Aug. 5, 1947. E. P. MEYER 2,425,159

ELECTRIC SNAP SWITCH

Filed Jan. 28, 1944

Fig. 1

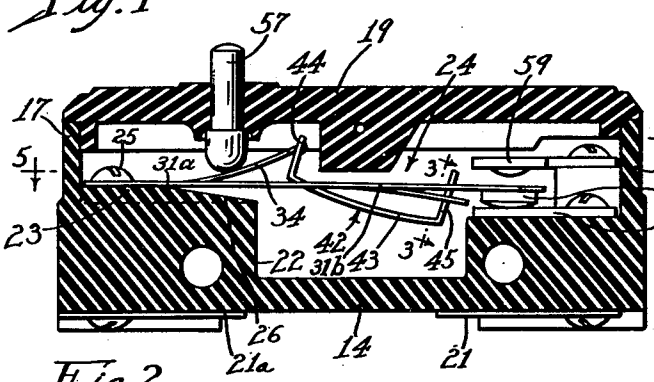


Fig. 3

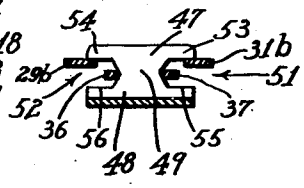


Fig. 2

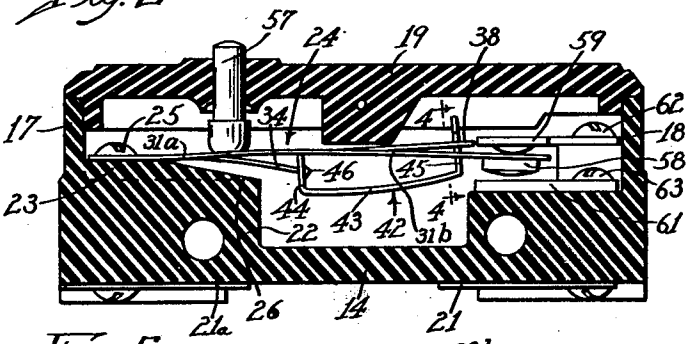


Fig. 4

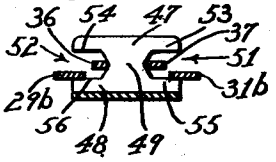


Fig. 5

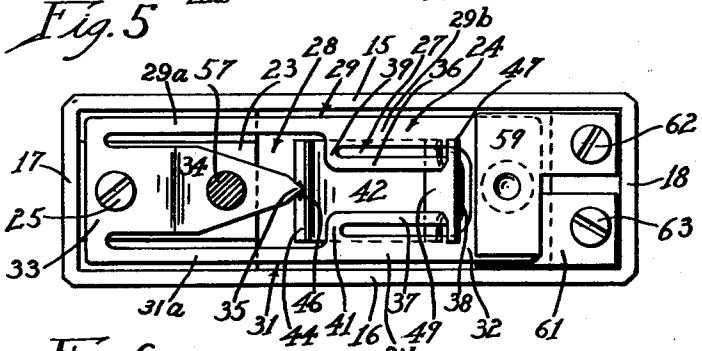


Fig. 6

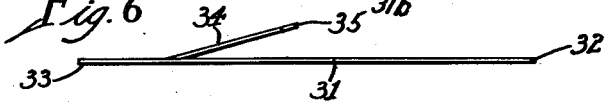
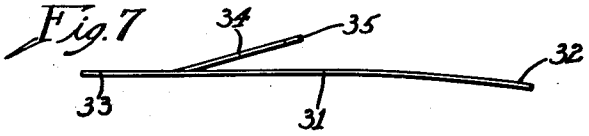


Fig. 7



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ELECTRIC SNAP SWITCH

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9 Claims. (Cl. 200—67)

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This invention relates to electric snap switches and to actuating mechanisms therefor.

An important object of the invention is the provision of a snap mechanism wherein a contact carrier is moved with a snap movement in response to movement of an overcenter snap spring mechanism.

Another object of the invention is the provision of a snap acting mechanism having a contact carrier movable between two opposed positions and an overcenter snap spring system wherein the spring system actuates the operator with a hammer blow after the start of snap movement by the spring system.

A still further object of the invention is the provision of a snap switch mechanism comprising a one-piece flat spring strip, a portion of which forms a part of a snap spring system and a portion of which forms a contact carrier movable with respect to the first mentioned portion.

A further object is the provision of a switch of the character described wherein contact pressure is positively maintained up to the instant the snap motion begins.

Other objects and advantages will appear from the following description and the accompanying drawings, in which—

Figure 1 is a vertical section taken longitudinally through a switch embodying the invention;

Fig. 2 is a section similar to Figure 1 showing the plunger depressed and the contacts in the opposite position;

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

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is a section substantially on the line 5—5 of Figure 1 showing a top view of the switch spring mechanism, and

Figs. 6 and 7 are side elevations of alternate forms of spring strips.

The present invention is concerned primarily with small precision type snap acting switch mechanisms of the type adapted to be operated by very small pressure and movement, and adapted to switch relatively heavy electrical loads. The specific embodiment of the invention herein comprises a base 14 of insulating material, such as molded plastic, having upstanding side walls 15 and 16 and end walls 17 and 18 to form part of a housing for the switch mechanism. Disposed on the top of the walls to complete the housing structure is a cover 19. Attached to the bottom face of the base 14 by screws engaging inserts (not shown) moulded into the base, are tabs 21 for the attachment of wires to connect the switch into suitable circuits. The base 14

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has an upstanding portion 22 adjacent one end providing a horizontally disposed central ledge 23 extending longitudinally of the base against which is attached one end of a leaf spring 24. The spring is rigidly and fixedly attached thereto in cantilever fashion by means of a screw 25 which engages the inserts and acts to interconnect the tabs and the spring. The ledge 23 slopes forwardly and downwardly, as shown at 26 (Figs. 1 and 2), to permit downward flexing of the switch spring.

In this instance, the switch spring 24 comprises a somewhat rectangular shaped piece or strip of relatively thin spring material, such as berylium copper, formed as by stamping, having two areas 27 and 28 (Fig. 5) of the central portion removed to provide side members 29 and 31 and end members 32 and 33, respectively, the end 33 being secured by the screw 25. Projecting from the end member 33 into the area 28 is an actuator element 34 which is of decreasing width terminating in a point, as shown at 35. Also disposed in the central area of the switch spring is a resilient U-shaped strip portion comprising legs 36 and 37 connected by an end portion 38, the opposite ends of the legs being connected, as shown at 39 and 41, to the side members 29 and 31 intermediate the ends of the side members. The legs 36 and 37 and that portion of the side members 29 and 31 disposed between the legs and the end 33, designated by the numerals 29*a* and 31*a*, form the tension members of a snap spring system as will presently more fully appear.

Cooperating with the switch spring to provide an overcenter snap spring system is a compression element indicated generally by the numeral 42, in this instance comprising a C spring having a central portion 43 and outwardly disposed ends 44 and 45. The end 44 has a depressed area 46 for the reception of the point 35 of the actuator element 34 (Fig. 5) while the end portion 45 has the shape shown in Figs. 3 and 4, taking the general form of the capital letter H. Thus, this end portion has effectively an upper bar 47, a lower bar 48, and a centrally disposed connecting bar 49, these bars being formed by slots 51 and 52 disposed in the edge of the upturned portion and defining shoulders 53 and 54 on the upper bar disposed in spaced relation to shoulders 55 and 56 on the lower bar. The bottoms of the slots 51 and 52 converge toward the center, as will be seen from Figs. 3 and 4, and the compression member bears against the end portion 38 of the U-shaped portion of the spring in this area so as to center the upturned portion of the compression element

with respect to the U-shaped portion of the spring. Thus, the compression element is compressed between the end 35 of the actuator element 34 and the edge of the end portion 38 of the U-shaped portion to provide an overcenter snap spring system. This snap spring system comprises an actuating means which includes the actuator element 34 and the compression element 42, both stressed in compression, and tension members one of which is formed by the leg 36 and by the portion 29*a*, and the other of which is formed by the leg 37 and the portion 31*a*, the tension members being interconnected by the end portion 38, the tension members being stressed in tension.

The side members 29 and 31 also include integral portions which form arms 29*b* and 31*b*, these arms being interconnected by the end member 32 on which a mobile contact 58 is carried. Being integral with the balance of the switch spring 24, the arms are of relatively thin spring material and constitute leaf springs supported in cantilever fashion intermediate the ends of the tension members so that they move at their points of support with the tension members, but the free interconnected ends thereof are capable of movement with respect to the tension members by flexing of the arms. The arms 29*b* and 31*b* and the end member 32 therefor form a contact carrier for the contact 58 in the form of a spring system interrelated with the snap spring system heretofore described.

The bars 47 and 48 are of such length as to over and underlie the arms 29*b* and 31*b*, as best shown in Figs. 3 and 4, and the cover 19 is provided with a longitudinally reciprocable plunger 57 arranged to bear against the actuator element 34 in the manner shown in Figs. 1, 2 and 5 so that as the plunger is moved longitudinally between the positions shown in Figs. 1 and 2, the snap spring mechanism is caused to move between the positions shown in these figures and the bars 47 and 48 concurrently engage the arms 29*b* and 31*b*, as shown in Figs. 3 and 4. It is, of course, not essential that the compression element 42 be in the shape of a C spring, and I have satisfactorily employed a coiled expansion spring as an equivalent part of the overcenter spring system.

Spaced below the mobile contact 58 is a stationary contact 61 secured and connected by suitable means, such as screws 63, to the tab 21 on the bottom of the switch. A stop 59 is secured in place above the mobile contact by a screw 62 and serves to limit the upward movement of the end member 32, the stop having an arcuate surface as shown permitting tilting movement of the end member. The screw 25 is likewise connected by suitable conducting means to the tab 21*a* so that by operation of the switch, circuit is opened or closed between the tab 21*a* and the tab 21, depending upon whether the mobile contact engages the stationary contact 61 or the stop 59. While I have shown this specific contact arrangement in the present embodiment of the invention, it will be understood that the invention is capable of embodiment in any of the well known contact arrangements in accordance with the teachings of the art.

In the specific embodiment of the switch shown, the position of the parts shown in Figure 1 is the normal position of the switch mechanism, the mobile contact being disposed in engagement with the stationary contact 61 and clamped thereagainst by the shoulders 53 and 54. When the plunger 57 is depressed, the actuator element 34

is depressed from the position of Figure 1 to the position of Fig. 2, during which movement the point 35 of the actuator element is moved downward toward the compression center line of the switch spring against the compression of the compression element 42. When this point is moved through the axis of maximum stress the spring system reverses its position to that shown in Fig. 2 with a snap movement. The modulus of the actuator element 34 is such that when the plunger is moved downwardly until the downward force exerted by the end thereof slightly exceeds the upward component of the force exerted through the compression element by the legs 36 and 37, downward motion at an accelerated rate occurs due to the fact that the slope of the force-movement curve of the compression element is greater than that of the actuator element. When the spring system occupies the position shown in Figure 1, the bar 47 has its edges 53 and 54 bearing downward against the arms 29*b* and 31*b*, as shown in Fig. 3, pressing the mobile contact 58 against the stationary contact 61 with considerable force due to the downward component of the force exerted by the compression element 42. It will also be seen that as the plunger 57 is moved gradually downward from the position of Figure 1 (or upwarly from the position of Fig. 2), a corresponding gradual movement of the actuator element 34 occurs until the spring system reaches the axis of maximum stress. During this gradual approach movement, the bars of the H-portion continue to exert a lateral force on the contact carrier to maintain the contact pressure. As soon as the axis is passed by the actuator element 34, snap movement of the spring system begins. During the initial part of this movement the bar 47 moves away from the arms 29*b* and 31*b* and the bar 48 approaches the lower side of the arms. Contact pressure is, however, maintained due to the fact that the arms of the contact carrier are spring members carried on the tension members of the snap spring system which exert a downward component of force on the arms and the mobile contact. The initial part of the snap movement is utilized in lost motion as between the spring system and the contact carrier to permit the spring system to gain velocity before the bar 48 strikes the contact carrier so that the carrier is struck a sudden impact by the opposed bar of the H-portion which in this instance moves with the compression elements of the snap spring system. Therefore, if the contacts have not already opened by movement of the tension members when the bar 48 (or the bar 47 depending upon the direction of movement) strikes the contact carrier, it imparts thereto a hammerblow to break loose any minor welding of the contacts which may have previously occurred and to drive the mobile contact rapidly to the opposite position.

Directing attention now more particularly to Figs. 6 and 7, it will be seen that the actuator element 34 is given a permanent upward set for the purpose of making the switch self-returning. The unstressed shape of this actuator element and the positions of the stationary contacts 59 and 61, which in this instance also serve as stops, may be adjusted for the purpose of causing the contacts to be retained in either position in accordance with the teaching of the art. Furthermore, in accordance with the invention, the balance of the switch spring may be entirely coplanar, as shown in Fig. 6, or the spring may be given a set along an arc, as indicated in Fig. 7, for the pur-

pose of producing a bias on the spring system. Thus, with the shape characteristics shown in Fig. 7, it will be seen that when the plunger **57** is moved inward from the position shown in Figure 1 to that shown in Fig. 2, and snap movement of the spring system begins, the bias of the spring particularly in the arms **29***b* and **31***b* will retain the mobile contact **58** in engagement with the lower stationary contact **61** through a greater degree of movement of the snap spring system and until the lower bar **48** of the H-portion engages the side members so as to insure that the contact pressure is maintained until the mobile contact is snapped away from the contact **61** by operation of the bar **48**.

Attention is directed to the fact that I have provided a novel combination wherein an overcenter snap spring driving system functions through a lost motion connection to engage a driven system comprising a contact and a contact carrier, the driven system being actuated from the snap spring system adjacent the free end with a lost motion so as to produce a hammer-blow for the purpose of breaking minor welds as between the contacts and for the purpose of expediting the speed with which the contacts are made and broken. An important advantage of the arrangement is the fact that high contact pressure is maintained until after snap movement of the spring system begins.

Attention is also directed to the fact that the system is such as to allow for substantial lateral twisting through the length of the system due to the flexibility of the slender side members of the spring and to the point contact engagement action between the actuator element and the compression element. This permits the system to adjust itself for alignment and maintains the friction of the system at a minimum.

I claim:

1. The combination in a snap acting control mechanism of a snap spring system comprising spaced tension members arranged in edgewise spaced parallel relation mounted at one end and interconnected at their opposite ends to provide an end free to move between opposed positions, actuating means disposed between the tension members positioned to move through the plane of the tension members with a snap action to move the free end between said opposed positions, said actuating means comprising an actuator element having a movable end and a resilient compression element having one end supported on said free end, the movable end of said actuator element and said compression element being pivotally connected to form a connection providing an axis of maximum stress for said spring system and for movement of said elements through the axis of maximum stress between opposed positions of reduced stress and thereby move said free end between said opposed positions thereof with a snap motion, a carrier comprising arms carried on said tension members in spaced relation to said free end and projecting in the direction of said free end, and means interposed between said snap spring system adjacent said free end and said carrier for engaging the carrier with a snap action after said snap spring system has crossed its axis of maximum stress in either direction.

2. The combination recited in claim 1 wherein the tension members, the actuator element and the carrier are formed of a single strip of resilient spring metal.

3. The combination in a snap acting control mechanism of a snap spring system comprising spaced tension members arranged in edgewise spaced parallel relation mounted at one end and interconnected at their opposite ends to provide an end free to move between opposed positions, actuating means disposed between the tension members positioned to move through the plane of the tension members with a snap action to move the free end between said opposed positions, said actuating means comprising an actuator element having a movable end and a resilient compression element having one end supported on said free end, the movable end of said actuator element and said compression element being pivotally connected to form a connection providing an axis of maximum stress for said spring system and for movement of said elements through the axis of maximum stress between opposed positions of reduced stress and thereby move said free end between said opposed positions thereof with a snap movement, a carrier comprising arms connected to said tension members in spaced relation to said free end and projecting in the direction of said free end, and a lost motion connection interposed between said snap spring system adjacent said free end and said arms for alternately moving said arms in opposite directions after said spring system has crossed its axis of maximum stress during the aforesaid snap movement of the snap spring system.

4. The combination in a snap acting control mechanism of a snap spring system comprising spaced tension members mounted at one end and interconnected at their opposite ends to provide an end free to move between opposed positions, actuating means disposed between the tension members positioned to move through the plane of the tension members with a snap action to move the free end between said opposed positions, said actuating means comprising an actuator element having a movable end and a resilient compression element having one end supported on said free end, the opposite ends of said actuator element and said compression element being pivotally connected to form a connection providing an axis of maximum stress for said spring system and for movement of said elements through the axis of maximum stress between opposed positions of reduced stress and thereby move said free end between said opposed positions thereof with a snap movement, a fixed contact, a contact carrier comprising a mobile contact and resilient arms connected at one end to said tension members in spaced relation to said free end projecting in the direction of said free end for supporting the mobile contact in engagement with the fixed contact, and means interposed between said snap spring system adjacent said free end and said arms for engaging said arms after the spring system has crossed its axis of maximum stress to clamp the mobile contact against the stationary contact.

5. An overcenter snap spring driving system having tension means movable between opposed positions, a contact carrier having arms of spring metal attached to said tension means intermediate the ends thereof for supporting the carrier on the tension means for limited flexing movement with respect to the tension means, and lost motion means other than the aforesaid arms interposed between the driving system and said arms for engaging and moving said arms after said driving system has passed overcenter.

6. The combination in a switch of tension means including a free end movable between two

positions, an actuating means including an actuator element having a free end movable between two positions and a resilient compression element interposed between and engaging the said two free ends to form a resilient connection therewith and provide a snap spring system having an axis of maximum stress and opposed positions of reduced stress, said compression element and said actuator element being pivotally connected for movement of said actuating means between alternate positions of reduced stress with snap action, said actuator element having a spring portion for deflection of said actuator element across said axis of maximum stress upon the application of external force to store energy in said actuator element to move the free end of said tension means between its two positions with a snap motion, said portion being biased in a direction to move back across the axis of maximum stress upon release of the external force, a carrier mounted on the tension means and movable with respect thereto, and means movable with the free end of the tension means for engaging the carrier after lost motion snap movement of the snap spring system past the axis of maximum stress to move said contact carrier.

7. The combination in a switch of a substantially flat spring having tension means including a free end, an actuating means including an actuator element having a free end movable transverse to the plane of the tension means between two positions and a resilient compression element interposed between and engaging the said two free ends to form a resilient connection therewith and provide a snap spring system having an axis of maximum stress, said compression element and said actuator element being pivotally connected for movement of said actuating means between alternate positions of reduced stress with snap action, said actuator element having a spring portion for deflection of said actuator element across said axis of maximum stress to store energy in said actuator element to move the free end of said tension means between its two positions, said flat spring including a contact carrier of flexible spring metal integral with the tension means intermediate the ends of the latter and having a free end movable between two opposed positions, a mobile contact on the free end of said

contact carrier, and means interposed between the snap spring system adjacent the free end of the tension means and the contact carrier for engaging and flexing said contact carrier to urge the free end thereof into either of its two opposed positions after said snap spring system has moved across said axis of maximum stress.

8. The combination recited in claim 7 wherein the last mentioned means comprises a lost motion connection including a shoulder moved by said compression element positioned to engage said contact carrier after said element crosses said axis of maximum stress to move said mobile contact with a hammerblow.

9. The combination in a snap acting control mechanism of a snap spring system comprising a strip of resilient material having at least one tension member mounted at one end and having an end free to move between opposed positions, an overcenter actuating means acting on said strip to stress the same in tension, positioned to move through an axis of maximum stress between opposed positions of reduced stress to move the free end between said opposed positions, a carrier including a resilient strip connected to and movable with said tension member at a point spaced from the ends thereof allowing a limited degree of movement of the carrier with respect to said tension member, stops disposed on opposite sides of said carrier for limiting movement thereof by said tension member, the distance between said stops being less than the opposed positions of said tension member, and lost motion means interposed between said spring system and said carrier, for flexing said resilient strip to press the carrier against the stops upon movement of the tension member to said opposed positions.

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