United States Patent [19]

Deubel et al.

[11] **3,769,474**

[45] **Oct. 30, 1973**

[54] **CONTACT PRESSURE SUSTAINING SWITCH**

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[22] Filed: Nov. 29, 1971

[21] Appl. No.: **202,759**

[52] **U.S. Cl.** ..... **200/76**, 200/67 A

[51] **Int. Cl.** **H01h 15/18**

[58] **Field of Search** ..... 200/67 R, 67 B, 67 A, 200/67 D, 76

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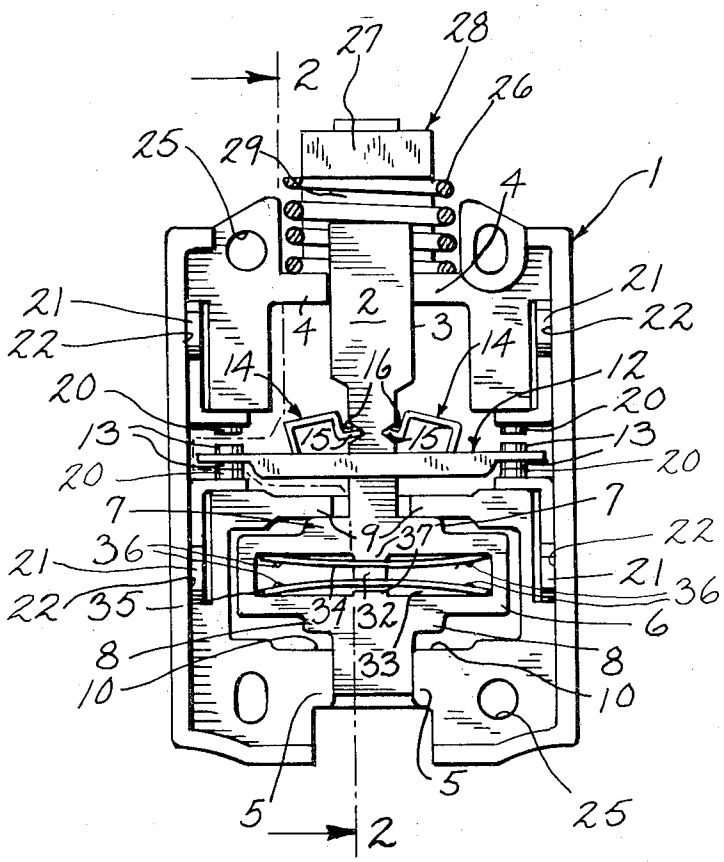
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[57] **ABSTRACT**

A snap-action switch includes an actuator, the movement of which initially loads one of two bias springs and thereafter produces advancement of a reciprocally movable toggle bar. A toggle spring is positioned between the toggle bar and a movable contact spanner, which toggle spring acts to apply contact closing pressure and also to resist advancement of the toggle bar until it is overcome by the loaded bias spring. At this point in operation the toggle bar is rapidly advanced through and past toggle center, to accomplish a snap-action of the toggle spring forcing the movable contact member out of engagement with one pair of contacts and into engagement with a second pair of contacts, and such snap-action occurs without diminution of contact pressure to dangerously low values.

10 Claims, 10 Drawing Figures



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SHEET 1 OF 3

Fig. 1

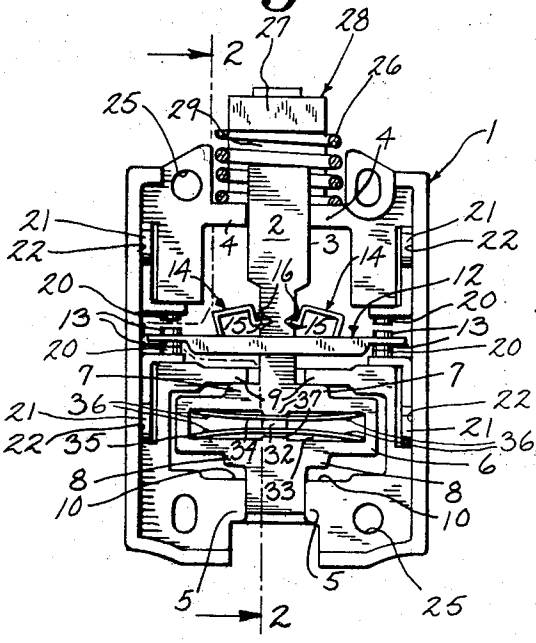


Fig. 2

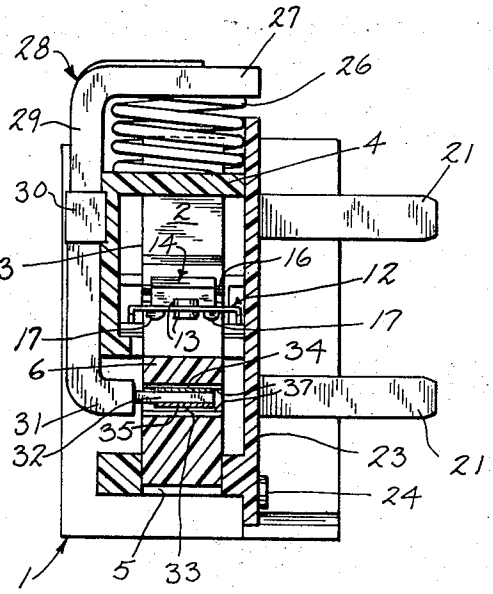
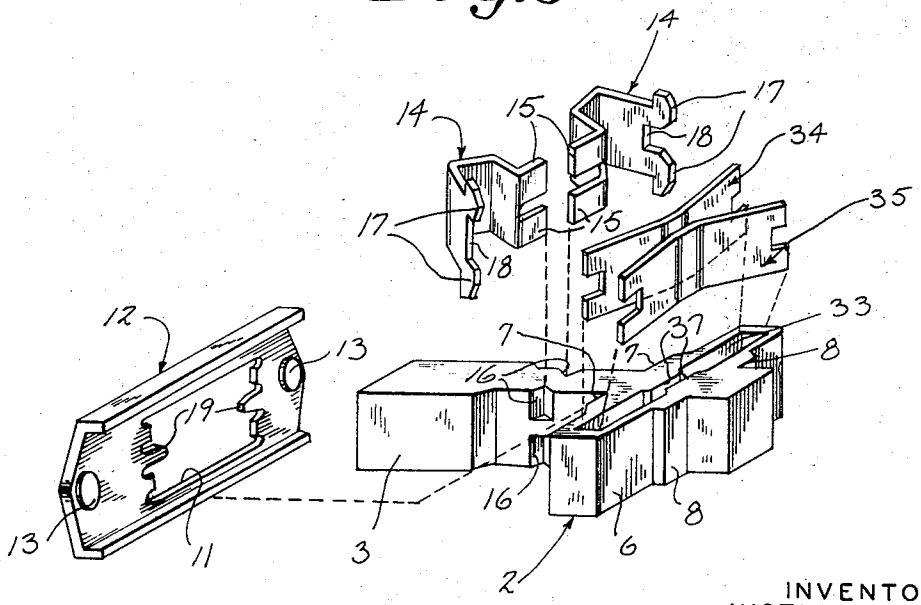


Fig. 3

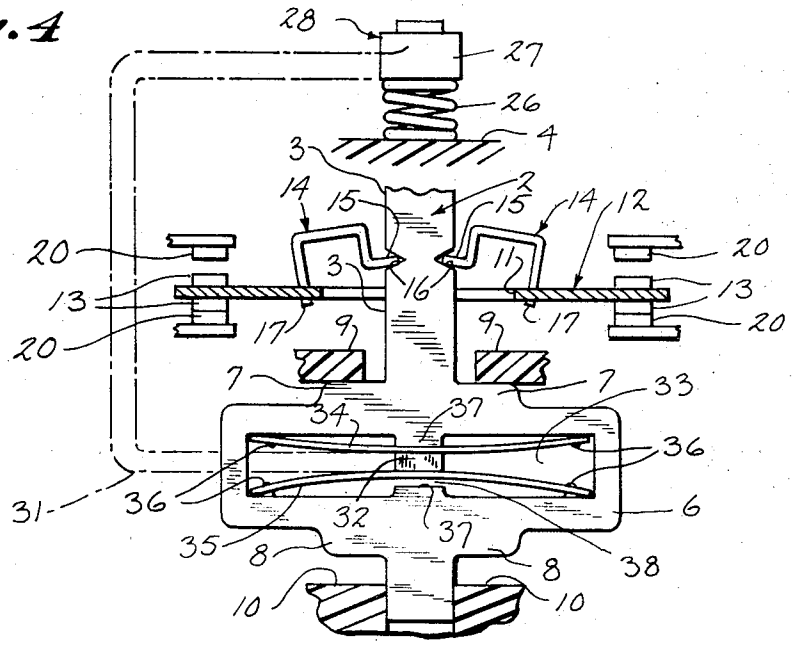


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Fig. 4



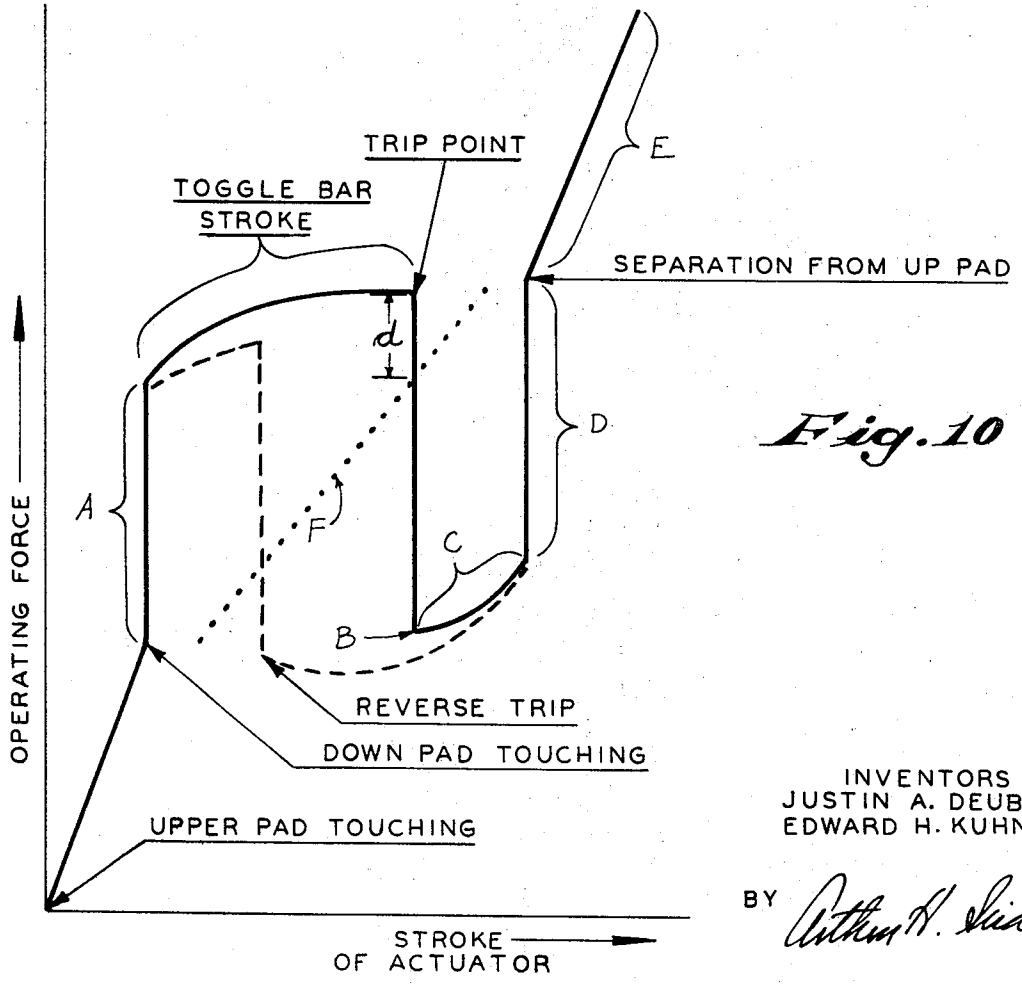


Fig. 10

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Fig. 5

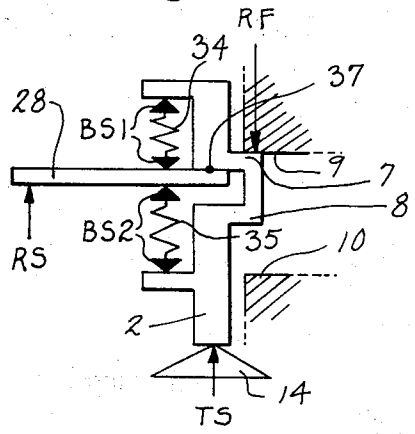


Fig. 6

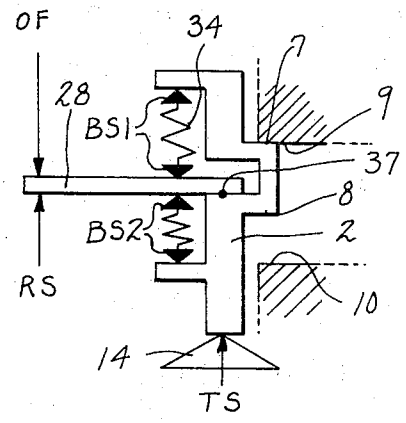


Fig. 7

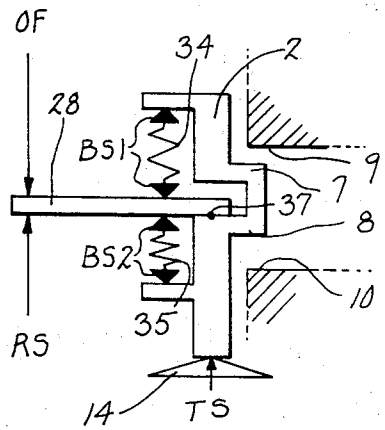


Fig. 8

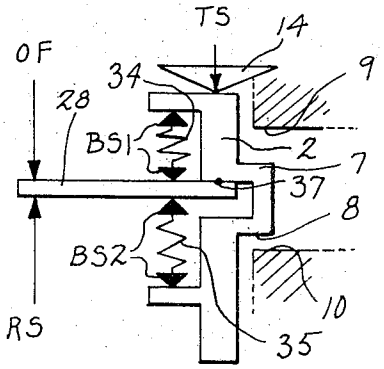
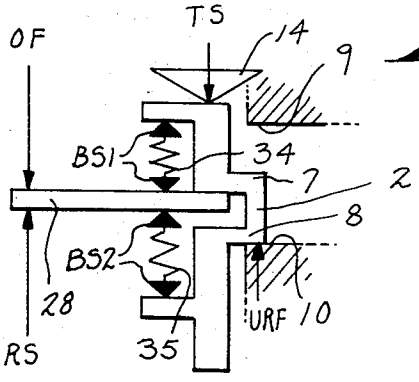


Fig. 9



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CONTACT PRESSURE SUSTAINING SWITCH

Background of the Invention

This invention relates to toggle actuated snap-action switches having substantial contact force for all stable positions and suitable for opening and closing electrical contacts in response to slowly advancing actuation, as in thermostatic controls or the like. In operation, such switches may hover for considerable periods in close vicinity of the snap-over point and contact pressure must remain substantial to avoid contact damage from heating and welding of the contacts during such intervals, and up to the moment when snap-over occurs.

Heretofore, in many snap-action toggle operated switches contact force has been dependent upon the toggle occupying a position at a substantial toggle angle with respect to the toggle dead center. When contact throw does not occur until the toggle system has passed or is nearly aligned in a straightened central position contact forces will diminish to small value, or vanish altogether. Detrimental heating and welding of the contacts may then occur if the switch is permitted to hover near the snap-over position of the toggle. Consequently, such switches are not satisfactory for use with slowly or incrementally advancing actuators.

To retain sufficient contact force some snap-action switches have been provided which maintain substantial contact pressure up to the point of contact throw by utilizing the members of the toggle itself for storing energy as the toggle mechanism is brought toward the snap-over point. Such stored energy is released to initiate snap-over before the toggle elements are aligned with the dead center, or the line of maximum compression of the toggle. An example of such a mechanism is shown in U.S. Pat. No. 2,260,964. In switches of this type, the transverse force components determining contact pressure have been limited by the small toggle angles which their structures assume, or by resilient forces acting within the toggle itself in such fashion as to subtract from the effective transverse component. An attempt to improve upon this type of switch, in which energy is stored in the toggle members, is shown in U.S. Pat. No. 2,767,270.

In another form of snap-action switch, which is illustrated in U.S. Pat. No. 2,791,656, a leaf type toggle member is employed that has a pair of flat arms which extend from the toggle portions of the leaf. These arms mount the movable contacts of the switch, and energy is stored in these flat arms to effectively cause snap-over of the toggle member to a reverse position before insufficient contact pressure is reached. Thus, the stored energy is not stored in a part of the toggle mechanism itself. Rather, the energy is stored in a contact carrying arm that is located between the toggle and the switch contacts. In this construction the stored energy may decrease as toggle angles become small, and some of the same problems consequently arise as in prior snap-action switches. It would be desirable to have a snap-action switch in which stored energy is stored in spring members divorced from the toggle structure.

SUMMARY OF THE INVENTION

The present invention resides in a snap-action switch having a reciprocally movable actuator that receives an operating force and initially has a lost motion connection with a toggle bar on which a toggle spring acts to impede its movement. A bias spring interposed between the toggle bar and actuator is loaded upon lost motion advancement of the actuator. Further advancement of the actuator then operates against the force of the toggle spring to advance the toggle bar to a point at which the impeding force of the toggle spring is less than the force of the loaded bias spring, whereupon the bias spring fires resulting in a rapid incremental advancement of the toggle bar which reverses the direction of the force of the toggle spring to snap a contact member out of engagement with one set of contacts and into engagement with a second set of contacts.

The invention separates the members of a snap-action switch in which energy is stored, for initiating snap-over of switch contacts, from the members, which usually are a toggle, that sustain normal contact pressure. By providing this physical separation it becomes possible to store energy and maintain the storage without appreciable diminution up to the point at which contact movement is to occur. Movement of the switch contacts before contact pressure decreases to dangerously low levels becomes ensured.

In the form of the invention disclosed herein a toggle bar that operates a toggle mechanism, for moving the switch contacts and providing contact pressure, has an opening in which bias springs are mounted. A tongue of an actuator is positioned between the bias springs in such manner that movement of the actuator causes the loading of one or the other of the bias springs. Then, as the actuator moves the toggle bar and toggle mechanism toward center position the loaded bias spring causes a snap-over action. This will occur in both directions of actuator movement.

It is an object of this invention to provide a snap-action switch having substantial contact force for all stable positions of the switch elements.

It is a further object to provide a snap actuated switch suitable for use with a slowly advancing actuator, the movement of which loads one of two bias springs that precipitate the snap-over action of the switch.

It is another object of this invention to provide a snap-action switch in which excessively diminishing contact pressure at and near the throwing positions is avoided.

It is still another object to provide a snap-action switch with a contact member movable between two positions by the snap-over action of a toggle spring which is effectively forced to trip by an independent bias spring related to the toggle springs by a toggle bar.

The foregoing and other objects and advantages of the invention will appear from the following description. In the description reference is made to the accompanying drawings which form a part hereof, and in which there is shown by way of illustration one specific form in which the invention may be embodied. Such embodiment does not represent the full scope of the invention, but rather the invention may be employed in a variety of embodiments, and reference is made to the claims herein for interpreting the breadth of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view in elevation with the cover removed of a switch embodying this invention,

FIG. 2 is a view in elevation and in section of the switch, with the cover in place and taken along the section line 2—2 of FIG. 1,

FIG. 3 is an exploded view in perspective of a number of parts of the switch,

FIG. 4 is a fragmentary front view in elevation showing a number of parts of the switch for purposes of clarification and explanation,

FIGS. 5–9 are schematic free body diagrams illustrating sequentially the snap-over action of the switch, and

FIG. 10 is a graphical representation of operating force with stroke of the switch actuator.

Description of the Preferred Embodiment

Referring now to the drawings, FIGS. 1 and 2 show a molded housing 1 of complex configuration formed of a suitable insulating material and having an interior adapted to receive the elements of a switch. A contact operating member in the form of a vertically movable toggle bar 2 is supported within the central region of the housing 1 in a manner that it is guided for translatory, reciprocable motion. The toggle bar 2 is also of molded insulating material, with a generally inverted cross shape when viewed from the front, as in FIG. 1. This bar 2 has a vertical portion 3 guided at its upper and lower ends by a close fit with upper ribs 4 and lower ribs 5 of the housing 1. It also has a horizontal cross arm 6 extending from both sides of the vertical portion 3 that gives the toggle bar 2 its inverted cross like appearance. The cross arm 6 has a pair of upper shoulders 7 and a pair of lower shoulders 8, which protrude respectively from top and bottom surfaces of the cross arm 6. The upper shoulders 7 are beneath a pair of stroke limiting abutments 9 of the housing 1, and the lower shoulders 8 are above a second pair of stroke limiting abutments 10, so that the vertical, reciprocable motion of the toggle bar 2 is restricted to a short stroke in which contact actuation is accomplished.

As shown in FIG. 4, the toggle bar vertical portion 3 extends through a central opening 11 of a generally rectangular shaped, electrically conductive, movable contact spanner 12 having a configuration as shown in perspective in FIG. 3. The spanner 12 has downwardly turned edges for stiffening, and a set of upper and lower movable contacts 13 is mounted at each end. Two channel shaped toggle springs 14, of a configuration as shown in FIG. 3, are inserted in the central opening 11 of the contact spanner 12 and are held under compression between the ends of the opening 11 and the vertical portion 3 of the toggle bar 2. To hold the toggle springs 14 in place, one end of each is bent over and notched to form a pair of tabs 15 which are received in grooves 16 formed in the sides of the toggle bar 2. The opposite ends of the springs 14 are formed with pivot hooks 17 that extend through the spanner opening 11 to catch against the under surface of the spanner 12. The upper surface of the spanner 12 is engaged by spring edges 18 which rest against spanner fingers 19 located in the ends of the contact spanner opening 11. In this fashion, the toggle springs 14 are held captive, and exert forces upon the movable contact spanner 12 to urge the spanner 12 either upwardly or downwardly, depending upon whether the inner ends of the toggle springs 14 act upon the toggle bar 2 above or below the spanner 12.

Referring now to FIGS. 1 and 2, there are two pair of stationary contacts 20, one pair being positioned above and the other pair below the movable contacts 13. These stationary contacts 20 are mounted on stab type connectors 21 that are inserted into complementary niches 22 in the sides of the housing 1. The connectors 21 extend forward of the housing 1, as shown in FIG. 2, for making external connection with stab receptacles that are not shown, for the reason they are not a part of the present invention.

To retain the toggle bar 2 and stab connectors 21 in position a cover 23, shown only in FIG. 2, is secured to the housing 1 by means of a pair of cover pins 24. Only one of the pins 24 is shown, and that in FIG. 2, and the pins 24 fit tightly into cover mounting holes 25 in two diagonally opposite corners of the housing 1, as shown in FIG. 1.

As further shown in FIGS. 1 and 2, a coil type return spring 26 seats upon the upper surface of the housing ribs 4 and encircles the upper end of the toggle bar 2. The spring 26 is interposed under compression between the ribs 4 and a horizontal upper end 27 of a reciprocally movable actuator 28. The actuator 28 is generally C-shaped when viewed from the side, as in FIG. 2, and it has a vertical mid-portion 29 disposed behind the toggle bar 2 that slides in a guide 30 in the back of the housing 1. A lower end 31 of the actuator 28 turns horizontally and necks down into a narrow tongue 32 that extends forwardly into an aperture 33 formed in the cross arm 6 of the toggle bar 2. The toggle bar aperture 33 passes completely through the cross arm 6, as seen in FIG. 2, and has a substantially rectangular configuration when viewed from the front, as in FIGS. 1 and 4.

Two slightly arched, elongate leaf springs 34, 35, which are shown in perspective in FIG. 3, are disposed in the toggle bar aperture 33. Each spring 34, 35 has a length that conforms closely to the length of the aperture 33, and the upper spring 34 is bowed downwardly while the lower spring 35 is bowed upwardly. Thus, the two springs 34, 35 are positioned in a back-to-back relationship. The springs 34, 35 are notched at their ends to mate with nodes 36 formed inside the aperture 33, so as to retain the springs 34, 35 in place. When installed in the aperture 33, the springs 34, 35 arch across medially positioned upper and lower push pads 37 that project from the ceiling and floor of the aperture 33, and the tongue 32 of the actuator 28 is inserted between the arched centers of the springs 34, 35. The tongue 32 is located between the push pads 37, but it and the leaf springs 34, 35 do not occupy the entire vertical distance between the pads 37. This leaves a space 38, which is indicated in FIG. 4, in the region between the pads 37, and this space 38 provides a lost motion connection between the actuator 28 and the toggle bar 2, so that as the actuator tongue 32 is moved back and forth between the push pads 37 the springs 34, 35 can be alternately flattened.

In FIGS. 1, 2 and 4 the actuator tongue 32 is shown in an upper position relative to the toggle bar 2, so as to slightly flatten the upper spring 34 against the upper push pad 37. The flattening of the spring 34 from its natural arch loads the spring, so that its outer ends apply an upward force against the toggle bar 2. Thus, the spring 34 functions as a bias spring when flattened to urge the toggle bar 2 upward. In similar fashion, the lower spring 35 may be flattened by moving the actuator tongue 32 downward in the aperture 33, to thereby apply a downward bias force against the toggle bar 2.

With the actuator 28 in its normal, upper position, as dictated by the return spring 26, the tongue 32 not only flattens the upper bias spring 34 against the upper tog-

gle bar push pad **37**, but also moves the toggle bar **2** into its uppermost position, with the upper shoulders **7** against the stroke limiting abutments **9**. In this position, the toggle springs **14** are above the movable contact spanner **12**, as in FIGS. **1**, **2** and **4**, and the outer ends of the toggle springs **14** exert a downward force component that urges the contact spanner **12** against the lower stationary contacts **20**. A substantial contact force is thus established by the toggle mechanism.

When the actuator **28** is depressed against the return spring **26** to actuate the switch contacts, the actuator tongue **32** moves downward through the space **38**. This is a lost motion movement with respect to the toggle bar **2**, as described hereinabove, and in this lost motion movement the lower bias spring **35** is flattened against the lower push pad **37**. This loads the lower bias spring **35** and stores energy therein. After this loading of the bias spring **35**, the actuator **28** then moves the toggle bar **2** downward. The inner ends of the toggle springs **14** will be moved similarly downward, and a point will be reached in the downward travel when the toggle springs **14** will snap over to a position in which the inner toggle spring ends are beneath the movable contact spanner **12**. As a part of this snap-over action, the contact spanner **12** moves abruptly upward to have the movable contacts **13** make engagement with the upper stationary contacts **20**. The outer ends of the toggle springs **14** now exert an upward force component upon the contact spanner **12** to apply requisite contact pressure with the upper contacts **20**. Thus, the toggle springs **14** and contact spanner **12** provide a snap-action switch in which the toggle mechanism moves rapidly from one side to the other of an unstable central position. There is no dwell in a position of aligned toggle springs and contact spanner, in which the movable contacts **13** could hover without substantial engagement pressure with either the upper or lower stationary contacts **20**.

To accomplish the objective of operating a snap-action switch without loss of adequate contact pressure as snap-over is approached the bias springs **34**, **35** are incorporated into the structure. The manner in which they function to maintain contact pressure for all positions of the toggle bar **2** and the associated toggle springs **14** will now be described by reference to FIGS. **5–9**, which are schematic free body diagrams representing forces working on the actuator **28** and toggle bar **2** at different stages of switch motion. Commencing with FIG. **5**, the actuator **28** is represented as a horizontal rectangle, the toggle bar **2** is represented by a vertical member of more complex configuration, and the toggle springs **14** are represented by a triangle at the bottom of the toggle bar **2**. The return spring **26** applies an upward force RS that disposes the actuator **28** against the upper toggle bar push pad **37**, to thus place the toggle bar **2** in engagement with the upper stroke limiting abutment **9**. The toggle springs **14** also supply an upward force component TS against the toggle bar **2**, and there is a downward reaction force RF at the upper abutment **9** that equals the upward forces RS and TS in magnitude. The bias spring **34** exerts a force BS1 at its upper and lower ends, and the bias spring **35** exerts a force BS2 at its upper and lower ends. The positions and forces of FIG. **5** are the normal conditions existing in the switch of the invention when no external downward operating force is applied to the top of the actuator **28**.

Assume that a downward operating force OF is now applied to the actuator **28** which is slightly greater than the return spring force RS and the net of the forces BS1 and BS2. This will initiate a downward actuator motion that translates the actuator **28** away from the upper toggle bar push pad **37** toward an engagement with the lower push pad **37**. As the operating force OF is increased the movement of the actuator **28** will continue, and the position of FIG. **6** will be reached. The relation of the stroke of the actuator **28** to the operating force OF applied to the actuator **28** for accomplishing this initial downward actuator motion is shown in the graph of FIG. **10**.

FIG. **10** depicts the stroke-force graph for the actuator **28** through the full motion of the switch, and this graph will be referred to as the motion of the switch parts proceeds in the following discussion. The solid line of the graph is for a down stroke of the actuator **28**, working against the return spring **26**, and the dashed line represents departures that occur in the return stroke. The initial operating force OF occurring in the lower left hand corner of the graph is a value equal to the return spring force RS when the return spring **26** is in its most expanded condition, i.e. the actuator **28** is in its uppermost position as in FIGS. **1**, **2** and **4**. Commencing at this initial operating force and at zero stroke, for an increasing operating force OF the actuator **28** moves to the point where it contacts the lower toggle bar push pad **37**, that is it travels from the position in FIG. **5** to the position in FIG. **6**. This part of the curve is linear at a steep angle, and the operating force OF is that due to return spring **26** plus the combined net effect of the bias springs **34** and **35**. The rate of change of force OF in this part of the curve is equal to the combined rate of change of these springs **26**, **34** and **35**. The lower bias spring **35**, of force BS2, is flattened, or loaded, to store energy for a subsequent contact throw, as will be described, and the upper bias spring **34**, of force BS1, relaxes. Thus, the compression of the lower spring **35** increases the force BS2 as the force BS1 decreases.

Upon engagement of the actuator **28** with the lower push pad **37** the operating force OF now encounters the upward, resistive force TS of the toggle springs, and an abrupt increase in operating force OF is required before the stroke of the actuator **28** may continue. This abrupt increase is represented by the portion A of the graph of FIG. **10**, and it is this force condition at this moment that is represented in FIG. **6**. Note that the downward reaction force RF has vanished, and the force OF is equal and opposite to the return spring force RS and the toggle spring force TS.

The stroke force relation that next occurs is represented by the curved solid line portion of the graph of FIG. **10** identified as "toggle bar stroke." During this movement the toggle springs **14** are moved into a more horizontal position, i.e. a toggle alignment position is approached, and the vertical component of the toggle spring force TS decreases, resulting in a decrease in contact pressure. Also, the force RS increases as the return spring **26** is further compressed, so that the net operating force OF is rising. The "trip point" is now reached at which snap-over of the switch contacts will occur. The position of the switch parts as the "trip point" is reached is shown in FIG. **7**. The force TS has now fallen to a value approaching the value of the net of the forces BS2 and BS1. The combined spring rates

of the bias springs **34, 35** is less than the spring rate of the toggle springs **14,** so that as switch movement approaches the "trip point" the bias spring force overtakes the toggle spring force TS, and as a result the toggle bar **2** will move rapidly downward away from the actuator **28.** This movement carries the toggle springs **14** through the toggle center position, whereupon the toggle springs **14** immediately reverse themselves with an accompanying upward snap action of the movable contact spanner **12.** Contact pressure is immediately established against the upper stationary contacts **20.**

The position of parts shown in FIG. **8** is assumed immediately after contact actuation. There has been no further stroke of the actuator **28** from the position of FIG. **7,** but the toggle spring force TS is now additive to operating force OF, whereby force OF abruptly decreases, since force OF plus force TS offset the upward return spring force RS. Thus, the graph of FIG. **10** shows an abrupt drop in operating force OF to the point B. Now, as force OF is increased to move the actuator **28** further downward, in an overtravel motion, the graph follows a curved section C dictated in part by an increasing angularity of the toggle springs **14.**

Next, the toggle bar **2** strikes the lower stroke limiting abutments **10,** and the actuator **28** is then poised to leave the upper push pad **37.** The force OF, however, must abruptly increase before separation of the actuator **28** from the upper push pad **37** may occur, and this abrupt increase is represented by the portion D of the graph of FIG. **10.** The point in FIG. **10,** labeled "separation from up pad" indicates the condition that occurs, when the force OF fully resists the force RS less the combined force of springs **34** and **35.** At this point the force TS is counteracted by an upward reaction force URF at the lower stroke limiting abutment **10,** and the condition shown in FIG. **9** exists.

For further actuator stroke the force OF must overcome the force RS and the net of the bias spring forces BS1 and BS2. The remaining solid line portion of the graph, designated by the letter E, depicts the final stroke-force characteristic. For a reverse action of the switch of the invention the graph of FIG. **10** is retraced, except that the dashed lines are followed during a part of the stroke. The departure of the curved portions of the dashed part of the graph from curved portions of the solid line part of the graph can be attributed to friction within the system.

The contact pressure prevailing at the moment of commencement of the snap-action of the movable contact spanner **12** is illustrated in FIG. **10** by reference to the dotted line F. This line F represents the characteristic of the return spring **26,** and the distance *d* measured down from the "trip point" is a measure of the contact force at the instant of trip. This force *d* is adequate to ensure good electrical conduction through the switch contacts at all times, so that electrical erosion, sparking, pitting, or unwanted circuit interruption will not occur. This contact force is maintained with slowly advancing, or hovering, switch actuators, so that the invention provides a snap-action type switch that functions reliably under adverse operating conditions. The invention accomplishes this objective by utilizing the independent bias springs **34, 35** for the storage of energy that rapidly drives the toggle bar **2** through toggle center. Snap-over of the toggle springs **14** is initiated by the force of these separate springs **34, 35** while contact pressure is still substantial, and the invention provides a snap-action switch with consistent operation that prolongs contact life.

In the embodiment shown, energy is stored in bias springs **34, 35** that are separate from the toggle mechanism. These bias springs are interposed between a contact operating member, in the form of a toggle bar **2,** and a switch actuator **28.** A lost motion connection is provided between the actuator and contact operating member, so that the bias springs can be loaded for storage of energy before the toggle mechanism is operated. This stored energy will be maintained at its maximum level until called upon to initiate motion of the contact operating member away from the actuator. A reliable snap-action is obtained in this construction.

In the embodiment shown, the leaf type bias springs **34, 35** physically extend between the actuator tongue **32** and the push pads **37** of the toggle bar **2.** When the operation has been described in connection with FIGS. **5–10,** the actuator **28** has been spoken of as engaging the push pads **37.** Such description is intended to pertain to an interposition of the bias springs between actuator and toggle bar, as well as a construction where the bias springs are not directly in the lost motion path of the actuator, and the claims herein are to be similarly interpreted.

A preferred embodiment of the invention has been shown and described, but it will be obvious that various modifications might be made without departure from the spirit of the invention. It may well be suitable in some cases to have only an upper or a lower set of stationary contacts. Also, the same principle could be used with a multi-pole arrangement. In view of possible modifications, it is not intended that the invention be limited to the particular showing herein.

We claim:

1. In a snap-action mechanism the combination comprising:

a movable member operated by the snap-action mechanism that reciprocates in a stroke between two positions;

an over center spring means that has one end that acts upon said movable member and urges the movable member toward one of said two positions depending upon which side of center said spring means resides;

an operating member connected to another end of said over center spring means and that moves said over center spring means from one side of center to the other;

an actuator having a lost motion connection with said operating member, and operable to move the operating member upon completing the lost motion; and

bias spring means operatively connected to said operating member and to said actuator that are loaded by the actuator during lost motion movement, and which move the operating member from the actuator upon the operating member moving the over center spring means near its over center position, to thereby quickly move the over center spring means across its center position.

2. In a snap-action switch the combination comprising:

stationary contacts;

a movable contact member that travels toward and away from the stationary contacts;

an over center toggle spring having one end working upon said movable contact member to move said member with respect to the stationary contacts depending upon which side of over center said toggle spring resides;

an operating member engaged with the opposite end of said toggle spring and having a reciprocal stroke that moves said spring end in a corresponding motion;

a reciprocally movable actuator having a lost motion connection with said operating member, which actuator moves through such lost motion and then carries the operating member therewith in either direction of reciprocation; and

bias spring means operatively connected to said operating member and to said actuator so as to be loaded upon lost motion movement of the actuator with respect to the operating member.

3. In a snap-action switch the combination comprising:

a translatable toggle bar;

a movable contact member;

over center toggle elements each having one end connected to said toggle bar and an opposite end connected to said movable contact member, which elements are adapted to apply a force upon said movable contact member, and also a force upon said toggle bar that acts opposite to the direction of translation of the toggle bar;

an actuator having a lost motion connection with said toggle bar, and engageable with said toggle bar to translate the same upon the taking up of said lost motion; and

a bias spring that is operatively connected to said toggle bar and to said actuator and is loaded upon moving said actuator through said lost motion, such spring loading placing a bias force against said toggle bar in a direction opposing said toggle component force, whereby translation of the toggle bar in response to said switch actuator, after the taking up of said lost motion shifts said toggle elements to reduce said component force until said bias spring force overpowers said component force to move the toggle elements to a reverse toggle position.

4. A snap action switch as in claim **3** wherein the toggle elements have a spring means with a spring characteristic that changes at a greater rate than said bias spring when the bias spring is in a position of overpowering said component force.

5. In a snap action switch the combination comprising:

a reciprocally movable toggle bar with a bias spring receiving aperture that has oppositely disposed push pads spaced from one another with a gap therebetween that is in the direction of the line of motion of the toggle bar;

a reciprocally movable actuator member having a part that receives an operating force for moving the member in one direction, and having a tongue portion disposed between said push pads that is of lesser dimension than the gap distance between the push pads;

a pair of bias springs in said bias spring receiving aperture positioned on either side of the actuator member tongue portion to bias the toggle bar with respect to the actuator member;

a set of stationary contacts;

a movable contact spanner engageable and disengageable with said stationary contacts;

a pair of toggle springs associated with and forming snap-action connections between said toggle bar and said contact spanner; and

a return spring acting upon said actuator member to drive the member against one of said push pads and to carry said toggle bar to one end of its stroke.

6. In a snap action switch the combination comprising:

a reciprocally movable toggle bar with toggle engaging sections, and a bias spring receiving aperture that has oppositely disposed push pads spaced from one another with a gap therebetween that is in the direction of the line of motion of the toggle bar;

a set of spaced abutments on opposite sides of a part of said toggle bar to limit the stroke of the toggle bar;

a reciprocally movable actuator member having a part that receives an operating force for moving the member in one direction, and having a tongue portion disposed between said push pads and is of lesser dimension than the gap distance between the push pads;

a first bias spring within said aperture of said toggle bar interposed between said tongue portion of said actuator member and a wall of the aperture to bias the toggle bar away from said actuator member in one direction;

a second bias spring within said aperture of said toggle bar interposed between said tongue portion of said actuator member and another wall of the aperture of said toggle bar to bias the toggle bar away from said actuator member in a second, opposite direction;

a set of stationary contacts;

a movable contact spanner engageable and disengageable with said stationary contacts;

toggle springs interposed between the toggle engaging sections of said toggle bar and said movable contact spanner, which toggle springs are moved between opposite sides of an unstable central position by the motion of said toggle bar, and apply forces upon said movable contact spanner and said toggle bar in reverse directions as movement occurs from one side of such central position to the other; and

a return spring acting upon said actuator member to drive the member against one of said push pads and to carry said toggle bar to one end of its stroke.

7. In a snap action switch the combination comprising:

a movable contact member having a central opening and a pair of upper and lower contacts on each end;

a set of stationary contacts;

a reciprocally movable toggle bar having a vertical portion and a cross arm that define an inverted cross, said vertical portion has a pair of toggle engaging sections and extends through the central opening of the movable contact member, said cross arm has a rectangularly shaped aperture with upper and lower push pads spaced apart to form a gap;

a set of spaced abutments positioned above and below opposite sides of said toggle bar to limit the stroke of the toggle bar;

toggle springs interposed between the toggle engaging sections of said toggle bar and said movable contact member, which toggle springs are moved between opposite sides of an unstable central position by the motion of said toggle bar, and apply forces upon said movable contact member and said toggle bar in reverse directions as movement occurs from one side of such central position to the other;

a reciprocally movable actuator member having a part that receives an operating force for moving the member in one direction, and having a tongue portion disposed between said push pads and is of lesser dimension than the gap distance between the push pads;

a first bias spring within said aperture of said toggle bar interposed between said tongue portion of said actuator member and a wall of the aperture to bias the toggle bar away from said actuator member in one direction;

a second bias spring within said aperture of said toggle bar interposed between said tongue portion of said actuator member and another wall of the aperture of said toggle bar to bias the toggle bar away from said actuator member in a second, opposite direction; and

a return spring acting upon said actuator member to drive the member against one of said push pads and to carry said toggle bar to one end of its stroke.

8. In a snap action switch the combination comprising:

a reciprocally movable toggle bar with toggle engaging sections, and a bias spring receiving aperture that has oppositely disposed push pads spaced from one another with a gap therebetween that is in the direction of the line of motion of the toggle bar;

a set of spaced abutments positioned above and below opposite sides of said toggle bar that limit the stroke of the toggle bar;

upper and lower elongated bias springs disposed within said bias spring receiving aperture;

a C-shaped actuator with an upper portion that receives an operating force, a mid-portion parallel to the toggle bar and a lower portion having a tongue that extends forward into the gap defined by said toggle bar push pads and is interposed between said upper and lower bias springs so that vertical movement of the actuator will cause loading of one of the bias springs, which loaded spring will thereafter act to bias the toggle bar with respect to the actuator;

a set of stationary contacts;

a movable contact spanner engageable and disengageable with said stationary contacts;

toggle springs interposed between the toggle engaging sections of said toggle bar and said movable contact spanner, which toggle springs are moved between opposite sides of an unstable central position by the motion of said toggle bar, and apply forces upon said movable contact spanner and said toggle bar in reverse directions as movement occurs from one side of such central position to the other; and

a return spring acting upon said actuator to drive the actuator against one of said push pads and to carry said toggle bar to one end of its stroke.

9. In a snap action switch the combination comprising:

a movable contact member having a central opening and a pair of upper and lower contacts on each end;

a set of stationary contacts;

a reciprocally movable toggle bar having a vertical portion and a cross arm that define an inverted cross, said vertical portion has a pair of toggle engaging sections and extends through the central opening of the movable contact member, said cross arm has a rectangularly shaped aperture with upper and lower push pads spaced apart to form a gap;

a set of spaced abutments positioned above and below opposite sides of said toggle bar to limit the stroke of the toggle bar;

toggle springs interposed between the toggle engaging sections of said toggle bar and said movable contact member, which toggle springs are moved between opposite sides of an unstable central position by the motion of said toggle bar, and apply forces upon said movable contact member and said toggle bar in reverse directions as movement occurs from one side of such central position to the other;

upper and lower elongated bias springs disposed within said cross arm aperture;

a reciprocally movable C-shaped actuator with an upper portion that receives an operating force, a mid-portion parallel to the toggle bar vertical portion and a lower portion having a tongue that extends forward into the gap defined by said toggle bar push pads and is interposed between said upper and lower bias springs so that initial movement of the actuator will cause loading of one of the bias springs, which loaded spring will thereafter act to bias the toggle bar with respect to the actuator; and

a return spring acting upon said actuator to drive the actuator against one of said push pads and to carry said toggle bar to one end of its stroke.

10. In a snap-action mechanism the combination comprising:

a reciprocable toggle bar;

a movable member shiftable between opposite positions;

a toggle spring interposed between said toggle bar and said movable member, urging said toggle bar in one direction, and urging said movable member in opposite direction into one of its positions;

an actuator for driving said toggle bar that has a lost motion connection with said toggle bar, and that upon taking up said lost motion translates the toggle bar therewith to advance the toggle spring toward toggle center position; and

a bias spring operatively connected to said actuator and to said toggle bar, said bias spring being loaded during said lost motion and then working against said toggle spring as said actuator translates the toggle bar toward toggle center position, whereby said bias spring effects snap over of the toggle bar and toggle spring and said toggle spring shifts said movable member to its opposite position.

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