May 20, 1941. C. J. WERNER 2,242,769

SWITCH

Filed Feb. 17, 1938 2 Sheets-Sheet 1

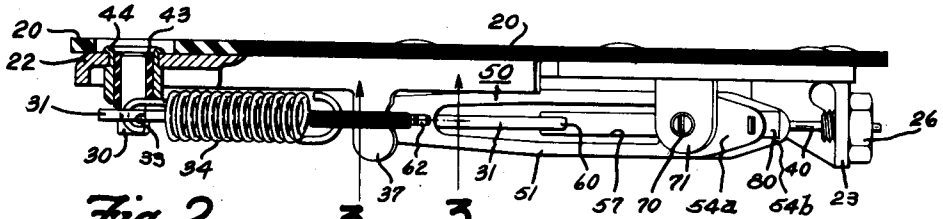


Fig. 2

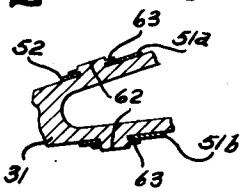


Fig. 3

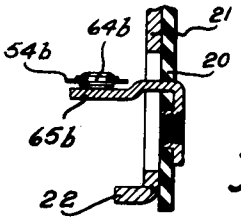


Fig. 4

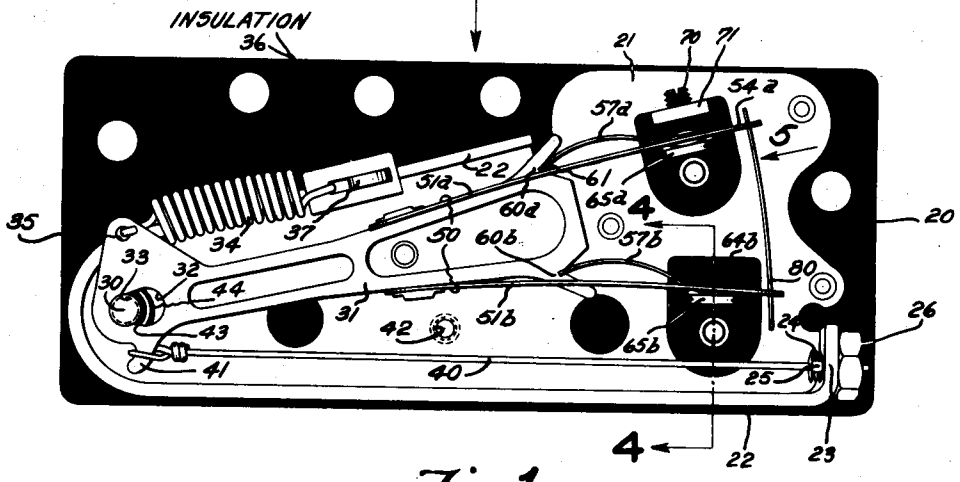


Fig. 1

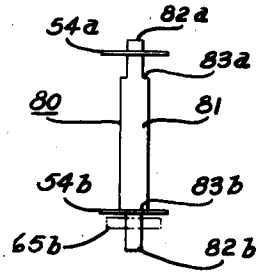


Fig. 5

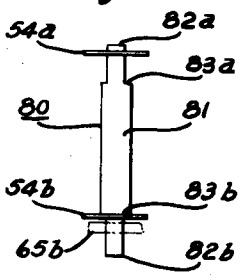


Fig. 6

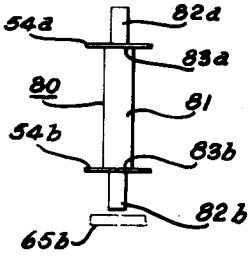


Fig. 7

INVENTOR
CALVIN J. WERNER
BY
Spencer Hardman & Fehr
his ATTORNEYS

May 20, 1941. C. J. WERNER 2,242,769

SWITCH

Filed Feb. 17, 1938 2 Sheets-Sheet 2

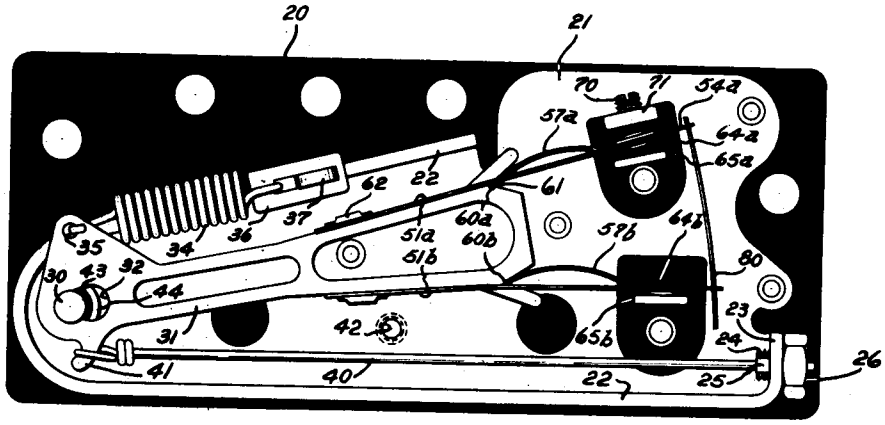


Fig. 8

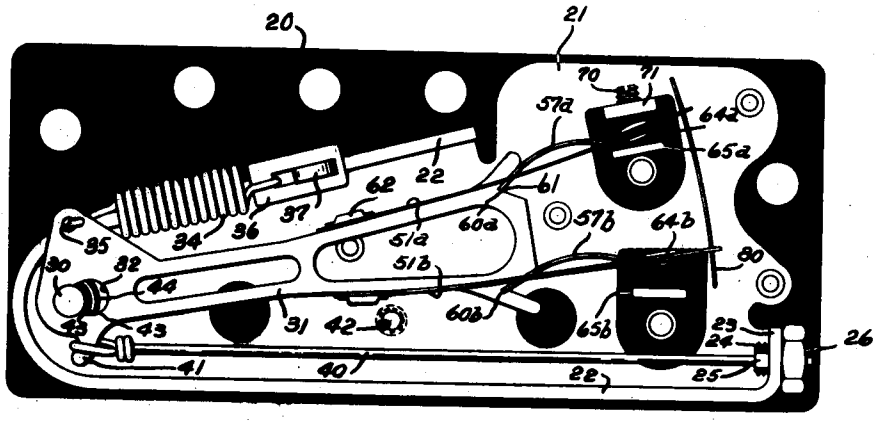


Fig. 9

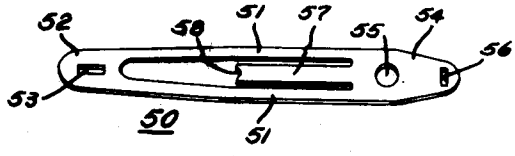


Fig. 10

INVENTOR
CALVIN J. WERNER
BY
Spencer Hardman & Fehr
his ATTORNEYS

Patented May 20, 1941 2,242,769

UNITED STATES PATENT OFFICE

2,242,769

SWITCH

Calvin J. Werner, Dayton, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application February 17, 1938, Serial No. 190,888

5 Claims. (Cl. 200—113)

This invention relates to circuit controllers for controlling a plurality of circuits by means of a single operating member.

More particularly the present invention relates to the type of circuit controller disclosed in my Patent No. 2,135,371, issued Nov. 1, 1938, which is a division of my Patent No. 2,095,579 issued October 12, 1937. The circuit controller of my application and patent comprises two toggle switches provided for rapid separation and closing of contacts. Each of the toggle switches comprises a contact arm carrying a contact point movable between spaced members, a biasing spring for urging the contact arm toward one or the other of said members and a movable toggle fulcrum which can be shifted relative to the action line of the spring to change the bias of the spring. A movable member, common to both switches, carries the toggle fulcrums. This movable member is actuated by means including a temperature responsive element. The circuit controller provides for adjusting the stop member in order that the spring bias of one spring is different from the spring bias of the other spring. In this way the two toggle switches are operated in a predetermined sequence.

The chief object of the present invention is to simplify the construction of the type of switch disclosed in my Patent No. 2,135,371 and thereby to reduce its cost of manufacture. The simplification of construction includes a simplification of the adjustment of the switch so that only one adjustment is required for both toggle switches.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of a switch embodying the present invention.

Fig. 2 is a side view thereof viewed in the direction of the arrow 2 of Fig. 1.

Fig. 3 is a fragmentary sectional view taken in the direction of the arrow 3 of Fig. 2, this view being on a larger scale than Fig. 1.

Fig. 4 is a fragmentary sectional view on the line 4—4 of Fig. 1, this view being on a larger scale than Fig. 1.

Fig. 5 is a diagram showing the relation between switch arms and the contact stop member. This view is taken generally in the direction of the arrow 5 of Fig. 1.

Figs. 6 and 7 are views similar to Fig. 5 showing other positions of the switch arms and stop members.

Figs. 8 and 9 are views of the switch similar to Fig. 1 showing other positions of operation.

Fig. 10 is a perspective view of a leaf spring member which provides a contact arm and a contact biasing spring.

Referring now to Figs. 1, 2, 3 and 4, 20 designates a nonconducting base to which is riveted a stationary metal frame 21 provided with a stiffening rib 22 which extends along the upper side of the frame 21 as viewed in Fig. 1, around the left hand end and entirely along the lower side. This rib 22 terminates in an ear 23 which is provided with a nonthreaded square hole for receiving a screw 24 having flats 25 which cooperate with the rectangular sides of the opening in the lug 23 to prevent turning of the screws 24 relative to said lug. The screw 24 receives a nut 26, the turning of which adjusts the screw 24 longitudinally relative to the hole in the lug 23. The frame 22 carries a pivot stud 30 which pivotally supports a movable frame 31 having an opening 32 larger at its right hand end than at its left hand end. The opening 32 at the right hand end is large enough to receive the head of stud 30 and the left hand end portion of the opening 32 is smaller than the head of the stud 30 so that that portion of the frame 31 which defines the left hand end of the opening 32 is received by that portion 33 of the stud 30 of smaller diameter than the head of stud 30. The frame 31 is retained in the groove 33 by the action of the means which moves the plate 31.

The means for moving the plate 31 comprises two elements. One of these elements is the helical coil spring 34 anchored to a spring eye 35 provided by the frame 31 and anchored to a nonconducting clip 36 which is supported by lug 37 extending from the flange 22 of the frame 21. The other means for moving the plate 31 is a wire 40 secured at its left hand end to a lug 41 provided by the frame 31 and at its right hand end to the screw 24. By turning the nut 26, the wire 40 can be placed under tension which is opposed to the force exerted by the spring 34. The screw 24 is adjusted so that the wire 40 and the spring 34 will hold the frame 31 in a predetermined normal position as shown in Fig. 1. The length of the wire 40 is substantially equal to the distance measured horizontally between the pivot stud 30 and the ear 23 to which the wire 40 is anchored. The material of the wire 40 has substantially the same coefficient of expansion as the material of the frame 21. Therefore, the relation between

the wire 40 and the frame 21 does not vary appreciably with changes in temperature of the surrounding atmosphere. The wire 40 is a thermal element responsive to variations in temperature due to the heating effects of an electric current passing through it. The circuit in which the wire 40 is located includes the frame 21 which is provided with a tapped hole 42 to which an electrical conductor may be secured. The pivot stud 36 carried by the frame 21 is insulated from the frame. To effect this insulation the stud 36 is press-fitted into a non-conducting bushing 43 which is in turn press-fitted into a metal bushing 44 which is directly attached to the frame 31 as shown in the fragmentary sectional portion of Fig. 2. Thus, the movable support 31 provides a portion of the circuit of the wire 40. This circuit continues through one of two toggle switches actuated by the plate 31 and of which plate 31 is a common part.

The two toggle switches actuated by plate 31 will now be described. These switches include similar leaf spring members designated in their entirety by numeral 50 and shown in perspective in Fig. 10. Each member 50 includes spaced spring arm portions 51 which are in effect resilient contact arms. The arms 51 merge at the left end of the part 50 with a hub or anchor portion 52 having a rectangular opening 53. The arms 51 merge at the right hand end of the part 50 with a pad or contact supporting portion 54 having an opening 55 through which the shank of the contact rivet passes. The pad 54 is provided with rectangular opening 56 which receives a contact stop member to be described later. Extending from the contact pad 54 and into the space between the contact arm portions 51, there is a portion 57 having a notched end 58. The spring portion 57 constitutes a biasing spring for a toggle switch. The notched end 58 of the spring 57 is received by a knife edge bearing or fulcrum 60 provided at the apex of a triangular notch 61 in the frame 31. As shown in Fig. 3, the hub 52 of the two spring contact arms 51 is attached to the side edge of the frame 31 by providing the frame 31 with a lug 62 which is received by the rectangular opening 53 of the hub 52 and which is riveted over at 63. When the spring arm 51 is secured to the frame 31 in this manner, the spring portion 57 will be bowed as shown in Fig. 1 in order to urge the free end of the spring 51 in a clockwise direction. The spring pad 54 carries a contact 64*a* which is urged against a stationary contact 65*a* secured to the insulating plate 20 to provide one of the switch terminals.

The circuit controller includes two toggle switches. The upper one as viewed in Fig. 1, has its parts indicated by certain numerals with the affix *a* and the lower switch has its parts referred to by numerals with the affix *b*. The construction of these toggle switches is identical, but the normal conditions of the two switches are different. The distance between the fulcrum 60*a* and the contact arm 51*a* is less than the distance between the fulcrum 60*b* and the contact arm 51*b*. Therefore, the action line of the bowed spring 57*a* makes with arm 51*a* an acute angle which is less than the acute angle between the action line of the bowed spring 57*b* and arm 51*b*. Therefore, the component of force exerted by the spring 57*a*, which is effective to bias the contact 64*a* into engagement with the contact 65*a*, is less than the component of force of the spring 57*b* which is effective to bias the contact 64*b* into engagement with the contact 65*b*. This feature of construction is required for the purpose of effecting the separation of contact parts 64*a* and 65*a* ahead of the separation of contact parts 64*b* and 65*b*.

The separation of the two pairs of switch contacts is effected by expansion of the wire 40 due to the heating effects of an electric current passing through it. As the wire 40 expands, the movable support 31 rotates clockwise by the spring 34 which tends to take up the slack in the wire 40 as it expands. As the support 31 moves to the normal position as shown in Fig. 1 to the position shown in Fig. 8 the fulcrum 60*a* moves from the upper side of the contact 51*a* to the lower side, thereby causing the bias exerted by the bowed spring 57*a* upon the contact arm 51*a* to be reversed, whereupon the contact 64*a* is shifted from engagement with the contact 65*a* into engagement with a stop screw 70 threaded through any suitable insulating collar in the ear 71 integral with the frame 21 as shown in Fig. 8. The circuit of the wire 40 continues through the contacts 64*b* and 65*b* which still remain in engagement as shown in Fig. 8. If further heating of the wire 40 takes place due to the application of an increased amount of electric current, the wire 40 will expand to permit further clockwise rotation of the frame 31 from the position shown in Fig. 8 to that shown in Fig. 9. During the movement of the frame 31 from the position shown in Fig. 8, the fulcrum 60*b* which previously has been located above the upper side of contact 51*b* as shown in Figs. 1 and 8, will be moved to the lower side whereupon the bias of the bowed spring 57*b* will be reversed, thereby causing contact 64*b* to be separated from contact 65*b*.

As shown in Fig. 9, the movement of contact 64*b* away from contact 65*b* is limited by stop member 80 which can best be described with reference to Figs. 5, 6 and 7 which shows the relation between the contact stop 80 and the contact pads 54*a* and 54*b* for three positions of the circuit controller, namely those positions shown in Figs. 1, 8 and 9. The stop 80 is a metal stamping shaped so as to provide a wider intermediate portion 81 and narrower end portions 82*a* and 82*b* which extend respectively through the rectangular openings 56 of contact pads 54*a* and 54*b*. The intermediate portion 81 is connected with the end portions 82*a* and 82*b* by shoulders 83*a* and 83*b* which are spaced apart a predetermined amount, thereby limiting the distance to which the pad 54*b* of contact arm 51*b* can approach the pad 54*a* of contact 51*a* as shown in Fig. 7. The stop 80 therefore eliminates the need for a separate ear integral with the frame 21 to provide a stop for the contact 64*b* when it moves away from the contact 65*b*. Furthermore, the single stop screw 70 provides for adjustment of both of the toggle switches. The position of screw 70 determines the amount of movement of the contact 64*a* away from the contact 65*a*. Consequently, the amount of movement of contact 64*b* away from contact 65*b* is determined by the setting of the screw 70. The distance between shoulders 83*a* and 83*b* of stop 80 is such as to allow the contact spring arm 51*b* to move into the position shown in Fig. 9 in which position the distance between it and the fulcrum 60*b* is greater than the distance between fulcrum 60*a* and the contact spring arm 51*a*. Therefore, in Fig. 9, the bias exerted by spring 57*b* is greater than the bias exerted by 57*a*. Therefore when the support 31 returns to normal position shown in Fig. 1, due to the decrease in temperature in

wire 40 which occurs after the interruption of current flow through it, the bias exerted by spring 57a will be reversed before the bias exerted by spring 57b is reversed again. However, despite the fact that the bias of spring 57a is reversed again or restored to normal ahead of the re-reversal of bias of spring 57b, the contact 54a cannot move back into engagement with the contact 65a ahead of movement of contact 64b into engagement with the contact 65b. This is due to the fact that the stop member 80 will prevent return movement (downward movement as viewed in Fig. 7) of the spring pad 54a ahead of downward movement of the spring pad 54b. Therefore, the closing of the pairs of switch contacts takes place concurrently. Contact 54a may reengage contact 65a slightly ahead of the engagement of contact 54b with contact 65b, but this difference is so slight as to be negligible.

It is therefore apparent from the foregoing description of the construction and mode of operation of the present switch that the switch is of the same general type as the switch of my Patent No. 2,135,371 in that it comprises a support carrying two stationary contact stops, a plate pivoted upon the support at a point remote from the stationary contacts, contact arm members each carrying a contact engageable with a stationary contact, spring members each connected with a contact arm member near its contact, each contact arm member and its companion spring member being hingedly connected with the plate at spaced points, one being substantially nearer to the pivot than the other, and the action line of force of each spring member making a relatively small acute angle with the companion contact arm member and lying normally on the side of the arm member on which its companion stationary contact is located, the angle between one pair of arm and spring members being less than the angle between the other pair of arm and spring members, means for moving the plate, while the pairs of contacts remain in engagement, in a direction to shift the spring lines of action to the opposite sides of the arms in order to reverse the bias by the springs upon the arms whereby the movable contacts are moved away from said cooperating stationary contacts, the bias by the spring making the lesser acute angle with its contact arm being reversed ahead of the bias by the other spring, whereby one contact arm is moved ahead of the other, and other stops for limiting said movement of the contact arms away from the first mentioned contacts in order that restoration of the contact arms to normal position may be effected by reversal of movement of the plate.

The circuit controller of the present application differs from the switch of my application in that the contact controlling spring is a bowed leaf spring instead of being a helical coil spring and this contact biasing spring is integral with the contact itself which is of resilient material. This integral construction of contact arm and biasing spring results in simplicity and economy of manufacture.

In the switch of my Patent No. 2,135,371, there are two contact adjustments to be made. In the switch of the present application, there is but one contact adjustment. The relation between the switch arms is predetermined by the contact stop 80.

The switch of the present application may be connected in the circuit of a split phase A. C. motor in the manner shown in my Patent No. 2,095,579. The contacts 64a, 65a control the starting winding. When these contacts separate, the starting winding is disconnected, but the main winding remains connected through the contact 64b, 65b. When these latter contacts open, the main winding is disconnected and the motor stops. Therefore, the switch functions to disconnect the starting winding after the engine has attained synchronous speed, and to interrupt the main winding circuit in order to protect the motor in case of overload.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An electric switch comprising a support carrying two stationary contact stops, a plate pivoted upon the support at a point remote from the stationary contact stops, contact arm members each carrying a contact engageable with a stationary contact stop, spring members each connected with a contact arm member near its contact, each contact arm member and its companion spring member being hingedly connected with the plate at spaced points, one being substantially nearer to the pivot than the other, and the action line of force of each spring member making a relatively small acute angle with the companion contact arm member and lying normally on the side of the arm member on which its companion stationary contact stop is located, the angle between one pair of arm and spring members being less than the angle between the other pair of arm and spring members, means for moving the plate, while the pairs of contacts remain in engagement, in a direction to shift the spring lines of action to the opposite sides of the arms in order to reverse the bias by the springs upon the arms whereby the movable contacts are moved away from said contact stops, the bias by the spring making the lesser acute angle with its contact arm being reversed ahead of the bias by the other spring, whereby one contact arm is moved ahead of the other, a stop for limiting the movement of one of the contact arms away from its companion contact stop and a stop bar supported entirely by the two contact arms and having shoulders which limit the spacing of the contact arms when these arms are separated from their first mentioned contact stops.

2. An electric switch comprising a pivoted frame providing two fulcrums, two sets of relatively movable and stationary contacts, two resilient blade contact arms each carrying a stationary contact, each arm being secured to the pivoted frame; a biasing spring associated with each contact arm and hingedly engaging a fulcrum on the frame, the fulcrums normally being on the same side of their respective contact arms whereby both movable contacts will be biased toward contact closing position and whereby in response to movement of the common contact support, the bias of the two springs will be reversed in the same sense in order to separate the pairs of contacts, there being a single contact stop for engaging one of the movable contact arms to limit its separation movement from its companion stationary contact, and there being a stop bar supported entirely by the movable contact arms and having stop shoulders spaced apart so that separation of both pairs of contacts is limited through the stop bar by the engagement of one of the movable contact arms

with the stop thermal means for actuating the frame in one direction and resilient means for operating the frame in the other direction.

3. An electric switch comprising a plurality of stationary contacts, a plurality of cooperating movable contacts each carried by a resilient arm provided with a biasing spring portion, a pivoted frame upon which said resilient means are secured, said frame also providing a fulcrum hingedly engaged by the biasing spring portion of each resilient arm, said fulcrums being so arranged relatively to each other that said arms are actuated simultaneously into contact engagement and sequentially in the direction of contact breaking by their respective biasing spring portions in response to movement of said pivoted frame in one direction and the other respectively, thermal means for actuating said frame in the one direction; resilient means for actuating the frame in the other direction; a single stop engageable by the first moving arm from contact making position; a lost motion connection between the arms, providing a stop for the second arm moving from contact making position, said connection providing for the simultaneous movement of both arms into contact making position.

4. An electric switch comprising a plurality of stationary contacts, a plurality of cooperating movable contacts each carried by a resilient arm provided with a biasing spring portion, a pivoted frame upon which said resilient arms are secured, said frame also providing a fulcrum hingedly engaged by the biasing spring portion of each resilient arm, said fulcrums being so arranged relatively to each other that said arms are actuated simultaneously in one direction and sequentially in the other direction by their respective biasing spring portions in response to movement of said pivoted frame in one direction and the other respectively, thermal means for actuating said frame to effect sequential operations of the respective contact carrying arms; resilient means for actuating the frame to effect simultaneous operation of said arms; a single stop member for limiting the one arm in its movement in said other direction ahead of the other arm; and means supported between said arms, limiting the movement of the second arm in said other direction and providing for concurrent movement of both arms in the said one direction.

5. An electric switch comprising in combination a movable frame; resilient means urging the frame in one direction; opposing thermal means adapted to actuate the frame in the opposite direction; stationary contacts; cooperating resilient contacts secured to the frame and provided with biasing means adapted to actuate the contacts in one direction as the frame reaches predetermined points in its movement in the opposite direction; means supported between said resilient contacts providing a lost motion connection therebetween which will effect concurrent movement of said contacts in one direction and a movement limiting member for the one contact as it moves in the other direction; and a positive stop for the other movable contact as it moves in said other direction.

CALVIN J. WERNER.