

May 23, 1939.

H. J. CRABBS

2,159,884

ELECTRICAL SWITCH

Filed Dec. 30, 1937

4 Sheets-Sheet 1

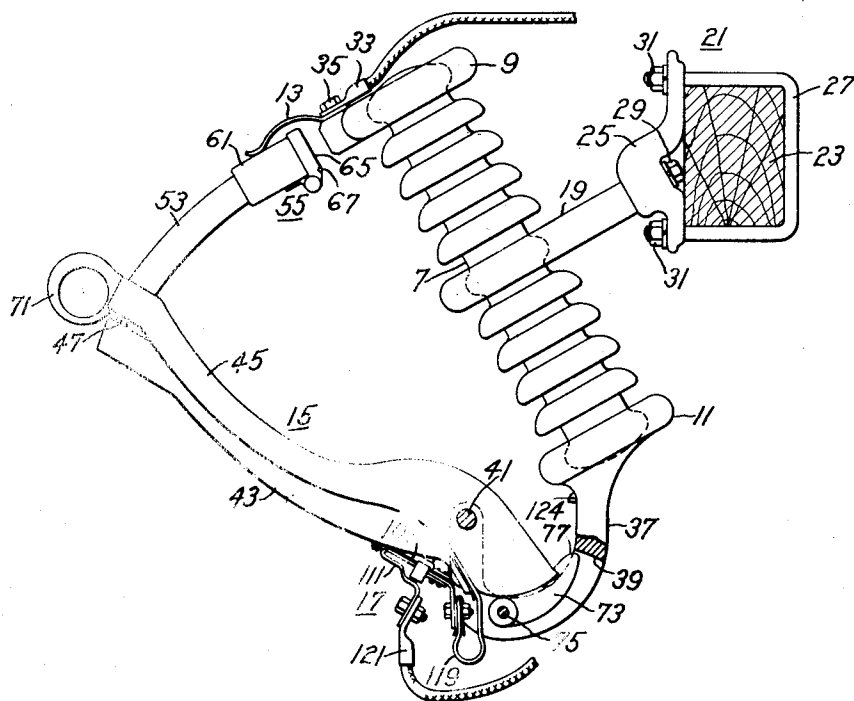


Fig. 1.

WITNESSES:

Wm. B. Sellers
G. S. Parker

INVENTOR

Herbert J. Crabbs.

BY
Ralph H. Swingle
ATTORNEY

May 23, 1939.

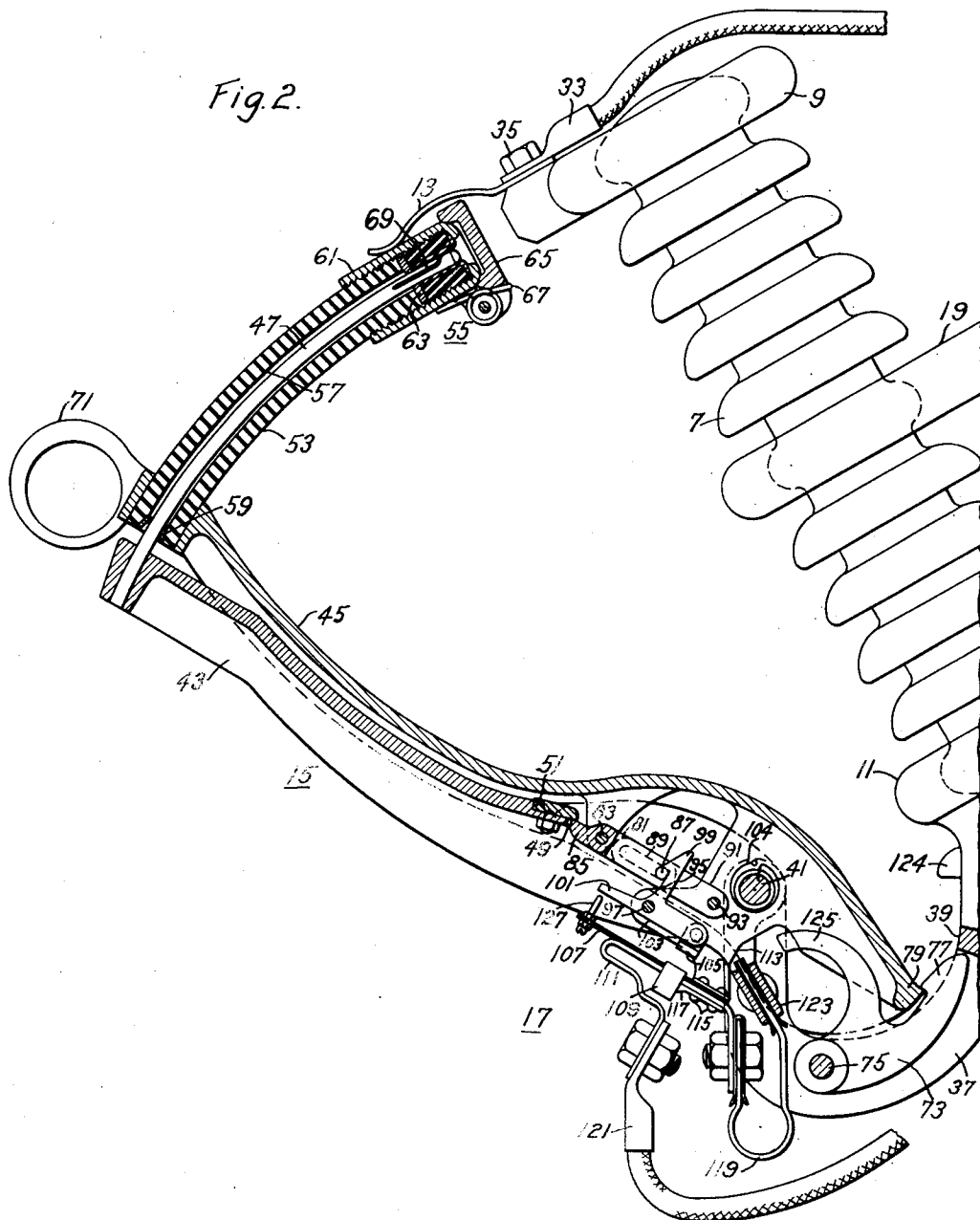
H. J. CRABBS

2,159,884

ELECTRICAL SWITCH

Filed Dec. 30, 1937

4 Sheets-Sheet 2



WITNESSES:

Wm. R. Sellers
G. S. Parker

INVENTOR

Herbert J. Crabbs

BY

Ralph H. Swingle
ATTORNEY

May 23, 1939.

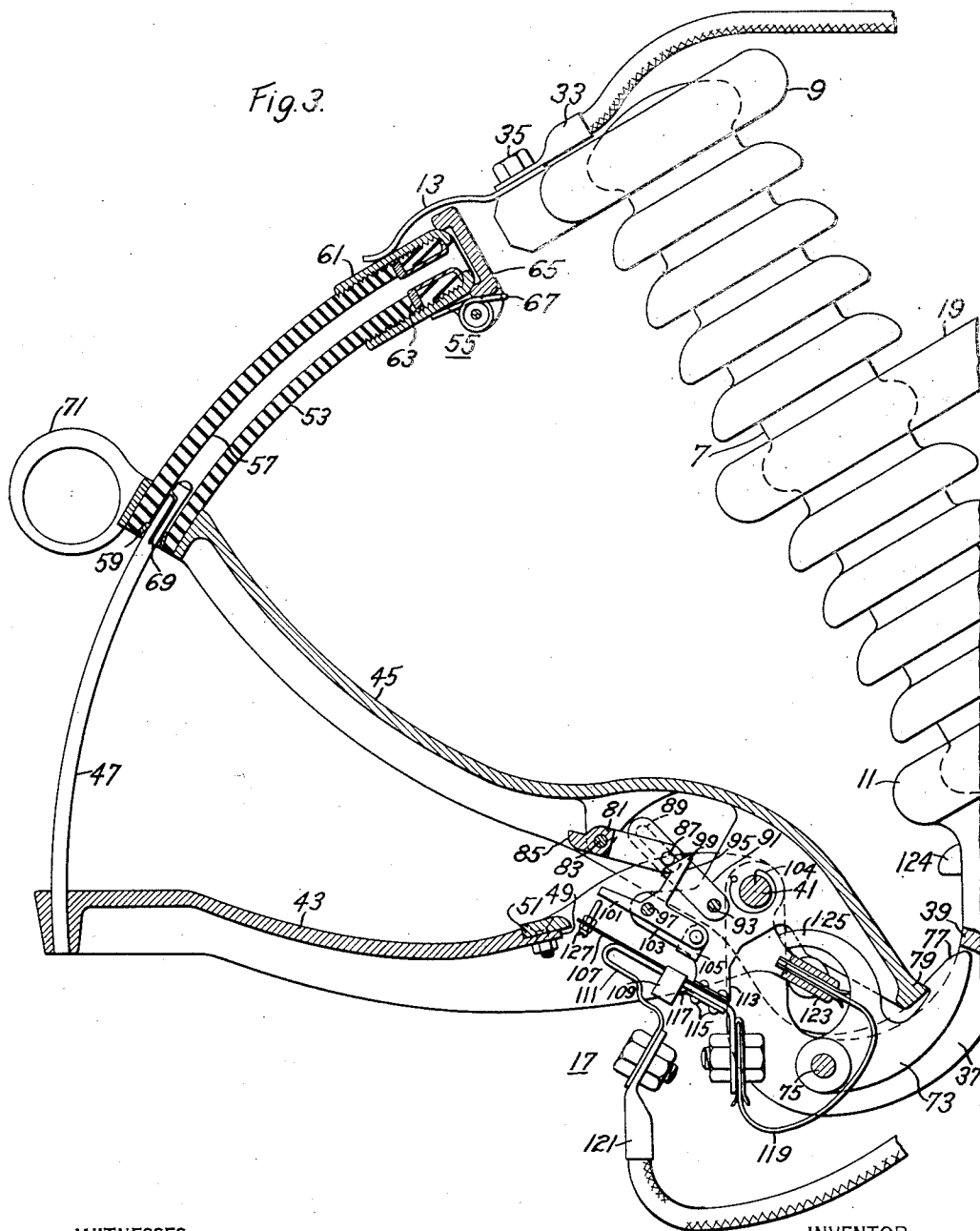
H. J. CRABBS

2,159,884

ELECTRICAL SWITCH

Filed Dec. 30, 1937

4 Sheets-Sheet 3



WITNESSES:

Wm. B. Sellers.

G. S. Parker

INVENTOR

Herbert J. Crabbs.

BY
Ralph J. Swingle
ATTORNEY

May 23, 1939.

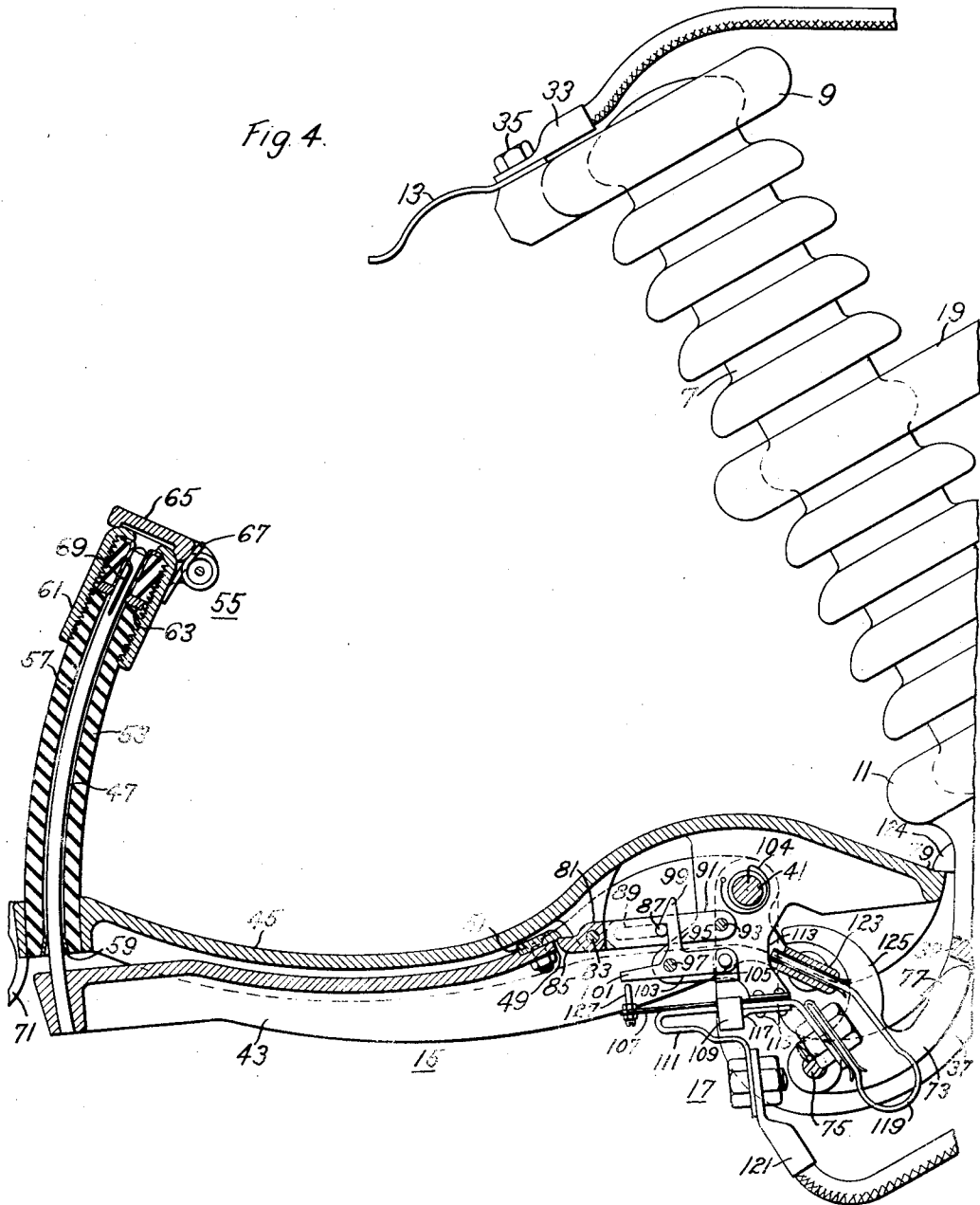
H. J. CRABBS

2,159,884

ELECTRICAL SWITCH

Filed Dec. 30, 1937

4 Sheets-Sheet 4



WITNESSES:

Wm. B. Sellers.
G. S. Parker

INVENTOR

Herbert J. Crabbs.

BY

Ralph J. Swingle
ATTORNEY

UNITED STATES PATENT OFFICE

2,159,884

ELECTRICAL SWITCH

Herbert J. Crabbs, Wilkinsburg, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

Application December 30, 1937, Serial No. 182,495

17 Claims. (Cl. 200—48)

The present invention relates in general to electrical switches and more particularly to an air break switch.

It has heretofore been the usual practice to protect distribution transformers by the provision of fuse type cutouts in the primary circuits. The fuse type cutout while satisfactory in many respects has the inherent disadvantage that the fuse holder must be removed and a new fuse refill inserted after a circuit opening operation. Where the transformer and cutout are mounted on a pole, it is necessary for the operator to climb the pole in order to renew or refill the fuse. The use of overload responsive air break switches in place of the fuse type cutouts for protecting distribution transformers has not been considered practical principally because the air break switches that have heretofore been known have been too large, complicated and expensive to compete with modern fuse type interrupters.

An object of the invention is the provision of an improved air break switch that is operable to open the circuit, quickly extinguish the arc formed, and to provide an air gap in the circuit capable of withstanding high voltages.

Another object of the invention is the provision of an air break switch as described in the preceding paragraph, all of the parts of which are mounted on a single insulating support adapting the switch for mounting on a pole or other support.

Another object of the invention is the provision of an improved air break switch for pole mounting that is automatically operable to open the circuit and extinguish the arc in response to predetermined conditions and that can be easily reclosed from the ground or pole by means of a hook stick.

Another object of the invention is the provision of an air break switch embodying a stationary contact and a movable switch means for opening and closing the circuit, the switch means including a movable contact member and a movable arc extinguishing structure both of which are movable away from the stationary contact.

Another object of the invention is the provision of an air break switch embodying a stationary contact and a movable switch means including a movable contact member and a movable arc extinguishing structure, and an actuating means that is operable during a circuit opening operation to first cause opening movement of the movable contact member and then to cause movement of the arc extinguishing structure away from said stationary contact.

Another object of the invention is the provision of an air break switch as previously described in which the actuating means includes a thermally responsive trip means operable to cause a circuit opening operation in response to lower magnitude overloads of predetermined duration and a magnetically responsive trip means operable to cause a circuit opening operation in response to higher magnitude overloads or short circuit conditions.

Another object of the invention is the provision of an electrical switch as previously described in which the arc extinguishing structure is carried by an operating member to which the movable contact member is releasably connected so as to be trip free of the operating member.

Another object of the invention is the provision of an improved air break switch that is simple, safe and reliable in operation, compact so as to occupy a relatively small amount of space and that can be manufactured at a relatively low cost.

The present invention while capable of general application as an air break switch for protective and sectionalizing purposes is particularly well adapted for protecting distribution transformers and its compact, simple and inexpensive design renders it capable of superseding existing fuse type cutouts for such purposes.

The novel features that are considered characteristic of the invention are set forth in the appended claims. The invention itself both as to structure and operation, together with additional objects and advantages thereof will best be understood from the following detailed description of one embodiment thereof when read in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view partly in section of the electrical switch constructed in accordance with the invention, illustrating the switch in mounted position on a cross arm support.

Fig. 2 is an enlarged fragmentary view, partly in elevation and partly in section, of the switch shown in Fig. 1, illustrating the position of the parts in the closed circuit position of the switch.

Fig. 3 is a view similar to Fig. 2 illustrating the position of the parts at an intermediate stage of a circuit opening operation just prior to release of the operating member; and

Fig. 4 is a view similar to Figs. 2 and 3 illustrating the switch means in the full open circuit position following a tripping operation.

Referring to the drawings, the electrical switch

illustrated therein comprises, in general, a single insulating support 7 on which is mounted a pair of end terminal members 9 and 11, a stationary contact 13, a movable switch means indicated generally at 15 for opening and closing the circuit, and an actuating means indicated generally at 17 for effecting a circuit opening operation of the switch means.

The support 7 consists of an insulating column 10 of vitreous insulating material such as porcelain which has a supporting bracket 19 secured thereto intermediate its ends. The extending end of the bracket 19 is provided with a clamp 21 for mounting the switch on a cross arm 23 of a tower, pole structure or other form of support. The clamp 21 consists of a pair of clamp members 25 and 27, the member 25 of which is secured to the extending end of the bracket 19 by means of a nut 29. The other clamp member 27 is U-shaped for encircling the cross arm 23 and is clamped to the clamp member 25 by means of the nuts 31.

The terminal members 9 and 11 are rigidly secured to the opposite ends of the insulating column 7 in any suitable manner. The stationary contact 13 is of resilient conducting material and this contact, together with a terminal lug 33 is secured to the upper side of the terminal member 9 by a bolt 35 which engages a threaded opening in the terminal member 9. The resilient stationary contact 13 extends outwardly from the terminal member 9 and is adapted to engage a contact sleeve of the switch means, as will be hereinafter described.

The lower terminal member 11 has a depending curved supporting arm 37 formed integral therewith which serves to pivotally support the switch means 15. The lower portion of the supporting arm 37 is bifurcated as indicated at 39 for accommodating the lower end of the switch means 15 and for supporting the transverse pivot pin 41 which forms the pivot axis of the switch means.

The switch means 15 comprises a channel-shaped contact carrying arm 43 and a channel-shaped operating arm 45, both of which are pivotally mounted for swinging movement on the supporting arm 37 by means of the transverse pivot pin 41. The contact carrying arm 43 has a smaller cross section than that of the operating arm 45 so as to lie within the channel of the operating arm in the closed circuit position of the switch, as is shown in Fig. 2.

The contact carrying arm 43 has a movable contact member 47 secured to the outer end thereof. The contact member 47 consists of a curved rod of conducting material, the center of curvature of which coincides with the pivot axis of the switch means formed by the pivot pin 41. The lower portion of the contact carrying arm 43 is provided with a recess, as indicated at 49 (Fig. 2), to allow the arm to clear the actuating means 17 when the arm 43 moves to open circuit position relative to the operating arm 45. A latch piece 51 is secured to the contact carrying arm 43 at the edge which forms the upper end of the recess 49. The latch piece 51 forms a part of a latch means which serves to normally connect the contact carrying arm 43 to the operating arm 45 for movement therewith during the closing operation, and also to hold the contact carrying arm 43 in closed circuit position.

The operating arm 45 of the switch means which is pivotally mounted for swinging movement on the pivot pin 41 carries an arc extinguishing means 53 for extinguishing the arc

formed during circuit interruption, and a contact means indicated generally at 55 which cooperates with the contact member 47 and the stationary contact 13. The arc extinguishing means 53 consists of a curved tube of insulating material secured to the outer end of the operating arm 45. The center of curvature of the tube 53 coincides with the pivot axis of the switch means formed by the pin 41, and the tube is provided with a bore 57 for receiving the movable contact member 47. The tube 53 may be composed of any suitable insulating material which serves to extinguish the arc formed during circuit interruption. The tube may be formed of refractory material, or horn fiber, or of molded insulating material, but in any case, its bore would preferably be lined with an arc extinguishing material. The diameter of the bore 57 of the tube 53 is only slightly greater than the diameter of the contact member 47 so as to provide a restricted confining passage for the arc formed during circuit interruption. The lower end of the bore 57 is provided with a flared metallic sleeve 59 providing a flared outlet to facilitate and guide entrance of the contact member 47 within the bore.

The tube 53 functions as an expulsion arc extinguishing device utilizing a blast of gas through the arc for extinguishing the same. The gas is produced by the action of the arc on the arc extinguishing material of the tube.

The contact means 55 is carried by the upper end of the tube 53 and comprises an outer sleeve 61 of conducting material which is threaded on the outer end of the tube, and an inner ferrule 63 also of conducting material. The ferrule 63 is threaded within the sleeve 61 and is adapted to be engaged by the upper end of the movable contact member 47, as shown in Fig. 2. The members 61 and 63 thus form a contact means which is engaged by the movable contact member 47 and which engages the stationary contact 13 in the closed circuit position of the movable switch means 15. The tip of the contact 47 and the ferrule 63 are preferably formed of a suitable arc-resisting material.

The sleeve 61 pivotally supports a closure cap 65 which serves to close the upper end of the tube 53. The closure cap 65 is biased to closed position by means of a coil spring 67 which encircles the pivot pin of the cap and which has one end in engagement with the sleeve 61 and its other end in engagement with the cap 65.

During the circuit opening operation, the contact carrying arm 43 and the movable contact member 47 move from the closed circuit position shown in Fig. 2 to the open circuit position shown in Fig. 3. During this movement, the operating arm 45 with its arc extinguishing tube 53 and contact means 55 remains in the position shown in Fig. 2. The movable contact member 47 separates from the ferrule 63 of the contact means 55 and moves outwardly of the tube to the position shown in Fig. 3. The arc drawn between the movable contact member 47 and the ferrule 63 of the contact means 55 is quickly extinguished by the action of the arc on the material of the tube, or on the arc extinguishing material lining the tube which produces gas which flows through arc and extinguishes the same. The gas pressure causes the closure cap 65 to open allowing the hot gases to escape. Some of the gas also escapes out of the lower end of the tube 53. The spring 67 returns the closure cap 65 to closed position following escape of the gases. The cap

normally serves to prevent the entrance of moisture within the bore of the ferrule 63 and the tube 53. The upper end portion of the movable contact member 47 is slotted, as indicated at 69, in order to provide resilient pressure engagement of the tip of the contact 47 with the contact means 55.

The operating arm 45 is provided at its outer end with an operating eye 71 which is adapted to be engaged by a hook stick with which means an operator can move the operating member 45 to closed circuit position to close the switch. The operating arm 45 is held in closed circuit position by means of a latch 73 which is pivotally mounted on a transverse pivot pin 75 carried by the bifurcated portion 39 of the supporting arm 37. The latch 73 is provided with a hooked end 77 for engaging the lower end 79 of the operating arm 45 to hold the arm in closed circuit position as shown in Fig. 2. The latch 73 is biased to latching position by means of a suitable spring means (not shown).

The operating arm 45 is provided with a latch member 81 which is pivotally mounted on a pivot pin 83 carried by the operating arm 45. The latch member 81 has a latch nose 85 which is adapted to engage beneath the latch piece 51 carried by the contact carrying arm 43, as shown in Fig. 2. The latch member 81, on the opposite side of the pivot pin 83 from the nose portion 85, carries a latch pin 87, the outer ends of which engage in a pair of slots 89 formed in a pair of guide links 91. The lower ends of the guide links 91 are pivotally mounted on a transverse pivot pin 93 which is carried by the operating arm 45. The latch member 81 and the links 91 form a toggle linkage which when held in its extended position as shown in Fig. 2, serves to connect the movable contact carrying arm 43 to the operating arm 45. The latch member 81 is normally held in latching position and the toggle linkage in the extended position by means of an auxiliary latch member 95 which is pivotally mounted on a pivot pin 97 carried by the operating arm 45. The auxiliary latch member 95 has a hooked end 99 for engaging the pin 87 carried by the latch member 81 to hold the latch member 81 in latching position. The auxiliary latch member 95 is biased to latching position by suitable spring means (not shown). The auxiliary latch member 95 is also provided with a pair of legs 101 and 103, the leg 101 of which is adapted to be engaged by a thermal trip element to effect a tripping operation, and the leg 103 of which carries an armature 105 which forms a part of an electromagnetic tripping means for tripping the switch.

The contact carrying arm 43 and the operating arm 45 are both biased in a counter-clockwise direction about their pivot axis 41 to open circuit position by means of a pair of torsional springs 104 (only one spring being shown). The springs 104 encircle the pivot pin 41 and have their one end secured to the fixed pivot pin 41 and their opposite end secured to the arms 43 and 45, respectively. As has previously been mentioned, the contact carrying arm 43 is normally connected to the operating arm 45 by means of the latch consisting of the latch piece 51 and the latch member 81, and the auxiliary latch means consisting of the pin 87 and the auxiliary latch member 95. The operating arm 45 in turn is releasably held in closed circuit position by means of the latch member 73 which engages the lower end 79 of the operating arm 45.

The actuating means for causing circuit opening operation of the switch means 15 comprises in addition to the biasing forces and latches previously described, a bimetallic trip means consisting of a bimetallic trip element 107, and an electromagnetic trip means consisting of a stationary core 109 and the armature 105 carried by the auxiliary latch member 95. The bimetallic trip element 107 is adapted to be heated in response to the current flowing through the switch by means of a heater strip 111 which is connected in the circuit extending through the switch. The heater strip 111 also forms the energizing conductor for the electromagnetic trip means. The lower end of the heater strip 111 is secured to a bracket 113 which is formed integral with the operating arm 45, the strip being secured to the bracket by means of the rivets 115. The bracket 113 also serves to support the stationary core 109 which is carried by a bracket 117, the bracket 117 being clamped to the bracket 113 by means of the rivets 115. The core 109 is U-shaped and the heater strip 111 passes between the legs of the core, as shown in Fig. 2. The lower end of the contact carrying arm 43 is electrically connected to one end of the heater strip 111 by means of a flexible shunt conductor 119 and the other end of the heater strip 111 is electrically connected to a terminal lug 121. The main body portion of the heater strip 111 passes between the legs of the stationary core 109 and extends for a considerable distance along and against the bimetallic trip element 107. Thus the heater strip 111 serves to heat the bimetallic trip element and to energize the electromagnetic trip means in response to the current flowing through the switch. The circuit through the switch extends from the upper terminal lug 33 to the stationary contact 13, conducting sleeve 61 and ferrule 63 of the contact means 55, through the movable contact member 47, contact carrying arm 43, flexible shunt conductor 119, and through the heater strip 111 to the lower terminal lug 121.

The lower end of the contact carrying arm 43 is provided with a depending portion 123 to which is connected the flexible shunting conductor 119. The depending portion 123 is adapted to engage a projection 125 carried by the latch member 73 when the contact carrying arm 43 moves to open circuit position, to move the latch member 73 to its releasing position. Thus the contact carrying arm 43 in moving to open circuit position automatically moves the latch member 73 to its releasing position. Thus the contact carrying arm 43 when it reaches open circuit position effects release of the operating arm 45 and allows that arm to move to open circuit position. The opening movement of the switch means is limited by a stop lug 124 carried by the lower terminal member 11.

The operation of the switch is briefly as follows: With the parts in closed circuit position, as shown in Fig. 2, let it be assumed that an overload of lower magnitude and predetermined duration occurs in the circuit. The overload current in flowing through the heater strip 111 heats the bimetallic trip element 107 and causes that element to flex in an upward direction. The upper free end of the bimetallic element 107 carries an adjusting screw 127 which engages the leg 101 of the auxiliary latch member 103. The flexing of the bimetallic element 107 moves the auxiliary latch member 95 in a clockwise direction about its pivot axis 97 to disengage the

hooked end 99 thereof from the pin 87 to release the latch member 81. Since the contact carrying arm 43 is biased in a counter-clockwise direction, the release of the latch member 81 permits the contact carrying arm 43 to move downwardly to open circuit position, as shown in Fig. 3. The initial opening movement of the contact carrying arm 43 causes counter-clockwise movement of the latch member 81 about its pivot axis 83, carrying the pin 87 upwardly where it is engaged by the beveled edge of the hook portion 99 of the auxiliary latch member 95 when that member is disengaged by the bimetallic trip element. Thus, resetting of the auxiliary latch 95 is prevented until the operating arm 45 moves to open circuit position. During the movement of the contact carrying arm 43 to open circuit position, the arc drawn between the movable contact member 47 and the ferrule 63 is drawn in and extinguished by the arc extinguishing tube 65. As the contact carrying arm approaches the open circuit position, shown in Fig. 3, the depending projection 123 thereof engages and moves the latch member 73 to releasing position to effect release of the operating arm 45. Since the operating arm 45 is biased to open circuit position, it moves downwardly in a counter-clockwise direction about its pivot axis 41 to open circuit position carrying with it the tube 53 and the contact means 55. Since the circuit has already been interrupted by the movement of the contact carrying arm 43 to open circuit position, no arc will be drawn between the conducting sleeve 61 and the stationary contact 13. The movement of the operating arm 45 with its tube 47 and contact means 55 away from the stationary contact 13 provides an air gap between the switch means 15 and the stationary contact 13 which is capable of withstanding high voltages.

The movement of the operating arm 45 to open circuit position effects automatic resetting of the latch means which serves to normally connect the contact carrying arm 43 with the operating arm 45. As the operating arm 45 approaches the open circuit position, shown in Fig. 4, the nose 85 of the latch member 81 engages the latch piece 51 carried by the contact carrying arm 43 causing clockwise movement of the latch member 81. This clockwise movement of the latch member 81 resets the pin 87 beneath the hooked end 99 of the auxiliary latch member 95, resetting this latch means. The length of the slots 99 in the links 91 is sufficient to allow the toggle linkage to move beyond extended position to allow the nose 85 of the latch member 81 to move past and engage under the latch piece 51. It will thus be seen that in the final portion of the opening movement of the operating member 45, the latch means 51—81, and 97—95 are automatically reset to re-establish the normal connection between the contact carrying arm 43 and the operating arm 45.

If a high magnitude overload or short circuit condition occurs in the circuit controlled by the switch, the electromagnetic trip means consisting of the core 109 and the armature 105 effect a tripping operation to cause automatic opening of the switch. Under such conditions, the armature 105 carried by the auxiliary latch member 95 is attracted by the core 109 causing movement of the auxiliary latching member 95 to its releasing position. This movement of the auxiliary latch member 95 to releasing position effects a circuit opening operation of the switch means 15 in the same manner as previously described in

connection with the thermal tripping operation.

To reclose the circuit breaker, the operator inserts a hook stick in the operating eye and moves the operating member 45 from the open position shown in Fig. 4 to the closed position shown in Fig. 2. As soon as the operating member 45 reaches closed circuit position, the hooked end 77 of the latch 73 reengages the lower end 79 of the operating member 45 to hold the switch means in closed circuit position.

It will be noted that the contact carrying arm 43 is trip free of the operating member 45 so that even though the operator moves the operating member 45 to closed circuit position to close the switch against an overload, the actuating means 17 will cause opening movement of the contact carrying arm 43 irrespective of the position of the operating member 45.

The actuating mechanism 17 is almost entirely enclosed by lower portions of the arms 43 and 45 and is thus effectively protected from rain, sleet and ice formation.

The invention provides an air break switch that is automatically operable to open the circuit and extinguish the arc in response to predetermined overload conditions. The movable switch means including the tube 53 in moving to open circuit position away from the stationary contact 13 provides an air gap capable of withstanding high voltages. The switch embodies the desirable trip free action of the movable contact member so that the switch cannot be closed against an overload. The structure is simple, safe and reliable in operation, occupies a small amount of space and can be manufactured at a relatively low cost, thus enabling the switch to compete with fuse type cutouts for use in protecting distribution transformers. With the tube 35 moved away from the stationary contact in the open position there is no creepage surface between this contact and the switch means other than the insulating support 7.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various omissions, substitutions and changes may be made therein without departing from the spirit of the invention. It is desired, therefore, that the appended claims be given the broadest reasonable construction permissible in view of the prior art.

I claim as my invention:

1. In an electrical switch, a stationary contact, switch means for opening and closing the circuit comprising an arm carrying a movable contact and a second arm carrying an arc extinguishing device, both of said arms being mounted for swinging movement about the same axis to open and to closed circuit position, said contact carrying arm being movable relative to said second arm; and actuating means operable during a circuit opening operation to first cause opening movement of said contact carrying arm relative to said second arm and to then cause movement of said second arm to open circuit position away from said stationary contact member.

2. In an electrical switch, a stationary contact member, switch means movable to open and to closed circuit position for opening and closing the circuit comprising a movable contact member and a movable arc extinguishing device for extinguishing the arm formed during circuit interruption, actuating means for the switch means operable during each circuit opening operation to cause opening movement of said movable contact member followed by movement of said arc

extinguishing device away from said stationary contact, said actuating means comprising releasable latch means for normally holding said switch means in closed circuit position and electro-responsive means operable in response to predetermined conditions to release said latch means to cause a circuit opening operation of said switch means.

3. In an electrical switch, a single insulating column, a stationary contact member mounted on said column at one end, switch means mounted on said column adjacent the other end for movement to open and to closed circuit position to open and to close the circuit comprising a movable contact member and a movable means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption, said movable contact member being movable relative to said means forming the arc extinguishing passage.

4. In an electrical switch, a single insulating column, a stationary contact mounted on said column adjacent at one end thereof, switch means mounted on said column for movement to open and to closed circuit position to open and to close the circuit comprising a movable contact member and a movable means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption and within which the movable contact member extends in the closed position of the switch, actuating means carried by said column operable during each circuit opening operation to first cause movement of said movable contact member to open circuit position during which movement the arc is extinguished, and to then cause movement of said movable means forming the passage to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltage.

5. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a first pivoted arm carrying a movable contact member and a second arm pivoted about the same axis carrying a means forming an arc extinguishing passage into which said movable contact member extends in the closed circuit position of the switch means, actuating means operable during a circuit opening operation to cause movement of said movable contact member and the first arm to open circuit position during which movement the arc is extinguished, and to then cause movement of said second arm and the means forming the passage to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltage.

6. In an electrical switch, a single insulating column, a stationary contact carried by said column adjacent one end thereof, switch means movable to open and to closed circuit position to open and to close the circuit comprising a first and a second arm pivoted to said column adjacent its other end for swinging movement about the same axis, said first arm carrying a movable contact and said second arm carrying a means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption and into which said movable contact extends in the closed position of the switch, actuating means carried by said column operable during a circuit opening operation to first cause

movement of the first arm and movable contact to open circuit position during which movement the arc is extinguished, and to then cause movement of the second arm and means forming the passage to open circuit position away from said stationary contact to provide an air gap between the switch means and stationary contact capable of withstanding high voltages.

7. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a movable contact and a movable means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption, actuating means operable during each circuit opening operation to first cause movement of said movable contact to open circuit position during which movement the arc is extinguished and to then cause movement of said movable means to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltages, said actuating means including an electro-responsive trip means operable in response to predetermined conditions to cause a circuit opening operation.

8. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a movable contact and a movable means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption, actuating means operable during each circuit opening operation to first cause movement of said movable contact to open circuit position during which movement the arc is extinguished and to then cause movement of said movable means to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltages, said actuating means including a bimetallic trip means and an electromagnetic trip means each operable in response to predetermined overload conditions to cause a circuit opening operation.

9. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a first pivoted arm carrying a movable contact member and a second arm pivoted about the same axis carrying a means forming an arc extinguishing passage into which said movable contact member extends in the closed circuit position of the switch means, actuating means operable during a circuit opening operation to cause movement of said movable contact member and the first arm to open circuit position during which movement the arc is extinguished, and to then cause movement of said second arm and the means forming the passage to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltage, said actuating means including an electro-responsive trip means operable in response to predetermined conditions to cause a circuit opening operation.

10. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a first pivoted arm carrying a movable contact member and a second arm pivoted about the same axis carrying a means forming an arc extinguishing passage into which said

movable contact member extends in the closed circuit position of the switch means, actuating means operable during a circuit opening operation to cause movement of said movable contact member and the first arm to open circuit position during which movement the arc is extinguished, and to then cause movement of said second arm and the means forming the passage to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltage, said actuating means including a thermally responsive trip means and an electromagnetic trip means each operable in response to predetermined overload conditions to cause a circuit opening operation.

11. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a movable contact member and a movable means forming an arc extinguishing passage within which said movable contact member is adapted to extend and move, said movable means being provided with a contact means engaged by said movable contact member and engaging said stationary contact in the closed position of the switch means, actuating means operable during each circuit opening operation to first cause movement of the movable contact member to open circuit position during which movement the arc is extinguished, and to then cause movement of said movable means and its contact means to open circuit position away from said stationary contact to provide an air gap between the switch means and stationary contact capable of withstanding high voltages, said actuating means comprising releasable latch means for normally holding said switch means in closed position, and electroresponsive means operable in response to predetermined conditions to release said latch means to cause a circuit opening operation of said switch means.

12. In an electrical switch, a stationary contact, switch means movable to open and to closed circuit position for opening and closing the circuit comprising a pivoted arm carrying a movable contact member and a second arm pivoted about the same axis as said first arm and carrying an arc extinguishing tube within which said movable contact member is adapted to extend, said tube being provided with contact means engaged by said movable contact member and engaging said stationary contact in the closed circuit position of the switch means, actuating means operable during a circuit opening operation to first cause movement of said first arm and movable contact member to open circuit position during which the arc is extinguished, and to then cause movement of said second arm with its tube and contact means to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltages.

13. In an air break switch, a stationary contact, switch means movable to open and to closed circuit position to open and to close the circuit comprising a movable contact member, a movable operating member provided with a means forming an arc extinguishing passage for extinguishing the arc formed during circuit interruption, means releasably connecting said movable contact member to said operating member, actuating means including a trip means operable in response to predetermined conditions to release said movable contact member from the operat-

ing member and cause movement of said movable contact member to open circuit position during which movement the arc is extinguished, and for then causing movement of said operating member and the means forming the passage to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltages, and to reset the connection between the movable contact member and the operating member, said movable contact member being trip free of said operating member.

14. In an air break switch, a stationary contact, switch means movable to open and to closed circuit position for opening and closing the circuit comprising a pivoted arm carrying a movable contact member, an operating arm pivoted about the same axis as the contact carrying arm, said operating arm carrying a means forming an arc extinguishing passage within which said movable contact is adapted to extend and a contact means engaged by said movable contact member and engaging said stationary contact in the closed circuit position of the switch means, means releasably connecting said contact carrying arm and said operating arm for movement together and to maintain said movable contact in engagement with said contact means, actuating mechanism including a trip means operable in response to predetermined conditions to release the connection between said arms and cause movement of said contact carrying arm to open circuit position, during which movement the arc is extinguished, and to then cause movement of said operating member with the means forming the passage and the contact means to open circuit position away from said stationary contact to provide an air gap between said switch means and said stationary contact capable of withstanding high voltages, and to reset the connection between said arms.

15. In an electrical switch, a stationary contact, switch means for opening and closing the circuit comprising a movable contact member biased to open circuit position, an operating member biased to open circuit position, said operating member carrying a means forming an arc extinguishing passage and a contact means engaged by said movable contact member and engaging said stationary contact in the closed position of the switch means, a first latch means for releasably holding said movable contact member in engagement with the contact means of the operating member and for normally connecting said movable contact member to said operating member, a second latch means for releasably holding said operating member in closed circuit position with its contact means engaging said stationary contact, electro-responsive trip means operable in response to predetermined conditions for releasing said first latch means to cause movement of said movable contact member to open circuit position during which movement the arc is extinguished by the arc extinguishing passage, the movement of said movable contact member to open circuit position effecting release of said second latch means to cause movement of said operating member with its contact means to open circuit position away from said stationary contact, the movement of said operating member to open circuit position effecting resetting of said first latch means to connect said movable contact member to said operating member.

16. In an air break switch, a stationary contact, switch means for opening and closing the circuit comprising a pair of arms mounted for swinging movement about the same axis to open and to closed circuit position, one of said arms being movable relative to the other and carrying a movable contact member, the other of said arms carrying a means forming an arc extinguishing passage for extinguishing the arc drawn by said movable contact member.

17. In an electrical switch, a stationary con-

tact, a channel-shaped switch arm pivoted for swinging movement to open and to closed circuit position, said switch arm being disposed so that its channel faces substantially downwardly in both open and closed circuit positions of the arm, and actuating mechanism for the arm including an electro-responsive trip device, said mechanism being disposed within the channel of said arm whereby it is protected from adverse weather conditions.

HERBERT J. CRABBS.