July 25, 1939. R. C. DICKINSON 2,167,499

DISCONNECTING SWITCH

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Fig. 1.

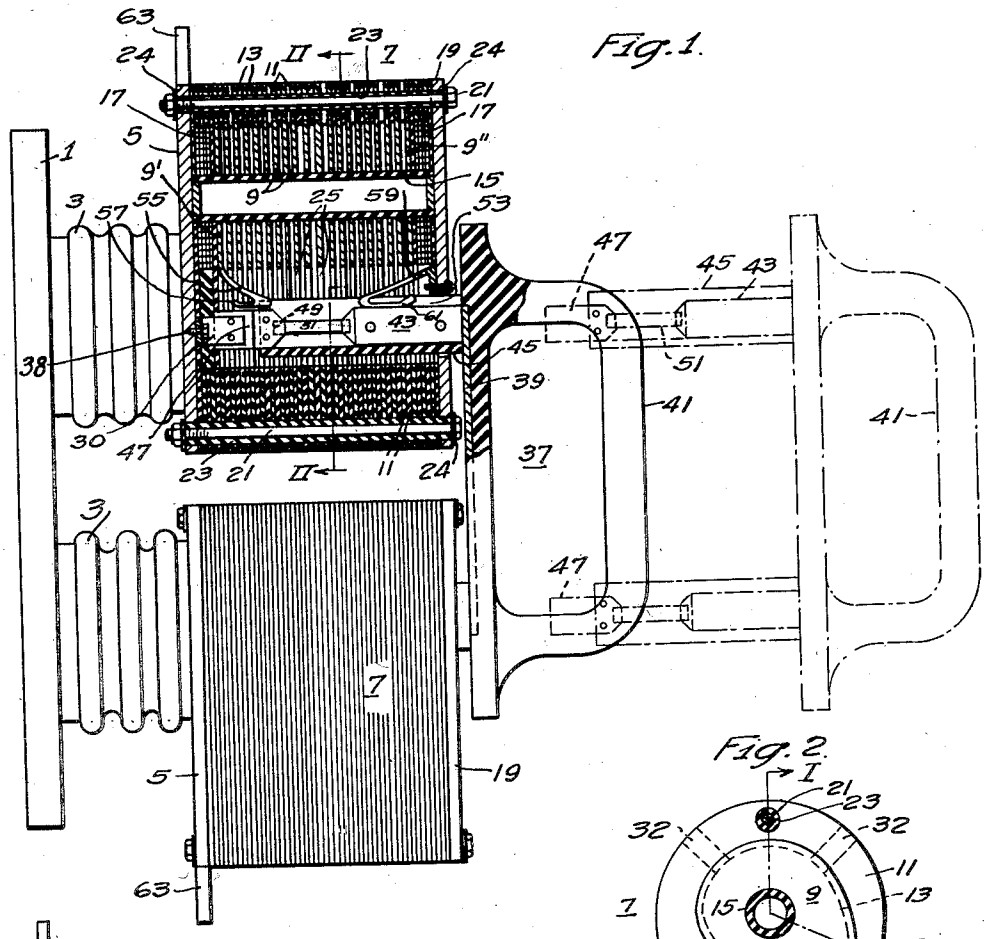


Fig. 2.

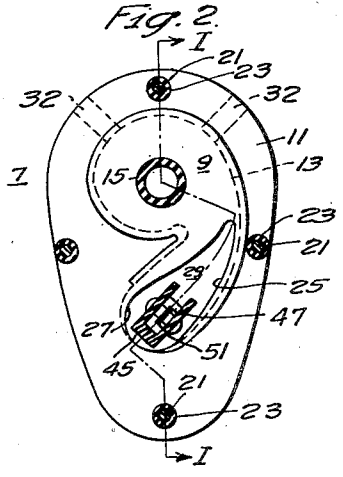
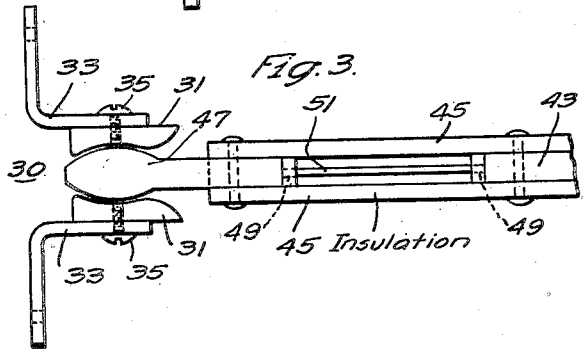


Fig. 3.



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DISCONNECTING SWITCH

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9 Claims. (Cl. 200—114)

This invention relates to circuit interrupters and more particularly to disconnect devices adapted to be operated to an open position during conditions of load and which are capable of effectively interrupting the circuit upon the occurrence of predetermined overloads.

The usual practice in distribution systems or networks of moderately high voltage is to provide each feeder circuit with overload protection and also switching means for disconnecting or isolating the feeder from its source of supply. This practice entails the use of an oil circuit breaker and disconnect switches in systems wherein long interruptions of the supply of power are not to be tolerated. However, in distribution systems wherein the continuity of service is of lesser importance, overload protection may be secured by the use of fuse devices. Although the fuse devices are capable of providing overload protection and of isolating the feeder from its source of supply, they provide no means for opening the circuit under normal conditions of load. Therefore, if load switching is to be accomplished, the fuse devices of the prior art must be replaced with a suitable circuit breaker which adds materially to the cost of the installation.

It is, therefore, an object of my invention to provide a circuit interrupting device which is capable of being operated to the open position for isolating the connected circuit during normal load conditions and which is also capable of giving overload protection to the connected circuit.

A more specific object of my invention is to provide a circuit interrupter embodying an arc extinguisher which is effective to entinguish arcs resulting from the separation of the interrupter contacts under normal conditions of load and effective to extinguish arcs resulting from the blowing of a fuse under conditions of overload.

A further object of my invention is to provide a protective load break disconnect device of the type above referred to which is simple in construction, efficient in operation and economical to manufacture.

Other objects and advantages relate to details of the circuit interrupting structure and will appear more fully in the following description, taken in connection with the accompanying drawing, in which—

Figure 1 is a side elevational view of the circuit interrupter of my invention showing a portion thereof in cross section, which section is taken along the line I—I of Fig. 2.

Fig. 2 is a cross sectional view taken through the arc extinguishing structure at II—II of Fig. 1, and

Fig. 3 is an enlarged plan view of the contact structure utilized in the interrupter of my invention.

Referring to the drawing, the numeral 1 designates a base or support upon which are mounted two insulators 3 in spaced relation, as shown. Upon each of the insulators 3 is mounted in any suitable manner a contact supporting plate 5 of conducting material. The contact supporting plates 5 serve as a support for the arc extinguishing units generally indicated at 7. The arc extinguishing structure 7 consists of a plurality of metallic plates 9 preferably of the form shown in Fig. 2. The plates 9 are surrounded by plates 11 of insulating material and of the same thickness as the plates 9. The plates 11 determine the outer envelope of the arc extinguishing device. The metallic conducting plates 9 and the surrounding insulating plates 11 are spaced apart by means of spacers 13. The plates 9, 11 and 13 are assembled about a tubular member 15 of insulating material which passes through the central opening of the annular portion of the plates 9. A small coil 17 is positioned adjacent each end of the stack of plates 9 and comprises a relatively small number of turns of relatively large cross sectional area so as to provide a conducting path of considerable current carrying capacity and of low resistance. The purpose of the two coils 17 and their connections with respect to the circuit through the interrupter will be treated more fully as the description proceeds.

The outer end of the arc extinguishing structure 7 is provided with a face plate 19 which is secured to the stack of plates and to the back supporting plate 5 by means of through bolts 21 passing respectively through the plates 11 and 13. The through bolts 21 are insulated from the plates 5 and 19 by means of insulating tubes 23 of suitable material and washers 24. It is, therefore, apparent that the through bolts 21 hold the entire arc extinguishing device 7 in the assembled position.

The metallic plates 9, as more clearly shown in Fig. 2, are provided with a tapered V shaped slot 25 extending from one end thereof toward the annular portion. The slot 25 in conjunction with a semi-circular notch 27 in the insulating plates 11 form an aligned groove or passage 29 which is completely enclosed at its lower end by virtue of the spacing plates 13 of insulating material. It will, of course, be apparent that this aligned channel or groove communicates

with the annular spaces between adjacent plates 9, which spaces provide recurrent paths between the plates 9 about the central tubular support member 15. The upper portions of the spaces between the plates 9 may be provided with vent passages 32 formed in the spacing plates 13 as shown in Fig. 2.

A fixed contact structure, generally indicated at 30, as more clearly shown in Fig. 3, is mounted upon the support plate 5 in alignment with the passage 29 and comprises a pair of opposed contact members 31 secured to resilient bracket arms 33 by suitable fastening means, as screws 35 which bracket arms are, in turn, secured to the plate 5 by means of cap screws 38. The fixed contacts 30 of the two arc extinguishing devices 7 are adapted to be electrically connected by means of a bridging member generally indicated at 37.

The bridging member 37 comprises a conducting bar 39 which is preferably moulded into a handle 41 of insulating material. The ends of bar 39 are provided with conducting members 43 disposed in parallel relation with respect to each other and spaced so as to be in alignment with the respective fixed contact structures 30. To each of the conducting portions 43 is secured a channel member 45 of insulating material which may be secured thereto in any suitable manner. The free end of the channel 45 is utilized to support a movable contact member 47, which is adapted to be yieldingly engaged on opposite sides by the fixed contact members 31 of the contact structure 30. The opposed ends of the members 43 and 47 may be tapered as shown in Figs. 1 and 3, and provided with a slot 49 for the reception of a fusible link 51. The fuse link 51 which electrically connects the conducting portion 43 and contact member 47 may be secured at its ends to these respective members by means of solder or other suitable engaging means. The face plates 19 of each unit 7 are each provided with a suitable aperture 53 to permit the entrance and withdrawal of the end portions of the bridging member 37 into the respective arc passages 29.

The metallic plate 9' adjacent the left-hand coil 17 is provided with an arc horn 55 of resilient material and which extends downwardly and angularly to the right and has a horizontal portion 57 adjacent and normally in parallel with the movable contact member 47. A similarly shaped arc horn 59 is secured to the face plate 19 and extends downwardly and to the left and has a resilient contact portion 61 normally in spring pressing engagement with the conducting portion 43 of the bridging member 37. The gap between the arc horns 55 and 59 is substantially equal to the spacing between the conducting portion 43 and the movable contact 47, the latter space being bridged by the fuse link 51.

With particular reference to the left-hand coil 17, one terminal thereof is connected to the back plate 5 whereas the other terminal is connected to the plate 9' which supports the arc horn 55. The right-hand coil 17 has one of its terminals connected to the plate 9'' immediately adjacent and its other terminal connected to the face plate 19. The two coils 17 are so connected in the circuit that the radial lines of flux between the coils will flow in the same direction.

Current flow through the interrupter for the various conditions of operation of the device will now be considered. Each of the back supporting plates 5 may be provided with a line terminal 63. During normal operation or when the bridging member 41 is in the closed circuit position, as shown in Fig. 1, current entering the upper terminal 63 flows through the back supporting plate 5, the fixed contact members 31, the movable contact member 47, fuse link 51, conducting portion 43, conducting bar 39, and thence through a similar circuit provided in the lower extinguishing unit 7 and out through the lower terminal member 63. In the event that it is desired to open the circuit during normal conditions of load, the bridging member 37 may be withdrawn from the arc extinguishing unit 7 by means of the handle 41. Upon the disengagement of moving contact 47 from the contact 31 a short arc will be drawn between the horn 55 and the contact 47 and the current flow is from the back plate 5 through the left-hand coil 17, plate 9', arc horn 55, moving contact 47, fuse link 51, conducting portion 43, conductor 39 and through the lower unit 7.

It may be said at this time that for the succeeding situations, the circuit through the two arc extinguishing units 7 are identical and for this reason, only the circuit and operation of the upper arc extinguishing unit 7 will be given. As the moving contact 47 continues its outward movement the arc drawn between the moving contact and the horn, will be progressively lengthened. As soon as the movable contact 47 engages the arc horn 59, the right-hand end of the arc will readily transfer thereto. The arc will then be moved upwardly with its ends in contact with the respective arc horns on account of the inherent tendency of diverging arc horns to produce arc movement. Movement of the arc is also augmented by the effect of the left-hand coil 17 which was placed in circuit to produce a radial field immediately upon the separation of the movable contact 47 and the fixed contacts 31. As the right-hand end of the arc approaches the upper portion of the arc horn 59, it transfers to the plate 9'' adjacent the right-hand coil 17 thereby connecting the right-hand coil in circuit with the arc. The circuit through the device then is from the support plate 5, left-hand coil 17, plate 9', arc horn 55, through the arc, plate 9'', the right-hand coil 17, the face plate 19, arc horn 59, movable contact 47, fuse link 51, conducting portion 43 and the conductor 39.

Under the influence of the radial magnetic field of both coils 17, the arc is rapidly moved toward the apex of the passage 29 formed by the slots 25 in the plates 9. As the arc reaches the end of the slots 25, it splits into a plurality of series related arcs having their terminals on the spaced conducting plates 9. These short arcs are then rotated by the radial magnetic field produced by the coils 17 along the annular path provided between the plates 9 until the arcs are extinguished. Inasmuch as the deionizing action of the conducting plates 9 is very rapid, the arc will be extinguished by the time the moving contact 47 is ready to separate from the spring contact surface 61 of arc horn 59. It will be apparent that the complete withdrawal of the bridging member 37 from within the extinguishing units 7 as shown in dotted position of Fig. 1, provides adequate insulation between the fixed contacts 31 of these units to withstand the voltage which is expected to be encountered on the particular installation.

In the event of an overload, the operation is as follows: With the bridging member 37 is the closed circuit position, as shown in Fig. 1, the circuit through the device is the same as that

previously described. Upon the occurrence of a predetermined overload, the fuse link 51 will be blown, thereby establishing an arc between the opposed surfaces of conducting member 43 and the movable contact 47. Inasmuch as the supporting channel 45 surrounding the fusible link 51 is composed of an insulating material which gives off a gas when acted upon by an arc and since the open side of the channel 45 is facing the converged end of the passage 29, the arc thus formed will be blown laterally on to the arc horns 55 and 59. In other words, the channel member 45 provides an expulsive arc chamber within the arc passage 29. The expulsive blast from the channel 45 is so directed that it moves the arc upwardly along the arc horns 55 and 59 until the arc is driven between the conducting plates 9 whereupon it is split into a plurality of short serially related arcs and caused to be rotated between these plates until extinguished by the radial magnetic field produced by the two coils 17. The gas evolved from the channel 45 not only assists in moving the arc but also aids in extinguishing it.

From the foregoing description, it will be apparent that various modifications may be made in the circuit interruptive structure as, for example, a single coil may be used for rotating the arc, which coil may be disposed in the center of the stack of plates 9 whereupon the direction of radial field produced by the coil would be of a different sense on opposite sides thereof. This would necessitate arranging the slots of the plates on one side of the coil for clockwise rotation of the arc and for a counterclockwise rotation of the arc between the plates on the other side of the coil.

Although the above description has been directed to a specific arrangement showing the essential features of my invention and suggestions as to certain modifications, it is to be understood that the same is for the purpose of illustration and that other changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, an arc extinguishing device having an arc chamber in which an arc may be drawn, said arc chamber being dimensioned to provide for substantial lateral movement of the arc therein, a stationary contact within said chamber, a movable contact member normally in contacting engagement with said stationary contact and adapted to be moved out of engagement with said stationary contact for establishing an arc within said chamber, said contact member having a fusible portion normally within said chamber and adapted to establish an arc therein upon the occurrence of predetermined current conditions and means of insulating material partially surrounding said fusible portion for causing the arc established by said fusible portion to be moved laterally within said arc chamber.

2. In a circuit interrupter, an arc extinguishing chamber, arc terminals within said chamber between which an arc is adapted to be moved, a fixed contact within said chamber, a cooperating movable contact member normally within said chamber and adapted to be withdrawn therefrom to establish an arc between said terminals, said contact member having two portions joined by a fusible element, said fusible element being disposed adjacent said arc terminals, and means for supporting said portions of said contact member in spaced relation, said support means comprising a material which gives off a gas when acted upon by an arc for directing the arc resulting from the fusion of said fusible element toward said arc terminals.

3. In a circuit interrupter, an arc extinguishing chamber, arc terminals within said chamber between which an arc is adapted to be moved, a fixed contact within said chamber, a cooperating movable contact member normally within said chamber and adapted to be withdrawn therefrom to establish an arc between said terminals, said contact member having two portions joined by a fusible element, said fusible element being disposed adjacent said arc terminals, and a tubular member partially surrounding said fusible element for supporting the two portions of said contact member in spaced coaxial relation, said tubular member being composed of a material which gives off a gas when acted upon by an arc to aid in extinguishing the arc and disposed with respect to said arc terminals so that the arc formed by fusion of said fusible element is moved laterally by the gas evolved from the tubular member toward said arc terminals.

4. In an air break disconnect device, a pair of spaced fixed contacts, an arc interrupting chamber surrounding each of said contacts, a bridging member having two substantially parallel end portions each of which extends through one of said arc interrupting chambers for normally completing the electrical circuit between said contacts, means for manually and laterally withdrawing said bridging member from said contacts to interrupt the circuit therebetween, each of the parallel end portions of said bridging member having a fusible section normally disposed within said arc chambers and adapted to establish an arc within said chambers upon the occurrence of predetermined current conditions.

5. In an air break disconnect device, a pair of spaced fixed contacts, an arc interrupting chamber surrounding each of said contacts, a bridging member having its end portions extending through said chamber for normally completing the electrical circuit between said contacts, means for manually withdrawing said bridging member from said contacts to interrupt the circuit therebetween, each of the end portions of said bridging member having a fusible section normally disposed within said arc chambers and adapted to establish an arc within said chambers upon the occurrence of predetermined current conditions, and means of insulating material partially surrounding each of said fusible sections for directing the movement of the arcs formed by said sections laterally within said arc chambers.

6. In an air break disconnect device, a pair of spaced fixed contacts, an arc interrupting chamber surrounding each of said contacts, a bridging member having its end portions extending through said chamber for normally completing the electrical circuit between said contacts, said bridge member being provided with an insulating handle for manually withdrawing said member from said contacts to interrupt the circuit therebetween, said end portions of said bridging member comprising a contact portion for releasably engaging said fixed contacts, an intermediate portion, a tubular member of insulating material carried by said intermediate portion for supporting said contact portions in spaced relation with respect to said intermediate portion and a fusible element partially surround-

ed by said tubular member for connecting each of said contact portions with the intermediate portion, said tubular support member being open on one side to direct the arc formed upon the fusion of said fusible element therein laterally within said arc chamber.

7. In a circuit interrupter, a base, a pair of contacts insulatingly mounted in spaced relation upon said base, an arc extinguishing structure surrounding each of said contacts, each of said arc extinguishing structures having a passage therethrough extending outwardly in alinement with its respective contact and disposed in substantially parallel relation with relation to each other, a bridging member having two substantially parallel end contact portions each of which is adapted to extend into one of said passages to engage one of said contacts, manually operative means for withdrawing said bridging member outwardly to interrupt the connected circuit under load conditions and each of said parallel end portions of said bridging member having a fusible section normally disposed in one of said passages to interrupt the connected circuit under conditions of overload.

8. In a circuit interrupter, an arc chamber, a pair of spaced arc terminal members within said chamber, means for establishing an arc between said spaced arc terminal members comprising a pair of separable contacts, and means in response to engagement of one end of said arc with at least one of said arc terminal members for producing a magnetic field for moving the arc laterally between said arc terminal members, one of said separable contacts having a fusible portion normally within said arc chamber for establishing an arc under predetermined current conditions, and means of insulating material partially surrounding said fusible portion for causing the arc established by said fusible portion to be moved laterally onto said arc terminal members.

9. In a circuit interrupter, a pair of separable contacts for establishing an arc along a predetermined path, a deionizing structure comprising a plurality of conducting plates transverse to the arc path, means responsive to the establishment of said arc for producing a radial magnetic field for moving said arc into said plates to establish a plurality of short arcs and for rotating the short arcs between said plates, at least one of said contacts having a fusible section normally disposed longitudinally of said arc path for establishing an arc under predetermined current conditions, and means of insulating material partially surrounding said fusible section for causing the arc formed by said fusible section to be moved laterally into said conducting plates.

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