May 7, 1940. H. L. RAWLINS 2,200,122

CIRCUIT INTERRUPTING DEVICE

Filed March 25, 1938 3 Sheets-Sheet 1

Fig. 1.

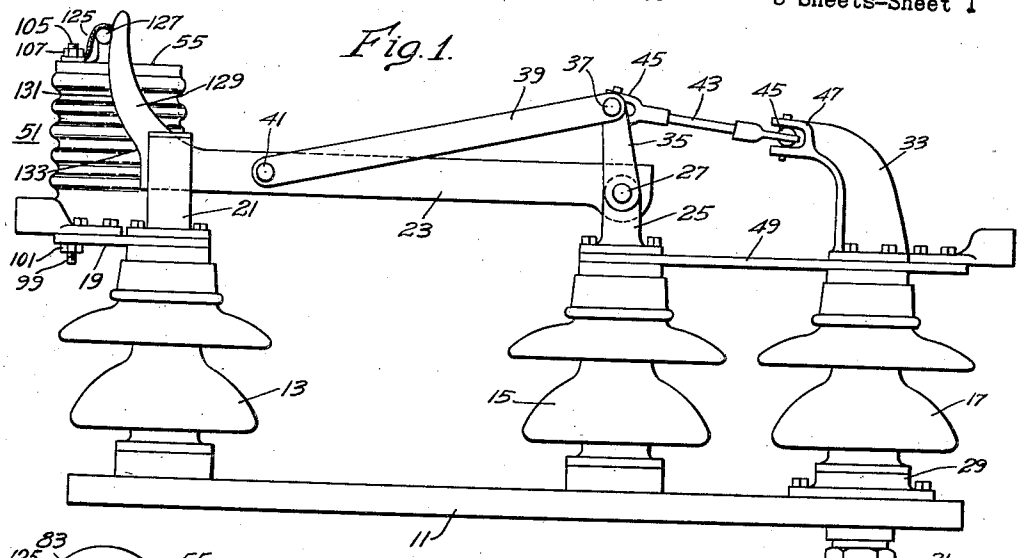


Fig. 2.

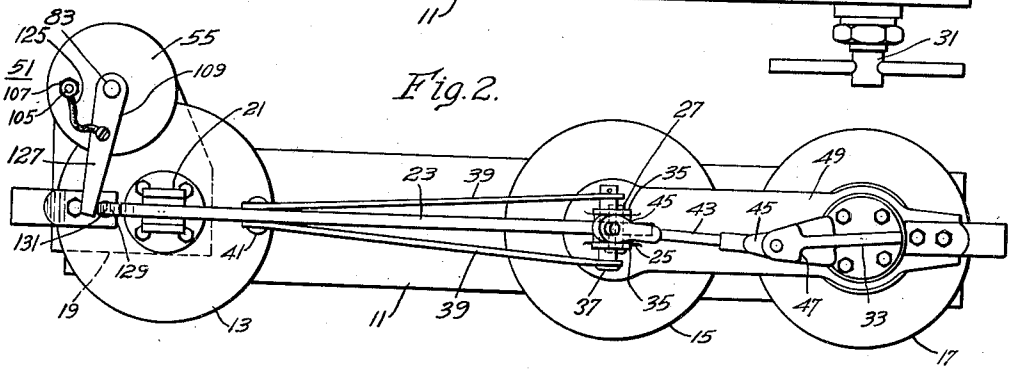
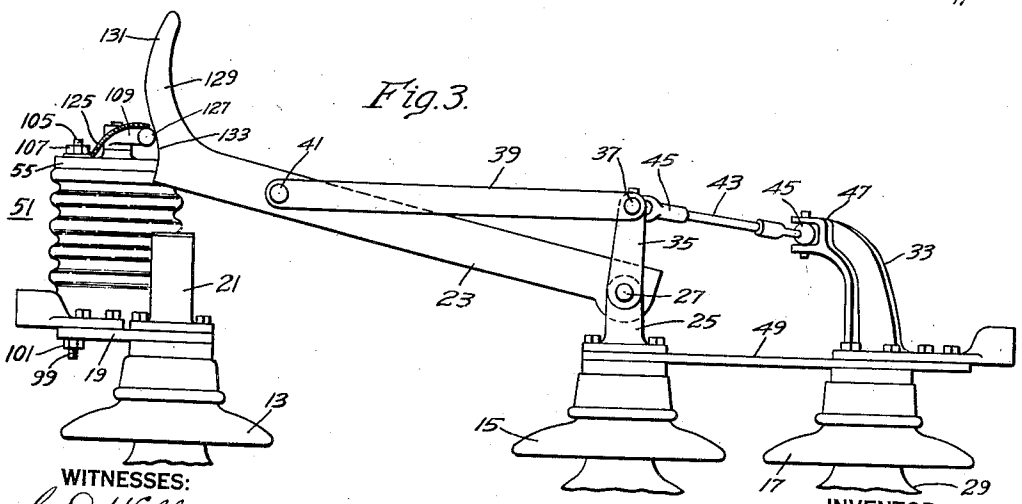


Fig. 3.



WITNESSES:

C. J. Weller.

G. S. Parker

INVENTOR

Herbert L. Rawlins.

BY

Ralph R. Swingle

ATTORNEY

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CIRCUIT INTERRUPTING DEVICE

Filed March 25, 1938 3 Sheets-Sheet 2

Fig. 4.

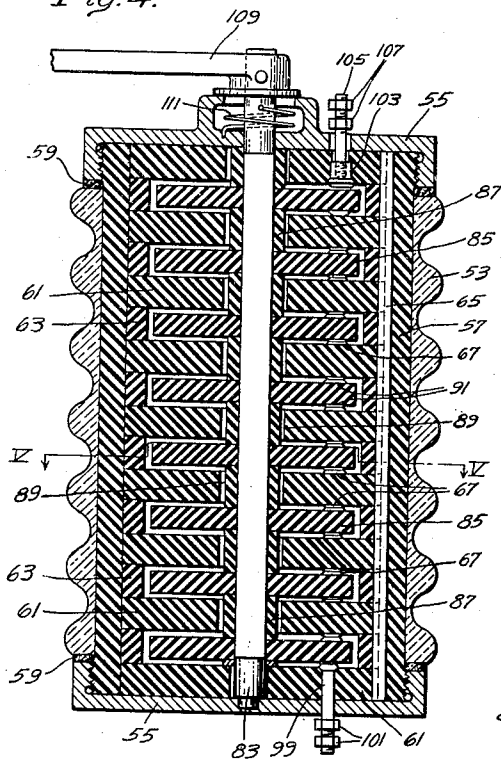
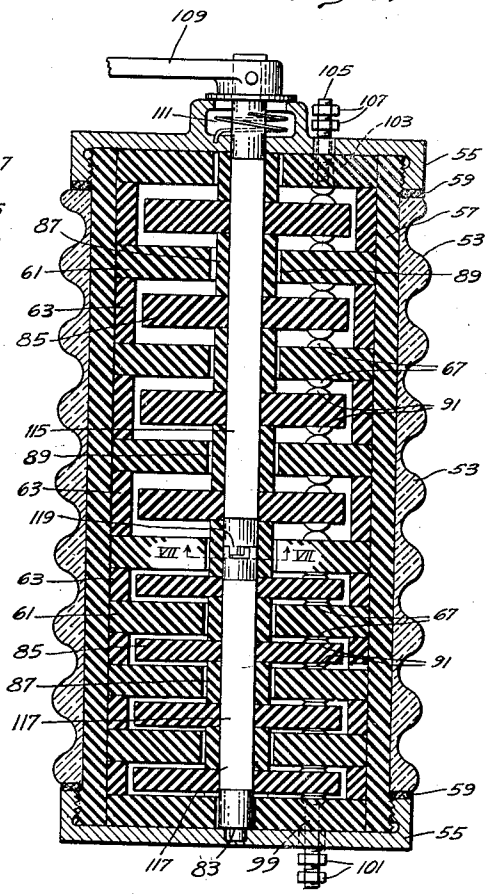


Fig. 6.



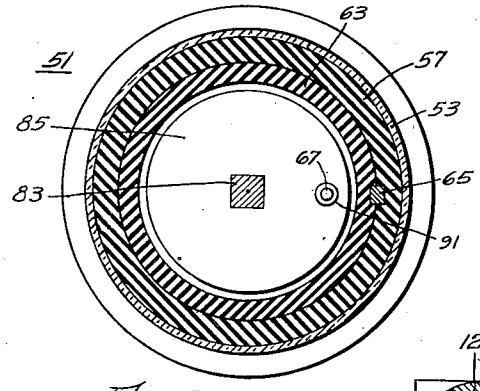


Fig. 5.

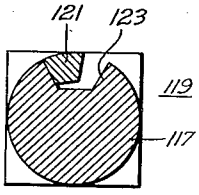


Fig. 7.

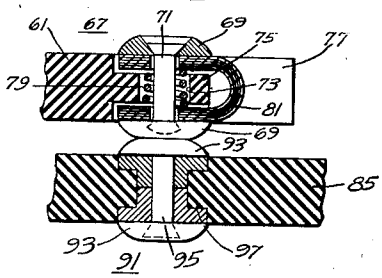


Fig. 8.

WITNESSES:

C. J. Weller.

G. S. Parker

INVENTOR

Herbert L. Rawlins.

BY

Ralph Z. Swingle

ATTORNEY

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CIRCUIT INTERRUPTING DEVICE

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Fig. 9.

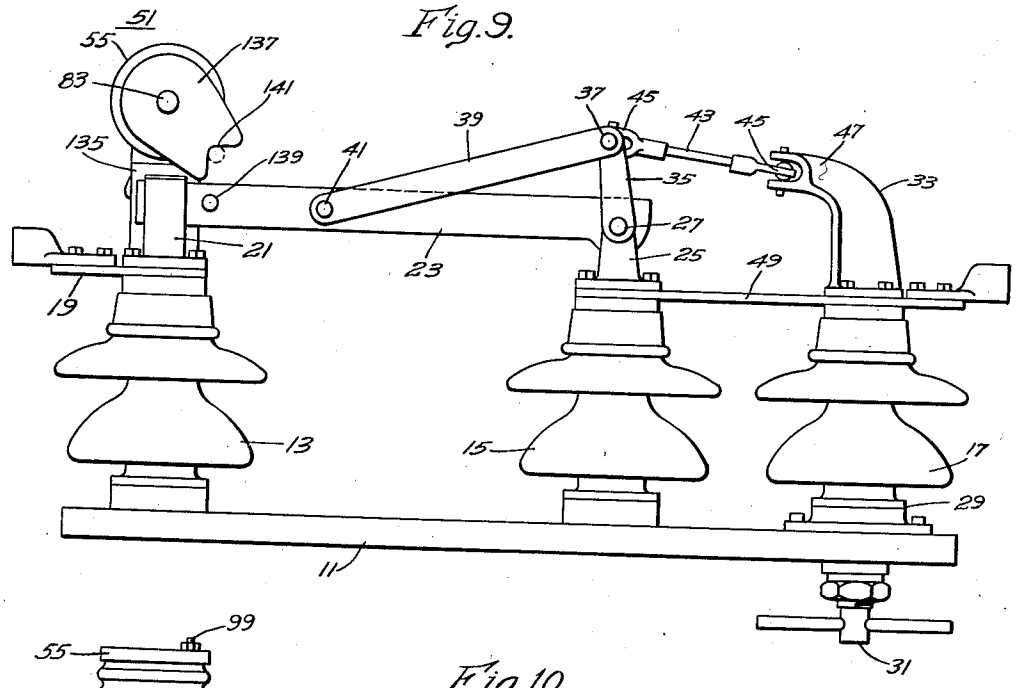
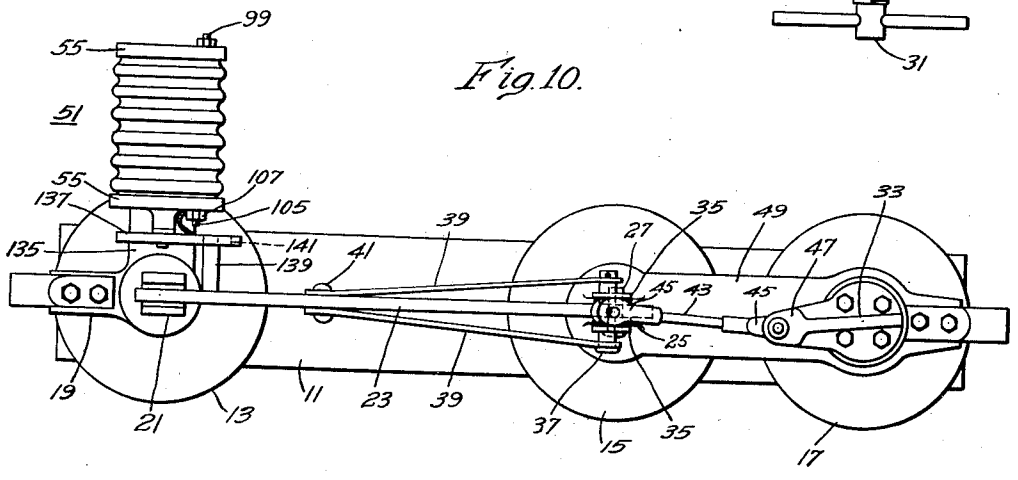


Fig. 10.



WITNESSES:
C. J. Weller.
G. S. Parker

INVENTOR
Herbert L. Rawlins.
BY
Ralph W. Swingle
ATTORNEY

Patented May 7, 1940 2,200,122

UNITED STATES PATENT OFFICE

2,200,122

CIRCUIT INTERRUPTING DEVICE

Herbert L. Rawlins, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application March 25, 1938, Serial No. 198,072

17 Claims. (Cl. 200—146)

The invention relates to circuit interrupting devices, in general, and more particularly, to load break disconnecting switches.

An object of the invention is the provision of a circuit controlling device which functions both as a load current interrupter and as a disconnecting switch.

Another object of the invention is the provision of a load break disconnecting switch in which the opening movement of the switch blade causes actuation of the contact means of an associated arc-extinguishing device for effecting load current interruption subsequent to the separation of the switch blade from the break jaw and prior to swinging the blade to open position away from the break jaw and interrupting device.

Another object of the invention is the provision of a load break disconnecting switch embodying an enclosed current interrupting device operable by movement of the switch blade so that the circuit is always established and interrupted within the interrupting device, thus preventing any arcing between the switch blade and break jaw during operation of the switch.

Another object of the invention is the provision of a load break disconnecting switch embodying an enclosed current interrupting device operable by a rotatable crank which is slidably engaged and operated by a projection on the switch blade during a portion of the movement of the blade. The fact that the interrupter is operable by a rotary movement prevents ice formation from interfering with its operation, since the ice formation is readily broken up by torsional and shearing stresses produced by the rotary movement.

Another object of the invention is the provision of a load break disconnecting switch embodying a current interrupting device that is positively operated to both its open and closed circuit position by the switch blade during a portion of its movement.

Another object of the invention is the provision of an improved current interrupting device which may be readily incorporated in existing disconnecting switch structures to render them capable of interrupting load currents.

Another object of the invention is the provision of an improved load break disconnecting switch as previously described which is simple, reliable in operation under all kinds of adverse weather conditions and which is inexpensive to manufacture.

Another object of the invention is the provision of an improved circuit interrupting device embodying a plurality of pairs of serially connected relatively movable contacts mounted in stack formation within an enclosing casing of insulating material and operable by a single rotatable operating member.

Another object of the invention is the provision of a circuit interrupting device as described above in which the arcs drawn between the contacts during circuit interruption are restricted and extinguished in narrow arc-extinguishing passages or slots.

Another object of the invention is the provision of a circuit interrupting device as previously described in which the stationary contacts are carried by a stack of spaced stationary plates of insulating material and the moving contacts carried by a stack of insulating plates which are rotated between the stationary plates by the operating member so that the arcs drawn between the contacts are restricted and extinguished in the spaces between the insulating plates.

Another object of the invention is the provision of a circuit interrupting device as previously described in which certain of the insulating plates are spaced a sufficient distance apart to interrupt high current arcs and the remaining plates are more closely spaced to interrupt low current arcs, the operating member which operates the rotatable plates being formed in two parts which are coupled by a lost motion connection to insure interruption of the high current arcs in the wider spaced plates before any arcs are drawn in the closely spaced plates.

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

Figure 1 is a side elevational view of a load break disconnecting switch constructed in accordance with the invention, the switch being shown in closed position;

Fig. 2 is a plan view of the switch shown in Fig. 1;

Fig. 3 is a side elevational view similar to Fig. 1, showing the switch blade in the partly opened position and the circuit interrupting device in the open circuit position;

Fig. 4 is an enlarged vertical sectional view of the circuit interrupting device with certain parts shown in elevation;

Fig. 5 is a horizontal sectional view of the circuit interrupting device taken substantially on the line V—V of Fig. 4 and looking in the direction of the arrows;

Fig. 6 is a vertical sectional view, with parts shown in elevation, of a modified form of a circuit interrupting device which is capable of interrupting either high or low current arcs;

Fig. 7 is an enlarged fragmentary sectional view taken substantially on the line VII—VII of Fig. 6;

Fig. 8 is an enlarged fragmentary sectional view showing two of the cooperating contacts of the circuit interrupting device;

Fig. 9 is a side elevational view of a modified load break disconnecting switch; and

Fig. 10 is a plan view of the switch shown in Fig. 9.

Referring to the drawings, and particularly Figs. 1 through 3 thereof, the reference numeral 11 designates a base on which is mounted a pair of stationary insulators 13 and 15 and a rotatable insulator 17, each of which has a metal cap secured to the upper end thereof. The stationary insulator 13 has a terminal plate 19 and a break jaw terminal member 21 bolted to the cap thereof. The jaw member 21 forms a stationary contact of the clip type for receiving the end of a switch blade 23 which is pivotally mounted at its other end on a hinge terminal member 25 bolted to the cap of the other stationary insulator 15. The switch blade 23 is pivotally mounted on a pivot bolt 27 carried by the hinge terminal 25 so that the blade is adapted for swinging movement into and out of engagement with the break jaw terminal 21.

The third insulator 17 is rotatably mounted at its lower end in a bearing 29 secured to the base and has a shaft 31 rigidly secured to the lower end thereof which projects through the base 11 and is adapted to be rotated by any suitable form of operating means. The cap of the insulator 17 has a cast crank arm 33 bolted thereto for rotation with the insulator 17 and the shaft 31. A pair of links 35 are pivoted at their lower ends on the pivot bolt 27 at opposite sides of the blade 23 and have their upper ends pivotally connected by means of a pivot pin 37 to the ends of a pair of actuating links 39. The opposite ends of the actuating links 39 are pivotally connected to the switch blade 23 intermediate its ends by means of a pivot pin 41. A connecting link 43 has its ends connected by the universal connections 45 to the pivot pin 37 and to the forked end 47 of the crank 33 so as to connect the actuating links 39 to the crank 33 for operating the blade 23 to open and to closed circuit position. An elongated terminal plate 49 is clamped at one end to the cap of the insulator 15 and has a bearing opening adjacent its other end for receiving the base of the crank 33. The terminal plate 49 serves to mechanically interconnect the insulators and 15 and 17 to prevent them from being subjected to cantilever stresses during operation of the switch, and also serves as a means for connecting the switch in an electrical circuit.

The switch blade 23 is adapted to be moved to open and to closed circuit position by the rotation of the insulator 17. With the switch in the closed circuit position, as shown in Figs. 1 and 2, rotation of the insulator 17 in a counterclockwise direction, as viewed in Fig. 2, effects rotation of the switch blade 23 in a clockwise direction about its pivot axis 27 from the closed circuit position shown in Fig. 1 to an open circuit position in which the blade assumes a substantially vertical position. Conversely, rotation of the insulator 17 in a reverse or clockwise direction effects movement of the switch blade 23 in a counter-clockwise direction from its substantially vertical open position to the closed position shown in Fig. 1.

In order to render the switch capable of interrupting load currents, there is provided an enclosed circuit interrupting and arc-extinguishing device indicated generally at 51. The arc-extinguishing device 51 is mounted on an extending portion of the terminal plate 19 at the side of the break terminal member 21, and is adapted to be connected in circuit and operated by the switch blade 23 during that portion of the movement of the blade adjacent the break jaw terminal 21, as will be hereinafter described.

Referring to Fig. 4, the arc-extinguishing device comprises a cylindrical casing 53 of strong insulating material, on the ends of which are threaded a pair of metallic closure caps 55. The casing 53 is surrounded by an outer weather-proof housing 57 of vitreous insulating material, such as porcelain or the like, the housing 57 being clamped between the closure caps 55, as shown in Fig. 4. Suitable gaskets 59 of resilient material are interposed between the ends of the housing 57 and the closure caps 55 for sealing the openings and for permitting relative expansion between the inner insulating casing 53 and the housing 57.

Assembled within the casing 53 are a plurality of annular insulating discs or plates 61 arranged in stack formation and spaced apart from each other by a plurality of insulating rings 63. Rotation of the discs 61 and the rings 63 is prevented by a key 65 which engages a vertical slot provided therefor in the casing 53, and aligned key slots provided in the peripheries of the discs 61 and rings 63.

Each of the insulating plates 61 carries a stationary contact means 67 of the construction shown in Fig. 8. The contact means 67 of each plate 61 comprises two annular contact members 69 which are slidably mounted on a rivet 71 carried by the disc 61. The rivet 71 is loosely mounted in an opening 73 provided in a reduced portion 75 of the disc which extends into an opening 77 formed in the disc for the purpose of mounting the contact means. The contacts 69 are disposed on opposite sides of the reduced portion 75 and are biased apart against the enlarged heads of the rivet 71 by means of a coil compression spring 79 which encircles the body of the rivet and is disposed in the opening 73. The contacts 69 are electrically connected together by means of a semi-flexible shunt conductor 81. The stationary contact means 67 of the discs 61 are disposed in vertical alignment within the casing, one above the other.

A rotatable shaft 83 having a square body portion and cylindrical end portions extends centrally within the casing 53 and is rotatably mounted in bearings provided therefor in the closure caps 55. A plurality of rotatable insulating discs 85 are assembled in spaced relation on the squared portiton of the shaft 83 for rotation between the stationary discs 61. The discs 85 are mounted for rotation with the shaft 83 by having square central openings which closely fit the squared portion of the shaft 83, and the discs are spaced the proper distance apart by means of insulating spacer sleeves 87. The sta-

tionary insulating discs 61 are each provided with an enlarged centrally disposed cylindrical opening 89 for accommodating the shaft 83 and the insulating spacer sleeve 87.

Each of the rotatable insulating discs 85 carries a movable contact means 91 comprising a pair of contacts 93 which are rigidly clamped together by means of a rivet 95 in a shouldered opening 97 provided in the disc 85. The contacts 93 project from the opposite sides of the disc 85 and are adapted to engage the stationary contact means 67 on the two adjacent stationary discs 61. The movable contact means 91, which will hereinafter be referred to as the movable contact, thus serves to bridge the stationary contact means 67 of the adjacent stationary discs 61 to establish an electrical circuit therebetween. The movable contacts 91 of the rotatable discs 85 are disposed in vertical alignment, one above the other, and are adapted to be rotated by the shaft 83 into and out of engagement with the stationary contact means 67 carried by the stationary discs 61, to open and to close an electrical circuit through the interrupter.

The lowermost stationary insulating disc 61 is provided with a terminal stud 99 which is disposed in alignment with the stationary contact means 67. The terminal stud 99 has an upper contact portion adapted to be engaged by the movable contact 91 of the lowermost rotatable insulating disc 85 in the closed circuit position of the interrupter, and also has a threaded portion which extends through an opening in the lower closure cap 55 for receiving a pair of terminal nuts 101. The uppermost stationary insulating disc 61 carries a contact member 103 which is disposed in alignment with the stationary contact means 67 of the other insulating discs 61 so as to be engaged by the movable contact 91 of the uppermost rotatable disc 85 in the closed circuit position of the interrupter. The contact 103 is internally threaded for receiving a terminal stud 105 on which are mounted a pair of terminal nuts 107. The terminal studs 99 and 105 serve to connect the interrupter in an electrical circuit.

The upper end of the rotatable shaft 83 extends through a collar in the upper closure cap 55 and has a crank arm 109 rigidly secured thereto for rotating the shaft 83. A helical spring 111 encircles the shaft 83 and has one end secured to the closure cap and its other end secured to the shaft 83. The spring 111 serves to bias the crank arm 109 to an open circuit position in which the movable contacts 91 are all separated from the stationary contact means 67.

The arc-extinguishing device 51 is shown in the closed circuit position in Fig. 4 and in this position a circuit is completed from the upper terminal stud 105 through the series of stationary contact means 67 carried by the stationary insulating discs 61 and through the cooperating movable contacts 91 carried by the rotatable discs 85 to the opposite terminal stud 99.

To open the circuit interrupter, the operating member 109 is released and the spring 111 rotates the shaft 83 and the plurality of discs 85 to cause simultaneous rotation of all of the movable contacts 91 carried by the discs 85 out of engagement with the stationary contact means 67 carried by the stationary insulating discs 61. To close the circuit interrupter the crank arm is rotated in the opposite direction to cause all of the movable contacts 91 to be simultaneously rotated into engagement with the stationary contact means 67. Suitable stops, not shown, may be provided for limiting rotation of the shaft 83 to insure alignment of the contacts in the closed circuit position of the interrupter and to determine the degree of opening of the contacts in the open circuit position of the interrupter.

The stationary discs 61, the rotatable discs 85, the spacer sleeves 87 and the rings 63 are preferably composed of a material known as horn fibre which gives off an arc-extinguishing gas when acted upon by an arc. If desired, however, other suitable types of insulating material may be used which are non-gas-evolving but which are not readily decomposed by the action of an arc. The plurality of serially connected arcs drawn between the movable contacts 91 and the stationary contact means 67 during a circuit opening operation of the device are restricted in the spaces between the stationary discs 61 and the rotatable discs 85, and are quickly extinguished due to their intimate engagement with the surfaces of the discs. The current interrupting ability of the device depends to a large extent upon the amount of space between the relatively movable insulating discs. Where the discs are spaced relatively close together, the device will interrupt high voltages, but will not be capable of withstanding very large values of ocurrent. Likewise, where the spaces between the discs are made larger, the device will interrupt larger amounts of current satisfactorily but will not be so effective on lower magnitude currents.

A slightly modified form of circuit interrupter is shown in Fig. 6 which is capable of interrupting currents of either high or low magnitude. The structure of the device shown in Fig. 6 is substantially identical to the interrupting device shown and described in connection with Fig. 4, with the exception that the stationary insulating discs 61 and the rotatable insulating discs 85 in the upper section of the device are spaced a wider distance apart than the discs in the lower section, and the rotatable shaft is made in two sections which are connected by a lost motion connection. Since the structure shown in Fig. 6 is substantially identical to the interrupting device previously described, with the exception pointed out above, it is not deemed necessary to describe this structure in detail. The same reference characters have been used to designate the corresponding parts wherever applicable. As has previously been mentioned, the stationary insulating discs 61 and the rotatable insulating discs 85 in the upper section of the interrupting device are spaced apart a greater distance than the discs in the lower section of the device. This is effected by having the spacer rings 63 and the spacer sleeves 87 in the upper section of greater width or depth than the corresponding elements in the lower section of the interrupting device. To compensate for the greater spacing of the discs, the movable contacts 91 carried by the rotatable discs 85 and the stationary contact means 67 carried by the stationary discs 61 are designed to project a greater distance above the surfaces of the disc so that they will engage in the closed circuit position of the interrupting device. The rotatable discs 85 in the upper section of the device are assembled upon an upper section 115 of the shaft 83 and the rotatable discs 85 in the lower section of the device are assembled upon a lower section 117 of the shaft 83. The sections 115 and 117 of the shaft are rotatable relative to each other and are connected together by a lost motion connection indicated

generally at 119. The lost motion connection comprises a projection 121 formed integral with the lower end of the upper section 115 of the shaft which engages in a V-shaped recess 123 formed in the upper end of the lower section 117 of the shaft. The V-shaped recess 123 is of considerably greater width than the projection 121 so that the upper section 115 is permitted to rotate a limited amount relative to the lower section 117.

The operation of the interrupting device is briefly as follows. When the crank arm 109 is released, the spring 111 causes rotation of the upper section 115 of the shaft to effect simultaneous rotation of the movable contacts 91 in the upper section of the device to open circuit position away from the stationary contact means 67 carried by the stationary discs 61. During the rotation of the upper section 115 of the shaft, the projection 119 rotates in the recess 123 until it engages the opposite wall. After the projection 119 engages the opposite wall, the rotation of the upper section 115 of the shaft causes rotation of the lower section 117 of the shaft to effect simultaneous rotation of the movable contacts 91 in the lower section to open circuit position away from the cooperating stationary contact means 67 carried by the stationary discs 61. In closing the interrupting device substantially the reverse action takes place. Rotation of the crank arm 109 in the reverse direction first effects movement of the movable contact 91 in the upper section into engagement with the cooperating stationary contact means 67. During this movement, the lost motion between the upper and lower sections 115 and 117 is taken up and the lower section 117 of the shaft is rotated to effect movement of the movable contacts 91 in the lower section into engagement with the stationary contact means 67. During a circuit opening operation of the device, currents of large magnitude are interrupted in the spaces between the stationary discs 61 and the rotatable discs 85 in the upper section of the device, that is, in the wider spaces. Interruption of lower magnitude currents is effected in the space between the discs in the lower section of the device, that is, in the smaller spaces. The lost motion connection insures opening of the contacts in the upper section to interrupt large magnitude currents before any arcs are drawn in the lower section of the device.

It will be understood that in both of the previously described embodiments of the circuit interrupter, the device may be provided with suitable vents to permit the escape of gases formed during circuit interruption.

The circuit interrupting device 51, which may be either of the structure shown in Fig. 4 or that shown in Fig. 6, is mounted in a vertical position on an extension of the terminal plate 19 at the side of the break terminal member 21, and is electrically connected to the break terminal member 21 by means of the terminal stud 99 and nuts 101. The upper terminal stud 105 of the interrupting device is connected by a flexible shunt conductor 125 to a conducting portion 127 of the crank arm 109. The switch blade 23 is provided with a cam projection 129 which has a cam surface 131 engageable with the conducting portion 127 of the crank 109 during that portion of the movement of the switch blade adjacent the break jaw terminal 21. The interrupting device 51 is thus electrically connected in shunt relation between the break jaw member 21 and the cam projection 129 of the switch blade 23.

The operation of the device is briefly as follows. When the switch blade 23 is in closed circuit position in engagement with the break jaw terminal 21, as shown in Fig. 1, the cam projection 129 engages the crank arm 109 of the interrupting device 51 to maintain the device in closed circuit position, in which the movable contacts 91 of the interrupting device are in engagement with the stationary contact means 67. In this position of the switch, substantially the greatest portion of the current flows through the switch blade 23 and the break jaw terminal 21, since the electric resistance of this path is considerably less than the path through the interrupting device 51.

To open the switch, the rotatable insulator 17 is moved in a counter-clockwise direction, as viewed in Fig. 2, to cause rotation of the switch blade 23 in a clockwise direction about its pivot axis 27 from the closed circuit position shown in Fig. 1 to a substantially vertical open position. The curvature of the cam surface 131 of the cam projection 129 is such that the crank arm 109 of the interrupting device is maintained in closed circuit position until after the blade 23 has separated a predetermined distance from the break jaw terminal 21. As soon as the blade 23 disengages the break jaw terminal 21, the current flowing through the blade is shunted through the contacts of the interrupting device 51 to the terminal plate 19, by-passing the break jaw terminal member 21. The continued opening movement of the switch blade 23 after it has separated from the break jaw terminal 21 causes the crank arm 109 which is biased against the cam surface 131 to move along the low portion 133 of the cam during which the crank arm 109 is rotated in a counter-clockwise direction as viewed in Fig. 2, to effect rotation of the movable contacts 91 of the interrupting device to open circuit position out of engagement with the stationary contact means 67. The arcs drawn between the contacts 91 and the stationary contact means 67 are quickly extinguished within the interrupting device and the circuit is thus interrupted. The continued opening movement of the switch blade 23 after the circuit has been interrupted by the device 51 causes the free end of the blade 23 to disengage the crank arm 109. The blade 23 then moves on to its substantially vertical open circuit position to provide a large air gap between the break jaw terminal member 21 and interrupting device 51 and the hinged terminal member 25. In closing the switch, substantially the reverse action takes place. The insulator 17 is rotated in a reverse or clockwise direction to cause movement of the switch blade 23 in a counter-clockwise direction from its substantially open vertical position to the closed circuit position shown in Fig. 1. During the latter part of the closing movement of the switch blade, before it engages the break jaw terminal 21, the cam projection 129 engages and moves the crank arm 109 in a clockwise direction, as viewed in Fig. 2, to effect closing of the contacts of the interrupting device 51. This closing of the contacts of the interrupting device takes place prior to the engagement of the blade 23 with the break jaw terminal 21. It will thus be seen that the circuit through the switch is always made and interrupted through the contacts of the interrupting device 51 so that no arcing will take place between the switch blade 23 and the break jaw terminal member 21.

A slightly modified form of load break disconnect switch is illustrated in Figs. 9 and 10. The

interrupting device and the switch in the modification shown in Figs. 9 and 10 are substantially identical to the interrupting device 51 and the switch previously described, with the exception that the interrupting device 51 is mounted in a horizontal position and has a different form of operating crank, which cooperates with the projection carried by the switch blade 23 thus eliminating the necessity for the cam projection described in the original embodiment of the invention. Since the switch and interrupting device shown in Figs. 9 and 10 are substantially identical in construction to the switch and interrupting device previously described, it is not deemed necessary to completely describe this structure. The same reference characters have been used to designate the corresponding parts wherever applicable. In this modification, the interrupting device 51 is mounted in a horizontal position on a U-shaped bracket 135 which is formed integral with the terminal plate 19. A forked crank arm 137 of conducting material is secured to the extending end of the shaft 83 of the interrupting device 51. One terminal of the interrupting device 51 is electrically connected to the bracket 135 and the other terminal is electrically connected by a flexible shunt conductor, not shown, to the crank arm 137. A laterally extending stud 139 projects from the side of the blade 23 for engaging a V shaped notch 141 of the crank 137. The operation of the switch is briefly as follows. When the switch blade 23 is moved from the closed circuit position shown in Fig. 9 to its substantially vertical open circuit position by rotation of the insulator 17, the projection 139 slidably engages one side of the V shaped notch 141 prior to disengagement of the blade 23 from the break jaw terminal 21 to electrically connect the blade 23 in circuit with the interrupting device 51. As soon as the blade 23 disengages the break jaw terminal 21, the current flowing through the blade is shunted through the interrupting device 51 to the terminal plate 19, bypassing the break jaw terminal 21. By the time the blade 23 has separated from the break jaw terminal 21 a predetermined distance, the projection 139 carried by the blade engages the opposite side of the V-shaped notch 141 so that further rotation of the blade positively moves the crank 137 in a counter-clockwise direction, as viewed in Fig. 9, to effect simultaneous opening of the contacts of the interrupting device 51. The plurality of arcs drawn between the contacts of the interrupting device 51 are restricted and quickly extinguished in the spaces between the relatively movable insulating plates to effect interruption of the circuit. The continued opening movement of the blade 23 following interruption of the circuit by the interrupting device causes the projection 139 carried by the blade 23 to disengage the crank 137. The switch blade 23 then continues its movement to its substantially vertical open position to provide a large air gap between the break jaw terminal 21, the interrupting device 51 and the hinged jaw terminal 25. In closing the switch substantially the reverse action takes place. The switch blade 23 is moved in a counter-clockwise direction from its substantially vertical open position to the closed circuit position shown in Fig. 9. During the latter part of the closing movement of the blade prior to its engagement with the break jaw terminal 21, the projection 139 engages the V-shaped notch 141 of the crank 137 and causes rotation of the crank in a clockwise direction to effect closing of the contacts of the interrupting device 51 prior to the engagement of the blade with the break jaw terminal member 21. Thus the circuit is always made and interrupted within the interrupting device 51 so that no arcing takes place between the blade 23 and the break jaw terminal 21. An important advantage of this form of switch is that the crank or operating member of the interrupting device is positively operated by the blade both during closing and opening of the switch.

Both forms of the disconnecting switch constructed in accordance with the invention embody an interrupting device which is operable by a rotatable operating member. This is a particularly desirable feature for the reason that ice and sleet formation are not likely to interfere with the operation of the switch or interrupting device due to the fact that the ice or sleet formation is readily broken by the rotatable movement of the operating member of the interrupting device. All arcing takes place within the interrupting device which is enclosed so that there is no danger of any uncontrolled arc causing damage to an adjacent apparatus. The interrupting device is capable of being readily incorporated in existing types of disconnecting switches with very slight changes in the existing structures.

The invention provides a disconnecting switch capable of interrupting load currents which is simple, reliable in operation under all kinds of adverse weather conditions, and which is inexpensive to manufacture.

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

I claim as my invention:

1. In a circuit interrupter, a stationary contact, a movable switch blade, means for moving said blade into and out of engagement with said stationary contact, an enclosed arc extinguishing device having relatively movable arcing contacts one of which is connected to said stationary contact, and a rotatable means for opening and closing said contacts, means including a projection on said blade engageable with said rotatable means during only a portion of the movement of said blade adjacent said stationary contact for connecting said blade in circuit with said device and for causing rotation of said rotatable means to open said arcing contacts immediately following disengagement of said blade from said stationary contact during an opening operation of the blade.

2. In a circuit interrupter, a pair of spaced conducting members, a movable switch blade for bridging said members, means for moving said blade into and out of engagement with at least one of said conducting members, an enclosed arc extinguishing device having relatively movable arcing contacts and a rotatable operating member for opening and closing said contacts, said arcing contacts being connected in circuit with said one conducting member and said operating member, means on said blade engageable with said operating member only during a portion of the movement of said blade adjacent said conducting member for connecting said blade in circuit with said device and for causing rotation of said operating member to open said arcing con-

tacts immediately following disengagement of said blade from said conducting member.

3. In a circuit interrupter, a pair of spaced conducting members, a movable switch blade for bridging said members to establish a circuit therebetween, means for moving said blade into and out of engagement with at least one of said conducting members, an arc extinguishing device having relatively movable arcing contacts and a rotatable operating member for opening and closing said contacts, said arcing contacts being connected in circuit with said one conducting member and said operating member, a cam on said blade engageable with said operating member only during a portion of the movement of said blade adjacent said conducting member for connecting said blade in circuit with said device and for causing rotation of said operating member to open said arcing contacts immediately following disengagement of said blade from said conducting member.

4. In a circuit interrupter, a stationary contact, a cooperating contact member movable to a closed circuit position in engagement with said stationary contact and to an open circuit position away from said stationary contact to provide an air gap capable of withstanding high voltages, means for moving said contact member to open and to closed circuit position, an arc extinguishing device having relatively movable arcing contacts and a rotatable operating member for opening and closing said arcing contacts, said contacts being connected to said stationary contact and to said operating member, means on said contact member engageable with said operating member during a portion of the movement of said contact member adjacent said stationary contact for shunting the current through said device when said contact member separates from said stationary contact and for causing rotation of said operating member immediately after said contact member has separated from said stationary contact to open said arcing contacts, during an opening operation of the contact member, said contact member and the means thereon disengaging said operating member and moving to open circuit position away from said device and conducting member following interruption of the circuit by said device.

5. In a circuit interrupter, a stationary contact, a movable switch blade, means for moving said blade into and out of engagement with said stationary contact, an enclosed arc extinguishing device having relatively movable arcing contacts, one of which is electrically connected to said stationary contact, and a rotatable crank for opening and closing said contacts, means including a projection on said blade engageable with said crank only during a portion of the movement of said blade adjacent the stationary contact for connecting said blade in circuit with said device and for causing rotation of said crank to open said arcing contacts immediately following disengagement of said blade from said stationary contact.

6. In an electrical switch, a terminal, a movable switch blade, operating means for moving said blade into and out of engagement with said terminal, an enclosed arc extinguishing device adjacent said terminal having relatively movable arcing contacts and a rotatable crank for opening and closing said contacts, said arcing contacts being connected in circuit with said terminal and said crank, means on said blade engageable with said crank during a portion of the movement of said blade adjacent said terminal for electrically connecting said blade in circuit with said device and for causing rotation of said crank, said blade and the means thereon being operable by said operating means during an opening operation to rotate said crank to open said arcing contacts immediately following disengagement of the blade from said terminal and to disengage said crank and move to a position away from said device and terminal following interruption of the circuit by said device to provide a large air gap in the circuit capable of withstanding high voltages.

7. In an electrical switch, a pair of spaced insulator columns, a terminal mounted on each of said columns, a movable switch blade for bridging said terminals to provide an electrical circuit therebetween, operating means for moving said blade into and out of engagement with at least one of said terminals, an enclosed arc extinguishing device supported on the insulator column of said one terminal comprising relatively movable arcing contacts and a rotatable crank for opening and closing said contacts, said arcing contacts being connected in circuit with said one terminal and a conducting portion of said crank, means on said blade engageable with the conducting portion of said crank during a portion of the movement of said blade adjacent said one terminal for connecting said blade in circuit with said device, and for causing rotation of said crank, said blade and the means thereon being operable by said operating means during a circuit opening operation to cause rotation of said crank for opening said arcing contacts immediately following the disengagement of the blade from said one terminal, and to disengage said crank following interruption of the circuit by said device and move to a position away from said device and said one terminal to provide a large air gap in the circuit capable of withstanding high voltage.

8. In a circuit interrupter, a stationary contact, a movable switch blade, operating means for moving said blade into and out of engagement with said stationary contact, an enclosed arc extinguishing device adjacent said stationary contact comprising a plurality of relatively rotatable arcing contacts connected in series and mounted within an insulating casing, a rotatable member extending into said casing for opening and closing said contacts, a crank on said rotatable member outside said casing for rotating said member, said device being connected in circuit with said stationary contact and said crank, means on said blade engageable with crank during a portion of the movement of the blade adjacent said stationary contact for connecting the blade in circuit with the device and for causing rotation of the crank to open said arcing contacts immediately following the disengagement of the blade from said stationary contact during an opening operation of the blade, said blade and the means thereon being disengageable from said crank and movable to an open position away from said device and the stationary contact by said operating means following interruption of the circuit by said device.

9. A circuit controlling device comprising stationary contact means, a cooperating contact member movable to a closed circuit position in engagement with the stationary contact means and to an open circuit position away from said stationary contact means, operating means for moving said contact member to open and to

closed circuit position, an arc extinguishing structure having arcing contact means through which the current is shunted as soon as the contact member separates from said stationary contact means, means of insulating material which gives off an arc extinguishing gas when acted on by an arc for restricting and extinguishing arcs drawn by said arcing contact means, and a rotatable operating member for opening and closing said arcing contact means, means movable with said contact member engageable with said rotatable member only during a portion of the movement of said contact member adjacent said stationary contact means for causing rotation of said operating member to open said arcing contact means immediately after said contact member disengages said stationary contact means.

10. A circuit controlling device comprising stationary contact means, a cooperating contact member movable to a closed circuit position in engagement with the stationary contact means and to an open circuit position away from said stationary contact means, operating means for moving said contact member to open and to closed circuit position, an enclosed arc extinguishing structure having relatively rotatable arcing contacts through which the current is shunted as soon as the contact member separates from said stationary contact means, means of insulating material which gives off an arc extinguishing gas when acted on by an arc for restricting and extinguishing arcs drawn by said arcing contact means, and a rotatable operating member for opening and closing said arcing contacts, means movable with said contact member and engageable with said rotatable member only during a portion of the movement of said contact member adjacent said stationary contact for causing rotation of said operating member to open said arcing contact immediately after said contact member disengages said stationary contact means.

11. A circuit interrupting device comprising a plurality of plates of an insulating material which gives off an arc extinguishing gas when acted on by an arc, said plates being superposed one above the other in predetermined spaced relation, predetermined plates being rotatable relative to the other plates, separable contacts between the plates actuable to open and to closed circuit position by the angular movement of the rotatable plates, and means restricting the arcs drawn between said contacts during circuit interruption in the space between said plates.

12. An enclosed circuit interrupter comprising a plurality of plates of an insulating material which gives off an arc extinguishing gas when acted on by an arc, said plates being superposed one above the other in predetermined spaced relation for defining a plurality of arc chambers, certain of said arc chambers being of larger dimension than other of said chambers, the alternate plates being mounted for rotation relative to the other plates, means for rotating said alternate plates through a predetermined angle, separable arcing contacts supported on adjacent plates actuable in response to rotation of said alternate plates to establish a plurality of serially connected arcs within said arc chambers which are quickly extinguished therein, and means for restricting the arcs drawn between said contacts substantially in the spaces between said plates.

13. In a circuit interrupting device, arc extinguishing means comprising a plurality of plates of insulating material superposed one above the other in predetermined spaced relation for defining a plurality of arc chambers, the dimensions of the arc chamber in one section of said device being larger than the dimensions of the arc chambers in the other section of said device, a plurality of separable contacts between the plates of each section of the device, means operable in one continuous movement for simultaneously opening all of the contacts in the section having the larger dimension arc chambers and for thereafter simultaneously opening all of the contacts in the other section of said device.

14. In an enclosed circuit interrupting device arc extinguishing means comprising a plurality of plates of insulating material superposed one above the other in predetermined spaced relation to define a plurality of arc chambers, the dimensions of the arc chambers in one section of said device being larger than the dimension of the arc chambers in the other section of said device, the alternate plates being mounted for rotation relative to the other plates, separable contacts in each arc chamber actuable to open and to closed circuit position by the angular rotation of said rotatable plates, and means operable in one continuous movement for simultaneously rotating the rotatable plates in the section having the larger arc chambers to simultaneously open the contacts in said section to draw a plurality of serially connected arcs, and for thereafter simultaneously rotating the rotatable plates of the other section to simultaneously open the contacts thereof.

15. An enclosed circuit interrupting device comprising a cylindrical casing of insulating material, a plurality of annular discs of insulating material superposed one above the other in predetermined spaced relation in said casing and forming a plurality of arc chambers, the alternate discs being mounted for rotation relative to the other discs, a closure for each end of said casing, a plurality of separable contacts between said discs actuable to open and to closed circuit position by the angular rotation of said rotatable discs, means operable from outside said casing and its closures for angularly rotating said rotatable discs, and means for restricting the arcs drawn between said contacts in the spaces between said discs, certain of said arc chambers being of larger dimension than other of said chambers.

16. In a circuit interrupter, a stationary contact, a movable switch blade, means for moving said blade into and out of engagement with said stationary contact, an arc extinguishing device comprising a plurality of plates of insulating material which gives off an arc extinguishing gas when acted on by an arc, said plates being superposed one above the other in predetermined spaced relation, predetermined plates being rotatable relative to the other plates, a plurality of serially connected separable arcing contacts between the plates actuable to open and to closed circuit position by the angular rotation of said rotatable plates, one of said arcing contacts being electrically connected to said stationary contact in the closed position of the interrupter, means restricting the arcs drawn between said arcing contacts in the spaces between said plates, a rotatable means for rotating said rotatable plates to open and to close said arcing contacts, means including a projection on said blade engageable with said rotatable means during a portion of the movement of said blade adjacent

said stationary contact for connecting said blade in circuit with said device and for causing rotation of said rotatable means to open said arcing contacts following disengagement of said blade from said stationary contact during an opening operation of said blade.

17. In a circuit interrupter, a stationary contact, a switch blade movable into and out of engagement with said stationary contact, an enclosed arc extinguishing device mounted adjacent said stationary contact, said device having relatively movable arcing contacts one of which is electrically connected to the stationary contact, and a rotatable means for opening and closing said arcing contacts, means on said blade engageable with said rotatable means only during a portion of the movement of said blade adjacent said stationary contact for positively rotating said rotatable means to cause opening of said arcing contacts following disengagement of said blade from said stationary contact during an opening operation of said blade.

HERBERT L. RAWLINS.