May 29, 1956 A. V. C. DAVIS 2,748,215

ELECTRIC SWITCH

Filed June 1, 1954

Fig. 1.

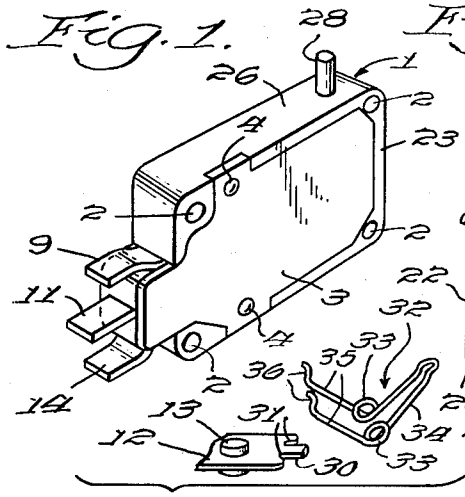


Fig. 3.

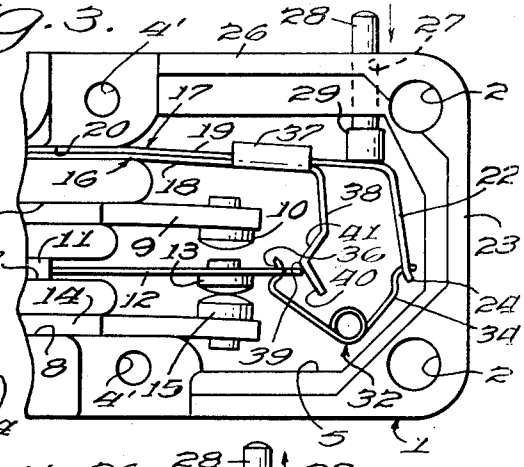


Fig. 7.

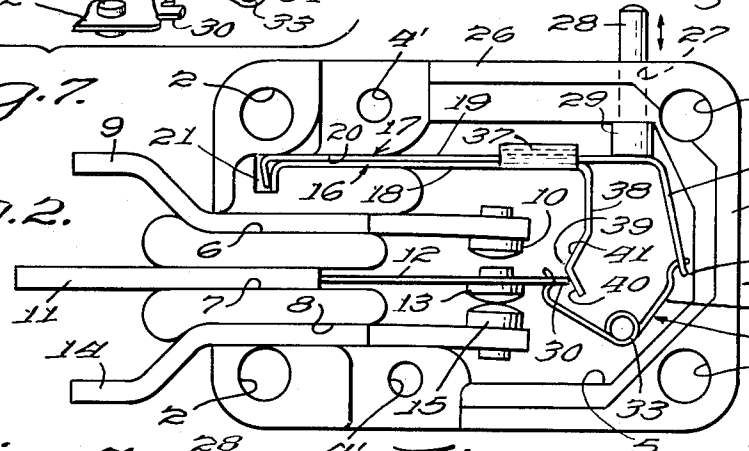


Fig. 2.

Fig. 4.

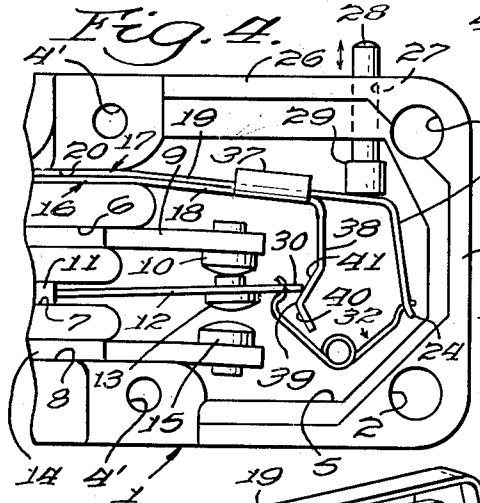
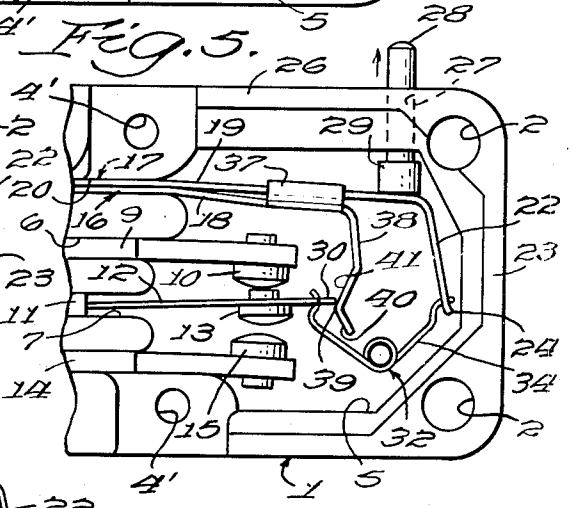


Fig. 5.



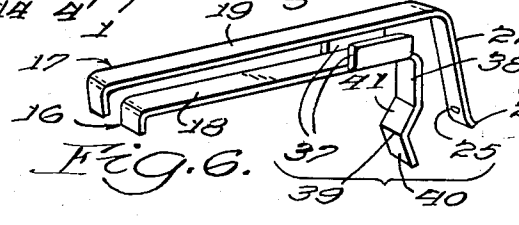


Fig. 6.

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ELECTRIC SWITCH

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6 Claims. (Cl. 200—67)

This invention relates to electrical switches and particularly to an improved form of sensitive switch which is not subject to a chattering action when at its critical point. Sensitive switches are employed in many types of control apparatus for opening or closing circuits when some maximum point is reached such as a pressure or temperature condition. The approach of the element which actuates the switch is very gradual and sensitive switches generally are actuated by spring means having an over center action. Heretofore, as the switch is actuated and the switch operating element moves the spring means up to the over center condition, a center point is reached at which the operating spring means has little power to move the spring contacts in either direction, and especially if the apparatus is subject to vibration as, for example in an aircraft, this center position results in a condition in which the contact points "chatter" and produce irregularities in the operation of the control that renders the control apparatus unreliable and unsatisfactory.

With the foregoing considerations in mind, the principal object of the present invention is to provide a sensitive switch for use with control apparatus which is so constructed and arranged that the over center spring means by which the switch contacts are moved into and out of engagement with each other is moved past its over center positions in both directions of its movement before the switch contacts are moved by the stored power of the spring means.

Another object of the invention is to provide a sensitive, snap action switch which is actuated by over center spring actuated means and which includes means for retaining the contacts in one position relative to each other while the spring means is being moved past its center position preliminary to moving at least one of the contact elements into another position.

Still another object of the invention is to provide a sensitive switch suitable for use with control equipment which is not subject to chattering as the operating means approaches a position to operate the switch contacts.

A further object of the invention is to provide a sensitive switch in which the foregoing objectives are realized in practice and which is both simple in construction and reliable in operation.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts, and in the construction, combination and arrangement of parts, disclosed, by way of example in the following specification of one mode of execution of the invention; reference being had to the following drawings which form a part of said specification and in which drawings:

Fig. 1 is a perspective view of a switch embodying the invention.

Fig. 2 is a side elevation of the switch shown in Fig. 1 in enlarged scale with the cover plate removed to disclose interior construction; the parts being shown in a position of repose,

Fig. 3 is a fragmentary view similar to Fig. 2, but showing the positions of the parts just prior to being moved by snap action to another position,

Fig. 4 is a second view similar to Fig. 3, but showing the parts moved to the said other position,

Fig. 5 is a third view similar to Fig. 3, but showing the position of the parts just prior to being moved by snap action to the position shown in Fig. 2,

Fig. 6 is a perspective exploded view of the detent and actuating elements of the switch and the connecting clip therefor prior to forming an interlock between them, and

Fig. 7 is an exploded view of the contact operating spring and portions of the other elements of the switch which are engaged by the contact operating spring.

Referring to the drawings, the illustrated embodiment of the switch is a double throw, single pole type although it will be evident to those skilled in the art that the invention can be applied to many other types of switches, single pole single throw switches or multiple pole switches in either single throw or double throw form. The illustrated embodiment of the invention comprises a base or case 1 of generally rectangular form having holes 2 through the corners thereof affording means for inserting mounting screws or the like. The case is provided with a removable cover 3 secured thereon by brads 4 engaging holes 4' in the case 1 and interiorly is provided with a cavity 5 in which the moving parts are contained as well as the contact points which are engaged by the moving parts. One edge of the case is provided with a series of three parallel slots 6, 7 and 8 in which are mounted, respectively, a conductor 9 carrying a stationary contact point 10, the conductive base 11 for the leaf spring element 12 carrying the moving contact point 13, projecting from both sides thereof, and the conductor 14 carrying the stationary contact point 15. Exteriorly of the case, the conductors 9, 11 and 14 are adapted for connection by soldering to the conductors of the circuit in which the switch is to be used. In the illustrated embodiment of the invention, the moving contact point 13 is disposed between the stationary contact points 10 and 15 and by flexing of the leaf spring 12 in either direction by means to be described in detail is moved to contact one or the other of the stationary contact points. It will be evident that by eliminating either of the stationary contact points and their support, the switch would act as a simple single throw switch, and it is equally obvious that other arrangements of contact points are possible for other circuit arrangements such as stacking a plurality of contact points on separate spring leaves to be brought into contact with each other by the action of the controlled moving contact point, and that such arrangements may be formed on either or on both sides of the moving contact point.

The switch operating means includes a detent member 16 and an actuating member 17; both of said members being formed of strips of resilient metal and having straight parallel runs 18 and 19, the rear portions of which are disposed in side by side relation in a slot 20 formed in the case 1 parallel to the slots 6, 7 and 8 and with the run 18 of the detent member 16 being disposed closest to the conductor 11. The rear end of the slot 20 terminates in a right angle portion 21 and the rear ends of the members 16 and 17 are formed with corresponding right angle portions which engage the slot end 20 to prevent endwise movement of the members, and the cover 3 prevents movement of the various conductors and the members 16 and 17 out of their respective slots. From the slot 20, the run 19 of the actuating member 17 extends into the cavity 5 along one side thereof toward the opposite end of the cavity and thence is bent substantially at right angles to the run 19 to form a run 22 extending parallel to the end wall 23 of the cavity 5 and terminates in an outwardly curved end portion 24 having a slot 25 formed therein in about the plane extending medially of

the conductor 11 and parallel to the side surface thereof. The side wall 26 of the case 1 adjacent the end wall 23 is provided with a bore 27 in which a plunger 28 is slidingly mounted; said plunger within the cavity 5 having an enlarged head 29 engaging the distal end of the run 19 of the member 17. Normally, as shown in Fig. 2, the resilience of the member 17 holds the plunger with the head 29 engaging the inner surface of the side wall 26 and upon depression of the plunger, the runs 18 and 19 of the members 16 and 17 will be deflected as shown in Figs. 3 and 4.

The contact carrying spring leaf 12 extends beyond the contact 13 carried thereby and the free end thereof is formed into a detent engaging tongue 30 and with spring end engaging notches 31, 31 at each side thereof. Extending between and supported by the slot 25 in the member 17 and the notches 31, 31 is a bell crank like torsion spring 32 comprising a length of wire doubled on itself and thence formed intermediate its ends into two identical, but oppositely wound coiled portions 33, 33 extending along a common axial line outwardly from each side of the medial line of the first arm portion 34 formed by the doubled end of the wire and thence terminating in two laterally spaced arms 35, 35 having their distal ends bent to form notches 36, 36 engageable with the end edges of the spring leaf 12 within the notches 31, 31, respectively. The distal end of the first arm 34 of the spring is bent at right angles to the length of the arm and the bent end thereof is placed in the slot 25. As formed, the arms of the spring 32 are nearly in the same plane, but in assembly, they are compressed toward each other to about the extent shown in the drawings to provide an initial loading or bias thereon, wherefore, despite the fact that it has no pivotal mounting, the term "bell crank like" has been employed to describe its configuration. Incident to movement induced by the plunger 28 the run 22 of the member 17 is moved to an extent that causes the slot 25 therein to be moved to approximately equal extents past either side of the plane extending at right angles to the direction of movement of the slot 25 and disposed medially transversely of the path of movement of the moving contact 13. Thus, when the spring 32 is extending between the member 17 and the end of the spring leaf 12 and the plunger 28 is depressed sufficiently to bring the ends of the spring opposite each other with resultant compression of the spring arms toward each other, the spring is incapable of exerting any opening force. When the plunger is depressed further, as shown in Fig. 4 bringing the arm 34 below the end of the spring leaf 12, the spring will tend to open and thereby move the spring leaf upwardly as viewed in that figure and cause contact between the contacts 10 and 13. When the plunger is released, the resilience of the member 17 will return the member to its initial position to bring the end of the arm 34 above the ends of the arms 35, 35 with resultant movement of the spring leaf in the opposite direction and effecting contact (in the illustrated embodiment of the invention) between the contacts 13 and 15.

As thus far described, the switch is operative in the manner of sensitive snap switches but is subject to the difficulty that when the operating plunger is moved by some slowly moving element of a mechanism to be controlled by the switch and approaches the mid point the contact 13 would be just barely lifted from contact with the contact 15 and, especially if the device were subject to vibration, there would be an intermittent make and break action between these points until the plunger was moved sufficiently to effect the snap action or retracted and allowed the spring 32 to resume its contact making pressure. This chattering action at the over center position is highly undesirable but heretofore has been regarded as a necessary nuisance inherent in the operation of switches of this character.

In the present invention, this chattering tendency is overcome by the provision of means which holds the contacts in engagement with each other until the actuating, over center spring means has passed well beyond the over center position and is capable of exerting effective contact making pressure in the opposite direction. In the illustrated embodiment of the invention this means comprises the leaf spring member 16 positioned with the run 18 thereof adjacent the run 19 of the actuating member on the side thereof opposite the side engaged by the plunger 28. The run 18 of the member 16 has a lost motion connection with the run 19 of the actuating member formed by ear portions 37, 37 bent to extend around the run 19 with sufficient clearance for limited relative movement between the runs 18 and 19. The run 18 terminates at a point substantially in a plane transverse to the end 30 of the member 12 and the member 16 continues in a run 38 toward and past the end 30. Opposite the end 30, the run 38 is bent in a wide shallow V-shape portion to form a detent 39 with the outer surface thereof resiliently engaging the end 30 of the leaf spring member 12 and the point thereof being so disposed that assuming the leaf spring element to be in its mid travel position, this point will be opposite the end 30 when it also is in its mid travel position when moved by the action of the plunger 28 on the member 17.

The operation of the device is as follows: Starting with the switch in its normal position as shown in Fig. 2, the spring 32 by reason of the position of the member 17, urges the leaf spring member in the opposite position to effect connection between the contacts 13 and 15. Referring to Fig. 3, the plunger 28 is depressed sufficiently to bring the point of the detent 39 directly opposite the end 30 of the spring element 12 which is beyond the mid travel or over center position of the spring 32. However, during this movement the inclined face 40 of the detent has been bearing against the end 30 and preventing movement thereof by the spring 32 while at the same time in going past its center position, the spring 32 is ready to effect movement of the leaf spring element 12 and the contact 13 carried thereby in the opposite direction. As soon as the continued movement of the plunger causes the point of the detent to pass the end 30 of the spring element 12, the spring 32 moves the element in the opposite direction to effect engagement of the contacts 13 and 10 as shown in Fig. 4. As the plunger 28 moves in the opposite direction, the resilience of the members 16 and 17 move the spring back to and past its over center position while the inclined face 41 of the detent rides against the end 30 of the element 12, holding the contacts 13 and 10 in engagement until power to move the element 12 back to its former position has been stored in the spring 32 by being moved over center again until the position shown in Fig. 5 is reached at which time slight additional movement will move the point of the detent beyond the end 30 and allow the spring 32 to move the element 12 back to the position shown in Fig. 2. It is to be noted that the lost motion connection between the actuating and detent members formed by the ear portions 37, 37 permits the detent member to lag behind the actuating member in both directions of its movement by reason of its frictional engagement with the end 30 of the member 12. Consequently, in either direction of movement of the actuating member, the over center spring will have been moved well beyond its center position before the movable contact member is released to the action of the over center spring by passage of the point of the detent beyond the end of the member 12.

Thus, once engaged in either position, the switch contacts are held in engagement until the over center spring means has passed its center position and is able to effect positive movement of the moving contact element in the opposite direction and by this means, any chattering tendency is completely eliminated.

It is appreciated that in the light of the foregoing

disclosure, changes and modifications may suggest themselves to others skilled in the art. Consequently, the invention is not to be deemed to be limited to the exact mode of execution disclosed by way of example, but the invention includes as well, all such changes and modifications in the parts, and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. In an electric switch, a base, a movable contact means and a stationary contact carried by said base, reciprocable means for moving said movable contact means into and out of engagement with said stationary contact; said reciprocable means including a resilient, bell crank like, torsion spring means having its respective ends operatively engaging a member of said reciprocable means and said movable contact means; said spring being normally effective to impart snap action movement to said movable contact means as it is moved past its mid-travel position by movement of said member of said reciprocable means, and yielding detent means movable with said member of said reciprocable means, and engaging said movable contact means effective to resist the tendency of said spring means to move said movable contacts means until said member of said reciprocable means has reached a point between its mid-travel position and the end of its path of travel toward which it is being moved.

2. In an electrical switch, a base, a stationary contact point carried by said base, movable contact means carried by said base comprising a resilient spring leaf member having one end fixed to said base and having a contact point adjacent the other end thereof normally spaced from engagement with said stationary contact point, means for flexing said leaf element to effect engagement and disengagement between said contact points including a second spring leaf member, means for imparting reciprocable movement to said second spring leaf member and a bell crank like torsion spring having the ends thereof operatively engaging the distal ends of both of said spring leaf members and normally effective to impart snap action flexing movement to said contact carrying leaf spring member with resultant movement of the contact point carried thereby toward or away from said stationary contact point as said second leaf spring member passes its mid-travel position, and yielding detent means movable with said second leaf spring member and engaging the distal end of said contact point carrying leaf spring member effective to resist the said snap action imparting movement of said torsion spring until said distal end of said second leaf spring member has been moved to a point between its mid-travel position and the end of its path of travel in the direction of its movement.

3. In an electric switch, a base, a pair of fixed contacts carried by said base and disposed in spaced apart relation to each other, a movable contact interposed between said fixed contacts and means supporting said movable contact for movement therewith into engagement with one or the other of said fixed contacts, actuating means for effecting said movement of said contact supporting means including a bell crank like torsion spring means operatively interposed between said movable contact supporting means and a member of said actuating means effective to impart a snap action to said movement of said supporting means in response to movement of said actuating means member, and other means including a resilient detent element movable with said actuating means member slidingly engaging said supporting means effective to delay action of said spring means until said actuating means member has moved said spring means a substantial distance beyond its center point of travel in the direction said actuating means is being moved.

4. In an electric switch, a base, a pair of fixed contacts carried by said base and disposed in spaced apart relation to each other, a movable contact interposed between said fixed contacts, a resilient flexible member carried by said base and carrying said movable contact, reciprocable, switch actuating means carried by said base and including a bell crank like torsion spring having one end connected to said flexible member and the other end connected to said actuating means and effective in response to movement of said actuating means to impart a snap action movement of said flexible member in either direction with resultant engagement of said movable contact with one or the other of said fixed contacts, and a resilient detent element comprising a leaf spring having one end fixed to and movable with said reciprocable means and extending therefrom at right angles to said flexible member to a free end portion having opposed sloping sides and forming a detent engaging the end of said flexible member; said detent being effective to delay action of said torsion spring to cause said snap action until said other end of said spring has been moved substantially past the center position thereof with respect to said one end thereof in the direction said other end is being moved by said reciprocable means.

5. In an electric switch, a base, a pair of fixed contacts carried by said base and disposed in spaced apart relation to each other, a movable contact interposed between said fixed contacts, a resilient flexible member carried by said base and carrying said movable contact, reciprocable, switch actuating means carried by said base and including a bell crank like torsion spring having one end connected to said flexible member and the other end connected to said actuating means effective to impart a snap action movement of said flexible member in either direction with resultant engagement of said movable contact with one or the other of said fixed contacts, and a resilient detent element connected to and movable with said reciprocable means and engaging said flexible member; said detent incident to movement with said reciprocable means being effective to delay the occurrence of said snap action of said spring until said other end of said spring has been moved a substantial distance beyond its center position with respect to said one end in the direction said other end is being moved by said reciprocable means.

6. In an electric switch, a base, a movable contact means including a resilient, flexible member having one end thereof fixed to said base and a stationary contact carried by said base, reciprocable means for moving said movable contact into and out of engagement with said stationary contact and including a bell crank like torsion spring having its ends operatively engaging said reciprocable means and said flexible resilient member; said spring being normally effective to impart snap action movement to said flexible resilient member as it is moved past its mid-travel position by movement of said reciprocable means, and yielding detent means comprising a leaf spring having one end thereof attached to and movable with said reciprocable means and having a free end portion extending therefrom at right angles to and past the free end of said flexible member; said free end of said detent member having opposed sloping sides forming a detent portion slidingly engaging said free end of said resilient flexible member and being effective by said engagement to delay movement of said flexible resilient member by said spring until said spring has been moved a substantial distance beyond its center position in the direction of movement of said reciprocable means.

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