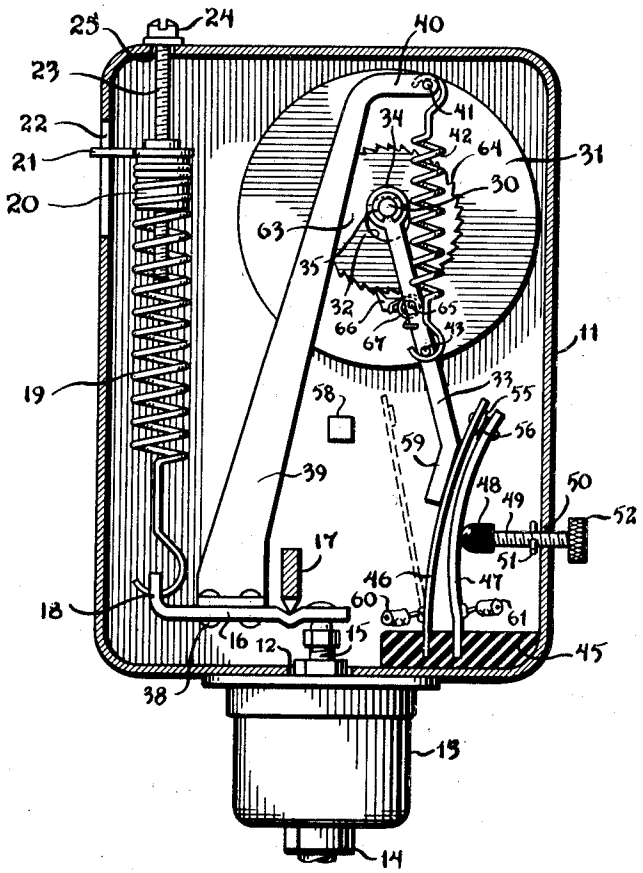
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SNAP MAKE-SLOW BREAK SWITCH

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SNAP MAKE-SLOW BREAK SWITCH

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This invention relates generally to the art of switching and is directed more specifically to the type of switch which closes its contacts with a snap action and opens them with a slow action.

In many cases it is desirable to operate an open contact switch with a snap action. Such a switch action assures a good positive contact pressure on switch closing and prevents the condition where the two contacts are just barely touching and there is no contact pressure between them. Such a condition is likely to cause "frying" of the contacts. When the contacts are separated with a snap action, this point of zero contact pressure is again eliminated.

Where an alternating current circuit is being controlled, it is found that a switch providing for a snap closing of the contacts gives very satisfactory results, but if the contacts should be snapped apart when the alternating current is at its maximum value a large arc would appear at the contacts. If the alternating current curve should be passing through zero value when the contacts were snapped open no arcing would result. In other words, there is about a fifty-fifty chance of bad arcing when a switch is snapped open in an alternating current circuit.

It is an object of this invention to provide a switch for use in an alternating current circuit which will close its contacts with a snap action but which will separate its contacts with a slow but positive action. With the contacts separating slowly, even though the alternating current curve should be at its peak at the moment of separation, the contact will have separated only a small amount before the current curve passes through zero. This means that only a small arc will be drawn and as the current curve passes through zero, the arc will disappear and due to the air gap between the contacts the arc will not strike again as the current builds up again to its maximum value. Thus a slow breaking switch will prevent a large arc being drawn in an alternating current circuit.

Another difficulty which is experienced with snap action contacts is the tendency to bounce. That is, after they have snapped into engagement with each other, they have a tendency to separate again momentarily due to their own resilience.

It is therefore a further object of this invention to provide a switch which closes its contacts with a snap action and which has an arrangement which materially reduces the possibility of the contacts bouncing.

This invention has so far been discussed only in connection with electric switching but it is obvious that the principle could be used in connection with other devices, such for example as a valve. The valve could be made to either snap open and close slowly or to open slowly and snap shut.

It is therefore a broad object of the present invention to provide a mechanism for operating a control device in one direction with a snap action and in the other direction with a slow action.

These and other objects will readily become apparent as the following specification is read in the light of the accompanying drawing in which the single figure shows an elevation of a mechanism embodying my invention.

The switch mechanism is housed with a switch casing 11 which is shown in section in the drawing and which is provided with a hole 12 which extends through the bottom. Suitably connected to the outside of the casing around the hole 12 is a housing 13 inside of which is suitably secured a bellows which is adapted to respond to variations in pressure within the housing. A capillary tube is adapted to be connected to the housing at 14 and to extend to a source of variable pressure or to a thermal bulb depending upon whether it is desired to operate the switch mechanism in accordance with pressure variations or in accordance with temperature changes. The bellows within the housing 13 is adapted upon expansion and contraction to vertically move the stem 15 which is connected to the bellows and which extends freely through the hole 12 in the switch casing.

At its upper end the stem 15 is adapted to abut against one end of a lever 16 which is fulcrumed on a knife edge 17 suitably connected to the switch casing 11. The opposite end of lever 16 is provided with an up-turned ear 18 through which a small hole extends. One end of a tension spring 19 is hooked into the hole in ear 18 and is rigidly connected at its upper end to a nut 20. The nut 20 is provided with a horizontally extending arm 21 which projects through a vertical slot 22 in the casing 11 to permit the nut to be adjusted vertically and at the same time prevent it from rotating. A screw 23 is provided with a head 24 and extends loosely through a hole 25 in the top of the casing 11 and screw-threadedly engages the nut 20. The head 24 of the screw 23 is provided with a kerf for engagement with the blade of a screw-driver or other tool so that the screw may be rotated

for the purpose of vertically adjusting the nut 20 which will in turn vary the tension of the spring 19. It will be noted that the spring 19 is arranged to oppose the upward movement of stem 15 by means of the bellows in housing 13 and therefore the variation of the tension of the spring 19 will vary the pressure at which the bellows will rotate the lever 16 about the knife edge 17.

Suitably connected to the back of casing 11 is a pin 30 which extends forwardly and on which is mounted a wheel 31 having a concentric hole 32 therethrough which is placed around the pin 30 and which has a diameter considerably larger than the diameter of the pin. A lever 33 which has an eyelet 34 at its upper end is mounted by means of the eyelet on the pin 30 and maintained thereon by means of the metal clip 35 which engages in a groove in the end of the pin 30.

Suitably connected to the lever 16 as by means of rivets 38 is an upstanding arm 39 having a horizontally extending portion 40 at its upper end which is provided with a pin 41. Hooked around the pin 41 is one end of an over-center tension spring 42, the other end being looped around a pin 43 which is carried by the lever 33.

In the lower right-hand corner of the switch casing 11 is a block of insulating material 45 to which are fixed two upstanding resilent contact blades 46 and 47. The normal position of the contact blade 46 is shown in dotted lines in the drawing whereas the blade 47 is normally straight and is biased into engagement with the insulating tip 48 which is mounted upon the adjustment screw 49 which screw-threadedly engages the casing 11 at 50. The adjusting screw 49 is provided with a transverse pin 51 to limit its withdrawal from the casing 11 and is also provided with a knurled head 52 to facilitate its manual adjustment in the casing 11. The contact blade 46 is provided at its upper end with a contact button 55 and the blade 47 is provided at its upper end with a contact button 56, said contacts being positioned so that they will engage each other as the contact blade 46 is moved to the right under the influence of the lever 33.

It will be seen that as the arm 39 is moved by the stem 15 that it will move the spring 42 over center with respect to the pin 30 on which the lever 33 is pivoted and will therefore snap the lever 33 back and forth. The movement of the lever 33 in one direction is limited by the switch blade 46 in its engagement with the blade 47, and in the opposite direction by means of the stop 58 suitably connected to the back of the switch casing 11. The lever 33 is provided with a foot 59 having a flat contact surface which is adapted to slide with respect to the switch blade 46 as the lever 33 is rotated in a counter-clockwise direction. The purpose of this action will be described later. The switch blade 46 is provided with a conductor 60 and the switch blade 47 is provided with a conductor 61, which conductors may connect the switch to an external circuit.

Rigidly connected with the wheel 31 is a ratchet wheel 63 which is provided with a plurality of teeth 64 about its circumference. Wheel 63 also has a hole which is of the same diameter as, and which registers with the hole 32 through the wheel 31. Pivoted on the lever 33 by means of a pin 65 is a pawl 66 which is biased by means of the coil spring 65 into engagement with the teeth 64 of the ratchet wheel. The pawl and the ratchet wheel are so arranged that as the lever 33 is rotated in a counter-clockwise direction the pawl will slip free of the teeth and exert no turning effect on the wheels 63 and 31, but as the lever is rotated in a clockwise direction the pawl 66 will engage the teeth 64 and cause a rotation of the two wheels 63 and 31. It will be noted that the center of gravity of the two wheels is at some point below the pin 30 due to the fact that the hole 32 through the wheels is of a considerably larger diameter than the diameter of the pin 30. This means that a greater force will be required to rock the wheels about the pin 30 than would be required if the wheels were concentrically mounted on the pin because as the wheels are rocked their center of gravity must be raised. As the lever 33 is rotated in a clockwise direction, it will cause the wheels to rock on the pin 30 until the point of engagement between the wheels and pin, instead of being directly at the top of the pin will be moved down toward the right side of the pin as viewed in the drawing. At some time during its movement, the wheels will slip with respect to the pin so that the contact point will again be on top of the pin 30. Due to this action, it will require a relatively large force to rock the wheels about the pin but after the lever 33 has come to rest against the stop 58, the wheels 63 and 31 will slip over the pin 30 until they again contact it at its top and the wheels will then exert no force tending to rotate the lever 33 back again in a counter-clockwise direction. In other words, the over size hole through the two wheels produces a sort of leverage action as the lever 33 moves clockwise and therefore produces a greater retarding effect than if the two wheels were mounted concentrically on the pin 30, but due to the fact that they will slip with respect to the pin 30 after the lever 33 has come to rest adjacent the stop 58 they will not tend to return the lever 33 in a counter-clockwise direction as the ordinary lever would do.

Considering the operation of the device as a whole, it will be assumed that the lever 33 is adjacent the stop 58 that the pin 41 to which the spring 42 is connected is on the same side of the pin 30 as is the pin 43 so that the spring 42 is tending to hold the lever 33 against the stop 58; that the contact blade 46 is in its dotted line position, and that the resilient blade 47 is straight at its upper end, but due to its own bias is pressing against the tip 48 on the adjusting screw 49. On a variation in the condition to which the bellows within the housing 13 responds, the stem 15 will move downwardly and the lever 16 will follow its movement under the influence of the spring 19 which will cause the arm 39 to move the spring 42 over center with respect to the lever 33 and pin 30. This will cause the lever 33 to snap in a counter-clockwise direction, which snap action will be unopposed by the wheels 63 and 31 due to the fact that the pawl 66 will merely slide over the teeth 64. As the foot 59 of the lever 33 moves the resilient contact blade 46, it also slides with respect thereto and the friction of this sliding contact will absorb some of the energy of the snap action mechanism to tend to eliminate the bounce due to the impact of the contacts 55 and 56. It will be noted also that the blade 46 bends about the point where it connects to the block 45 and the blade 47 bends about the point where it contacts the tip 48 and therefore the contacts 55 and 56 will slide with respect to each other

as they are brought into engagement, thus further reducing their tendency to bounce. As the contacts **55** and **56** engage, the resilient contact blade **47** will be pressed back toward the right as shown in the drawing and the amount of this pressback is greater than the pitch of the teeth **64** so as to prevent the contact **55** from bouncing back out of contact with the contact **56**. It will be noted also that the resilient contact blade **47** is placed under an initial tension by the adjusting screw **49** which will have an additional effect tending to prevent the contact **56** from bouncing out of contact with the contact **55** as they engage.

As the condition changes in the opposite direction, the arm **39** will again move the spring **42** over center with respect to the lever **33**, tending to cause it to snap in the opposite direction against the stationary stop **58**. In this case, however, the pawl **66** engages one of the teeth **64** so that before the lever **33** can move in a clockwise direction, it must swing the wheels **63** and **31** about the pin **30**. This retards the action of the lever **33** and gives it a slow but positive movement in a clockwise direction to cause a slow but positive separation of the contacts **55** and **56** which is the desired action where the contacts are breaking an alternating current circuit. The mechanism will then be in the position from which it originally started and will be ready for another cycle of operation.

If it is desired to adjust the condition value at which the switch will operate in each direction, the screw **23** is rotated by means of the head **24** to vary the tension of the spring **19** as described above. A further adjustment is provided for the differenital of operation of the switch. One way of adjusting the differential of an over center snap action switch is to vary the limits to which the member operated by the over center spring can be snapped. This in turn will vary the distance which the over center spring will have to be moved to produce a snap action in the opposite direction, which is the factor which introduces the differential of operation. In this case, the adjusting screw **49** is provided to vary the position of the contact blade **47** which limits the rotation of the lever **33** in a counter-clockwise direction. By varying the position of this blade, the condition value at which the switch is opened is adjusted without varying the condition value at which the switch is closed.

The present invention has been shown in the drawing and described in the specification as being applied to a switch. It is obvious, however, that this same type of mechanism can be used to operate a valve so that it will be moved rapidly in one direction and slowly in another. Certain other modifications may also occur to those who are skilled in the art and it is therefore to be understood that I am to be limited by the scope of the claims and not by the specific embodiment of the present invention which has been disclosed.

I claim as my invention:

1. In a device of the character described comprising in combination, a condition responsive element, a control device, a snap action mechanism operated by said element for actuating said device in two directions, and means for retarding the action of said mechanism in one direction.

2. In a device of the character described comprising in combination, a condition responsive element, an over center spring, connections between said element and said spring, a pivoted lever connected to said spring, movement of said spring back and forth by said element causing operation of said lever, a control device actuated by said lever, and means for retarding the movement of said lever in one direction only whereby said control device is actuated with a snap action in one direction and a slow action in the other.

3. In a device of the character described comprising in combination, a condition responsive element, an over center spring, connections between said element and said spring, a pivoted lever connected to said spring, movement of said spring back and forth by said element causing operation of said lever, a control device actuated by said lever, a movable means having a relatively large inertia, and a one way connection between said lever and said means whereby said lever moves said means as it is moved in one direction by said spring but is free to move in the other direction without moving said means.

4. In a device of the character described comprising in combination, a condition responsive element, an over center spring, connections between said element and said spring, a pivoted lever connected to said spring, movement of said spring back and forth by said element causing operation of said lever, a control device actuated by said lever, a rotatably mounted wheel having a relatively large inertia, a one way drive connection between said wheel and said lever comprising a ratchet mechanism whereby as said lever is moved in one direction under the influence of said spring it causes rotation of said wheel, but as it is moved in the other direction by said spring it exerts no rotation force on said wheel.

5. In a device of the character described comprising in combination, a snap action mechanism, an actuating member controlled thereby, a control device actuated by said actuating member, a condition responsive element for operating said snap action mechanism, a support, a pin mounted on said support, a wheel having a concentric oversize hole mounted on said pin, and means causing said wheel to swing about said pin under the influence of said actuating member as it is moved in one direction.

6. In a device of the character described comprising in combination, a snap action mechanism, an actuating member controlled thereby, a control device actuated by said actuating member, a condition responsive element for operating said snap action mechanism, a support, a pin mounted on said support, a wheel having a concentric oversize hole mounted on said pin, and means mounted on said actuating member for establishing a driving connection between said actuating member and wheel as said actuating member is moved in one direction, and for releasing said driving connection as said actuating member is moved in the opposite direction.

7. In a device of the character described comprising in combination, a snap action mechanism, an actuating member controlled thereby, a control device actuated by said actuating member, a condition responsive element for operating said snap action mechanism, a support, a pin mounted on said support, a wheel having a concentric oversize hole mounted on said pin, a gear rigidly connected to said wheel, a pawl pivoted to said actuating member, and spring means for urging said pawl in engagement with said gear.

8. In combination, a switch casing, a knife edge connected to said casing, a first lever, a pressure responsive device engaging one end of said lever to rotate it about said knife edge, a

first spring opposing rotation of said lever by said device, an arm carried by said lever, a second spring connected to one end of said arm, a second pivoted lever, said second spring being connected to said pivoted lever at a distance from its pivot, said arm moving said second spring over center with respect to the pivot for the second lever as the first lever is rotated back and forth, a rotatably mounted ratchet wheel, a pawl pivoted on said second lever to engage said wheel so that as said second lever moves in one direction it must rotate said wheel but is free to move in the opposite direction independently of said wheel, and switch means actuated by said second lever.

9. A snap action switch comprising a resiliently mounted contact, a movable contact arm, snap action mechanism for snapping said arm into engagement with said resiliently mounted contact and pressing it back, and means for effectively locking the contact arm to prevent it from bouncing as much as the amount of said press back.

10. A snap action switch comprising a contact, spring means biasing said contact in one direction, a movable contact arm, an operating arm for moving said contact arm into engagement with said contact and pressing said contact back against the action of said spring means, snap action mechanism for said operating arm, a rotatably mounted ratchet wheel having teeth, and a spring pressed pawl on said operating arm cooperating with said teeth, whereby said operating arm rotates the wheel as it moves in one direction but not as it moves in the opposite direction, the pitch of the teeth on the ratchet wheel being less than the amount of press back of said contact.

11. A snap action switch comprising a contact, spring means biasing said contact in one direction, a movable contact arm, an operating arm for moving said contact arm into engagement with said contact and pressing said contact back against the action of said spring means, snap action mechanism for said operating arm, a rotatably mounted ratchet wheel having teeth, a spring pressed pawl on said operating arm cooperating with said teeth, whereby said operating arm rotates the wheel as it moves in one direction but not as it moves in the opposite direction, the pitch of the teeth on the ratchet wheel being less than the amount of press back of said contact, condition responsive means for operating said snap action in one direction at one condition value and in the other direction at another condition value, and means for varying the difference between condition values at which said mechanism is actuated in each direction.

12. A snap action switch comprising a contact, spring means biasing said contact in one direction, a movable contact arm, an operating arm for moving said contact arm into engagement with said contact and pressing said contact back against the action of said spring means, snap action mechanism for said operating arm, a rotatably mounted ratchet wheel having teeth, a spring pressed pawl on said operating arm cooperating with said teeth, whereby said operating arm rotates the wheel as it moves in one direction but not as it moves in the opposite direction, the pitch of the teeth on the ratchet wheel being less than the amount of press back of said contact, condition responsive means for operating said snap action in one direction at one condition value and in the other direction at another condition value, means for varying the difference between condition values at which said mechanism is actuated in each direction comprising an adjustment for said contact, and means for adjusting both said condition values simultaneously.

13. A snap action switch comprising a contact, spring means biasing said contact in one direction, a movable contact arm, an operating arm for sliding along said contact arm and moving it into engagement with said contact and pressing said contact back against the action of said spring means, snap action mechanism for said operating arm, a rotatably mounted ratchet wheel having teeth, and a spring pressed pawl on said operating arm cooperating with said teeth, whereby said operating arm rotates the wheel as it moves in one direction but not as it moves in the opposite direction, the pitch of the teeth on the ratchet wheel being less than the amount of press back of said contact.

14. An automatic control device comprising a condition responsive element, a switch, and means actuated by said condition responsive element for closing said switch with an overcenter snap action and opening said switch with a retarded overcenter action.

15. An automatic switch comprising a pair of contacts adapted to make and break a circuit, a condition responsive element, and means actuated by said condition responsive element for producing an overcenter snap make and a retarded overcenter break of said contacts.

16. In a snap acting device, in combination, a condition responsive element, a control device, and means for transferring movement to said device from said element with an overcenter snap action in one direction and a retarded overcenter action in the other direction.

17. In a snap action switch, a base, a pivot thereon, an elongated lever rotatably mounted on said pivot, the end of said lever being movable through an arc, snap actuating means for moving said lever, a movably mounted contact arm, a stationary contact positioned for cooperation therewith, said movable contact arm being moved by the end of said lever through an arc curving in a direction different from the arc of movement of said end, and means for adjusting the position of said stationary contact to change the control setting of the switch.

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