Oct. 28, 1941. E. F. CARLSON 2,261,016

SWITCH

Filed April 14, 1939

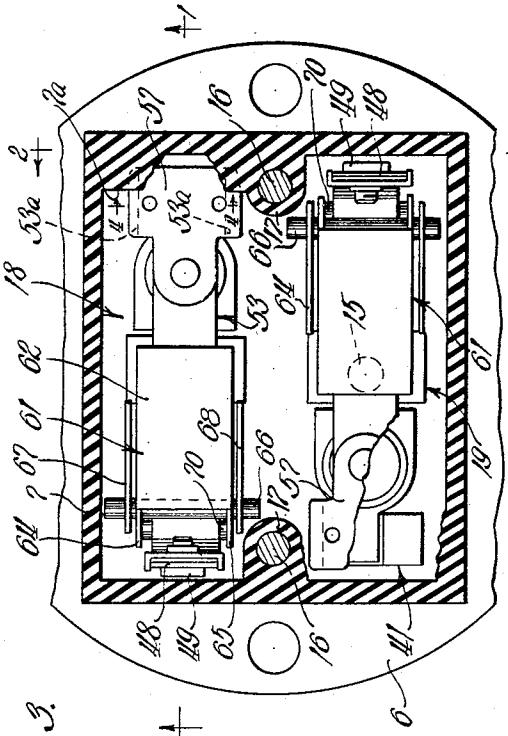

Fig. 3.

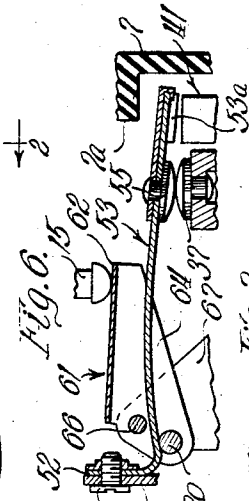

Fig. 6.

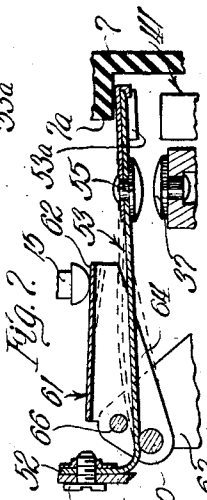

Fig. 7.

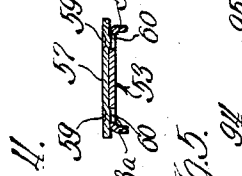

Fig. 4.

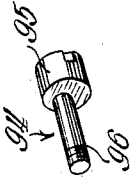

Fig. 5.

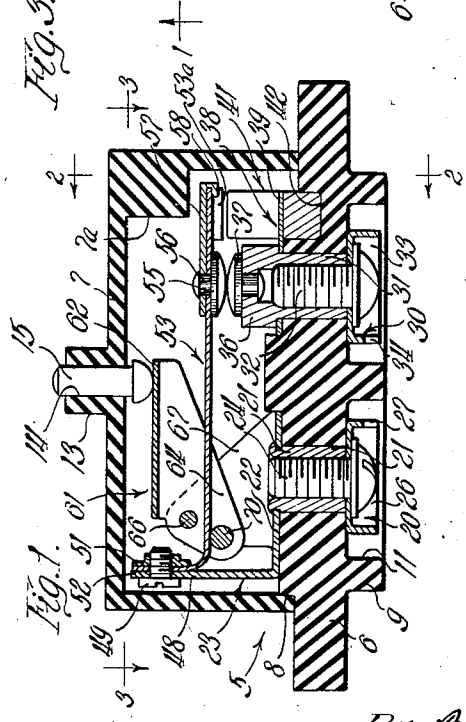

Fig. 1.

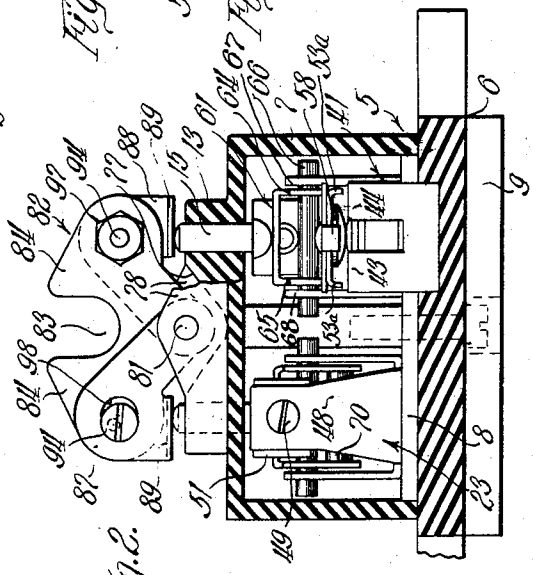

Fig. 2.

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2,261,016

SWITCH

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Application April 14, 1939, Serial No. 267,754

4 Claims. (Cl. 200—67)

This application is a continuation-in-part of the copending application, Serial No. 228,566, filed September 6, 1938, by Oscar F. Carlson and Elis F. Carlson, now Patent No. 2,232,996, issued February 25, 1941.

The object and general nature of this invention resides in the provision of new form of electric switch of the snap action type which when opened separates the contacts rapidly and produces a wider air gap than previous switches of this type, thus permitting the use of larger contacts and increasing the electrical capacity of the unit. Further, it is a feature of this invention to provide a switch in which only a small movement of the operating plunger is required to produce the wide opening movement just mentioned. Still further, it is a feature of this invention to provide a light action short movement switch which is compact yet sturdy and rugged.

Another feature of this invention is the provision of a snap action switch in which the required movement of the operating means is small yet positive opening and closing movements are secured with rapidity of action in either direction. Another feature of this invention is the provision of a switch in which a substantial amount of overtravel of the operating member is accommodated, thus making it possible to permit a continued movement of the switch operating means after the contacts are separated and eliminating disadvantages of having to restrict the switch operating means within close structural or manufacturing limits.

More specifically, it is a feature of this invention to provide a switch unit that includes a pair of contacts, one of which is movable with respect to the other and is carried on a spring arm that normally is held by suitable releasable or yielding means in a position maintaining the movable contact in one position relative to the other, in connection with suitable actuating means which acts through the spring arm and flexes the same, first, to overcome the releasable or yielding means and then to shift the movable contact with a quick or snap action into its other position. Preferably, such releasable or yielding means is in the form of a fixed permanent magnet and an armature on the movable spring arm. An additional feature of this invention is the provision of means for limiting the minimum air gap between the armature and the magnet.

These and other objects and advantages of the present invention will be apparent to those skilled in the art after a consideration of the following detailed description, taken in conjunction with the accompanying drawing.

In the drawing:

Figure 1 is a longitudinal vertical section taken through the preferred form of switch;

Figure 2 is a section taken along the line 2—2 of Figure 1;

Figure 3 is a section taken along the line 3—3 of Figure 1;

Figure 4 is a fragmentary section taken along the line 4—4 of Figure 3;

Figure 5 is a perspective of one of the adjusting screws;

Figure 6 is a fragmentary section similar to Figure 1, showing the position of the parts just before contact is broken; and

Figure 7 is a view similar to Figure 5, showing the switch in open circuit position.

Referring now more particularly to Figures 1 and 2, the switch of the present invention comprises a casing 5 that is made up of a base member 6 and a cover 7, both preferably formed of insulating material. The base 6 includes at one side thereof a raised portion 8 around which the edge of the cover 7 fits, and the opposite side of the base 6 is also provided with a raised section 9 which is recessed at 11 to receive terminals referred to below. The cover 7 of the switch casing 5 is provided with a boss 13 which is apertured, as at 14, and receives an axially shiftable operating plunger 15. The base 6 and the cover 7 are made of insulating material, and a pair of screws 16 pass upwardly through the base and are threaded into tapped openings in bosses 17 formed on the cover 7 to secure the cover and base together.

As best shown in Figure 3, the housing 5 encloses two separate switch units 18 and 19 which are arranged alongside one another but in opposite relation. The switch units 18 and 19 are substantially identical so that a description of one will suffice, corresponding parts of the two units being indicated by the same reference numerals.

Referring now to Figure 1, the base 6 carries a stationary terminal 20 that includes a sleeve 21 to which the horizontal portion 22 of a bracket 23 is riveted or otherwise fixed in a suitable manner. The sleeve 21 is threaded to receive a screw 24 under the head of which a flanged terminal washer 26 is disposed. Each washer has one or more notches 27 to accommodate the wire or conductor that is fastened by the screw 24 to the terminal 20. The base 6 also carries a stationary contact structure 30 which comprises a sleeve 31 internally threaded to receive a terminal screw 32 substantially identical with the screw 24 described above. Underneath the head of the screw 32 is a flanged terminal washer 33 having a conductor receiving recess 34. The sleeve 31 carries an apertured head 36 in which a contact element 37 is fixed, as by being riveted therein. Underneath the head 36 of the sleeve 31 is a plate 38 having an end 39 extending over the intermediate portion of the small horseshoe magnet 41, the latter being seated in a recess 42 formed in the base

6 to receive it. The two poles of the magnet 41 are indicated at 43 and 44 (Figure 2). The magnet 41 influences a movable switch element which will now be described.

The bracket 23, which is fixed to the base by the terminal 21, includes a standard section 48 which is apertured to receive a screw 49 which is threaded into a clip 51 and secures the upwardly bent end 52 of a spring arm 53. The opposite end of the spring arm 53 carries a contact element 55 which has a shank 56 extending through an aperture in the spring arm 53 and through an aperture in an armature 57 preferably formed of iron, steel or similar metal. The outer end of the latter has a tongue 58 bent over the outer end of the spring arm 53 to secure the firm attachment of the armature 57 to the outer end of the spring arm 53. As best shown in Figure 5, portions 59 of the armature are pressed into openings 60 in the arm 53, thereby preventing any relative movement between the arm and the armature. The spring arm 53 is made of copper or other non-magnetic material, and has lugs 53*a* bent downwardly to form stops extending about two-thirds of the distance between the armature 57 and the poles of the magnet 41. These stops 53*a* limit the movement of the armature 57 toward the magnet so that at no time can the air gap between the armature and stop be less than the height of the stops.

The armature 57 is disposed, as best shown in Figure 1, directly above the magnet 41, close enough to the magnet 41 so that when the contacts 37 and 55 are in engagement the magnet exerts an appreciable pull on the armature to hold the contacts in engagement until a force is exerted through the spring arm 53 that is sufficient to overcome the pull of the magnet, as will be explained more fully below, whereupon the contacts 37 and 55 separate with a quick or snap action. The movement of the outer end of the spring arm 53 is limited by its contact with the abutment portion 7*a* formed on the casing cover 7.

The means acting through the spring arm 53 to separate the contacts consists of a lever 61 which is generally U-shaped in section and has an extended portion 62 engaged by the head of the associated operating plunger 15. The sides of the member 61 are extended in the form of arms 64 and 65 and receive a pivot pin 66 which is supported in a pair of ears 67 and 68 which extend upwardly from and form a part of the bracket 23. The spring arm 53 passes between the arm sections 64 and 65, and the ends of the arm sections 64 and 65 are apertured to rotatably receive the reduced ends of a roller 70 that lies underneath the spring arm 53 adjacent the point where the latter is anchored to the standard 48.

The switch units 18 and 19 may be operated by any suitable means, either simultaneously or alternately as desired. Where the switches are to be operated alternately a rocker operating mechanism is mounted on the switch case and arranged to engage the plungers 15.

Referring now more particularly to Figure 2, the boss 13 is provided with a central elongated recess 77 having two upstanding side walls 78. A pivot pin 81 is disposed in suitable openings in the recess walls 78, and a lever 82 has a portion disposed within the recess 77 and pivotally mounted on the pin 81. The lever 82 has a recess 83 and lateral arm sections 84 disposed generally in the plane of the boss 13. A pair of arms 87 and 88 are also pivotally mounted on the pin 81 and formed to lie alongside the sections 84 of the lever 82. Each of the arms 87 and 88 is provided with a laterally extended lug 89 disposed over the bores 14 formed in the cover 7 and engaging the associated operating plunger 15.

Each of the arms 87 and 88 may be fixed in adjusted position relative to the lever 82 independently of the other arm. Each adjusting means includes a cam screw 94 which is best shown in Figure 5. Each cam screw 94 includes a head 95 and a threaded shank 96 formed integrally with and arranged in eccentric relation with respect to the head 95. The lever 82 is provided with two screw threaded openings receiving the cam screws 95, and each cam screw carries a lock nut 97. The head 95 of each of the cam screws is generally cylindrical and is received within an elongated slot 98 formed in each of the arms 87 and 88. Thus, when the lock nut 97 of either cam screw is loosened, the screw may be turned, and due to the eccentric relation between the shank and the head of the screw, turning the screw 95 adjusts the position of the arm relative to the lever. After the arm is adjusted, the lock nut 97 may be tightened to retain the desired adjustment. It will be noted that adjustment of either of the arms 87 and 88 takes place about the pivot 81, which is a pivot about which the lever 82 swings, and that each adjustment is independent of the other.

The operation of the switch described above is as follows:

Any suitable means, such as liquid level, pressure or temperature responsive devices, or any other mechanism, may be arranged to actuate the lever 82, or either or both of the plungers 15. Assuming that the plunger 15 of the switch unit 18 is actuated by any suitable means, the inward movement of the plunger 15 exerts a pressure on the end of the lever 61, tending to swing the same in a clockwise direction (Figures 1, 6 and 7) the roller 70 presses upwardly against the spring contact arm 53 closely adjacent its anchored end. However, the magnet 41 exerts a relatively strong pull on the armature 57 that is at the other end of the spring arm 53. This pressure exerted by the roller 70 first flexes the spring contact arm into the position indicated in Figure 6, in which the arm 53 is bowed upwardly between the roller and the contacts 37 and 55 and the contact 55 shifted slightly across the contact 37. The corresponding movement of the outer end causes the armature 57 to move closer to the magnet 41, and the latter therefore momentarily exerts an even stronger pull on the spring arm 53. The stops 53*a* prevent the armature 57 from moving so close to the magnet as to prevent the switch from opening. When the continued swinging of the lever 61 bends the spring arm 53 to the precise point where the flexure of the spring arm overcomes the pull of the magnet, even though the armature 57 is moved somewhat nearer the magnet, the force stored in the flexed spring arm 53 quickly snaps the latter into the position up against the stop 7*a* shown in Figure 6, separating the contacts 37 and 55 and producing a wide air gap between them. It will be noted that by virtue of the force of the magnet holding the contacts closed until the resilience of the spring arm exerts a force greater than that exerted by the magnet, the

switch snaps open with great rapidity, whether the operating means acting through the plunger 14 is itself moved slowly and positively or relatively rapidly. When the pressure on the plunger 15 is released, the bias of the spring arm 53 causes the same to move toward the magnet 41, but as the armature 57 moves within the effective field of the magnet the latter pulls the arm 53 downwardly and brings the contacts 37 and 55 into engagement with a snap action, since the pull of the magnet rapidly increases as the armature approaches it. While preferably the stops 53a are lugs formed integrally with the arm 53, they may be separate parts if desired.

It will thus be noted that even if the movement of the operating plunger 15 is both slow and positively controlled, as for example by a liquid or metal expansion or contraction device, the contacts 37 and 55 are, according to my invention, both opened and closed with a quick snap action.

It will be noted, particularly from Figure 7, that an additional inward movement of the operating plunger 15 is accommodated by additional bending of the spring arm 53, as indicated by dotted lines in Figure 7, without damaging or in any way affecting the switch. This provision for overtravel is important since extreme accuracy of adjustment or construction of the operating means is not necessary. Switches of this type require only a small movement to operate, and according to the present invention it is not necessary to hold the operating means to critical limits at both ends of its movement.

The lever means 82 shown in Figure 3 is representative of any suitable operating means, and provides for alternate operation of the two switch units. Adjustment of the point of break may be secured by loosening the lock nut 97, turning the screw 94 in one direction or the other, and then tightening the nut 97. If desired, of course, the lever 82 may be eliminated and the plungers 15 operated either simultaneously or alternately, as desired, by any suitable means. The dual switch unit shown in the drawing, is especially useful for simultaneous or alternate switching of two independent circuits.

While I have described my invention as embodied in a switch of the normally closed type, it will be seen that, if desired, the spring contact arm 53 may be arranged to be biased to open position and pressed into closed position by the lever 61 or its equivalent. Thus, also, the contacts will operate with a snap action, both when engaged and when disengaged just as in the case of the switch unit shown in Figure 1. Also, the spring arm need not be biased to move into either position, but may be shifted from one position to the other by a lever, such as the lever 61, connected with the arm 53 to move it in either direction. In this case, also, the contacts will engage and disengage with a snap action. Other modifications of the present invention may be adopted, as defined by the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A switch comprising a base, a terminal carried by said base, a bracket fixed to said terminal, a spring contact arm fixed to said bracket, a second terminal carried by said base spaced in insulated relation with respect to said first terminal, a pair of contacts, one carried by said second terminal and the other carried adjacent the outer end of said spring arm, an operating lever pivotally mounted on said bracket and having sections lying on opposite sides of said spring arm, and means carried by said sections and engaging said spring arm for moving said other contact relative to said one contact.

2. A switch comprising, in combination, a stationary contact member extending upwardly, a flat spring arm extending horizontally, means fixedly holding one end of said spring arm, a movable contact member carried underneath said spring arm at its other end, a permanent magnet cooperating with said spring arm for biasing the contact member carried thereby into engagement with said stationary contact member, a bifurcated support member with the arms thereof extending upwardly past opposite edges of said spring arm, a bifurcated operating lever with the arms thereof extending downwardly and interfitting with said support member, means pivotally mounting said operating lever on said support member above said spring arm, and a roller carried between the depending arms of said operating lever and adapted to engage the underside of said spring arm for moving the same to disengage said contact members.

3. A switch comprising, in combination, an insulating base, a pair of terminal members carried by said base in spaced relation, a stationary contact member carried by one of said terminal members, a metallic support member secured to the other of said terminal members and extending substantially at right angles to said base, a flat spring arm secured at one end to said support member and extending therealong toward said base for a portion of its length with the remaining portion curved away from said support member and extending substantially parallel to said base, a movable contact member carried by said remaining portion of said spring arm and biased thereby into engagement with said stationary contact member, and operating means reacting against said spring arm adjacent the curved part thereof in a direction away from said stationary contact member for disengaging said movable contact member therefrom.

4. A switch comprising, in combination, an insulating base, a pair of terminal members carried by said base in spaced relation, a stationary contact member carried by one of said terminal members, a metallic support member secured to the other of said terminal members and extending substantially at right angles to said base, a flat spring arm secured at one end to said support member and extending therealong toward said base for a portion of its length with the remaining portion curved away from said support member and extending substantially parallel to said base, a movable contact member carried by said remaining portion of said spring arm and biased thereby into engagement with said stationary contact member, a pair of ears extending from said base on opposite sides of said spring arm, an operating lever pivotally mounted between said ears about an axis on the side of said spring arm away from said base, side members extending from said lever toward said base, and a cross member carried by said side members and arranged to engage said spring arm adjacent the curved part thereof on the side adjacent said base for disengaging said movable contact member from said stationary contact member.

ELIS F. CARLSON.