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2,313,341

SNAP ACTION SWITCH

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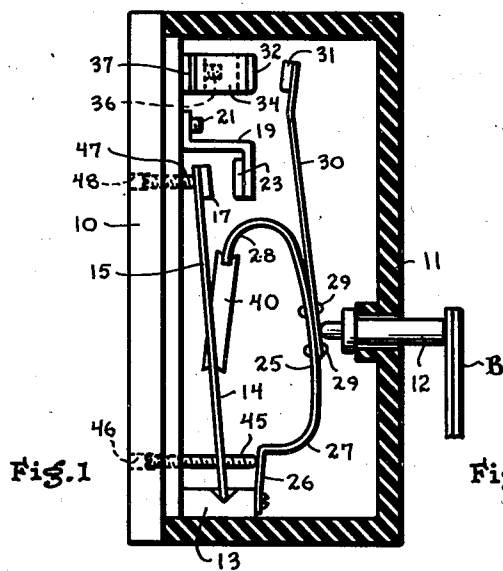


Fig. 1

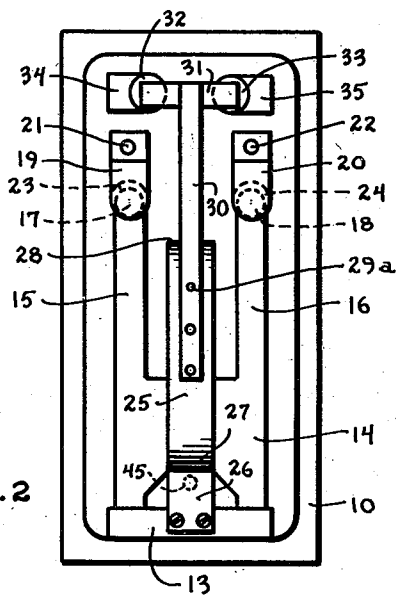


Fig. 2

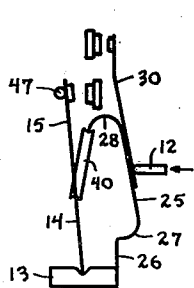


Fig. 4

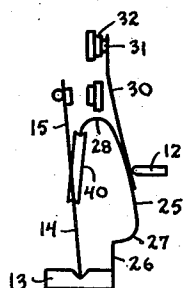


Fig. 5

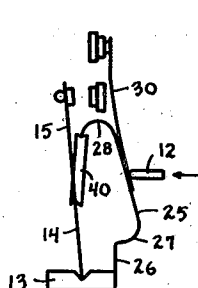


Fig. 6

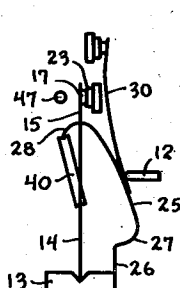


Fig. 7

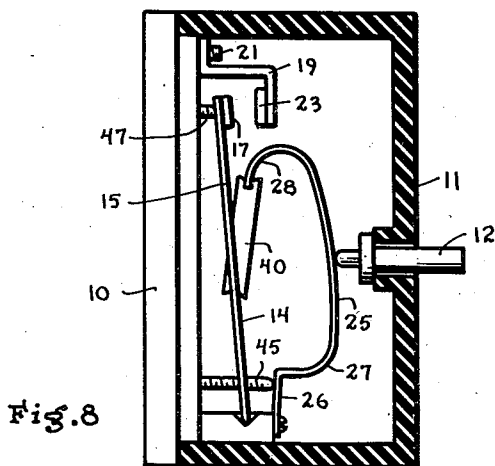


Fig. 8

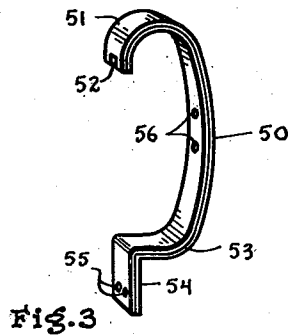


Fig. 3

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SNAP ACTION SWITCH

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7 Claims. (Cl. 74—100)

The present invention relates to snap acting mechanism and has as its primary object the provision of a compact and positive acting mechanism of this character.

Another object is to provide a switch of the type set forth in the above object which utilizes the principle of an overcompensated spring to obtain a snap action.

A further more specific object is to combine an overcompensated spring snap action with a toggle over center snap action to obtain a simplified "double snap action."

Another object is to provide means for arresting the overcompensated spring snap action, and to subsequently add an over center snap action to it to produce a two stage snap action.

A further object is to provide convenient means for operating a control of the character of the present invention by providing, as an element in the control mechanism, a condition responsive element.

Still other objects will be apparent upon consideration of the following specification and appended claims taken in connection with the drawing, in which:

Figure 1 is an elevation of my invention with the cover shown in section;

Figure 2 is an elevation looking to the left in Figure 1 and with the cover removed;

Figure 3 is a perspective view of an alternative part for my invention;

Figures 4, 5, 6, and 7 are diagrammatic views of my invention shown in Figures 1 and 2 in various stages in the practical operation thereof, and

Figure 8 is an elevation similar to Figure 1, but with certain parts eliminated.

In the drawing the switch mechanism is mounted on a base 10. The base 10 is provided with a cover 11 which is secured to the base by suitable means, not shown. A pin 12 extends through the cover and abuts a condition responsive element, shown as a portion of a bimetal thermostat B, which is adapted to actuate the switch therein in a manner that will be hereinafter more fully described. The base 10 is provided with a lug 13 upon which the operative parts of the switch are mounted. A generally U-shaped contact member 14 is pivotally carried by the lug 13 and is provided with a pair of contact arms 15 and 16, which carry movable contacts 17 and 18. Carried upon a pair of brackets 19 and 20, which are suitably secured to terminal posts shown as screws 21 and 22, respectively, are stationary contact buttons 23

and 24 which cooperate with contacts 17 and 18 in making and breaking an electrical circuit upon movement of the U-shaped contact member 14. The contact member 14 serves as a bridge between the two stationary contacts 23 and 24.

Also mounted on the lug 13 is a resilient actuating arm 25. The actuating arm 25 is secured to the lug 13 by means of screws which pass through a depending portion 26. The lower end of the resilient member 25 is curved as shown at 27 and the upper end of the member is formed into a return bend or hook as indicated at 28.

Suitably mounted upon the resilient member 25 by means of rivets 29 is a resilient arm 30. A rivet hole 29a is provided in the arm 30. This hole 29a registers with a corresponding rivet hole (not shown) in the resilient member 25. These holes are adapted to receive a rivet to stiffen the upper part of the resilient member 25 to change the operation of the device. This operation will be more fully described hereinafter.

The arm 30 carries a bridge member 31 which cooperates with stationary contact buttons 32 and 33 carried upon contact brackets 34 and 35, respectively. The contact brackets 34 and 35 are suitably secured to the base 10 by means of terminal screws, one of which, screw 36 being shown in Figure 1. A plurality of spacers 37 provide an adjustment for the contacts 32 and 33.

The hook shaped end 28 of the resilient member 25 is adapted to firmly engage the upper end of a link 40 which is made of electrical insulating material. A suitable slot may be provided in the end 28 to maintain the link 40 transversely non-rotatable therein. The lower end of the link 40 engages the horizontal bridge portion of the U-shaped member. This lower end may also be fitted into a slot to maintain the link in transverse non-rotatable engagement with said U-shaped member.

The resilient member 25 is provided with an adjustment screw 45. The screw 45 is adapted to fit into a tapped hole 46 and may be adjusted to bear against the lower portion 26 of the resilient member 25 to initially tension said member. An adjustment is also provided to limit the travel of the contacts 17 and 18 and is shown as a screw 47 which fits into a tapped hole 48 and bears against the back of one of the contact arms 15 or 16 to limit the travel of the entire U-shaped member 14 in one direction.

Figures 1 and 2 show a mechanism which may

be operated from the exterior of the case by the push-pin 12. This push-pin may be actuated by any suitable pressure, temperature, or humidity responsive device. However, the present invention is readily adaptable to self-contained automatic operation in response to temperature by merely substituting the thermal element 50, shown in Figure 3, for the resilient member 25 of Figure 1. The upper end of the bimetallic element 50 is shown as being hooked as at 51 and is provided with a slot 52 which is adapted to transversely non-rotatably secure the upper end of the link 40. The lower end of the element 50 is curved as at 53 and has a depending mounting portion 54 with holes 55 therein which receive screws for mounting the member 50 to the lug 13. Other holes 56 are shown as being in the elongated portion of the element and may receive rivets 29 for mounting the resilient member 30 on the thermostat 50 in the same manner as shown in Figure 1.

Referring again to Figure 1, the forces to produce the snap action are created by the resilient element 25. This element is secured to the lug 13 and is stressed by the link 40 which separates the ends 27 and 28 of the resilient element 25 to create stresses in two directions. Both of these stresses are caused by the angular relationship of the link 40 to the actuating member 25 and the contact member 14. It is seen in Figure 1 that the link 40 is arranged in relation to the contact member 14 and the actuating member 25 in such a manner that compression of the element 25 will tend to rotate the link 40 in a clockwise direction. This force will be resisted by the contact member 14 when it is in engagement with the adjustment stop 47. Therefore the compressional stress will act to move the upper end 28 of the member 25 toward the right. This movement toward the right will be resisted by the push pin 12 to cause the element 25 to assume some stable position where the force exerted toward the right is resisted by forces which will act toward the left due to the engagement of the push pin 12 with the resilient actuating member 25. The adjustment screw 45 is adapted to change the initial tension of the end 28 toward the right as well as to change the direction of the compressional force exerted by the member 25 on the link 40 by moving the lower end 27 either to the right or left as desired. Therefore it is seen that due to the rotatable mounting of the link 40 there is a force exerted toward the right and this force is resisted by the push pin 12.

Referring now to the operation, upon movement of the push pin 12 toward the left as shown in Figure 4, there will be a force built up in the actuating element 25 which tends to move the upper end 28 toward the left. This force will be resisted because of the angular relation of the link 40 to the elements 25 and 14. This latter force is great enough to prevent the end 28 from moving toward the left until sufficient force has been stored in the element 25 to overcome the force due to this angle. When sufficient force is stored the end 28 will move toward the left. When such movement begins the force built up in the spring 25 drops off at a lower rate than the force exerted by the link 40 drops off. By such a force changing relationship a spring rate compensation snap action is obtained. Therefore the end 28 will move rapidly toward the left and will tend to go completely to the left. Complete movement to the left however will be

arrested because the contacts 31, 32 and 33 will engage and cause the spring arm 30 to exert a force on the actuating element 25 which acts towards the right. This force added to the force due to the now decreased angle of the link 40 will be enough to overcome the force exerted by the resilient element 25 and cause the mechanism to stop in this first snap action stage. This position is shown in Figure 5.

Upon further movement of the push pin 12 toward the left as shown in Figure 6, the upper end 28 will rotate the link 40 past dead center with respect to the contact member 14. When this dead center position is crossed the contact 14 will be snapped away from the stop 47 and the contacts 17, 18, 23 and 24 will engage. This position is shown in Figure 7.

Upon returning the switch in the opposite direction, the reverse of this operation will be effected. When the link 40 passes the dead center line in moving toward the right in relation to the contact member 14, the contacts 17, 18, 23 and 24 will disengage with a snap action. The switch will then assume the position shown in Figure 5. Upon further movement of the pin 12 to the right, the force stored in the element 25 will be released and the link 40 will be rotated toward the right. When a sufficient angle has been attained by the link 40, and the force in the element 25 has diminished sufficiently, the force due to the angle will overcompensate the force stored in the element 25 and the contacts 31, 32 and 33 will snap out of engagement.

To obtain a self-contained temperature responsive snap action device, the resilient bimetallic element 50 may be substituted for the resilient actuating member 25. Substantially the same operation is obtained by the substitution of this element. The stages of operation are identical with those hereinbefore described.

Referring now to Figure 8, the mechanism shown comprises exactly the same parts as that mechanism shown in Figure 1. However, in Figure 8 certain parts have been eliminated to obtain a single stage switch actuated by a double snap action. The first snap action is an overcompensated spring rate snap, and the second snap action is a simple toggle over center snap action. Inasmuch as the parts utilized are exactly the same as those hereinbefore described in connection with Figure 1, only the operation of the device shown in Figure 8 will be explained.

Assuming that the pin 12 is moved toward the left; a force will be stored in the resilient actuating member 25. This force will be resisted by the force exerted due to the angle formed by the link 40 and the contact carrying member 14. Sufficient force must be stored in the actuating member 25 to overcome this force exerted due to this angle. In storing the force the actuating member 25 will be straightened out. Therefore when the force stored overcomes the force exerted due to the angle of the link 40, the upper end 28 of the actuating member 25 will move past the center line of the contact carrying member 14 with a rapid or snap action. When the upper end of the link 40 has passed the center line of the contact carrying member 14, there will be a force exerted in the opposite direction upon the contact carrying member. This force will cause the member 14 to be rotated in a clockwise direction to close the contacts 17, 18 and 23 and 24. This latter force will be caused by the tendency of the toggle arrangement formed by the link 40 and the lower portion of

the contact carrying member 14 to elongate or separate the ends of the actuating member 25. Therefore it is seen that the contacts will engage each other with a positive pressure. In returning to the initial position, the pin 12 will be moved to the right to relieve the force now exerted by the actuating member 25 to allow said member to straighten up in position in accordance with the setting of the adjustment screw 45. When a point is reached where the force due to the angle between the link 40 and the contact carrying member 14 is overcome by the returning force of the actuating member 25, the upper end of the member 25 will move rapidly across the center line position of the contact member 14 and will therefore cause the contacts to be disengaged with a snap action.

Although I have shown structures which are operated by a push-pin acting upon a resilient driven member, it will be understood that the mechanisms may be actuated by a condition responsive device. A self contained actuating device has hereinbefore been described as a bimetallic element 50. This element 50 is constructed of resilient material and moves in accordance with changes in temperature. It is obvious that substantially the same operation is obtained by replacing the resilient element 25 with the resilient bimetallic element 50. The stages of operation of the devices will be identical with the stages of operation hereinbefore described. When a bimetallic actuator is used the adjustment screw 45 will change the temperature setting at which the bimetal will actuate the switch mechanism.

While I have shown my device as being adapted to make and break electric circuits, it will be clearly understood that such a device may find use in other arts, such as, for example, the valve art where snap action is desired in opening and closing valves. It will also be quite apparent that other mechanical uses of the device will occur to those skilled in the arts and therefore it should be clearly understood that I am not to be limited in my invention only to those forms shown and described but by the scope of the appended claims.

I claim as my invention:

1. In combination, a movable actuating member operatively mounted at one end with the other end free to move for exerting a force, a first movable control member resisting said force, said control member being movable between two stable positions and said actuating member having three operating positions, a second movable control member carried by said actuating member, and a connecting link between said first movable control member and the free end of said actuating member to obtain said force relationship between said two members, said link being disposed at an acute angle to said first movable control member and said actuating member, said angle determining the correlation of said force between said two members, said actuating member being capable of storing a force to cause said link to move toward said first movable control member with a spring rate compensation snap action, said second movable control member being capable of stopping such movement before said link has passed beyond an overcenter position in relation to said first movable control member, said actuating member being capable of further moving said link to cause said link to pass overcenter in relation to said first movable control member to thereby cause said mem-

ber to change its position with an over-center snap action, and means for causing movement of said actuating member by variations in a variable condition.

2. Snap action mechanism comprising the combination of a resilient elongated actuating member operatively mounted at one end with the other end free to move and a rotatable link in engagement with movable abutting means at one of its ends with its other end engaging the free end of said member at an acute angle so as to tension said member and offer resistance to movement thereof with a force predetermined by said angle and the tension of said member, said member being capable of storing a force to overcome said resistance to rotate said link and change said angle, the change in angle between the link and member overcompensating the spring rate of said member whereby said link and member move with a snap action, and movable control means operatively associated with said abutting means engaging said link, said control means resisting the force exerted upon said link by said actuating member in one direction until said link moves overcenter with relation to said abutting means whereupon said control means moves from one to another position with an overcenter snap action.

3. Snap action mechanism comprising the combination of a resilient elongated actuating member operatively mounted at one end with the other end free to move and a rotatable link in engagement with movable abutting means at one of its ends with its other end engaging the free end of said member at an acute angle so as to tension said member and offer resistance to movement thereof with a force predetermined by said angle and the tension of said member, said member being capable of storing a force to overcome said resistance to rotate said link and change said angle, the change in angle between the link and member overcompensating the spring rate of said member whereby said link and member move with a snap action, said abutting means including first movable control means engaging said link, said control means resisting the force exerted upon said link by said actuating member in one direction until said link moves overcenter with relation to said abutting means whereupon said first control means moves from one to another position with a snap action, and second movable control means moved by said actuating member, said second control means being capable of halting said spring rate snap action before said link passes overcenter with relation to said first movable control means.

4. Snap action mechanism comprising, an over-center switch member, a tensionable actuating member operatively mounted at one end with the other end free to move, and a compression link pivotally connected to the free end of said actuating member and to said switch member, said link being angularly arranged with respect to both of said members so as to create a tension force in said actuating member, said force having at least two angularly disposed components which change at different ratios of deflection to force to obtain a first snap action with relationship to said link and said actuating member, control means operated by said first snap action for performing a first controlling function and for retarding said snap action in so doing, said link being adapted to be moved further after being so retarded so that it will pass a center line relationship with said switch member to obtain an overcenter second

snap action for performing a second controlling function.

5. A device of the character described comprising in combination, an elongated resilient member, a support, one end of said member being fixed to said support, said member being bowed so that its other free end extends generally toward said first end, a movably mounted control arm, and a link connected between an intermediate portion of said control arm and the free end of said resilient member, said link being arranged at an acute angle with respect to said resilient member and control arm and exerting a force on said member in a direction to tend to straighten said member, movement of the free end of said member causing such a reduction in the angle between said link and said member as to cause overcompensation of the spring rate of said member whereby said free end moves with a snap action, said link passing over center with respect to said control arm to cause said arm to move with a snap action.

6. A device of the character described comprising in combination, an elongated resilient member, a support, one end of said member being fixed to said support, said member being bowed to increase its effective resiliency, a movably mounted control arm, and a rigid link connected between said control arm and the free end of said resilient member, said resilient member exerting a compressive force on said link, said link being arranged at an acute angle with respect to said

resilient member and said control arm, movement of the free end of said member causing such a reduction in the angle between said link and said member as to cause overcompensation of the spring rate of said member whereby said free end moves with a snap action, said link passing over center with respect to said control arm to cause said arm to move with a snap action.

7. A two stage snap action mechanism comprising in combination, a resilient actuating member fixed at one end and having a movable free end, means for opposing movement of said free end comprising a floating link, a movably mounted control arm, said link being mounted between the free end of said resilient member and said control arm at an acute angle with respect to each of them, the relationship between the spring rate of said resilient member and the angle of said link being such that the spring rate of said resilient member is overcompensated as its free end is moved against the opposition afforded by said link whereby such movement occurs with a snap action, and additional resilient means rendered operative as a result of the movement of the free end of the resilient member for increasing the effective spring rate of said resilient member an amount sufficient to terminate the snap movement thereof, further movement of said free end causing said link to pass over center with respect to said control arm and operate it with a snap action.

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