

Jan. 14, 1941.

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2,228,523

SNAP ACTION SWITCH

Filed Dec. 31, 1937

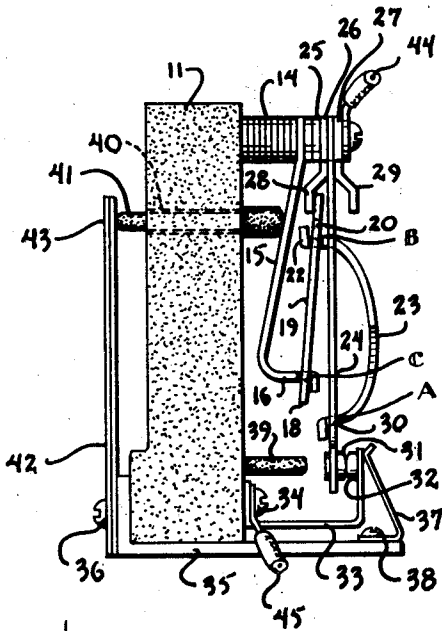


Fig. 1

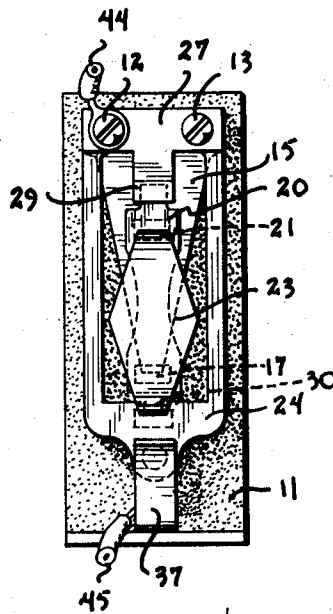


Fig. 2

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2,228,523

SNAP ACTION SWITCH

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Application December 31, 1937, Serial No. 182,770

7 Claims. (Cl. 200-67)

This invention relates generally to the art of electric switches, and more particularly to that type of switch wherein the contacts are made and broken with a snap action.

A difficulty experienced with most switches of the snap action type is that while a good contact pressure is obtained when the contacts are first snapped shut, this pressure must be reduced to zero by the tensioning of the snap action mechanism before it will definitely snap in the other direction to open the contacts. At this point where the contact pressure is zero, the movable contact is apt to make and break several times and cause burning of the contacts with resulting inaccurate switch operation.

It is therefore one of the objects of this invention to provide a snap action switch wherein the contact pressure will not be zero for any appreciable time.

Another object is to produce a switch which has a double snap action.

Another object is to provide an over center spring one end of which snaps a contact arm into and out of engagement with a stationary contact, and a mechanism for snapping the other end of the over center spring back and forth so that the pressure between the contact arm and the stationary contact is only equal to zero for an instant during the time that the mechanism is snapping the end of the over center spring from one position to another.

Still another object of this invention is to provide a snap action switch wherein a means is provided for preventing the movable and stationary contacts from bouncing with respect to each other as they are snapped into engagement.

Another object is to provide a snap action switch wherein the energy of contact of the two contacts is absorbed frictionally.

These and other objects will be apparent when the following specification is read in the light of the accompanying drawing in which:

Figure 1 is a side elevation of the switch structure, and

Figure 2 is a front view with some of the invisible parts shown in dotted lines.

The switch structure of the present invention is mounted on an insulating base 11 which carries at one end two screws 12 and 13. Mounted on screws 12 and 13 and adjustably spaced from the insulated base 11 by means of washers 14 is an operating arm 15 of spring material. The operating arm has an intumed end 16 which is inserted through a hole 17 located at one end 18 of the connecting link 19. The other end 20 of the link

19 is provided with a second hole 21 in which is inserted one end 22 of a bowed compression spring 23. A flexible contact carrying arm 24 is mounted at one end of the screws 12 and 13 and held in spaced relation to the arm 15 by means of washers 25. The arm 24 has a hole cut in its center sufficiently large to permit spring 23 and end 20 of link 19 to operate therein. Mounted on either side of the arm 24 on the screws 12 and 13 are two stop carrying plates 26 and 27. Plate 26 carries a stop member 28 and plate 27 carries a stop 29 between which the end 20 of link 19 is adapted to oscillate. These stops may be readily bent to vary the distance between them to afford an adjustment of the distance through which the end 20 of link 19 may oscillate. At its free end the contact arm 24 is provided with a notch 30 in which the other end of the bowed spring 23 fits. The movable contact 31 is also carried by the free end of the contact arm 24 and is adapted to cooperate in one position with a stationary contact 32 which is carried by a U-shaped bracket 33 which is fastened to the insulating base 11 by means of screw 34. An L-shaped bracket 35 is attached to base 11 by means of screw 36 and carries a spring 37 which is attached thereto by means of screw 38 and which exerts a force on contact 32 which gives it a bias in the direction of the movable contact 31 for a purpose to be described later. A stop 39 is provided on the base 11 to limit the movement of the contact arm 24 away from the stationary contact 32. A hole 40 is provided in the base 11 through which is inserted an operating pin 41. As far as this switch is concerned, it is immaterial what means is used for operating the pin 41, whether it be manual or automatic. In this instance, a bimetallic element 42 is shown as being clamped at one end to the base 11 by means of the screw 36 and whose free end 43 is adapted to flex on cooling to move the pin 41 to the right. The movable contact 31 is connected by means of the contact arm 24 to conductor 44 and the stationary contact 32 is connected by means of spring arm 33 to the conductor 45, which conductors may lead to any suitable electrical circuit which is to be controlled by the disclosed switch.

Referring now to the operation of the switch and assuming the parts to be in the position shown in Figure 1 where the switch is closed, it is pointed out that the operating arm 15 which is of resilient material is biased to its left-hand position which holds the operating pin 41 against the free end of the bimetallic element 43. The bowed compression spring 23 is exerting an upward force

on the end 20 of link 19, which force due to the angular position of the spring 23 has a component which holds end 20 against the stop 28. The upward force exerted by link 19 on the end 16 of operating arm 15 tends to swing it to the right and hence builds up a resilient force in this member. It will be seen also that the bowed spring 23 is exerting a force on contact arm 24 tending to hold the contacts 31 and 32 in engagement.

In order to make the operation of this switch a little clearer, the reference numeral A will be used to designate the contact point between the compression spring 23 and the contact arm 24, reference numeral B will designate the contact point between the compression spring 23 and the tension link 19, and the reference numeral C will designate the contact point between the end 16 of the resilient operating arm 15 and the link 19. It might be pointed out that the tendency of the compression spring 23, as the point C is moved back and forth, is to cause the point B to follow so as to place the points A, B, and C in the same straight line. For example, in Figure 1, the spring 23 is tending to move the point B to the left and if the stop 28 were removed, it would move point B to the left until it lay in the straight line connecting the points A and C.

Assuming now that the temperature to which the bimetallic element 42 responds is rising, it will cause the end 43 to bend toward the right, which, through the pin 41, will cause the operating arm 15 to move its end 16 toward the right. It will be remembered that the arm 15 has a natural bias toward the left and that the effect of the pull of link 19 on end 16 of the arm 15 is to bend it toward the right. On further increase in temperature, thermostat 42 will continue to flex toward the right and eventually cause the point C to fall on the line connecting the points A and B, at which time the contact pressure between the end 20 of the link 19 and the stop 28 will be zero due to the fact that the compression spring 23 will at this time exert no lateral force on the link 19. There will still be pressure between contacts 31 and 32, however, due to the force exerted on arm 24 by spring 23. A further movement of point C to the right in response to a further temperature increase will cause the spring 23 to move point B to the right in an attempt to align the point B in the line connecting the points A and C. It will be noted that the point B must have a much greater movement than the point C in order to stay in the same straight line due to the fact that point B must move about an arc of which A is the center. As the point B moves to the right, the angle between the link 19 and the resilient operating arm 15 is increased with the result that the bending force exerted by the link 19 on arm 15 is correspondingly increased, which will cause a further movement of the point C to the right causing in turn a further and greater movement of the point B to the right. The result of this action is that once the point B starts moving to the right, the force will so build up that it will be snapped to its right-hand position into engagement with the stop 29.

The compression spring 23 has an over center action with respect to the contact arm 24, that is, in the position shown in Figure 1 with the point B to the left of the contact arm, it exerts a force tending to close the contacts 31 and 32 but as point B passes to the right of the contact arm 24 the force exerted thereon is reversed to move the contact 31 to the left against the stop 39. In view of the fact that the spring 23 passes a dead center

position with respect to the contact arm 24, the contact 31 will be snapped from one position to another. As the spring itself is snapped at point B from one position to another, it will be seen that the switch involves a double snap action, that is, the point B is first snapped from one position to another which causes a snapping of the point A which carries with it the contact 31.

At this point, C would be located to the right of the line connecting the points A and B and as the temperature begins to drop the bimetallic element 42 will flex towards the left and the natural resilience of the arm 15 will start to pull the point C towards the left until it lies on the line connecting the points A and B. At this time, the pressure between the end 20 of the link 19 and the stop 29 will be zero and any further movement to the left of the point C will result in the compression spring 23 moving the point B to the left in an attempt to keep it in line with the points A and C. As B moves to the left, the angle between the link 19 and the arm 15 will decrease so that the bending force exerted by link 19 on arm 15 will decrease resulting in a further movement to the left of the point C. In the same manner as before, this action will result in a snapping of the end 20 from engagement with stop 29 into engagement with the stop 28, which will cause spring 23 to pass over center with respect to the contact arm 24 and cause the contacts 31 and 32 to snap shut.

In this instance, the stationary contact 32 has been so arranged that bouncing between it and contact 31 as they are snapped into engagement will be prevented. This is accomplished by mounting contact 32 on the spring arm 33 which allows it a very small amount of movement as contact is made with the contact 31. It will be seen that the contact 31 is moving about an arc whose center passes through the screws 12 and 13. Now as the contact 31 snaps into engagement with contact 32 and moves it a small amount, the contact 32 will move in an arc which is located somewhere below the spring arm 33. This means that there will be a slight wiping action between the two contacts which will produce a certain amount of friction. In addition to this, the spring 37 is provided for the purpose of resisting or snubbing the movement of contact 32 to the right and for the additional purpose of producing a sliding action between the contact 32 and the spring 37. Thus it will be seen that as the contact 31 is snapped into engagement with the contact 32, friction will be produced between the two contacts as contact 32 is moved slightly to the right and further that friction is produced between the contact 32 and the spring 37. Therefore the kinetic energy of the contact 31 as it strikes contact 32 will be absorbed by the friction between the two contacts and between the contact 32 and spring 37. This prevents any separation of the contacts 31 and 32 after they have once engaged so that a good contact is maintained. In addition, the wipe between the two contacts will keep their surfaces clean and therefore assist in establishing a good electrical connection between them.

It will be noted that this snap action switch does not have vanishing contact pressure, that is, there is no stable condition of the switch operating mechanism at which pressure between the contacts is zero. Until the end 20 of the link 19 starts to move, the spring 23 is exerting a definite pressure between the contacts 31 and 32. As has been explained above, as soon as the end 20 starts to move leaving the stop 28 it continues with a very rapid or snap action until it strikes the stop 29.

This causes the spring 23 to pass over center very rapidly with respect to the contact arm 24 and it can never stop in dead center position where it is exerting no tensioning force on the contact arm. Therefore there is good contact pressure until the snap action mechanism starts to operate and when it once starts it operates through its complete movement, thus assuring a good clean make and break of the switch contact.

Certain changes and modifications of this invention will doubtless occur to those who are skilled in this art, and therefore it is to be understood that I am not to be limited by the specific embodiment disclosed but the limits of this invention are to be defined by the scope of the appended claims.

I claim as my invention:

1. A snap action mechanism comprising in combination, a tension link, a flexible operating arm having one fixed end and one free end, said free end being connected to one end of said tension link, a pair of stops, the other end of said tension link being adapted to move therebetween, a contact arm fixed at one end and free at the other, and a compression spring connected between said other end of said tension link and said free end of said contact arm, said one end of said tension link moving between the ends of said compression spring.

2. A snap action mechanism comprising in combination, a tension link, a flexible operating arm having one fixed end and one free end, said free end being connected to one end of said tension link, a pair of stops, means for adjusting said stops, the other end of said tension link being adapted to move therebetween, a contact arm fixed at one end and free at the other, said contact arm having a longitudinal slot therein, and a compression spring located within said slot and connected between said other end of said tension link and said free end of said contact arm.

3. A snap action mechanism comprising in combination, a tension link having a hole in each end, a flexible operating member fixed at one end, the other end being free to move, said other end having an intumed portion which is inserted through the hole in one end of said tension link, a pair of stops, the other end of said tension link being adapted to oscillate between said stops, a flexible contact arm fixed at one end and free to move at the other, said contact arm having a longitudinal slot therein, a bowed compression spring within said slot having one end inserted in the hole in said other end of said tension link, the other end of said compression spring engaging the end of said longitudinal slot in the free end of said contact arm.

4. A snap action switch comprising in combination, a tension link, a flexible operating arm hav-

ing one fixed end and one free end, said free end being connected to one end of said tension link, a pair of stops, the other end of said tension link being adapted to move therebetween, a contact arm fixed at one end and free at the other, said free end carrying a contact, a compression spring connected between said other end of said tension link and said free end of said contact arm, means adapted to exert a force on said operating arm near its fixed end to cause movement of said operating arm and a consequent snapping of said contact arm, a stationary contact positioned to cooperate with said contact carried by said contact arm as it moves in one direction, and stop means to limit its movement in the opposite direction.

5. A snap action switch comprising in combination, a tension link, a base, a flexible operating arm having one end fixed to said base and the other end free, said free end being connected to one end of said tension link, a pair of stops, the other end of said tension link being adapted to move therebetween, a contact arm fixed at one end to said base and free at said other end, said free end carrying a movable contact, a compression spring connected to said other end of said tension link and said free end of said contact arm, and an operating pin extending through said base and adapted to engage said operating arm at a point near its fixed end for moving it to produce switch actuation.

6. A snap action mechanism comprising in combination, a tension link, a control member, a compression member connected between said tension link and said control member, a resilient actuating member connected to a point on said tension link, said tension link being entirely supported and floatingly controlled by said compression member and said actuating member, and means associated with said actuating member for moving said point between the ends of said compression member whereby said compression member snaps over center with respect to said control member causing said control member to move with a snap action.

7. A snap action mechanism comprising in combination, a tension link, a resilient operating member connected to one point on said tension link, a movably mounted contact arm, and a compression member connected to a movable portion of said contact arm and to a second point on said tension link, said tension link being supported entirely by said operating member and said compression member, said first point on said tension link being movable by said operating member between the second point on said tension link and the point where said compression member is connected to said contact arm.

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