Feb. 5, 1952 P. C. JACOBS, JR 2,584,460

SNAP ACTION SWITCH

Filed Dec. 24, 1947

Fig. 1.

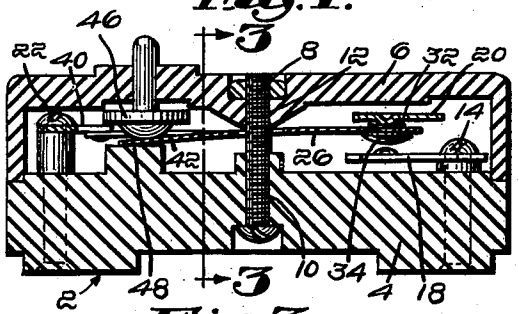


Fig. 2.

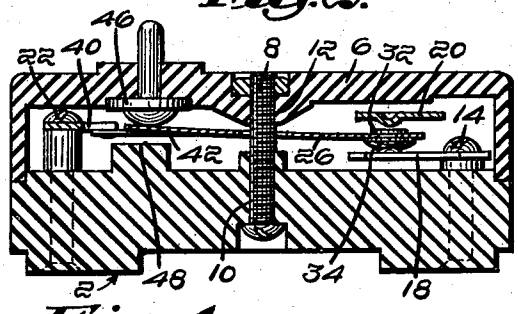


Fig. 3.

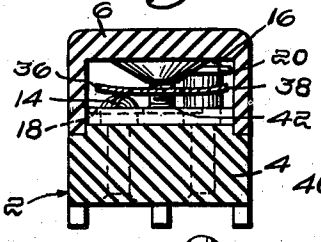


Fig. 4.

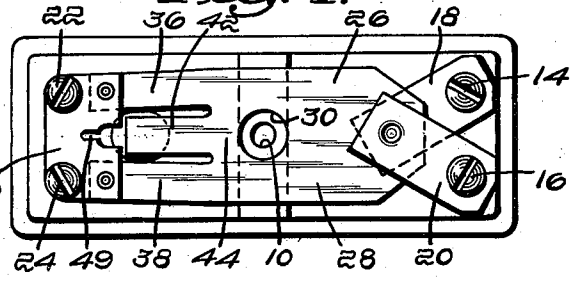


Fig. 5.

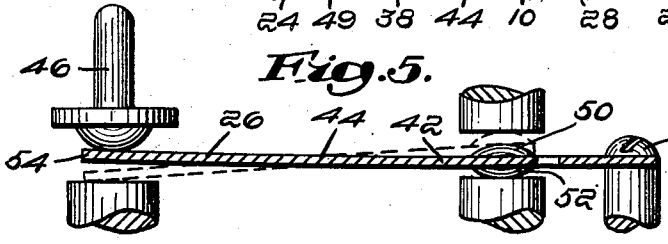


Fig. 10.



Fig. 6.

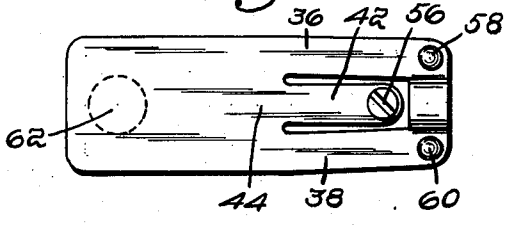


Fig. 7.

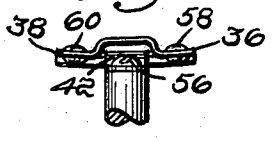


Fig. 9.

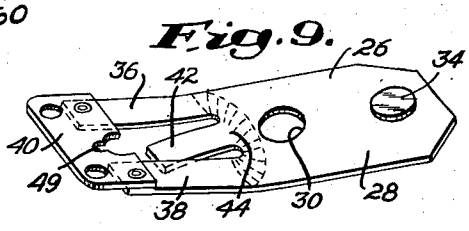
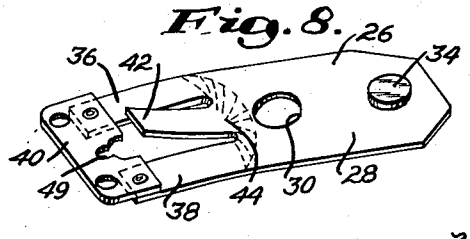


Fig. 8.



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Patented Feb. 5, 1952 2,584,460

UNITED STATES PATENT OFFICE

2,584,460

SNAP ACTION SWITCH

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Application December 24, 1947, Serial No. 793,687

7 Claims. (Cl. 200—67)

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This invention relates to electrical snap action switches.

In snap action switches of the type herein disclosed it is desirable in certain installations that the force required to actuate a switch be very small, not more than an ounce or two. It is also desirable that the switch construction be such that after the blade has snapped from stable to unstable position, the amount of retreat of the operating button necessary to cause the blade to reverse itself, moving from unstable to stable position, be a very short distance.

In the switches now available in this art it will be found that the pressure that must be applied to the blade in order to cause actuation will be somewhere between four and twelve ounces. After the blade has snapped to unstable position, the operating lever must then be backed off at least .002 to .003 of an inch from initial actuation position before reverse movement of the blade to stable position will occur.

The invention herein disclosed provides a switch having all of the electrical characteristics of switches of the prior art but which can be operated on pressures as little as two ounces or less, with the general range being between one to four ounces. At the same time, the blade is so constructed that by backing off the operating lever as little as .0005 inch, blade reversal will take place.

The novelty of the present invention resides in both the particular construction of the blade and the combination of the blade with the supporting housing and electrical contacts.

The invention will be more clearly understood with the aid of the accompanying drawings, in which

Fig. 1 is a vertical sectional elevation showing the operating button in maximum depressed position and the switch blade in raised unstable position.

Fig. 2 is a vertical sectional elevation similar to Fig. 1, in which the operating button is in maximum upward position and the switch blade is in downward stable position.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a plan view of the construction shown in Figs. 1 and 2, with the cover and operating button removed.

Fig. 5 is a diagrammatic illustration showing how the operating button and contacts may be varied with respect to the blade.

Fig. 6 is a further illustration in which the blade is mounted in still a different manner.

Fig. 7 is an end elevation of Fig. 6, looking from the right.

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Fig. 8 is a somewhat exaggerated perspective view of the blade as shown in Fig. 2.

Fig. 9 is a somewhat exaggerated perspective view of the blade as shown in Fig. 1.

Fig. 10 is a side elevation of a blade similar to that shown in Fig. 5 but having a different point of support, a different position for the contacts, and a different position for the force applying button.

Referring to Figs. 1–4, the switch comprises a housing 2 of insulating material, having a base 4 and a removable cover 6. These two parts are held firmly together by the nut and bolt 8, with the bolt passing through centrally aligned apertures 10 and 12 in the base and cover.

Two electrical terminals 14 and 16 are mounted in the right hand end of the base. These terminals extend downward through the base to a point where convenient connection may be made with the electrical circuit with which the switch is used.

Terminals 14 and 16 carry individual contact members 18 and 20 which extend toward each other at an angle and overlap in spaced vertical relationship in the manner shown in Figs. 1–4.

At the left end of the housing are two other terminals 22 and 24, to which is secured the switch blade 26. This switch blade is of novel construction, and comprises a main body portion 28 having a hole 30 therethrough, through which passes bolt 8. The right hand end of the body of the switch blade has affixed thereto upper and lower contacts 32 and 34, which are adapted to engage with contacts 20 and 18, respectively, as the body end of the blade may be moved up and down.

The left hand end of blade 26 has a pair of legs 36 and 38 extending from the body 28, which legs are drawn together or toed in and secured to an end plate 40 which in turn is rigidly affixed to the terminals 22 and 24. Between legs 36 and 38 is a tongue or operating lever 42 extending from the body 28 and of such length that when moved vertically it will not be interfered with by plate 40.

The toed-in character of legs 36 and 38 produces a stressed area in the region indicated at 44. The more the legs are toed in, the more the blade will be stressed and buckled at the area 44. The nature of this curvature is illustrated in Fig. 3, which is a section on the line 3—3 of Fig. 1, showing that when the operating lever 42 is in down position, as in Fig. 1, the legs at section 3—3 and the stressed area 44 will be concave upwardly and the contact 32 in engagement with contact 20. The blade in the position in Fig. 1 is in

unbalanced condition and will remain there only so long as operating button 46 is held in a sufficiently depressed position. When the operating button is released or allowed to move upwardly a sufficient distance so that operating lever 42 moves upwardly past the critical point, the stressed area 44 will cause the sides of the body and adjacent portion of the legs to snap downwardly, so that the blade at the stressed area 44 is now convex on its upper side and simultaneously causing the right hand end of the blade to snap downwardly, putting contact 34 in engagement with contact 18, as shown in Fig. 2.

Reference to Figs. 8 and 9 will aid in a better understanding of the character of the stressed area. The legs 36 and 38, being toed in, produce a normal inner edge buckling and an outer edge tension condition over the general area where they connect with the body. At the same time, the toed-in legs cause the body in the immediate vicinity to be arched upwardly or downwardly according to the stressed position the blade has been placed in. The tongue or lever 42 is on the convex side of the body.

It will be understood that the toeing-in of the legs causes a stressing of the area of the body adjacent the ends of the legs and tongue 42. This area is generally indicated as at 44 and, as illustrated in Fig. 8, will be convex on its upper side and concave on its underside. The entire area which includes the stressed area of the legs and the body will be formed with a compound curvature with the center of the relatively flat arch so formed some place between the end of tongue 42 and the hole 30.

When tongue 42 as shown in Figs. 2 and 8 is pressed downwardly, the stressed area at the end of the tongue will be forced through neutral position, thereby changing the direction of the stresses so that the blade substantially instantaneously reverses itself to assume the position shown in Figs. 1, 3 and 9. In this position the upper side of the blade is concave and the lower side convex at the stressed area. The blade, when in this position, will present a flat dished area extending away from the center of area 44 to form a compound curved section in the nature of an inverted shallow arched member which resists deformation in all directions.

It will be understood that the exact limits of the stressed area cannot be accurately defined as the limits vary with the degree the legs are toed-in. The more the legs are toed-in, the greater the stress and the greater the area over which the stress is applied, and a correspondingly greater force will be required to cause reversal of the blade from the position of Fig. 8 to the position of Fig. 9. In all cases, however, the effective center of the stressed area in the body portion will be relatively close to the end of tongue 42.

In a typical switch construction, the blade will be limited in its movement in one direction by a stop or contact so that when actuated, it cannot reach the second stable position. Thus in the arrangement shown in Figs. 1 and 2, contact 20 checks upward movement of blade 26 at an unstable point. However, if contact 20 were moved upwardly a sufficient distance, blade 26 could reach an upward position of stability. In the ordinary instance, it is not desired that an upward stable position be reached for if this were the case, the blade would not return of its own volition to the initial stable position against contact 18 upon release of operating button 46. Figs. 8 and 9 thus illustrate that the blade per se if unrestrained in its movements has two stable positions that may be assumed alternately when the lever 42 has been moved sufficiently to cause the blade curvature to reverse itself.

Blade 26, when mounted in normal position on contacts 22 and 24 and before any downward force has been applied to the operating lever 42 other than the weight of button 46, will be in stable position, with contacts 34 and 18 in engagement, as shown in Fig. 2. When operating button 46 has been depressed a maximum amount, with operating lever 42 in contact with stop 48, as shown in Fig. 1, blade 26 will be in raised unstable position, so that upon release of operating lever 42 the blade can reassume normal stable position shown in Fig. 2.

Operating button 46, generally hemispherical at the engaging area and having a stem 47 which extends through a suitable opening in cover 6, is shown as engaging operating lever 42 at a point an appreciable distance to the right of the left end of the operating lever. It will be understood, however, that this position of engagement may be varied considerably. If it is moved toward the end of lever 42 the total overall movement of button 46 required to effect actuation will be increased but the pressure required will be reduced. Conversely, if the point of engagement is moved toward the stressed area 44, the extent of the required movement of the button will be less before actuation occurs, but more force will be required. In switches that have been tested, the force required to cause actuation, when applied at the left end of operating lever 42 will be in the order of 50 per cent of the force required at the base of operating lever 42.

After actuation of the blade, the extent of the retreat necessary to cause the blade to return to stable position is greatest at the body end of the tongue, decreasing gradually as the point at which the force of the operating button is moved toward the free end of the tongue.

If the point of application of the force is gradually moved in the direction of the stressed area, it will be found that a point will be reached where the blade will not function to snap upwardly, but, on the contrary, contacts 34 and 18 will be forceably maintained in engagement, even though the stressed area 44 is depressed and has snapped to a position in which the concave side is upward.

From the foregoing description it will be understood that a blade constructed and mounted in the manner shown will snap from stable down position to unstable up position on sufficient movement of operating lever 42, and will return to stable position when the lever is allowed to retreat to the critical point.

The principal advantage of the present switch, however, comes from the fact that the construction disclosed results in the return of the switch to stable position upon very slight upward movement of lever 42 from the position which caused initial actuation. That is to say, if we consider the position of the parts shown in Fig. 2 as the starting position, then lever 42 will be increasingly deflected downwardly as pressure is exerted on button 46 until a certain critical point is reached. At this point, the blade will snap to and remain at the position of Fig. 1 without further movement of button 46. If button 46 is maintained in this position, the switch blade will

continue in the position of Fig. 1, with the contacts in suitable engagement for proper passage of current.

When button **46** is moved in the reverse direction, that is, upwardly, it will be found that upward movement of the button of less than .001 inch will be sufficient to cause the switch blade to reverse itself and snap to the stable position of Fig. 2.

Stated in other words, button **46** may be actuated up and down over a distance of not more than .001 inch to produce complete actuation of the blade. As can be understood by those familiar with this field, this is a substantial advance in the sensitivity of snap action switches of this general type.

The distance that the button must move to cause actuation in both directions will vary somewhat as the applied force is shifted along the tongue. The movement will be greater toward the body end and less toward the free end.

The force required to move operating lever **42** to the critical point at which the blade snaps to up position is likewise reduced below that of switches of the prior art. This force may be in the order of one or two ounces, depending on the blade construction and point of force application. After actuation, the force required to hold the switch blade in unbalanced position may be as little as half of the force originally required to cause actuation.

The stressed portion **44** of blade **26** shown in Figs. 1–4 has been produced by toeing in legs **36** and **38** and holding them in that position by plate **40**. If desired, however, the blade may be made flat without any toe-in to the legs. Thereafter the blade may be struck with a concavo-convex die so as to deform and stress the area **44** to produce a condition substantially the same as that obtained by toeing in the legs. Both methods are equally effective in creating a satisfactory snap action in the blade. Furthermore, the blade may be of one piece throughout with the end plate **40** being integral with the legs **36** and **38**. End plate **40**, partially split as at **49** as shown in Fig. 4, has the desirable characteristic of being capable of being squeezed together or spread apart to vary the toe-in of the legs and thereby vary the stressing of area **44** and thus varying the force required against operating lever **42** to cause actuation.

In Figs. 1–4, the blade is shown as being anchored at the ends of legs **36** and **38** with the contacts **32** and **34** on the opposite movable end of the body **28** and with actuation caused by pressure against operating lever **42**. If desired, however, this arrangement may be reversed, as illustrated in Fig. 5. Here the contacts **50** and **52** are fixed to the end of what in Figs. 1–4 was operating lever **42**, while button **46** is arranged to press against the end of body **28**. The toed-in legs are mounted as in Figs. 1–4 on contacts **22** and **24**. The stressed area **44** is in the same relative position between the end **54** of the body which formerly carried contacts **32** and **34** and the former operating lever **42** which now carries the contacts.

The construction of Fig. 5 could be used where it is desired to reduce the operating force required still more, although the overall movement of operating button **46** will necessarily be somewhat greater.

A further modification of the supporting arrangement is illustrated in Figs. 6 and 7, in which the blade is mounted by affixing the operating lever **42** of Figs. 1–4 to the housing by a supporting contact **56**. The contacts, of which there may be one or two sets, as illustrated at **58** and **60**, are placed on the ends of the legs **36** and **38**, while the operating button presses against the far end of the body as at position **62**. The blade otherwise is the same as that illustrated in Figs. 1–5, having the usual stressed area at **44**.

Another modification is illustrated in Fig. 10. In this form, the blade is similar to that shown in Figs. 1 to 7 but differs as to the positions of the mounting, contacts and operating button. The blade is mounted at the left-hand end of the body as at **64**. The contacts **66** and **68** are on opposite sides of the cross bar that connects the ends of the legs, one of which legs is indicated at **70**. The operating button **72** is located where it may press against the end of the operating lever **42**. Lower contact **68** is normally in engagement with a contact attached to the housing, such as contact **18** shown in Figs. 1 and 2, so that when operating button **72** is pressed downwardly, operating lever **42** will likewise be moved downwardly to cause the legs to reverse their positions by snapping upwardly, thereby shifting contacts **66** and **68** from "down" to "up" position. The blade has the usual stressed area **44** located at the junction of the operating lever **42** with the body **28**.

Thus, in all of the figures the blade is the same, having a body, a stressed area in the body, two legs and a tongue, or operating lever, between the legs. The contacts may be placed either on the body end of the blade, as in Figs. 1–4, the operating lever, as in Fig. 5, or the end connecting the legs, as in Figs. 6 and 10. If the contacts are on the end of the body, the blade may be supported at the ends of the legs and the pressure applied to the operating lever, as shown in Figs. 1–4, or the blade may be supported at the end of the operating lever and the pressure applied to the end plate or cross bar that connects the ends of the legs.

If the contacts are positioned on the ends of the operating lever, then the blade may be supported by the end plate, as in Fig. 5, and the force of the button applied to the end of the body, or the free end of the body may be supported and the force applied to the end plate connecting the legs.

If the contacts are attached to the end plate that connects the legs, then the blade may be supported at the end of the body and the force applied to the operating lever, as in Fig. 10, or the blade may be supported at the end of the operating lever and the force applied to the end of the body, as in Fig. 6.

In all three situations the snap action will occur, the force required will be very small, and the return to stable position will take place upon very small return movement of the force applying button.

It will also be understood that the length of the operating lever **42** may be varied within reasonable limits without affecting the principle of operation, so long as the stressed area **44** is present.

Also, the presence of hole **30** does not affect the operation so long as there is adequate surface to form a suitably stressed area **44**. If desired, the housing may be assembled in a different manner, so that bolt **8** may be omitted, with hole **30** in the blade likewise omitted.

While preferred forms of the invention have

been described and shown in the drawings, it will be understood that I do not intend to be limited thereby, but only by the appended claims.

I claim:

1. A snap action switch comprising a base, a pair of spaced contacting members at one end of said base, a support at the other end of said base, said support having rigidly affixed thereto a switch blade, said blade comprising a movable elongated body portion having contacts on opposite sides of the end thereof, which contacts are positioned between said spaced contacting members, a pair of legs extending from said body portion, the ends of said legs being secured to said support, a tongue extending from said body between said legs and being movable at its free end, said body having a single stressed area with a compound curvature adjacent said tongue and extending into said legs a limited distance, said stressed area being remote from said contacts so that in stable position one of the said contacts on the end of said body will press against one of said spaced contacting members, means for applying a force against that side of the tongue which is opposite the contact and contacting member that are normally in engagement whereby said tongue may be moved to cause said stressed area to reverse itself and to cause said normally engaged contact and contacting member to separate and the other of said contacts on said body to engage the other of said spaced contacting members, said other of said spaced contacting members being located to hold said body portion in unstable position, whereby when said force is partially removed from said tongue said stressed area and body of the blade will returned to stable position.

2. A snap action switch comprising a base, a pair of spaced contacting members on said base, a support at one end of said base, said support having rigidly affixed thereto a switch blade, said blade comprising a movable body portion, a pair of legs extending from said body portion, the ends of said legs being secured to said support, a tongue extending from said body between said legs, said tongue having contacts on opposite sides of the free end thereof, which contacts are positioned between said spaced contacting members, said body having a single stressed area with a compound curvature adjacent said tongue and extending into said legs a limited distance so that in stable position one of the said contacts on the end of said tongue will press against one of said spaced contacting members, means for applying a force against that side of said body portion which is opposite the contact and contacting member that are normally in engagement, whereby said body portion may be moved to cause said stressed area to reverse itself and to cause said normally engaged contact and contacting member to separate and the other of said contacts on said tongue to engage the other of said spaced contacting members, said other of said spaced contacting members being located to hold said tongue in unstable position whereby when said force is partially removed from said body portion, said stressed area and said tongue will return to stable position.

3. A snap action switch comprising a base, a pair of spaced contact members on said base, a support within said base, said support having rigidly affixed thereto a switch blade, said blade comprising a body portion which is secured to said support, a pair of movable legs extending from said body portion having contacts on opposide sides of the ends thereof which contacts are positioned between said spaced contacting members, a tongue extending from said body portion between said legs, said body portion having a single stressed area with a compound curvature adjacent said tongue and extending into said legs a limited distance so that in stable position one of said contacts on the end of said legs will press against one of said spaced contacting members, means for applying a force against that side of the tongue which is opposite the contact and contacting member that are normally in engagement, whereby said tongue may be moved to cause said stressed area to reverse itself and to cause said normally engaged contact and contacting member to separate and the other of said contacts on said legs to engage the other of said spaced contacting members, said other of said spaced contacting members being located to hold said legs in unstable position, whereby when said force is partially removed from said tongue, said stressed area and said legs will return to stable position.

4. A snap action switch comprising a base, a switch blade secured in a stable position on said base with part thereof movable, a pair of spaced fixed members of which at least one is a contact straddling a movable part of said switch blade, said switch blade comprising three parts, said parts being an elongated body portion, a pair of legs extending from said body portion and a tongue extending from said body between said legs and terminating in a free end, said blade having a single stressed area with a compound curvature in said body portion, said stressed area being relatively small in relation to the total area of said body portion, said area being located immediately adjacent said tongue and extending from side to side of said body portion and into said legs a limited distance, a contact on that part of said blade that is between said spaced fixed members and in engagement with one of said fixed members, and means for applying a force to that part of said blade that is not secured to said base and does not include said contact whereby upon application of said force said stressed area and that part of the blade including said contact will be caused to snap from stable position to unstable position with said contact in engagement with the other of said fixed members.

5. A blade for use in a snap action switch, comprising an elongated body portion, a pair of legs extending therefrom with the outer edges of said legs forming a continuation of the side edges of said body portion, a movable tongue shorter than said legs extending from said body portion between said legs and terminating in a free end, a single reversible stressed area with a compound curvature in said body portion adjacent the body portion end of said tongue, said stressed area extending into said legs a limited distance, said stressed area being subject to reversal from convex to concave upon the movement of either the body portion, legs or tongue relative to the two in a direction generally normal to the plane of the blade and beyond a critical point, said tongue in its movement with respect to said legs always being in the direction of the convex side of said stressed area.

6. A blade for use in a snap action switch, as set forth in claim 5, in which said legs have been drawn together at their ends beyond the position they would normally assume and secured by a connecting plate, thereby deforming part of

said body portion to produce said stressed area adjacent said tongue.

7. A blade for use in a snap action switch, comprising an elongated body portion, a pair of legs extending therefrom with their outer edges forming a continuation of the side edges of said body portion, a connecting portion comprising an end plate adapted to serve as means for mounting said blade joining the ends of said legs, a tongue extending from said body portion between said legs and terminating short of said connecting portion, a stressed area in said body portion commencing at the body end of said tongue and extending laterally to the edges of said body portion and away from said tongue toward the remote end of said body portion for a limited distance and into the said legs for a limited distance, said stressed area being dished and having in normal position curvature both longitudinally and transversely, the stressed area tapering into an unstressed area at the remote

end of said body portion, said stressed area being subject to reversal from convex to concave upon the movement of either the body portion, legs or tongue relative to the other two in a direction generally normal to the plane of the blade and beyond a critical point.

PHILIP C. JACOBS, JR.

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