April 5, 1949. A. M. MacFARLAND 2,466,459

ELECTRIC SNAP SWITCH

Original Filed July 11, 1945

Fig. 1.

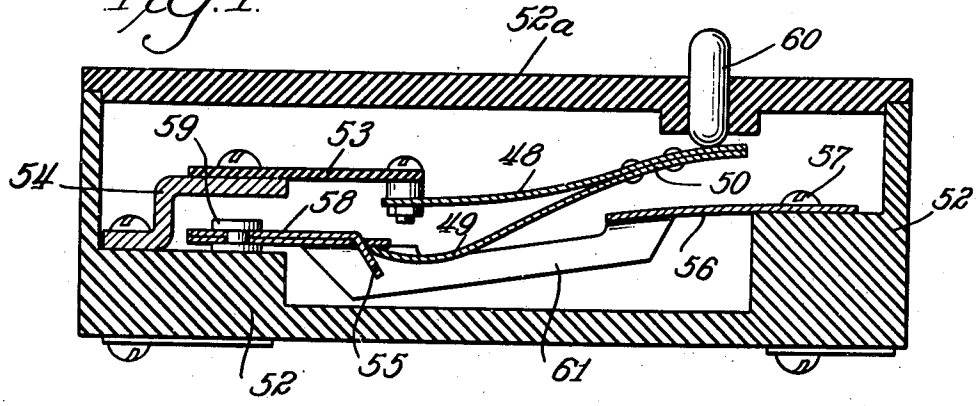


Fig. 2.

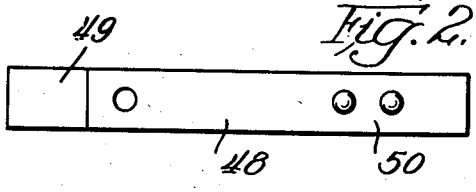
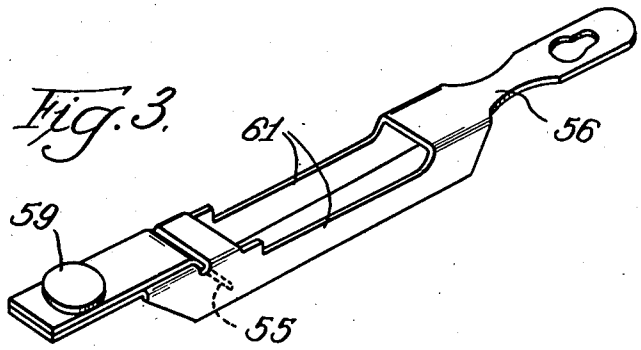


Fig. 3.



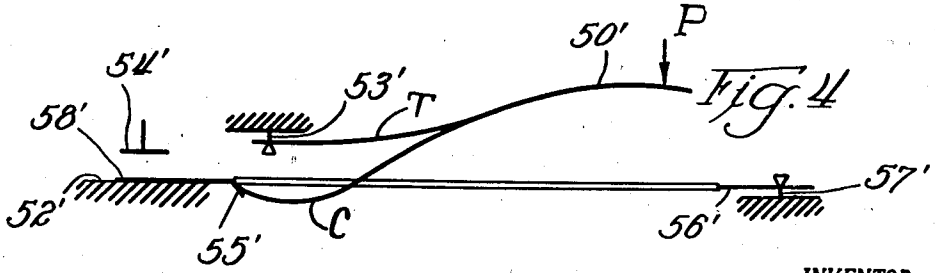


Fig. 4

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ELECTRIC SNAP SWITCH

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5 Claims. (Cl. 200—67)

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This invention relates to improvements in electric snap switches. More particularly, the invention pertains to snap switches of the type wherein the snap action results from the application of forces applied by a leaf spring system having an unstable dead center position. This application is a division of co-pending Allison M. MacFarland application now Patent No. 2,459,661, Jan. 18, 1949.

The object of the invention is to provide a snap switch of improved construction and operating characteristics. The device is extremely simple and compact, and is adaptable for operation by a wide variety of actuating impulses and over a broad range of capacities. The small space required by the switch is a particular feature of this invention.

In the accompanying drawings,

Fig. 1 is a cross-sectional elevation of a complete snap switch embodying the invention;

Fig. 2 is a plan view of the leaf spring of the switch of Fig. 1;

Fig. 3 is a perspective view of the contact bar of the switch of Fig. 1; and

Fig. 4 is a diagrammatic view of the essential operating elements of the switch.

Briefly, the switch consists essentially of a contact bar anchored at one end and having a free end which moves between stops, one or both of which may be electrical contacts, and leaf spring actuating means. The leaf spring comprises a tension leg or strip anchored at one end and a compression leg or strip rigidly connected at one end to an end of the tension strip in juxtaposition therewith. The free end of the compression strip bears against a thrust seat on the contact bar in a direction calculated to place the contact bar in tension from the point of anchorage. The switch is actuated by the application of a force which shifts the position of the butt end of the leaf spring.

A simple embodiment of the invention is illustrated in Figs. 1 to 3 of the drawings. The switch mechanism is mounted upon a base **52** of ceramic, thermo-setting plastic, or other suitable structural insulating material which, together with cover **52a** forms a housing for the switch. An electrical contact **54** is fixed upon base **52** and is electrically connected to a suitable switch terminal by suitable means, as illustrated. A contact bar **56** is anchored at one end to base **52** by means of an anchor pin or screw **57** supported in base **52** and electrically connected to a second switch terminal by suitable means, as illustrated. The free end **58** of contact bar **56** is provided with

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an electrical contact block **59** which is adapted to engage contact **54** to close the switch circuit.

Contact bar **56** is actuated and its position controlled by the forces exerted by a leaf spring system. In the particular form of switch illustrated, this leaf spring **50** is a composite element formed by laying one strip of suitable spring metal upon another and firmly fastening the strips together at one end, as by riveting. The leaf spring is separately illustrated in Fig. 2. The upper strip **48** is anchored or fastened to fixed switch structure by suitable means such as insulating strip **53** extending from electrical contact **54**. It may be noted that the operation of the switch requires only that spring strip **48** be anchored to a support, the fixed mounting being illustrated because of the greater convenience in assembly with this arrangement. The lower spring strip **49** is stepped in thrust seat **55** provided to receive the end of the strip at a point near the free end of contact bar **56**. This seat faces the anchored end of the contact bar and receives the thrust of compression spring strip **49** outwardly from the anchorage at **57**. The relative lengths of spring strips **48** and **49** and the location of the anchorage of strip **48** are such that strip **49** must be bowed in order to insert its end in seat **55**. In assembling the switch, strip **49** is depressed, and, being under compressive stress in this position, the butt end of the leaf spring **50** is urged upwardly against the switch actuating plunger **60**.

In order to accommodate the bowed compression strip **49** of the spring and avoid the exertion of a sidewise force, the middle section of the contact bar is depressed or an opening for the spring is provided. While any one of several forms of contact bar may be suitable, one which is bifurcated at the thrust seat to divide the middle section of the contact bar into two space branches is illustrated in Fig. 3. The two branches **61** are far enough apart to provide necessary clearance for spring strip **49** to move between them.

Unless the nature of the anchorage is such that movement of the contact bar between the fixed contacts or stop and contact is unimpeded thereby, the section of the contact bar adjacent the anchored end is made flexible or hinged to permit this movement.

Operation of the device thus described may be explained by reference to the diagrammatic illustration of the essential operating elements in Fig. 4. In this diagram, the character T designates the spring strip which is under tension in

the spring system and the character C designates the strip which is under compression. The corresponding elements of the switch of Fig. 1 are strips 48 and 49, respectively. The character P designates the arrow which represents the downward force applied by means of plunger 60. Other elements of the diagram are readily related to the mechanical counterparts in the switch structure of Fig. 1 by the similarity of numeral designation.

The switch mechanism diagrammatically illustrated in Fig. 4 is one in which the internal circuit is normally open. The face contact end 58' of contact bar 56' rests upon a stop formed by a portion of insulating base 52'. With the spring system anchored at 53' and the free or butt end of the spring 50' maintained at a given level by the force P, a thrust or force having both horizontal and vertical components is exerted at seat 55' of the contact bar 56'. The portion of the contact bar between step or seat 55' and the anchorage 57' is under tension, this condition being maintained for all positions of this element.

Analysis of the effective forces of the spring system shows that the vertical component of force applied by the spring to the contact bar at seat 55' may be altered in magnitude and reversed in direction by varying the magnitude of force P and thus the position of the butt end of the spring. As this force is increased, the butt end of the leaf spring is depressed, the magnitude of the stresses in tension strip T and compression strip C are increased and the direction of the resultant force applied to the contact bar at seat 55' changes. Although it is theoretically possible to apply a force at P which will result in a horizontal resultant force at seat 55' without vertical components, this being the condition for placing the switch mechanism in dead center position, the system is extremely unstable under such conditions and the dead center status is impossible to attain in practice. Actually, as the force P is increased, the downward component of force which holds the free or contact end of contact bar 56' against the insulating stop 52' abruptly changes to an upward component which starts the contact end 58' of the bar in upward motion. This initial displacement moves the point of application of the force of the spring system at seat 55' upwardly with the result that the upward component of force is increased and the motion of the bar greatly accelerated. The result is a snap action in bringing the contact end 58' of bar 56' into engagement with contact 54'. Similarly, diminution of the force P permits the free end of the leaf spring to move upwardly, opening the switch with a snap action.

Special attention is directed to the nature and effect of a lateral as well as a longitudinal force exerted by the compression strip C of the spring system. This leg of the leaf spring, being bowed and depressed below the general level of the tension strip T, exerts an upward force upon the contact bar due to the deformation of this spring strip at the point of junction with the butt end of the spring 50'. Thus, the compression strip becomes a floating cantilever. This force, which is only one element of the resultant force applied to the thrust seat, has the effect of lowering the dead center position of the contact bar and serves to accentuate the snap action. The latter effect is the result of an increased deformation of compression strip C as the butt end of the spring is depressed, the end of the strip in the thrust seat being below the center of rotation of the opposite end of the strip and thus approached as the butt end of the spring is depressed.

The extent of travel of plunger 60 and the magnitude of the force which must be applied to this plunger in order to operate the switch depend, in part, upon the location of the point of application of this force. In Fig. 1 the plunger engages the leaf spring near the free end. This force may be applied either at the butt end of the spring or it may be applied at any point along the length of the tension strip 48. Downward pressure applied, for example, midway between the anchorage on support member 53 and the junction of the tension strip with the compression strip has the effect of lowering the entire spring assembly at the same time as the free end is depressed. A greater force is required with less displacement at the lowering of the entire spring assembly under the influence of the depressing force appears to improve the snap action.

On the other hand, a switch to be operated with a smaller force and greater plunger travel may be provided by extending the free end of the spring in the manner suggested by the diagrammatic illustration of Fig. 4. When the spring is so extended, the flexible extension absorbs a portion of the motion of plunger 60, the result being a different actuating characteristic.

It will be appreciated that the form of the several elements of the switch herein described may be altered without departing from the mode of operation of the essential mechanism. Particularly, various forms of contact bar may be employed. Also, the structure may be readily adapted to duplex and multiple switch embodiments. Additional spring elements may be employed for this purpose.

The invention is claimed as follows:

1. A snap switch comprising a switch base, a pair of fixed stops at least one of which is an electrical contact mounted in said base, an electrically conductive contact bar anchored at one end to said base and having a free end movable between said stops and a thrust seat arranged near said free end and facing the anchored end thereof, and spring means for actuating said contact bar, said spring means comprising a composite leaf spring comprising two superposed spring strips rigidly fastened together at one end, the free end of the upper strip being anchored in fixed relation to said base, the lower strip being bowed in compression and its free end stepped in the thrust seat upon said contact bar, and means responsive to external manipulation for depressing said composite leaf spring to actuate the switch.

2. A snap switch in accordance with claim 1 in which the fixed stops are so arranged that upward movement of the free end of the contact bar is limited to a point at which the thrust seat is below the level of the anchored end of the upper spring strip.

3. A snap switch in accordance with claim 1 wherein said lower spring strip is bowed sufficiently to bring a portion of the strip below a line extending from the thrust seat to the point of anchorage of the contact bar and said contact bar is bifurcated at the thrust seat to form an opening in the middle section of said bar to accommodate said lower strip.

4. A snap switch in accordance with claim 1

wherein at least the portion of said contact bar adjacent the anchored end thereof is flexible in the direction of movement of said bar.

5. A snap switch comprising a switch base, a pair of fixed stops at least one of which is an electrical contact mounted in said base, an electrically conductive contact bar anchored at one end to said base and having a free end movable between said stops and a thrust seat arranged near said free end and facing the anchored end thereof, and spring means for actuating said contact bar, said spring means comprising a composite leaf spring composed of two superposed spring strips rigidly fastened together at one end, the free end of the upper strip being anchored

in fixed relation to said base, the lower strip being bowed in compression and its free end stepped in the thrust seat upon said contact bar, and means responsive to external manipulation for depressing said composite leaf spring to actuate the switch.

ALLISON M. MacFARLAND.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,170,748	Eaton	Aug. 22, 1939

Certificate of Correction

Patent No. 2,466,459. April 5, 1949.

ALLISON M. MACFARLAND

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 13, for the word "face" read *free;*

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of September, A. D. 1949.

[SEAL]

JOE E. DANIELS,
Assistant Commissioner of Patents.