Dec. 31, 1940. J. W. SEAMAN 2,227,160

ELECTRIC SWITCH

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Fig. 2

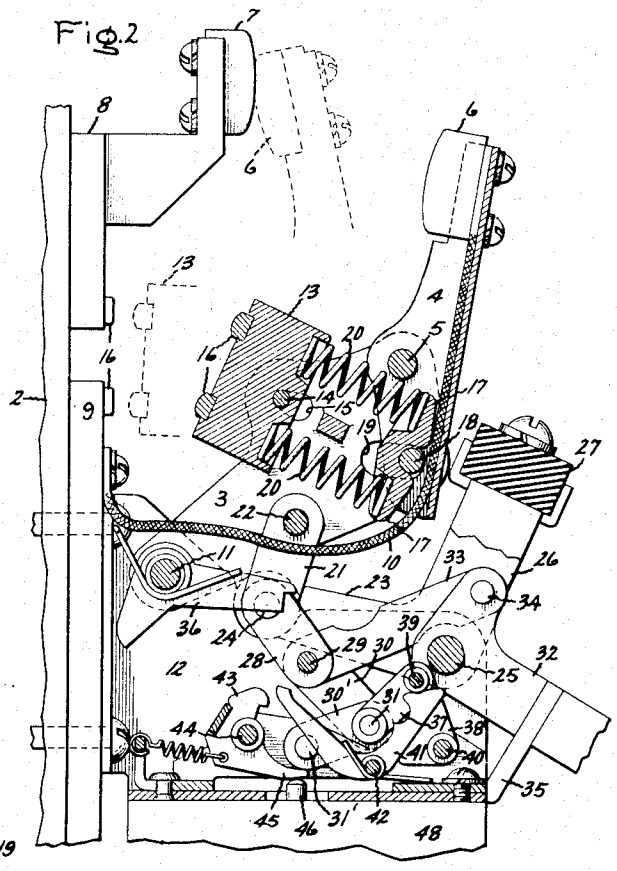
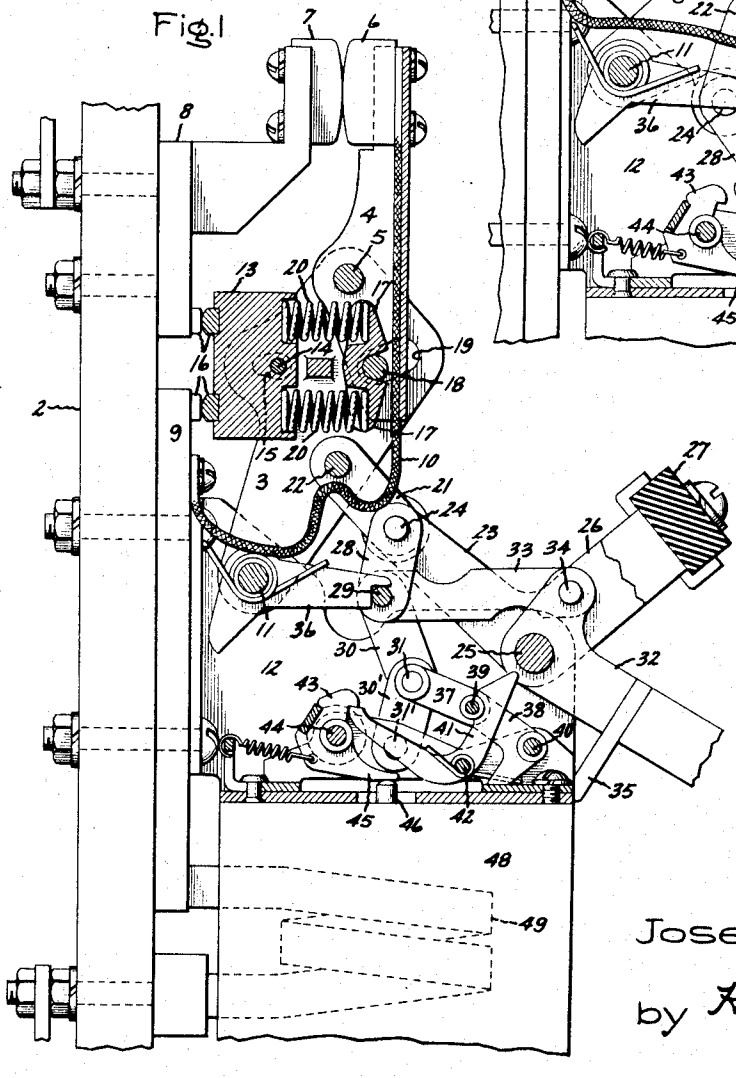


Fig. 1



Inventor:
Joseph W. Seaman,
by Harry E. Dunham
His Attorney.

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ELECTRIC SWITCH

Joseph W. Seaman, Upper Darby, Pa., assignor to General Electric Company, a corporation of New York

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8 Claims. (Cl. 200—146)

My invention relates to improvements in electric switches and more particularly circuit breakers and especially to improvements in switch contact structure for providing a plurality of consecutive makes and also breaks in parallel.

Circuit breakers provided with arcing contacts have been constructed with the arcing contact carrying arm pivoted on the lever on which the main bridging contact is pivoted. A spring acting on the bridging member at a point directly behind its pivot and on the arcing contact carrying arm at one point was intended to maintain a definite angular relation between the bridging contact and the lever on which it is pivoted when the circuit breaker is open. With this construction most of the spring force was concentrated directly in pressure on the bridging contact pivot. This accomplished essentially nothing more than to increase the pivot friction of the bridging contact since practically none of the spring force was effective to produce a torque for aligning the bridging contact relatively to its carrying lever. In consequence, the relative relation between these two parts was so indefinite that the bridging contact might close on either of its stationary contacts, or on both, and might even close on one of its stationary contacts before the arcing contact is closed. This lack of a definite position of the bridging contact relatively to the lever on which it is positioned, when the circuit breaker is open, frequently resulted in destructive burning of the main contacts of the circuit breaker particularly while closing on motor starting load currents several times the normal current carrying capacity of the circuit breaker.

One object of my invention is to provide an improved switch contact construction such that the required alignment of the parts is definitely maintained when the circuit breaker is open so as to insure the proper sequence for the closing and opening of the main and secondary contacts. Another object of my invention is to provide a switch contact construction wherein biasing forces are so applied as to obtain the maximum rotative effects for a given friction load. A further object of my invention is to provide an economical contact structure by which a plurality of makes and also breaks can be effected in a definite order with a minimum of destructive arcing at the contacts. These and other objects of my invention will appear in more detail hereinafter.

My invention will be better understood from the following description when considered in connection with the accompanying sheet of drawings, and its scope will be pointed out in the appended claims.

In the accompanying sheet of drawings, Fig. 1 illustrates an embodiment of my invention in a circuit breaker shown in the closed position in a side elevation partly in section and Fig. 2 shows a similar view of the circuit breaker except that it is in the open position.

In the illustrated embodiment of my invention I have shown an electric switch, such as a latched closed circuit breaker, mounted on a suitable base 2 of insulating material and comprising two contact carrying members 3 and 4 which are arranged for relative movement. For this purpose the contact carrying member 4 is shown as an arm mounted on a pivot 5 carried by the contact carrying member 3. The contact carrying arm 4 carries an arcing contact 6 which cooperates with a stationary arcing contact 7 suitably conductively connected to a circuit breaker upper stationary contact 8. The arcing contact 6 is conductively connected to the circuit breaker lower stationary contact 9 by suitable means, such as a flexible conductor 10. As shown, the contact carrying member 3 is an angularly movable lever mounted on a stationary pivot 11 in the circuit breaker frame 12. The lever 3 carries a main bridging contact element 13 which is mounted for angular movement relatively to the lever 3. For this purpose the bridging contact 13 may be carried on a pivot 14 which is mounted in a slot 15 provided in the lever 3 so as to permit a desired freedom of motion of the bridging contact 13 particularly when the bridging contact closes on the cooperating stationary contacts 8 and 9. As illustrated, the stationary contacts 8 and 9 and the bridging contact 13 may be provided with suitably shaped contacting inserts 16 of silver, for example, to obtain high pressure line contact. In order to reduce friction and also galling of the bridging contact 13, as the circuit breaker is closed, the lost motion slot 15 may be tapered slightly, as shown.

In order to maintain a predetermined angular relation between the bridging contact element 13 and the contact carrying lever 3 during a predetermined range of movement of this lever operative to allow a desired relative movement of the contact carrying members 3 and 4, I provide, in accordance with my invention, equalizing means, such as a supporting lever 17 engaging the contact carrying member 4 and angularly movable relatively thereto. For this purpose the

supporting lever 17 may be mounted on a pivot 18 carried by the contact arm 4 and so arranged, for example in a slot 19 in the lever 3, as to permit a desired limited movement of the contact carrying members 3 and 4 relatively to each other. In order to maintain the desired alignment between the lever 3 and the bridging contact 13, I provide suitable biasing means, such as springs 20 which are positioned between the bridging contact 13 and the equalizer 17 on opposite sides of the plane through the axes of angular movement of the bridging contact 13 and the equalizer 17. It will be observed that with this arrangement, the thrust of each of the springs 20 shown as compression springs, is exerted on the bridging contact 13 sufficiently far from its pivot 14 to insure the necessary torque for maintaining a definite angular relation between the bridging contact and the contact carrying member 3 when the circuit breaker is in the open position. In order to reduce friction and to insure that any sliding action of the bridging contact 13 cannot detract from the proper functioning of the springs 20, the lost motion slot 15 is preferably tapered to provide a wider opening at the rear, as shown.

In consequence of the definite positioning of the bridging contact 13, the lever 3 and the arcing contact 6 relatively to each other when the circuit breaker is open, the arcing contact 6 and the bridging contact 13 make and break with their respective cooperating stationary contacts 7, and 8 and 9 in the proper sequence during the closing and opening of the circuit breaker. Moreover, since the bridging contact 13 approaches and leaves its cooperating stationary contacts 8 and 9 at a definite angular relation relative to the lever 3, simultaneous making and breaking on both contacts 8 and 9 by the bridging contact is assured.

If the pin 14 in the bridging contact 13 were guided by a slot with parallel sides, that is, not opened up toward the rear, as shown, and a single compression spring were used directly back of the pin 14, then in closing the bridging contact 13 would tend to make on the lower silver contacts. If now a slight galling action were to take place, which is quite likely, then the combined action of this galling and the single compression spring would be to force the pin carried by the bridging contact against the top of the guiding slot. Consequently, such action would produce excessive pressure on the bottom silver contacts and little or none on the top silver contacts thereby forcing most of the current to flow through the secondary or arcing contacts 6 and 7 instead of the primary contacts 16. Of course, if the bridging contact first made contact at the top, the same condition would occur except in reverse order. With contact structure embodying my invention, these conditions are eliminated in consequence of the use of two separate compression springs which are so placed as to insure contact pressure for both the top and bottom silver contacts 16. Also the use of a plurality of springs insures that the contact pressure desired for each set of silver contacts cannot be altered by any other fact. This advantage cannot be obtained by the use of a single spring. Further the tapering or opening up of the slot 15, as shown, insures that any galling or sliding action of the bridging contact 13 cannot detract from the purpose for which the springs are intended.

In order to insure good pressure between the contacts 6 and 7 when first making and a continuously increasing and relatively heavy pressure while the circuit breaker closing action is continued, the pivot 5 of the circuit breaker arm 4 is preferably placed as close, as the circuit breaker construction will permit, to the contact 6 whereby to obtain a good mechanical advantage. Thus in the arrangement illustrated the distance between the pivot 5 and the pin 18 at which the spring pressure is applied to the arm 4 is approximately half the distance between the pivot 5 and the center of the arcing contact 6. By arranging the flexible conductor 10 below the pivot 5, as shown, the magnetic effect of the conductor loop helps to offset the tendency of the arcing contacts to separate due to magnetic effect.

While the type of operating mechanism for actuating contact structure embodying my invention is immaterial and forms no special part of my invention, I have illustrated a circuit breaker mechanism of the double toggle type together with a shock proof latching mechanism therefor. The primary toggle of the operating mechanism comprises a link 21 pivotally connected to the lever 3 at pin 22 and to another toggle link 23 at pin 24. The link 23 is pivoted in the circuit breaker frame at pin 25 and may have an extending arm 26 by which one or more circuit breaker poles can be interconnected by an insulating member 27 for simultaneous operation. The secondary operating toggle comprises a link 28 connected between the pin 24 and a pin 29, and a link 30 connected between the pivot 29 and a releasably supported pivot pin 31. This pin 31 is mounted in a link 30' which is supported on a pivot pin 31' in the circuit breaker frame 12. The secondary toggle 28—30 is interconnected to an operating handle 32, pivoted in the circuit breaker frame at 25, by a link 33 extending between the pivot 29 and a pivot 34 on the operating handle 32. The operating handle may be provided with a stop 35 which engages the circuit breaker frame 12. The secondary toggle 28—30 is restrained by a spring biased latch 36. The releasable abutment 31 is maintained in the circuit closed position of the circuit breaker by an underset latching toggle comprising links 37 and 38 interconnected at pivot 39. The link 37 is connected to the pivot 31, and the link 38 is pivoted on the circuit breaker frame 12 at 40. A primary latch 41 is pivoted on the breaker frame at 42 and suitably biased, as shown, for counter-clockwise rotation to engage the pivot 39. The primary latch 41 is in turn held in the restraining position by a secondary latch 43 pivoted in the circuit breaker frame at 44 and provided with a tripping tail 45. This tail is engageable by the tripping pin 46 of a suitable solenoid tripping mechanism 48 indicated as having an energizing coil 49 connected in series with the circuit breaker contacts. The secondary latch 43 is suitably biased for clockwise rotation to the latching position as shown.

With the parts positioned as shown in Fig. 1 actuation of the tripping pin 46 releases the latches 43 and 41 whereby to effect the release of the toggle 37, 38, which permits the dropping of the pivot pin 31 through the collapse of the toggle 30—30', and the parts move to the position shown in full line in Fig. 2. The dotted position of the bridging contact 13 is shown in Fig. 2 at the instant when the arcing contact 6, shown dotted, is leaving the stationary arcing contact 7. Upon the release of the pressure against the bridging contact 13 by reason of the

opening of the circuit breaker, the springs 20, operating against the bridging contact as well as the equalizer 17, force the pivot 14 to the extreme outer position in the slot 15 and also the pin 18 into the extreme outer position in the slot 19 as shown in Fig. 2. By suitable proportioning of the parts, this relative movement of the bridging contact and the contact arm 4 insures the maintenance of contact between the arcing contacts 6 and 7 long enough for the separation of the bridging contact 13 from its stationary contacts 8 and 9.

Counter-clockwise rotation of the operating handle 32 raises the toggle pivot pin 31 sufficiently to reset the latches 42 and 44 and to hold the toggle 37 and 38, as shown in Fig. 1. Clockwise rotation of the operating handle 32 then causes the operating secondary toggle 28—30 to straighten the primary operating toggle 21—23 and the latch 36 to engage the toggle pin 28 whereby to maintain the circuit breaker in the closed position shown in Fig. 1. As the circuit breaker closes, the arcing contact 6 first engages its cooperating stationary contact 7, as shown in the dotted lines in Fig. 2. At this time the bridging contact 13 is in the position shown in dotted lines in Fig. 2 with the pin 14 in the end of the slot 15, as shown in Fig. 2. As the operating handle 32 is turned clockwise further, relative angular movement of the contact lever 3 and contact arm 4 occurs at the pivot 5 so that the pivot 18 moves inwardly in the slot 19, as shown in Fig. 1. As the bridging contact engages its stationary contacts 8 and 9, its pivot pin 14 is forced backwardly in the slot 15. In consequence of these motions of the pivot pins 14 and 18 toward each other, the springs 20 are compressed, as shown in Fig. 1. During all of these movements, it will be obvious that the alignment between the bridging contact 13 and the operating lever 3 is maintained substantially without change.

While I have shown and described my invention in considerable detail, I do not desire to be limited to the exact arrangement shown, but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric switch comprising a pivotally mounted contact carrying member, a contact element pivotally mounted on said member, a contact carrying arm pivotally mounted on said member for a limited angular movement relative thereto, an equalizer pivotally engaging said arm, and resilient means comprising springs respectively positioned between said contact element and said equalizer on opposite sides of the plane through the pivotal axes thereof.

2. An electric switch comprising a pivotally mounted contact carrying lever provided with a slot, a bridging contact pivotally mounted on said lever in said slot, a contact carrying arm pivotally mounted on said lever for a limited angular movement relatively thereto, an equalizer pivotally engaging said arm, and resilient means comprising two compression springs positioned between said bridging contact and said equalizer on opposite sides of the plane through the pivotal axes thereof.

3. An electric switch comprising an angularly movable contact carrying lever, a contact element mounted on said lever for angular movement relatively thereto, a contact carrying arm mounted on said lever for a limited angular movement relatively thereto, and means for maintaining a predetermined angular relation between said contact element and said contact carrying arm during a predetermined range of movement of said lever comprising an equalizer engaging said contact carrying arm and angularly movable relatively thereto, and resilient means positioned between said contact element and said equalizer on opposite sides of the plane through the axes of angular movement of the contact element and equalizer.

4. An electric switch comprising two contact carrying members arranged for a limited relative movement, means for simultaneously moving both of said members, a first contact element mounted on one of said members for angular movement relatively thereto, a contact element mounted on the other of said members, and means for maintaining a predetermined angular relation between said first contact element and one of said contact carrying members during a predetermined range of movement of said one contact carrying member operative to allow relative movement of said contact carrying members comprising an equalizer engaging the other contact carrying member and angularly movable relatively thereto, and resilient means positioned between said first contact element and said equalizer on opposite sides of the plane through the axes of angular movement of said first contact element and said equalizer.

5. An electric switch comprising a pivotally mounted contact carrying lever provided with a slot, means for actuating said lever, a bridging contact pivotally mounted on said lever in said slot, two spaced stationary contacts engageable by said bridging contact on actuation of said lever in one direction, a contact carrying member pivotally mounted on said lever for a limited angular movement relatively thereto, an arcing contact mounted on said contact carrying member, a stationary contact engageable by said arcing contact before said bridging contact engages its cooperating stationary contacts, an equalizer pivotally engaging said arcing contact carrying member, and resilient means comprising two compression springs positioned between said bridging contact element and said equalizer on opposite sides of a plane through the pivotal axes thereof.

6. An electric switch comprising a pivotally mounted contact carrying lever, means for actuating said lever, a bridging contact pivotally mounted on said lever, two spaced stationary contacts engageable by said bridging contact on actuation of said lever in one direction, a contact carrying member pivotally mounted on said lever for a limited angular movement relatively thereto, a contact mounted on said member, a stationary contact engageable by the contact on said member before said bridging contact engages its cooperating stationary contacts, and means for maintaining a predetermined angular relation between said bridging contact and said lever during a predetermined range of movement of the lever operative to allow relative movement of said lever and said member comprising an equalizer engaging said member and angularly movable relatively thereto, and resilient means positioned between said bridging contact and said equalizer on opposite sides of the plane through the axes of angular movement of the bridging contact and equalizer.

7. An electric switch comprising a movable contact carrying member, a contact element piv-

otally mounted on said member, an equalizer pivotally supported on said member, and resilient means comprising springs respectively positioned between said contact element and said equalizer on opposite sides of the plane through the pivotal axes thereof.

8. An electric switch comprising a pivotally mounted contact carrying lever provided with a slot, a bridging contact pivotally mounted on said lever in said slot, an equalizer pivotally supported on said lever, and resilient means comprising two compression springs positioned between said bridging contact and said equalizer on opposite sides of the plane through the pivotal axes thereof.

JOSEPH W. SEAMAN.