

April 16, 1935.

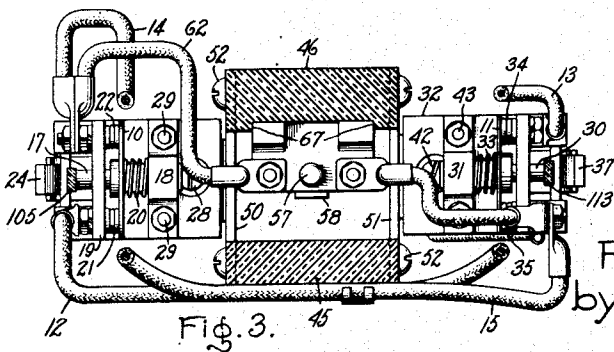
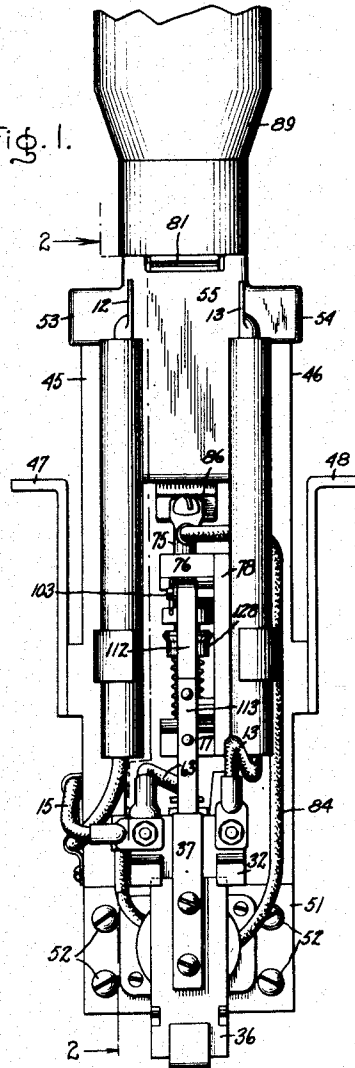
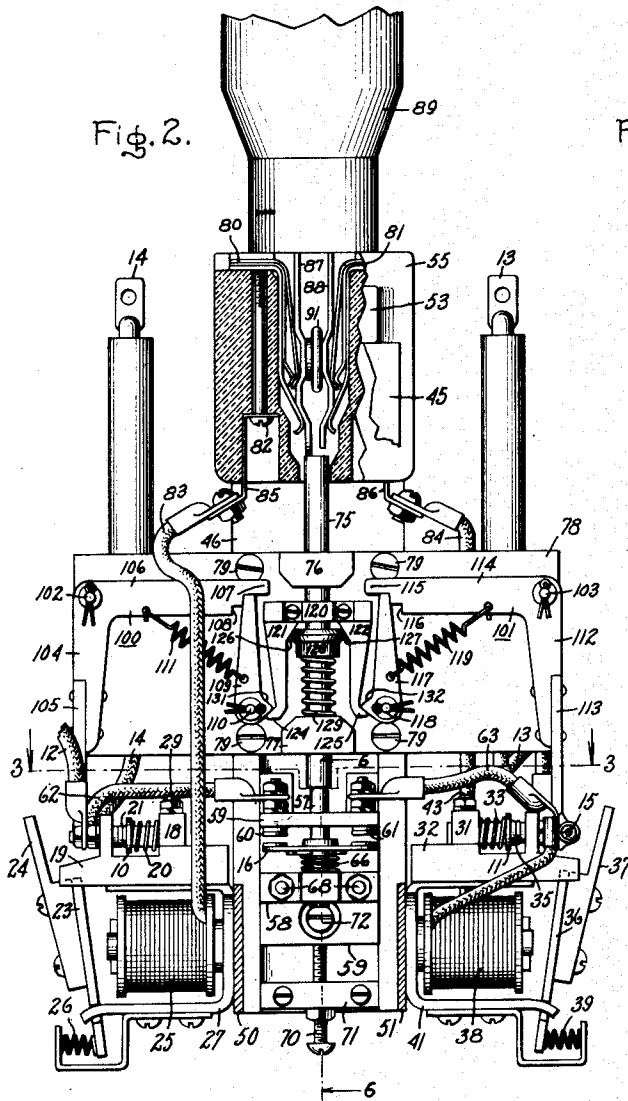
F. A. WEIGEL

1,998,403

ELECTRIC SWITCH

Filed Aug. 16, 1933

2 Sheets-Sheet 1



Inventor:
Frederick A. Weigel,
by Harry E. Dunham
His Attorney.

1,998,403

2 Sheets-Sheet 2

Inventor:
Frederick A. Weigel,
by Harry E. Dunham
His Attorney.

UNITED STATES PATENT OFFICE

1,998,403

ELECTRIC SWITCH

Frederick A. Weigel, East Lynn, Mass., assignor
to General Electric Company, a corporation of
New York

Application August 16, 1933, Serial No. 685,366

14 Claims. (Cl. 175—294)

The present invention relates to electric switches and especially to automatically operated electric switches for disconnecting from a series circuit a portion of the circuit in case the current therein fails and closing a shunt circuit around such portions so as to maintain the remainder of the circuit continuous.

One application of my invention is in connection with what are termed usually cut-out switches for series lighting circuits and accordingly, I have specifically illustrated and described my invention applied to this use. It is to be understood, however, this is only by way of example and that the invention is not limited thereto necessarily.

In connection with series lighting circuits, for example, series street lighting circuits, a large number of lamps may be placed in series along a main street and at intervals there may be what are termed usually loop circuits extending down side streets, these being in substance a part of and in series with the circuit extending along the main street but being in the form of a loop in that the series circuit extends down the side street and back again to the main street. If at any time, there occurs a fault, such as an open circuit, in a loop circuit, it is desirable to disconnect the loop circuit from the circuit on the main street and close a shunt circuit around the open end of the loop so as to maintain the continuity of the remainder of the series circuit, i. e., the continuity of the series circuit on the main street. Also it is desirable that the switch maintain such connections until the fault in the loop circuit has been corrected after which the shunt circuit may be again opened and the loop circuit connected into the main series circuit.

One object of my invention is to provide an improved switch structure whereby in case the current in the loop circuit fails, due to an open circuit, for example, the loop circuit is automatically disconnected and a shunt circuit is closed around the loop circuit to maintain the continuity of the main circuit and wherein after operating, the switch is mechanically latched in its new position so that even though the current is restored in the loop circuit, the switch will not be returned to its original position but must be reset to such position manually.

Another object of my invention is to provide an improved switch structure, the operation of which is controlled through the intermediary of a film cut-out, the arrangement being such that the switch after operating cannot be restored to

its normal position until the film cut-out is renewed.

A further object of my invention is to provide an improved switch structure wherein the renewal of the film cut-out and its insertion into position serves automatically to restore the switch structure to its normal position.

A further object of my invention is to provide an improved switch structure wherein upon insertion of the renewed film cut-out the shunt circuit is maintained closed until the connection between the main circuit and the loop is fully established.

A further object of my invention is to provide an improved switch, the operation of which is controlled by a film cut-out, the arrangement being such that the switch will operate in response to a break in the loop circuit, but will not operate merely in response to the failure of a lamp in that circuit.

Other objects and the advantages of my invention will be apparent and the invention itself will be better understood from the following description, when considered in connection with the accompanying drawings, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawings, Fig. 1 illustrates a side elevation of a series cut-out switch provided with a latching mechanism built in accordance with my invention; Fig. 2 is a front sectional view along line 2—2 of Fig. 1; Fig. 3 is a horizontal section taken along line 3—3 of Fig. 2; Fig. 4 is a diagrammatic illustration of the circuits, switch mechanism and the latching mechanism showing the switch in closed position; Fig. 5 is a diagrammatic illustration similar to Fig. 4, showing the switch latched into open position, and Fig. 6 is a sectional view along line 6—6 of Fig. 2 looking in the direction of the arrows.

Figs. 1, 2 and 3 of the drawings illustrate in detail, and Figs. 4 and 5 diagrammatically, a series cut-out switch having movable switch members 10 and 11 for connecting a loop circuit including conductors 12 and 13 to a main circuit including conductors 14 and 15. A switch member 16 is provided to shunt the conductors 12 and 13 and connect the conductors 14 and 15 to each other under certain conditions. A clear understanding of the circuits may be had by inspection of Figs. 4 and 5.

The switch member 10 is mounted on a shaft 17, slidable in bearings located in the insulating blocks 18 and 19 and is biased toward the closed position

by a spring 20. In this position the switch member connects to each other the contacts 21 and 22 which are mounted on the insulating block 19 and are connected to conductors 12 and 14, respectively. The switch member 10 is moved to the open position by an armature 23 to which is attached an insulating member 24. This member 24 engages and moves the shaft 17 when a magnet coil 25 is energized. When the magnet coil 25 is deenergized the armature 23 is moved away from the shaft 17 by a spring 26, the armature being pivoted on a U-shaped bracket 27 which also supports the coil 25 and the insulating block 19. The insulating block 19 is attached to the bracket 27 by a screw 28 and supports block 18 which is attached to it by screws 29.

The switch member 11 is operated by apparatus similar to that which operates the switch member 10. It is mounted on a shaft 30, slidable in bearings located in the insulating blocks 31 and 32 and is biased toward the closed position by a spring 33. In this position the switch member 11 connects to each other contacts 34 and 35 which are mounted on the insulating block 32 and to which are attached conductors 13 and 15, respectively. The switch member 11 is moved to the open position by an armature 36 to which is attached an insulating member 37 arranged to engage the shaft 30. This member 37 engages and moves the shaft 30 when the magnet coil 38 is energized. When the magnet coil 38 is deenergized the armature 36 is moved away from the shaft 30 by a spring 39, the armature being pivoted on a U-shaped bracket 41 to which the coil 38 and the insulating block 32 are attached. The insulating block 32 is attached to the bracket 41 by a screw 42 and supports block 31 which is attached thereto by screws 43.

The frame of the cut-out switch consists of two insulating members 45 and 46 which may be of wood or other suitable material, and are equipped with brackets 47 and 48 by means of which the entire switch may be supported in any convenient casing (not shown). The members 45 and 46 are attached to each other at their respective lower ends by plates 50 and 51 which are attached to the members by screws 52. The members 45 and 46 are respectively attached at their upper ends to lugs 53 and 54 of a socket 55 which will be described presently.

As stated above, the switch member 16 is arranged to connect the conductors 14 and 15 to each other under certain conditions. The switch member for this purpose is rigidly mounted on a shaft 57 slidable in blocks 58 and 59, and is arranged to engage contacts 60 and 61 connected respectively to conductors 14 and 15 by short leads 62 and 63. The contacts are mounted on the block 59 which is similar in shape to the blocks 19 and 32, as clearly shown in Fig. 6. The shaft 57 is biased upwardly by a spring 66 which acts against the switch member 16 and the block 58. The block 58 is attached to the block 59 by screws 68. The block 59 and thereby shaft 57 and the contacts 60 and 61 may be slightly raised or lowered on the frame members 46. The block 59 is slidable on the member 46 in a groove therein defined by the walls 67. It may be slightly raised or lowered by a screw 70 mounted in a block 71 which is rigidly attached to the member 46. If it is desired to adjust the block, a screw 72 extending through a hole in the block 59 and a slot 69 in the member 46 is loosened and the screw 70 is turned until the block 59 and the shaft 57 are raised or lowered the desired amount, after which

the screw 72 is tightened. The slot 69 in member 46 through which screw 72 extends is made long enough to give the desired range of adjustment for this purpose.

As shown in Fig. 2, the shaft 57 is held against its bias by a shaft 75 which engages the upper end of the shaft and thereby holds the switch member 16 separated from the contacts 60 and 61.

The shaft 75 is slidably mounted in bearing lugs 76 and 77 attached to a plate 78, which in turn is attached to the insulating member 46, by screws 79, and supports the latching mechanism which will be described later in this specification. At its lower end the shaft projects through the lug 77 and engages the shaft 57 and at its upper end it projects through lug 76 and into the socket 55.

The socket 55, as stated above, is rigidly attached to the members 45 and 46 by means of its lugs 53 and 54. It is provided with a pair of contacts 80 and 81, each comprising a series of leaves attached to the socket by a screw 82 and connected respectively to one side of the coils 25 and 38 by conductors 83 and 84 and connection strips 85 and 86. The contacts 80 and 81 are of the type generally used in series sockets being biased towards each other and are arranged to be separated by and to engage prongs 87 and 88 mounted in a holder 89.

The prongs 87 and 88 are metallic strips mounted parallel to each other in a holder 89 in which they are rigidly mounted and insulated from each other. The prongs are arranged to support a film cut-out device 91, which is inserted between them. This device 91 comprises a pair of metallic discs separated from each other by an insulating film. The insulating film may be a film of metal oxide or any other suitable insulating film which will insulate the discs from each other under normal conditions, but will break down and permit current to pass if a predetermined voltage above normal is applied. I prefer to use for this purpose a cut-out device, such as is described and claimed in U. S. Patent 1,784,656, Butler, issued December 9, 1930.

The prong 87 is slightly longer than the prong 88 and engages the upper end of shaft 75 when the holder 89 and the prongs are placed into the socket, as shown. In this position the lower end of the shaft 75 forces the shaft 57 down and separates the switch member 16 from the contacts 60 and 61.

In automatically - operated series - cut - out switches, it is desirable to maintain the terminals of the circuit section, which have been separated from the main circuit by the switch, separated from the main circuit, irrespective of the current in the coils which originally opened the switch. If the switch should accidentally close during the time repairs are being made to the circuit, potential will be applied thereto and might injure the workman. I, therefore, provide in accordance with my invention an improved latching device which will maintain the switch open independently of the energy in the coil which opened the circuit and will maintain the switch in the open position until the switch is again reset by hand.

The latching device comprises a pair of bell cranks 100 and 101 pivotally mounted at their respective vertexes on pins 102 and 103 located in plate 78. The one arm 104 of the bell crank 100 is provided with an extension 105 which extends between the member 24 and the shaft 17 so that when the shaft 17 is moved to the open position by the armature 23 and the member 24, the bell crank is moved counter-clockwise

about its pivot. The second arm 106 of this bell crank 100 is provided at its end with a lug 107 and a notch 108. When the switch member 10 is in the closed position at which it engages its contacts, the bell crank is held positively in the position shown in Fig. 2, by latching pawl 109. The latching pawl 109 is pivoted on a pin 110 which is also mounted on the plate 78 and is biased towards the bell crank by a spring 111 which is under tension and attached to the arm 106 and the pawl 109. In the position shown, the pawl 109 engages the end of the arm 106 whereby the pawl cannot turn clockwise because of the tension of spring 111. In this position the pawl 109 also engages the underside of the lug 107 whereby the arm 106 cannot turn clockwise by action of the spring 111. When the armature 23 is attracted, the member 24 moves the extension 105 with the shaft 17 and thereby raises the arm 106 until the latching pawl moves into the notch 108 thereby preventing the return of the switch member 10 to the closed position.

The bell crank 101 is similar to bell crank 100 and is provided with an arm 112 to which is attached an extension 113 extending between the shaft 30 and the member 37 which is attached to the armature 36. The second arm 114 of the bell crank 101 is provided with a lug 115 and a notch 116. In the position shown in Fig. 2, this bell crank 101 is held in position by a latching pawl 117 pivoted on a pin 118 and biased towards the arm 114 by the spring 119 which is under tension and is attached to the arm 114 and the pawl 117. In the position shown, the pawl 117 engages the end of the arm 114 under the lug 115. When the armature 36 is attracted, however, the arm 114 is raised similarly to the arm 106 and the pawl 117 moves into the notch 116 thereby latching the bell crank and the switch member 11 into the open position.

For the purpose of unlatching the switch members by releasing the bell cranks, a cross-arm 120 is rigidly attached to the shaft 75. To this cross-arm are pivoted two releasing pawls 121 and 122 which are provided respectively with lugs 124 and 125 and cam surfaces 126 and 127. These pawls are biased outwardly by a collar 128 which engages the cam surfaces 126 and 127. This collar is loosely mounted on the shaft 75 and is urged upwardly by a spring 129 which surrounds the shaft 75 and is compressed between the collar 128 and the bearing lug 77. When the shaft 75 is pushed downwardly by the prong 87, the lugs 124 and 125 engage the upper sides of the lugs 131 and 132 which are attached to the lower ends of the pawls 109 and 117 and face the releasing pawls. When the holder 89 is withdrawn from the socket 55, the springs 66 and 129 urge the shafts 57 and 75 upwardly. The releasing pawls 121 and 122 are thereby moved inwardly so as to pass the points of the lugs 131 and 132. In order to do this the collar 128 is moved down over cam surfaces 126 and 127 against the action of spring 129 to permit the lugs 124 and 125 to move toward the shaft 75. When the lugs 124 and 125 pass the tips of the lugs 131 and 132, however, the spring 129 again moves the collar 128 upward and the pawls outwardly. When the shaft is then pushed downward by the prong 87, the lugs 124 and 125 exert considerable pressure on the lugs 131 and 132, thereby turning the latching lugs 109 and 117 about their respective pivots. This movement is clockwise on pawl 109 and counter-clockwise on the pawl 117. The pawl ends are thereby drawn out of the

notches 108 and 116, and the bell cranks are returned to their first described positions. Further movement of the shaft 75 causes the lugs to slide down the upper surfaces of the lugs 131 and 132 and move towards the shaft until they pass the tips of the lugs 131 and 132.

Figs. 4 and 5 are diagrammatic illustrations of the automatic-series cut-out switch applied to a series circuit. The main circuit is represented by conductors 14 and 15 having lamps 135 in circuit therewith. The contacts 22 and 35 are the main terminals of this circuit and the contacts 60 and 61 are in multiple therewith, being connected thereto by conductors 62 and 63, respectively. A section of the main circuit which may for convenience be called the loop circuit is represented by conductors 12 and 13 and lamps 136 connected in series therewith having contacts 21 and 34 as its terminals. In Fig. 4 the switch members 10 and 11 are shown in the closed or contact engaging position. In this arrangement of the circuit and the switch, the current flows from conductor 14 to the contact 22, switch member 10, contact 21, conductor 12, lamps 136, conductor 13, contact 34, switch member 11, contact 35 and conductor 15. If the loop circuit is then ruptured so that current cannot flow in this circuit, the potential of the circuit is applied across the cut-out device 91. This circuit may be traced from conductor 14, conductor 137, coil 25, conductor 83, contact strip 85, screw 82, contact 80, prong 87 to one side of the device 91; the other side of device 91, contact 81, screw 82', contact strip 86, conductor 84, coil 38, conductor 138 to conductor 15. The film of insulation in the device 91 then breaks down and passes current through the circuit just described whereby the coils 25 and 38 are energized. The armatures 23 and 36 are attracted and the switch members 10 and 11 are moved to the open position. At the same time the bell cranks having their respective arms 105 and 113 extending between the actuating armatures and the switch members, are moved and latched into the position shown in Fig. 5 by the latching pawls acting upon the respective other arms of the bell cranks. The switch members then cannot move back to the closed position, irrespective of whether the coils 25 and 38 maintain their armatures attracted.

When the loop circuit including conductors 12, 13 and the lamps 136 is repaired, the holder 89 is removed from the socket 55 and a new device 91 is placed between the prongs 87 and 88. When the holder 89 is removed, the shaft 75 is raised by the action of springs 66 and 129 and the cross-arm 61 being correspondingly raised, the pawls 121 and 122 are moved to the upper surfaces of the lugs 131 and 132, respectively. Simultaneously the coils 25 and 38 being shunted by the switch member 16 are deenergized and release their armatures which are then biased to the inactive positions by the springs 26 and 39, respectively.

When the shaft 75 is again pushed down by the prong 87, the lugs 124 and 125 of the pawls 121 and 122 bear down upon the lugs 131 and 132 sufficiently to rotate the pawls 109 and 117, respectively, about their pins until they move out of the notches 108 and 116 and engage the ends of the cross-arm 120. The bell-cranks 100 and 101 are thereby permitted to rotate about their pins until the lugs 107 and 115 again respectively engage the pawls 109 and 117, as shown in Figs. 2 and 4. The rotation of the pawls changes

the angular relation between the lugs 124 and 125 and the surfaces of the lugs 131 and 132 in such manner that a further movement of the shaft 75 downwardly causes the lugs 124 and 125 to slide over the lug surfaces and to move toward the shaft 75 against the action of the collar 128 and the spring 129. This movement toward the shaft continues until the lugs 124 and 125 pass the tips of the lugs 131 and 132. Further movement of the shaft 75 then simply permits the lugs to move outwardly until they assume the position shown in Figs. 2 and 4.

The block 59 is vertically adjustable, as above explained, for the purpose of establishing a proper relation between the shafts 57 and 75. When the shaft 75 is pushed downwardly by prong 87 it is arranged to first release the switch members 10 and 11 and permit them to connect the conductors 14 and 15 of the main circuit to the conductors 12 and 13 of the loop circuit. Upon further movement, the shaft 75 is arranged to engage the shaft 57 and open the shunt circuit about the loop circuit by separating the switch member 16 from its contacts 60 and 61. This arrangement is necessary since an opening of this shunt circuit before closing the connections between the loop and main circuits creates a condition similar to a broken loop circuit and naturally breaks down the film cut-out device before the switching operation is completed. The block 59 and thereby the shaft 57 is so adjusted that shaft 75 does not engage the shaft 57 until the releasing or unlatching operation is completed and, on the other hand, is arranged so that the switch 16 is fully separated from the contacts 60 and 61 when the holder 89 is seated in the socket 55.

As explained above, the film cut-out device 91 allows current to pass through it to the operating coils 25 and 38 upon failure of the current in the loop circuit. The loop circuit having lamps 136 connected in series therein will be, however, subject to current failure when a single lamp therein fails. It would cause considerable inconvenience to have the circuits disconnected because of a failure of a lamp and for this reason a film cut-out 139, similar to the cut-out 91, is provided for each lamp 136. The cut-out 139 is inserted between the prongs of a series type of socket and is thereby in shunt to the lamp filament. This type of socket and the method of inserting the cut-out device 139 is well known in the art. It is illustrated and described in detail, for example, in the U. S. patent to Butler, 1,713,215, issued May 14, 1929. I have therefore shown this only diagrammatically in Fig. 5 of the accompanying drawings.

If the filament fails the voltage across the terminals of the series socket increases and the insulating film of the cut-out device breaks down at a predetermined value. This value is lower than that at which the cut-out 91 fails. In one particular instance, for example, the cut-out 139 is constructed to fail at 100 volts and the cut-out 91 at 1000 volts. This allows a leeway such that if the current in the loop circuit fails due to the failure of one or two lamps, the switch will not operate. If the current fails due to a break in the circuit at a place other than the lamp filaments, the voltage across the cut-out 91 will continue to rise to the film rupturing value of the device 91 and will cause an operation of the switch.

By my invention I provide an improved latching device for the switch members 10 and 11. When

the switches have been opened by reason of the failure of the film cutout, the switches remain latched in the open position until the film cutout has been renewed and the holder replaced in the socket. The danger of the re-energization of the broken loop circuit due to the failure or de-energization of the trip coils is, therefore, eliminated.

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

1. In an automatic switch, the combination of a pair of contacts, a normally-closed switch member for connecting said contacts in a predetermined relation, operating means including a coil for operating said normally-closed switch member to its open position, a film cut-out device connected in series with said coil in shunt to said contacts for energizing said coil when a predetermined potential exists across said two contacts, a latching device for latching said switch member in the open position when moved thereto by said operating means, a holder for supporting said film cut-out device, and means operated by said holder for unlatching said switch member.

2. In an automatic switch, the combination of a pair of contacts, a switch member for connecting said contacts in a predetermined relation, means including an operating coil for operating said switch member to disconnect said contacts, a film cut-out device connected in series with said operating coil in shunt to said contacts for energizing said coil when a predetermined potential exists across said contacts, a latching mechanism for holding said switch member in the open position, a removable holder for said film cut-out device, a socket therefor, means operable by said holder for shunting said coil and film cut-out device when said holder is removed from said socket, and means for unlatching said switch member operated by said holder when it is inserted into said socket.

3. In an automatic switch, the combination of a pair of contacts, a normally-closed switch member for connecting said contacts in a predetermined relation, a normally-open switch member for shunting said contacts, operating means including a coil for operating said normally-closed switch member to its open position, a film cut-out device connected in series with said coil across said two contacts for energizing said coil when a predetermined potential exists across said two contacts, an operating shaft for said normally-open switch member, a latching device for latching said normally-closed switch member in the open position, and means operable by said shaft for unlatching said switch member.

4. In an automatically-operated switch, the combination of a pair of main circuit contacts, a pair of secondary circuit contacts, and a pair of shunting contacts, a pair of normally-closed switch members for connecting said main circuit contacts to said secondary circuit contacts respectively, a normally-open switch member for connecting said main circuit contacts to each other, means including a pair of normally-deenergized coils connected in series with an insulating film for opening said normally-closed switch members when said insulating film is broken down, a latching device for maintaining said normally-closed switch members in the open position including an operating shaft for said normally-open switch member, a latching pawl movable to latching position when said magnet operates to open said normally-closed switch members, a releasing pawl, and means including

said shaft and releasing pawl for moving said latching pawl to its release position.

5. In an automatic switch, the combination of a film cut-out, a holder therefor, a switch member, means for moving said switch member to open position when said film cut-out breaks down, means for latching said member in the open position including a pivotally mounted bell-crank having an arm arranged to engage said switch member and to be moved therewith by said switch-opening means, a latching pawl arranged to engage the other arm of said bell-crank and to move to locking position when said bell-crank is moved by said switch-opening means, means for moving said latching pawl to release said bell-crank including a releasing pawl arranged to engage said latching pawl, and means including said film cut-out holder for operating said releasing pawl.

6. In a cut-out device, the combination of a pair of main circuit contacts, a pair of loop circuit contacts, a switch member normally biased to connect said main circuit contacts to said loop circuit contacts respectively, a circuit connected between said main circuit contacts including a trip coil and a film cut-out device in series therewith arranged to break down and pass current when a predetermined voltage exists between said contacts, an armature operated by said trip coil to open said switch member when said trip coil is energized, latching means for said switch member for latching it in open position including a bell-crank pivoted at its vertex having one arm engaging the switch member, a latching pawl engaging the other arm of said bell crank, means for moving said latching pawl into position to latch said bell-crank in the open switch position, and means for moving said pawl to release said bell-crank including a releasing pawl pivotally mounted on a shaft, said shaft operating a switch member for connecting said main circuit contacts to each other, a holder for said film cut-out arranged to engage said shaft and hold it against its bias when the film cut-out is connected in the trip circuit, said shaft being biased to connect said main circuit contacts to each other when said holder is withdrawn to renew the film cut-out and to disconnect said contacts when the holder is replaced, said releasing pawl engaging said latching pawl for moving it to the release position when said shaft moves to separate said main circuit contacts.

7. In a series cut-out switch, the combination of a switch member for normally connecting a loop circuit to a main circuit, means including an operating coil for moving said switch member to open position, a film cut-out device connected in series with said coil and made to permit current flow through said coil upon application of a predetermined voltage across the terminals of said loop circuit, a holder for said device, latching means for holding said switch member in open position independently of said coil, and means operable by said holder for unlatching said switch member.

8. In a series cut-out switch, the combination of a switch member for normally connecting together parts of a series circuit, means including an operating coil arranged when energized to move said switch member to open position, a film cut-out device connected in series with the operating coil in shunt to one part of said circuit and made to pass current after the application of a predetermined voltage across the terminals

of said part, a holder for said cut-out device, a socket for said holder, a latching mechanism for latching said switch member into the open position when moved to that position by said operating coil, and means operated when said holder is placed into said socket for unlatching said switch member.

9. In a series cut-out switch, the combination of a switch member for normally connecting a loop circuit to a main series circuit, means including an operating coil for moving said switch member to open position, a second switch member arranged to be normally open and to shunt said loop circuit when moved to its closed position, a film cut-out device connected in series with said operating coil and made to pass current upon the application of a predetermined voltage across the terminals of said loop circuit, a latching mechanism for latching said switch member into the open position, means for unlatching said switch member, and a holder for said cut-out device for operating said unlatching mechanism and said second switch member.

10. In a series cut-out switch, the combination of a switch member for normally connecting a loop circuit to a main series circuit, means including an operating coil arranged when energized to move said switch member to open position, a second switch member normally open and to shunt said loop circuit in its closed position, a film cut-out device connected in series with said operating coil and made to pass current upon the application of a predetermined voltage across the terminals of said loop circuit, a latching mechanism for latching said switch member into the open position, means for unlatching said switch member, and a holder for said film cut-out device for operating said unlatching mechanism and said second switch member in such manner that said switch member will be moved to closed position before said second switch member is moved to said open position.

11. In an automatic switch, the combination of a pair of contacts, a switch member for connecting said contacts in a predetermined relation, means including an operating coil for operating said switch member to disconnect said contacts, a film cut-out device connected in series with said operating coil across said contacts for energizing said coil when a predetermined potential exists across said contacts, a latching mechanism for holding said switch member in the open position, a removable holder for said film cut-out device, a socket therefor, means operable by said holder for shunting said coil and film cut-out device when said holder is removed from said socket, and means operable by said holder for unlatching said switch member and for interrupting said shunt about said coil and film cut-out device when said holder is inserted into said socket.

12. In an automatic switch, the combination of a pair of contacts, a switch member for connecting said contacts in a predetermined relation, means including an operating coil for operating said switch member to disconnect said contacts, a film cut-out device connected in series with said operating coil across said contacts for energizing said coil when a predetermined potential exists across said two contacts, a latching mechanism for holding said switch member in the open position, a removable holder for said film cut-out device, a socket therefor, means operable by said holder for shunting said coil and film cut-out

device when said holder is removed from said socket and means operable by said holder when inserted into said socket for unlatching said switch member and for interrupting said shunt about said coil and film cut-out device in such manner that the contacts will be connected by said switch member before said shunt circuit is broken.

13. In an automatic switch, the combination of a pair of contacts, a switch member for connecting said contacts in a predetermined relation, means including an operating coil for moving said switch member to disconnect said contacts, a film cut-out device connected in series with said operating coil across said contacts for energizing said coil when a predetermined potential exists across said contacts, a latching mechanism for holding said switch member in the open position, means for supporting said film cut-out device, means operable by said supporting means for establish-

ing and for breaking a shunt circuit about said coil and film cut-out device, and means operable by said supporting means for unlatching said switch member before said shunt circuit is broken.

14. In an automatic switch, the combination of a pair of contacts, a normally-closed switch member for connecting said contacts in a predetermined relation, means including an operating coil for operating said normally-closed switch member to its open position, a film cut-out device connected in series with said coil across said contacts for energizing said coil when a predetermined potential exists across said contacts, a latching device for latching said switch member in the open position when moved thereto in response to the energization of said coil, means for supporting said film cut-out device, and means operable by said supporting means for unlatching said switch member.

FREDERICK A. WEIGEL.