

Oct. 8, 1957

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2,809,260

ELECTRIC CIRCUIT CONTROLLER

Filed Nov. 23, 1953

Fig. 1.

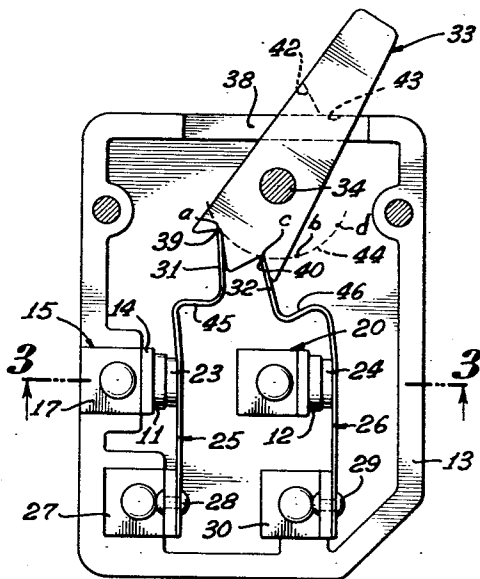


Fig. 2.

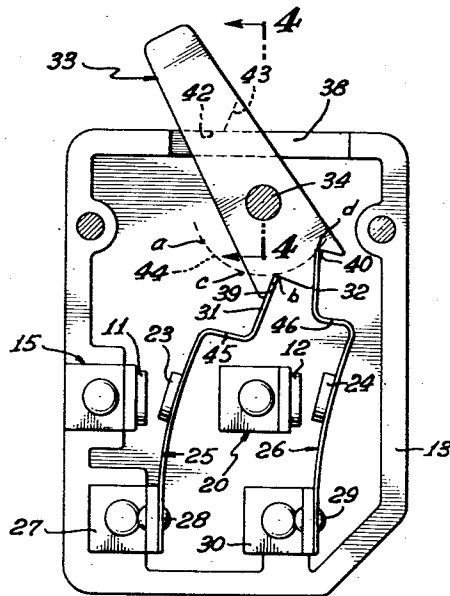


Fig. 3.

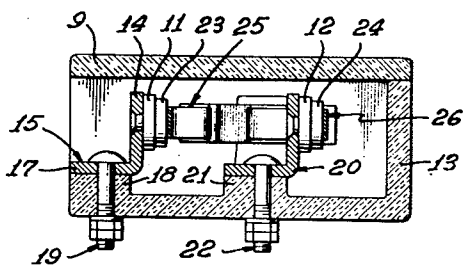
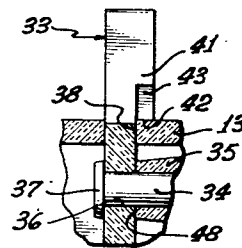


Fig. 4.



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ELECTRIC CIRCUIT CONTROLLER

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Application November 23, 1953, Serial No. 393,664

5 Claims. (Cl. 200—153)

This invention relates to an electric snap action switch. Snap acting switches of various forms have been provided in the past. However different in structure or operation, a singular characteristic of such switches has been complexity. It is, accordingly, an object of this invention to provide a novel and improved snap action switch that has for its operative mechanism, in addition to the switch arm, only a manually movable rocker. This is made possible by a particular novel cooperation between a specially though simply shaped switch arm and the rocker.

It is another object of this invention to provide a switch of this character in which the parts may be quickly and easily assembled.

It is still another object of this invention to provide an effective switch of this character in which a plurality of switch arms may be operated by a common manually movable rocker to provide a two-pole switch.

It is still another object of this invention to provide a double pole switch of this character in which the entire apparatus is compact.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a plan view of a switch incorporating the present invention, one of the casing parts being removed to show the operative structure;

Fig. 2 is a view similar to Fig. 1, but showing the switch in an alternate position;

Fig. 3 is a sectional view, taken along the plane indicated by line 3—3 of Fig. 1; and

Fig. 4 is a fragmentary sectional view, taken along the plane indicated by line 4—4 of Figure 2.

Aligned and similarly facing stationary contacts 11 and 12 are appropriately supported, for example, on a flat support or in a casing 13. The casing 13 and its cover 9 may be conveniently formed of molded insulation plastic material.

As shown most clearly in Fig. 3, the contact 11 is joined to a projecting arm 14 of an electrical conducting bracket 15. The other arm 17 of the conducting bracket 15 rests upon a raised apertured boss 18 extending upwardly from the side of the casing 13. A terminal post assembly 19 holds the bracket 15 in place upon the boss 18. The other stationary contact 12 is secured to a conducting bracket 20 which, in turn, is secured in place upon a raised boss 21 by the aid of another terminal post assembly 22.

Movable contacts 23 and 24, cooperable with the stationary contacts 11 and 12 respectively, are carried by

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resilient switch arms. The switch arms mount the contacts 23 and 24 respectively which cooperate with the stationary contacts. The switch arms 25 and 26 are quite thin to ensure flexibility and are made of electrical conducting material such as Phosphor bronze or any other suitable alloy of copper, lending resilience to the structure.

One end of the switch arm 25 is secured to an electrical conducting bracket 27 as by the aid of a rivet 28. The switch arm 26 similarly secured to a bracket 30 by a rivet 29. The brackets 27 and 30 for the ends of the switch arms 25 and 26 are supported in a manner similar to the electrical conducting brackets 15 and 20 for the stationary contacts.

Appropriate terminal post assemblies (not shown) cooperate with the conducting brackets 27 and 30 for appropriate electrical connections.

The electrical conducting brackets 27 and 30 are located laterally alongside the stationary contacts 11 and 12. These brackets 27 and 30 so mount the flexible switch arms 25 and 26 that they may be angularly flexed about axes parallel to and spaced from the flat operative surfaces of the stationary contacts 11 and 12. Accordingly, the contacts 23 and 24, carried by the flexible arms 25 and 26, are engageable with or disengageable from their corresponding stationary contacts 11 and 12, depending upon the arcuate flexure of the arms 25 and 26.

When the free ends 31 and 32 are moved toward the right from the position shown in Fig. 1, the contacts 23 and 24 move away from the stationary contacts 11 and 12 (see Fig. 2). When the free ends 31 and 32 of the flexible arms 25 and 26 are moved toward the left, the movable contacts 23 and 24 respectively move into engagement with the stationary contacts 11 and 12. These movements correspond to a switching operation.

For so moving the flexible switch arms 25 and 26, a rocker or lever 33 made of insulation material is provided. This lever 33 is pivotally mounted in the casing for movement about an axis parallel to the axis of angular flexure of the flexible switch arms 25 and 26. A pin 34 extends through a transverse aperture 36 of the lever 33 and is accommodated in an aperture boss 35 integrally formed on the inner wall of the casing 13. Axial movement of the lever 33 is limited in both directions by a head 37 of the pin 34 and the end surface 48 of the boss 35.

The lever 33 is accessible exteriorly of the casing 13 for manipulation. For this purpose, the lever 33 extends beyond an elongate slot 38 in a side wall of the casing 13.

The inner end of the lever 33 has two adjacent and symmetrically disposed grooves or notches 39 and 40, having converging plane faces, between which the free ends 31 and 32 of the switch arms 25 and 26 are seated. Thus, these ends continuously engage the bottom of the grooves 39 and 40. These grooves 39 and 40 extend generally radially outwardly of the axis of rotation of the lever 33 and face generally in a direction toward the fixed ends of the flexible switch arms 25 and 26.

The lever 33 is movable only through an angle less than a quarter of a revolution. For limiting the angular movement of the lever 33, the lever has an integrally formed lateral projection 41. This projection overlies one longitudinal edge of the slot 38.

Two surfaces 42 and 43, together defining the lower limit of the projection 41, are angled with respect to each other in an amount supplementary to the angular movement of the lever, and are alternately engageable with the casing. Thus, the surface 43 engages the casing at the longitudinal edge of the slot 38 when the lever is in its clockwise position, as viewed in Fig. 1. The other surface 42 engages the casing 13 when the lever 33 is in its counterclockwise position, as in Fig. 2.

The free ends 31 and 32 of the flexible switch arms 25 and 26 follow paths *a—b* and *c—d* along a common arc 44 shown in dotted lines in Figs. 1 and 2. These paths are respectively convex in a direction toward the anchored ends of the corresponding switch arms 25 and 26.

The arms 25 and 26 are longitudinally flexible in order that they be able to follow such arcuate paths; the resistance to increased longitudinal flexibility is availed of to provide alternate stable positions of the apparatus achieving snap action. The arms 25 and 26 are under maximum longitudinal flexure simultaneously in order that the longitudinal stress in the arms 25 and 26 act as a unit to exert similarly directed torques on the lever 33.

The walls at the end of the lever 33 forming the grooves 39 and 40 are inclined substantially to each other to permit free movement of those portions of the flexible switch arms 25 and 26 adjacent the free terminal portions thereof. In the position of the lever 33 shown in Fig. 1, the portions of the switch arms 25 and 26 adjacent the free terminal portions thereof extend along one side of the grooves 39 and 40. In the position shown in Fig. 2, those portions of the switch arms 25 and 26 adjacent the free terminal portions of the switch arms extend along the other walls of the grooves 39 and 40. The angle between the walls forming each groove corresponds substantially to the sum of the angular movement of the lever 33 and the angular movement of the corresponding switch arms 25 and 26.

The angles between the walls of each groove are sufficiently small to prevent the free ends from slipping out of their corresponding grooves for either of the extreme positions.

The normal or unflexed position of the switch arms 25 and 26 is such that they would, if unrestrained, occupy angular positions intermediate the extreme positions shown. Accordingly, the maximum amount of arcuate stress is small. Minimizing this arcuate stress ensures against its detracting from the effect of the longitudinal stress in determining alternate stable positions, and makes it possible for longitudinal flexibility to be sufficiently great to permit easy manipulation of the lever 33. Furthermore, the unflexed condition of the switch arms 25 and 26 is such as to provide a positive seating force for the free ends 31 and 32 in the grooves 39 and 40 for all positions of the lever 33.

The geometrical relationship ensuring that the arms 25 and 26 act to produce similarly directed torques on the lever 33 is that the angular spacing between the apices of the grooves 39 and 40 with respect to the axis of movement of the lever 33 substantially corresponds to the angular spacing between the anchored ends of the arms 25, 26 with respect to the axis of movement of the lever 33.

Maximum longitudinal flexure of the arms occurs substantially at the mid-position of the lever 33 to achieve alternate extreme stable positions. This is accomplished by locating the anchored ends of the arms 25, 26 along lines radial to the axis of movement of the lever 33 that pass respectively through substantially the mid-points of the paths *a—b* and *c—d* of the free ends 31 and 32 thereof.

In order to secure definite longitudinal flexibility in the arms 25 and 26, accompanied by a substantial stress in the longitudinal direction, the arms 25 and 26 are formed in a particular manner. Each arm 25 and 26 has an intermediate transverse portions 45 and 46. The portions 45 and 46 are each formed by opposite transverse bends in the arms.

The intermediate portions 45 and 46 respectively divide the length of each arm. Columnar flexibility is materially reduced. Longitudinal strain is accomplished by bending of the arms about the corners of the bends forming the intermediate portions. The intermediate portions 45

and 46 are of a small length as compared with the entire length of the switch arms.

This configuration ensures a longitudinal stress per unit of longitudinal strain that is large in comparison with the unit of stress accompanying a unit of arcuate strain.

When the lever 33 is in the position shown in Fig. 1, the lever arms 25 and 26 are both arcuately flexed in a counterclockwise direction about their anchored ends. In this position, the contacts 23 and 24 carried by the flexible switch arms 25 and 26 engage stationary contacts 23 and 24. These contacts 23 and 24 are interposed in the paths of counterclockwise arcuate movement of the switch arms 25 and 26 near the ends of the otherwise free arcuate travel thereof.

The free ends 31 and 32 are located at corresponding ends *a*, *c* of their arcuate paths *a—b* and *c—d*. The resistance of the arms 25 and 26 to increased longitudinal flexure maintains the lever 33 in the position shown in Fig. 1. The stress accompanying arcuate flexure of the arms 25 and 26 tends to move the lever 33 away from the position shown in Fig. 1. However, since the arcuate stress is small in comparison with the longitudinal stress, the arcuate stress is incapable of moving the arms from this stable position.

When the lever 33 is moved, as by the exertion of a positive force, to the position of Fig. 2, the switch arms 25 and 26 are flexed angularly in a clockwise direction about their anchored ends; the arms 25 and 26 simultaneously pass through conditions of maximum longitudinal flexure. The position of Fig. 2 corresponds to disengagement of the respective sets of contacts 11, 23 and 12, 24. In this position, the free ends 31 and 32 are at the other extreme ends *b*, *d* of their paths *a—b*, *c—d*. As in the position of Fig. 1, the resistance of the arms 25 and 26 to increased longitudinal flexure ensures that the lever 33 is maintained in the position shown in Fig. 2. The arcuate stress is insufficient to cause movement of the lever 33 from its position shown in Fig. 2.

When the lever 33 is in an intermediate position, the longitudinal stress in the arms 25 and 26 is at a maximum. Accordingly, the longitudinal stress in the arms 25 and 26 positively ensures movement of the lever 33 to either extreme limited position.

As set forth above, the condition of conjoint action of the longitudinal stress with the switch arms 25 and 26 is satisfied by a relationship between the arcuate spacing between the apices of the grooves 39 and 40 and the angular spacing of the anchored ends of the switch arms 25 and 26. In the present instance, both of these angular spacings are quite small, whereby it is possible to locate the anchored ends of the respective switch arms 25 and 26 close to each other to achieve a compact arrangement. Since the switching functions of the arms 25 and 26 are accomplished by corresponding angular movement, the stationary contact 12 cooperating with one of the switch arms 26 must be located between the arms. Opposite orientation of the intermediate transverse portions 45 and 46 of the respective switch arms 25 and 26 provides a space for accommodating the stationary contact 12. This orientation achieves appropriate angular spacing both of the anchored ends and the free ends of the arms.

In place of a molded casing 13, a punching from a flat sheet of insulation material may be provided. The simplicity of the switch is such as not to require any specially molded casing.

The only necessary function performed by the casing 13 in addition to supporting the parts is to provide an edge with which the lever projection 41 can cooperate. An appropriately located edge of a flat punching also can perform this function.

The inventor claims:

1. In combination: a support; electrically conductive

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mounting means carried by the support; a resilient electrically conductive switch arm, said arm having a bend intermediate its length so that the end beyond the bend is laterally offset from the other end of the arm, one of the ends being rigidly secured to said mounting means, the other of said ends being free; the bend being located adjacent the free end; a movable operator pivoted on an axis transverse to the arm; means for effecting a connection between the operator and said one end of said arm at a place eccentrically located with respect to said axis and a stationary contact engaging the arm on that side of the bend remote from the free end.

2. In combination: a pair of resilient switch arms disposed in opposed relationship, each arm having a free end and a secured end, the arms being angularly movable about spaced axes, each of said arms having an intermediate transverse portion to permit longitudinal flexure of said arms, said transverse portions offsetting the free ends of the arm from the secured ends of the arms, said intermediate portions being oppositely disposed and extending toward the other arm to orient the free ends of the respective arms adjacent each other; a manually movable operator pivoted on an axis transverse to the arms; means for effecting connections between the operator and the free ends of said arms eccentrically of said operator; and electrical contact elements respectively engageable with the arms between the transverse portions and the secured ends of the arms.

3. In combination: a lever pivoted for movement about an axis; means defining alternate limited positions of said lever about said axis; a pair of opposed resilient switch arms each having an end rigidly secured remote from said axis, each of said arms having movable ends; the arms being angularly movable about axes spaced from each other and parallel to said lever axis; said arms respectively having transverse portions providing longitudinal flexibility of said arms and offsetting the free ends of said arms from said secured ends, said transverse portions being oppositely disposed to locate said movable ends closer to each other than the secured ends; said

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lever having angularly spaced grooves located eccentrically of the lever axis and in which said movable ends of said arms are respectively seated; the corresponding movable and secured ends of the arms being respectively simultaneously in alignment radially of said lever axis at an intermediate position of said lever for substantially simultaneous maximum flexure of said arms; and stationary contact elements engageable with the switch arms respectively between the secured ends and the transverse portions upon movement of said lever to one of said alternate limited positions.

4. The combination as set forth in claim 3 in which the arcuate flexure of each of the arms is at a minimum when the lever is in an intermediate position.

5. In combination: a pair of opposed resilient switch arms, each arm having a free end and a secured end, the arms being angularly movable about spaced axes, each of said arms having an intermediate transverse portion to permit longitudinal flexure of said arms, said intermediate portions offsetting the free ends of the arms from the secured ends, said transverse portions being oppositely disposed and extending toward the other arm to orient the free ends of the respective arms adjacent each other; a manually movable operator pivoted on an axis transverse to the arms; means for effecting connections between the operator and the free ends of said arms eccentrically of said operator; an electrical contact element carried by each arm; and a stationary electrical contact member for each of said electrical contact element, and engaging the corresponding arm between the secured end and the transverse portion, one of said contact members being located between the arms.

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