that the spring rates of said resilient member and said blades are over compensated, engagement of said contacts limiting the rotation of the lever in each direction whereby substantially all of the force

which causes the snap action, acts to hold the contacts in engagement.

8. In a device of the character described, a lever pivoted at a mid point, a pair of resilient blades mounted on said lever with their free ends on opposite sides of said mid point, movable contacts carried by the free ends of said blades, stationary contacts, spring means exerting a compressive force on said lever at an angle of less than 45° and such as to tend to hold one pair of contacts closed and the other pair open, a resilient member for rotating the lever against the action of said spring means, the rotation of said lever causing such a reduction in the angle at which said spring means exerts its force on said lever that the spring rates of said resilient member and said blades are over compensated, and stop means for limiting the rotation of said lever in each direction whereby the pressure between the contacts is determined by the tension in the resilient blades.

9. In a device of the character described, a movable member, spring means exerting a compressive force on said movable member at an angle of less than 45° and such as to bias it for movement in one direction, a resilient member for moving said movable member against the force exerted by said spring means, said movement reducing the angle at which said spring means exerts its force on said movable member whereby the spring rate of said resilient member is over compensated thereby causing a snap action of said movable member, means for manually changing the angle at which said spring means exerts its force on said movable member, and a control device actuated by said movable member.

10. In a device of the character described, an insulating base, a lever pivotally mounted on said base, a movable contact carried by said lever, a stationary contact mounted on said base for cooperation with said movable contact, spring means mounted on said base, said spring means exerting a force on said lever at such an angle as to bias said lever for rotation in a given direction, a resilient arm having one end mounted on said base and the other end operatively associated with said lever, a cover for said base, a button extending through said cover and engaging said resilient arm at a point spaced from its other end, the application of an external force to said button building up a sufficient force in said resilient arm to rotate said lever, said rotation causing the angle at which said spring means exerts its force on said lever to change and over compensate the spring rate of said resilient arm, and means preventing said lever from going over center with respect to said spring means whereby said spring means returns said lever to its original position.

11. In a device of the character described, an insulating base, a lever pivotally mounted on said base, a movable contact carried by said lever, a stationary contact mounted on said base for cooperation with said movable contact, spring means mounted on said base, said spring means exerting a force on said lever at such an angle as to bias said lever for rotation in a given direction, a resilient arm having one end mounted on said base and the other end operatively associated with said lever, a cover for said base, a button extending through said cover and engaging said resilient arm at a point spaced from its other end, the application of an external force to said button building up a sufficient force in said resilient arm to rotate said lever, said rotation causing the angle at which said spring means exerts its force on said lever to change and over compensate the spring rate of said resilient arm, means preventing said lever from going over center with respect to said spring means whereby said spring means would normally return said lever to its original position when the external force applied to said button is removed, and a second spring means inside said cover applying a force to said button which is sufficient to prevent said first spring means for returning said lever but insufficient to rotate said lever against the force exerted by said first spring means.

12. In a device of the character described, an insulated base, a snap action switch of the shelf return type mounted on said base, an actuating member for said switch, a cover for said base enclosing said switch and actuating member, a pin extending through said cover and engaging said actuating member, and a spring mounted between said cover and said pin and exerting a force on said pin sufficient to prevent the return of said snap switch but insufficient to actuate said switch.

13. In a device of the character described, a substantially rigid pivoted lever, a movable contact carried by said lever, a stationary contact mounted for cooperation therewith, a support, a bowed leaf spring seated at one end on said support and engaging said lever at the other end to exert a force on said lever at an angle with respect thereto, a resilient member for rotating said lever against the force exerted by said leaf spring, the change in angle at which said spring exerts its force on said lever over compensating the spring rate of said resilient member, and means for adjusting said support along a line substantially parallel to the movement of said movable contact.

14. In a device of the character described, an elongated lever, pivot means pivoting said lever for rotary movement, a stationary contact, a movable contact carried by a free end of said lever for cooperation with said stationary contact, spring means exerting a compressive force on said free end of the lever at an angle of less than 45° and such as to tend to separate said contacts, a resilient arm acting upon said lever at a point between said pivot means and movable contact, and means for exerting a force on said resilient arm at a point remote from the point at which it acts on said lever, said force being sufficient to cause said resilient arm to rotate said lever in a contact closed direction, rotation of said lever causing a reduction in the angle at which said spring means exerts its force on said lever, said spring means exerting sufficient force to overcompensate the spring rate of said resilient arm.

15. In a device of the character described, an elongated lever, pivot means pivoting said lever for rotary movement, a stationary contact, a movable contact carried by a free end of said lever for cooperation with said stationary contact, spring means exerting a compressive force on said free end of the lever at an angle of less than 45° and such as to tend to separate said contacts, a resilient arm acting upon said lever at a point between said pivot means and movable contact, and means for exerting a force on said resilient arm at a point remote from the point at which it acts on said lever, said force being sufficient to cause said resilient arm to

rotate said lever in a contact closed direction, rotation of said lever causing a reduction in the angle at which said spring means exerts its force on said lever, said spring means exerting sufficient force to overcompensate the spring rate of said resilient arm, said stationary contact being so positioned as to stop rotation of said lever by its cooperation with the movable contact before said lever has reached its dead center position with respect to said spring means.

16. In a device of the character described, an elongated lever, pivot means pivoting said lever at a mid point for rotary movement, a first stationary contact, a first movable contact carried by one end of said lever for cooperation with said first stationary contact, a second stationary contact, a second movable contact carried by the other end of said lever for cooperation with said second stationary contact, spring means exerting a compressive force on one end of said lever at an angle of less than 45° and such as to tend to separate said first contacts, a resilient arm acting upon said lever at a point between said pivot means and one of said movable contacts, and means for exerting a force on said resilient arm sufficient to cause it to rotate in a direction to close said first contacts, rotation of said lever causing a reduction in the angle at which said spring means exerts its force on said lever, said spring means exerting sufficient force to overcompensate the spring rate of said resilient arm.

17. In a device of the character described, an elongated lever, pivot means pivoting said lever at a mid point for rotary movement, a first stationary contact, a first movable contact carried by one end of said lever for cooperation with said first stationary contact, a second stationary contact, a second movable contact carried by the other end of said lever for cooperation with said second stationary contact, spring means exerting a compressive force on one end of said lever at such an angle of less than 45° and such as to tend to separate said first contacts, a resilient arm acting upon said lever at a point between said pivot means and one of said movable contacts, and means for exerting a force on said resilient arm sufficient to cause it to rotate in a direction to close said first contacts, rotation of said lever causing a reduction in the angle at which said spring means exerts its force on said lever, said spring means exerting sufficient force to overcompensate the spring rate of said resilient arm, said first stationary contact being so positioned as to stop rotation of said lever by its cooperation with said first movable contact before said lever has reached its dead center position with respect to said spring means.

18. In a device of the character described, a movable member, means for limiting said member for movement between two positions, spring means, a toggle link carried at one end by said spring means and at the other end by a free end of said movable member, said toggle link transmitting said spring force to said movable member at an angle thereto for biasing said member for movement to one of its positions, a resilient member for moving said movable member against the force exerted by said spring means, the resultant reduction in the angle between the toggle link and movable member over compensating the spring rate of said resilient member so as to cause a snap action of said movable member, and means for adjusting the position of said spring means in the direction of movement of said free end of said movable member and over a sufficient range to change the action of said toggle link from a non over center action in which said spring means makes said device a device of the self return type, to an over center action with respect to said movable member whereby said device is changed from a self return.

19. In a device of the character described, a movable member, means for limiting said member for movement between two positions, spring means, a toggle link carried at one end by said spring means and at the other end by a free end of said movable member, said toggle link transmitting said spring force to said movable member at an angle thereto for biasing said member for movement to one of its positions, a resilient member for moving said movable member against the force exerted by said spring means, the resultant reduction in the angle between the toggle link and movable member over compensating the spring rate of said resilient member so as to cause a snap action of said movable member, and means for adjusting the position of said spring means in the direction of movement of said free end of said movable member and over a sufficient range to change the action of said toggle link from a non over center action in which said spring means makes said device a device of the self return type, to an over center action with respect to said movable member whereby said device is changed from a self return, and means for adjusting the magnitude of the force exerted by said spring on said toggle link.

ALBERT E. BAAK.