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CIRCUIT INTERRUPTER

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2 Claims. (Cl. 200—150)

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This invention relates to circuit interrupters, and, more particularly, to arc extinguishing structures therefor. Certain features of the invention are described and claimed in applicants' divisional application, filed December 22, 1945, Serial No. 636,940, entitled, "Circuit interrupters," and assigned to the assignee of the instant application.

Other features are described and broadly claimed in a divisional case, filed December 22, 1945, Serial No. 636,941, entitled "Circuit interrupters," and assigned to the assignee of the instant application.

More specifically our invention relates to a novel structure for effecting the very rapid extinction of electric arcs drawn in circuit interrupters. It is particularly applicable to the interruption of high voltage arcs, such as those drawn in a 287 kv. circuit, and will effect their interruption in less than one cycle. Our invention is, however, not limited in its application only to high voltage circuits. It is also applicable on low voltage circuits, but merely for purposes of illustration it is described in the specification in a preferred embodiment as used on a high voltage circuit.

Extensive experimental investigation has clearly demonstrated that a rapid lowering of the dielectric strength of an arc extinguishing fluid, such as oil, occurs after it impinges upon the arc stream. It is therefore desirable to eliminate such contaminated fluid as quickly as possible, and to subject the arc stream to the action of fresh fluid of high dielectric strength. It is one of the objects of our invention to provide an arc extinguishing structure which makes full use of this fact.

Another object of our invention is to provide improved piston means associated with the moving contact structure to effect the rapid extinction of low current arcs.

Another object is to provide an improved arc extinguishing structure which directs a plurality of radially inwardly flowing streams of fluid against the arc, changes the direction of flow to one which is longitudinal of the arc, and then provides a plurality of radially outflowing discharge streams which are substantially perpendicular to the arc.

Another object is to provide an improved arc extinguishing structure which will produce both a pressure-generating arc and an interrupting arc, the pressure-generating arc causing a plurality of inwardly flowing streams to converge on the interrupting arc. Preferably the direction

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of flow of the inwardly flowing streams is changed to a direction which is longitudinal of the arc, and a plurality of venting passages are provided for the rapid venting of contaminated fluid.

Another object is to provide an improved structure of the type described in the immediately preceding paragraph in which piston means are disposed between the two arcs to prevent contaminated fluid from the pressure-generating arc coming in contact with the interrupting arc.

Another object is to provide an improved circuit interrupter wherein fluid adjacent to a pressure-generating arc is forced under pressure toward the interrupting arc and to dispose piston means between the two arcs, which piston means can be by-passed near the end of its travel.

Further objects and advantages will readily become apparent upon a reading of the following description taken in conjunction with the drawing, in which:

Fig. 1 is a side elevational view in cross section of a circuit interrupter embodying our invention;

Fig. 2 is a side elevational view in cross section taken on the line II—II of Fig. 1; and

Fig. 3 is a sectional view taken on the line III—III of Fig. 1.

Referring to the drawing and in particular to Fig. 1, the reference numeral 1 designates generally an arc extinguishing unit suspended from one line terminal of the circuit interrupter in a suitable tank, not shown, and submerged in a suitable arc extinguishing fluid, such as oil. A conducting bridging bar 49 serves to connect electrically the arc extinguishing unit 1 with an identical unit, not shown, in a manner well known in the art.

We have found it desirable to rapidly vent ionized products of decomposition resulting from an arc extinguishing fluid impinging upon the arc stream. After an arc extinguishing fluid strikes the arc stream, performing its de-ionizing function by turbulently breaking up and cooling the ionized arc path, contamination of the fluid decreases its usefulness for further extinguishing and insulating purposes. We have, therefore, found it desirable to subject the arc stream to a plurality of radially inflowing streams of arc extinguishing fluid at a number of points along the length of the arc stream rather than to use a single stream to de-ionize a considerable length of arc. At a number of intermediate points along the arc stream, we provide a

plurality of vents to allow the contaminated fluid to be rapidly vented radially outward from the arc space.

Preferably the inflowing fluid which strikes the arc stream should strike the arc radially thereof from at least opposite sides to maintain the arc stream in a central position away from adjacently disposed insulating surfaces. If an arc contacts an insulating surface it tends not only to burn away the insulating surface but also to leave carbon thereon which has conducting properties. In the construction of our invention we preferably maintain the arc away from adjacently disposed insulating walls by subjecting at least opposite sides of the arc stream to a radially inward flow of fluid.

In this embodiment of our invention, a plurality of insulating plates are pressed together to form an insulating arcing structure having entrance and vent passages more fully described hereinafter. Tie rods 62 hold the insulating plates rigidly in position. A resiliently mounted relatively stationary contact 142 is provided which cooperates with an intermediate contact member 143 to draw a pressure generating arc 144, as more clearly shown in Fig. 2. The intermediate contact 143 has secured thereto at its lower end a metallic spider member 145 which serves as a lower seat for a battery of compression springs 146. Cooperating with the intermediate contact 143 to draw an interrupting arc 148 (see Fig. 2) is a lower movable contact 147. A conducting bridging member 149 operates the lower movable contact 147. Suitable operating mechanism, not shown, actuates the conducting bridging member 149. A flexible conductor 150 electrically connects the stationary contact 142 with a top metallic plate 151 which, in this instance, is an integral portion of the contact foot 152.

It will be apparent that in the closed-circuit position of the interrupter shown in Fig. 1, the electrical circuit therethrough comprises the contact foot 152, the top metallic plate 151, flexible conductor 150, relatively stationary contact 142, intermediate contact 143, lower movable contact 147 and conducting bridging member 149, from whence the circuit passes through another identical arc extinguishing unit, not shown, to the other terminal of the interrupter.

Rigidly secured by contact button 153 to the intermediate contact 143 is a metallic valve plate 154. A perforated metallic piston 155 has a limited permissible sliding movement with respect to the intermediate contact 143 as determined by the metallic valve plate 154 and integrally formed shoulders 156 formed on the intermediate contact 143.

When the interrupter is in the closed-circuit position, as is shown in Fig. 1, the battery of compression springs 146 is compressed, metallic piston 155 rests upon the shoulder 156 and the valve 157 is opened. When it is desired to open the electrical circuit through the interrupter, suitable operating mechanism, not shown, moves the conducting bridging bar 149 downward. The intermediate contact 143 being strongly biased downward by the compression springs 146 rapidly follows the initial downward movement of the lower movable contact 147 to result in the metallic valve plate 154 closing the apertures in the perforated piston 155, the piston 155 remaining practically stationary during this time because of the dashpot action. During the initial movement, the resiliently mounted stationary contact 142

follows the initial movement of the intermediate contact 143 until the shoulder 158 on the stationary contact 142 strikes the insulating plate 159. Further downward movement of the lower movable contact 147 draws substantially simultaneously both a pressure-generating arc 144 and an interrupting arc 148, as more clearly shown in Fig. 2.

It would, of course, be possible to have the two arcs formed sequentially by raising the position of the insulating plate 159. In this event the pressure-generating arc 144 would be formed first, and the resulting pressure would help to drive the piston 155 downward.

During the interruption of low currents, the pressure generated by the pressure-generating arc 144 will be relatively low and reliance for the fluid motion is placed on the compression springs 146. The downward movement of the piston 155 causes oil to flow as indicated by the arrows 160 in Fig. 1. The fluid flows downwardly as caused by the piston 155 through two kidney-shaped vertical flow passages generally designated by the reference numerals 2 provided in the plurality of contiguously disposed insulating plates, as shown more clearly in Fig. 3. After passing downwardly through the two vertically disposed flow passages 2, the fluid passes radially inwardly toward the interrupting arc 148 through a plurality, in this instance four, inlet passages 3 provided by a pair of insulating inlet plates 4 having a configuration more clearly shown in Fig. 3. The fluid after contacting the interrupting arc 148 passes upwardly and downwardly through adjacently disposed orifice plates 5 and out of the arc-extinguishing unit 1 through vent passages 167 disposed substantially at right angles to the direction of the inlet passages 3. The vent passages 167 are formed by insulating vent plates 7, which also provide an insulating orifice 8 of substantially the same diameter as the orifice provided by the insulating orifice plates 5. Thus, the orifices 8 provided by the insulating orifice plates 5 and the insulating vent plates 7 cause the arc-extinguishing fluid to flow longitudinally of the interrupting arc 148 intimately contacting therewith before this arc-extinguishing fluid is vented out of the arc-extinguishing unit 1 through the oppositely disposed venting passages 167 as provided by the vent plates 7.

Certain features of the flow passage arrangement are described and broadly claimed in U. S. patent application, Serial No. 574,856, filed January 27, 1945, by Winthrop M. Leeds and Benjamin P. Baker, and assigned to the assignee of the instant invention.

During the interruption of high short-circuit currents, the pressure generated by the pressure-generating arc 144 will assist the compression springs 146 in moving the piston 155 downwardly to cause an increased fluid flow toward the interrupting arc 148.

It will be observed that when the perforated metallic piston 155 strikes the insulating plate 161, as shown by the dotted lines in Fig. 1, fluid from the pressure-generating arc 144 may continue to flow past the perforated plate 155 in the annular space indicated by the reference numeral 162. On the interruption of high currents, this bypassing action is of advantage for arc interruption which possibly may not have occurred by the time the perforated plate 155 has come to rest, and further fluid motion caused by the pressure generating arc 144 is therefore desirable.

It will be observed that in this embodiment of our invention, we have provided annular pockets 165 disposed between the inlet passages and the vent passages. The annular pockets 165 provide a readily available quantity of oil adjacent the arc path, and also the annular pockets 165 break up the insulating surfaces adjacent to the arc 143 to minimize the possibility of carbonization of these insulating surfaces.

We have provided a plurality, in this instance two, additional annular oil-retaining pockets 166 at the lower end of the structure between the lower venting passages 167 and the bottom insulating plate 168. It is desirable to maintain an increased pressure within the arcing region, for the dielectric strength of an arc extinguishing fluid depends not only on the degree of ionization therein but also on the pressure, increased pressure causing increased dielectric strength. We have found that the provision of the oil-retaining pockets 166 reduces the gas and fluid leakage by making the flow more turbulent as the lower movable contact 147 is withdrawn out of the arc extinguishing structure.

The concept of securing a piston to an intermediate contact disposed in an arc extinguishing unit of the type which produces both a pressure-generating arc and an interrupting arc is described and broadly claimed in an application filed September 18, 1942, Serial No. 458,778, by Winthrop M. Leeds and Benjamin P. Baker, now U. S. Patent 2,372,589, issued March 27, 1945, and assigned to the assignee of the instant application. Also an application filed December 26, 1942, Serial No. 470,161, by John B. MacNeill and assigned to the assignee of the present application describes certain improvements in the concept of operatively connecting a piston to an intermediate contact in an arc extinguishing structure of the type producing both a pressure generating arc and an interrupting arc.

Although we have illustrated a specific embodiment, it will be clearly understood that the same was merely for purpose of illustration and that changes and modifications may be made therein by those skilled in the art without de-

parting from the spirit and scope of the appended claims.

We claim as our invention:

1. In a circuit interrupter, a relatively stationary contact, an intermediate contact, a moving contact, the intermediate contact being cooperable with the stationary contact to produce a pressure-generating arc, the intermediate contact being cooperable with the moving contact to draw an interrupting arc, passage means extending between the pressure generating arc and the interrupting arc, a piston operatively connected to the intermediate contact and movable therewith, the piston making a comparatively tight fit with the walls of the passage means during the initial movement thereof, an enlarged portion in the passage means operative after the piston has neared the end of its travel to permit a by-passing of fluid past the piston, the fluid pressure created by the pressure generating arc assisting in the extinguishment of the interrupting arc.

2. In a circuit interrupter, a relatively stationary contact, an intermediate movable contact, a movable contact, the stationary contact and the intermediate contact cooperating to establish a pressure-generating arc, the intermediate contact and the movable contact being cooperable to establish an interrupting arc, a pressure chamber adjacent the pressure-generating arc, an interrupting passage adjacent the interrupting arc, passage means extending between the pressure chamber and the interrupting passage, piston means operatively attached to and movable with the intermediate contact, valve means for the piston means operative upon the initial movement of the intermediate contact, the piston means extending across the passage means during the initial movement thereof, an enlarged portion in the passage means, the enlarged portion being so disposed that during the end of the travel of the piston means a by-passing of fluid around the piston means is permissible.

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