June 29, 1965 KARL-LUDWIG GESSNER 3,192,348

ARC EXTINGUISHING SWITCH STRUCTURE

Filed Feb. 15, 1962 2 Sheets-Sheet 1

Fig. 1b

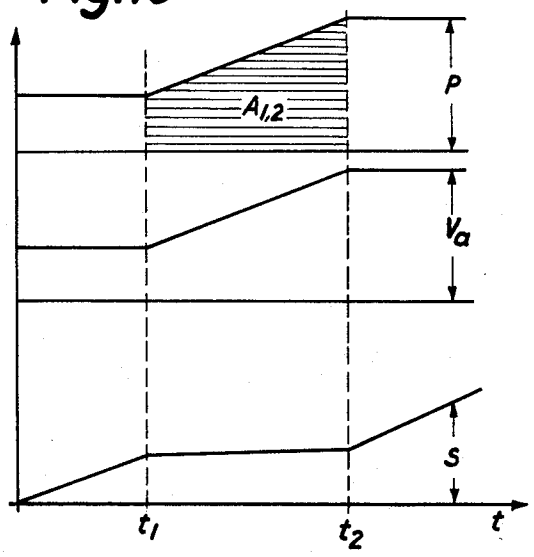


Fig. 1a

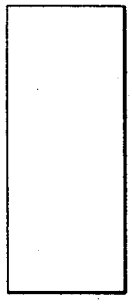


Fig. 2b

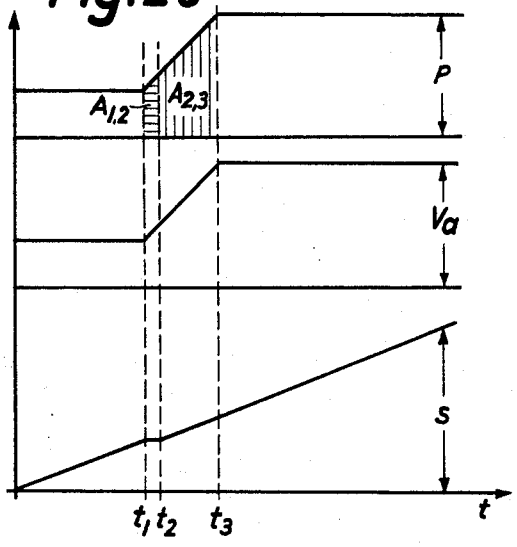
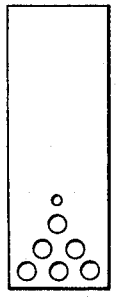


Fig. 2a



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June 29, 1965 KARL-LUDWIG GESSNER 3,192,348

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Filed Feb. 15, 1962 2 Sheets-Sheet 2

Fig.3

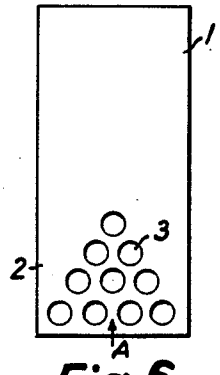


Fig.4

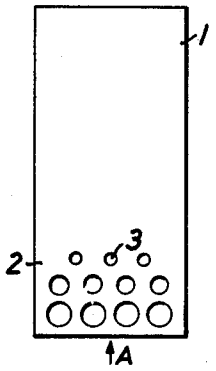


Fig.5

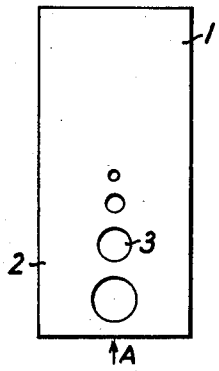


Fig.6

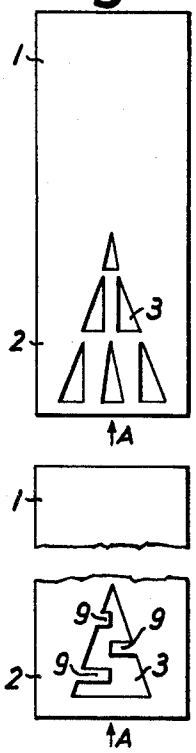
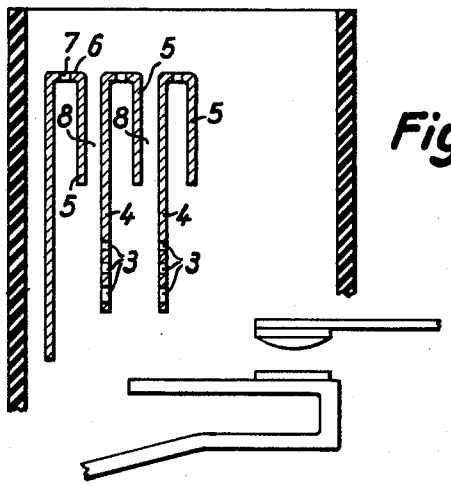


Fig.7

Fig.8



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3,192,348

Patented June 29, 1965

3,192,348

ARC EXTINGUISHING SWITCH STRUCTURE

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Filed Feb. 15, 1962, Ser. No. 173,400
Claims priority, application Germany, Feb. 20, 1961, L 38,244
12 Claims. (Cl. 200—144)

The present invention relates generally to the switch art, and, more particularly, to an arc extinguishing assembly for switchgear having contacts or other arc generating elements and using electrically conductive arc extinguishing baffles which are aligned at right angles to the arc.

Arc extinguishing assemblies of this type are particularly used in alternating current types of low tension or low voltage switches, for example, protective and power relays. The arc which is formed in the switch upon opening the contacts is usually forced, by a magnetic effect, against the edges of the arc extinguishing baffles and this arc is eventually split up into short partial arcs disposed between the baffles. At the natural zero point of the alternating current, the arc is extinguished.

The instantaneous stabilization of the arc path, which occurs during this extinction, increases proportionately with the number of partial arcs, and thus with the number of extinguishing baffles. The cooling and deionization of the arc gases which are also effected by the baffles, enhance restabilization of the arc path after the switch is opened. Such arc extinguishing assemblies are theoretically more effective if more arc extinguishing baffles are used and if a smaller distance is provided between the individual baffles.

However, in arc extinguishing baffle assemblies, there is difficulty in forcing the arc quickly and reliably into the arc extinguishing baffle section. The use of more numerous baffles and narrower distances between the baffles, renders it more difficult to force the arc between the baffles and causes it to form bases on the individual baffles. Often, the arc is maintained in front of the arc extinguishing baffle section for a relatively long period of time so that reliable opening of the switch is not always assured. Furthermore, opening of the switch, or switching it off, in such an event, causes a marked burning of the edges of the baffles and thereby renders the arc extinguishing assembly prematurely unusable.

In the conventional type of rectangular arc extinguishing baffle, the arc must extend or bend so far about the edge of the baffle on which it is to form a base, that it is lengthened and this lengthening provides the necessary voltage for the base formation. When closely spaced baffles are used, this is not possible unless there is a very vigorous magnetic effect upon the arc. In baffles which are too closely spaced, the arc will not go into the arc extinguishing baffle section at all.

Attempts have been made in the past to eliminate this drawback by providing the baffles with a wedge-shaped slot or recess. In such a device, the voltage which is necessary for the base formation of the arc is generated by narrowing the cross section of the arc which extends into the slot. Due to the narrowing of the cross section and intense cooling due to the baffles, by the time the arc has arrived at the end of the slot, i.e., at a point beyond the narrowed cross section, there is a voltage drop which is sufficient for base formation. However, in these slotted baffles re-ignitions may occur in the wedge-shaped slots. The space at the beginning of the slot over which the arc has just travelled is still so well ionized,

that the voltage increase of the arc which arrives at the end of the slot is sufficient to cause re-ignition at the broader entrance of the slot. The effect of this is that the arc which has already moved into the baffles is extinguished and the arc voltage breaks down. In this manner, the process of the arc entering or moving into the baffles may be repeated several times. This causes the opening or switching off of the switch to be delayed, and burning of the edges of the baffles is increased.

With these defects of the prior art in mind, it is a main object of the present invention to eliminate the abovementioned drawbacks of the prior art which, under some circumstances, will considerably impair the effectiveness of an arc extinguishing device.

Another object of the invention is to provide arc extinguishing baffles which are adapted to readily cause the arc to form partial arcs and to travel between the baffles, even when a large number of baffles are used and when they are closely spaced.

A further object of the present invention is to provide an arc extinguishing device which is superior to known devices due to the combination of good arc entry properties, as well as an inhibition of re-ignition, especially in switchgear which does not have any additional extinguishing of the arc by blowout coils or other types of auxiliary means.

These objects and others ancillary thereto are accomplished according to preferred embodiments of the invention wherein at least some of the arc extinguishing baffles are perforated at their ends nearer the arc generating portion of the device in such a manner that the aperture or opening area provided by the perforations and available to the arc for passage decreases in the direction of motion of the arc.

The present invention is based on the fact that the arc forms an anode base and a cathode base on a baffle only, if, at the section between the bases to be formed, there is a voltage which at least corresponds to the sum of the anode drop and the cathode drop.

The sieve-like perforations of the baffles also eliminate the drawbacks caused by a recycling or re-ignition of the arc. When the arc reaches the baffles it burns in parallel branches through several perforations. The transition of the condition of the arc before reaching the baffles into the condition stated above proceeds without difficulties. The perforations are so arranged that with further movement of the arc into the arc extinguishing baffle section, the number or cross section of the perforations available to the arc for passage decreases. Due to the cooling and a decrease in cross section, the voltage rises until finally the voltage drop of the arc column along the narrow point attains the sum of the cathode drop and the anode drop, and the arc forms bases or base points on the baffles.

However, at the same time, the perforations which have already been passed by the arc are very well deionized by the metal grid in a substantially better manner than that which is accomplished with the aforementioned slotted baffles, so that reignition of the arc in the region already passed by the arc will no longer occur. In the limiting case, this metal grid may comprise a member with but a single opening.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1*a* is an elevational view of a rectangular arc extinguishing baffle of the conventional type for an arc extinguishing chamber.

FIGURE 1*b* is a diagram showing a graph indicating various characteristics of such a conventional baffle.

FIGURE 2*a* is an elevational view of an arc extinguish-

ing baffle of the type which is perforated in accordance with the present invention.

FIGURE 2*b* is a diagram showing a graph indicating the characteristics of the baffle of FIGURE 2*a* similar to those indicated for FIGURE 1*b*.

FIGURE 3 is an elevational view of a first embodiment of a baffle constructed in accordance with the present invention.

FIGURE 4 is an elevational view of a second embodiment of the present invention.

FIGURE 5 is an elevational view of a third embodiment of the invention.

FIGURE 6 is an elevational view of a fourth embodiment of the invention.

FIGURE 7 is an elevational view of a fifth embodiment of the invention.

FIGURE 8 is a diagrammatic sectional view illustrating an arc extinguishing baffle assembly as it would be used in switch-gear.

With more particular reference to the drawings, and especially to FIGURES 1*a*, 1*b*, and 2*a*, 2*b*, it should be noted that in the diagrams of FIGURES 1*b* and 2*b* a constant arc current is assumed. The course S of the arc is indicated, as well as the arc voltage V_a and the arc power P, all of which are plotted against time *t*.

In FIGURE 1*b*, the arc is magnetically forced into the arc extinguishing assembly and reaches the edges of the baffles at instant t_1. The arc remains in this position until instant t_2. The arc path time-line S results from the time *t* when the arc is burning and extends horizontally. During this time, the arc voltage V_a rises continuously, since the arc increases in length by travelling into the spaces between individual baffles and because it transfers energy to the baffles. Furthermore, the power P rises to the same extent as the voltage V_a. The area $A_{1,2}$ is the energy which is converted from the arc during the time it remains in front of the baffles. This energy is responsible for the marked burning of the front edges of the baffles.

At instant t_2, base points have been formed on the baffles and a partial arc has travelled into the baffle assembly. In case dividing or splitting up of the arc does not occur at all, which may be the case with this type of baffle, the time period t_1 to t_2 will last until the zero point of the current, thereby increasing the area $A_{1,2}$, i.e., the energy which is transmitted to the baffles, and also thereby increasing the amount of burning away of these baffles.

With more particular reference to FIGURE 2*b*, the time t_1 to t_2, during which the arc is present at the front edges of the baffles, is extremely short. With the use of these sieve-like perforated baffles of the type indicated in FIGURE 2*a*, the arc no longer has to increase in length by bending about front edges of the baffles, and therefore the voltage V_a and the conversion of power P are still low. Therefore, the energy conversion in front of the baffle assembly which is represented by area $A_{1,2}$ will remain very small. A burning of the edges of the baffles will therefore no longer occur.

From instant t_2 to t_3 the arc will burn through the perforations and continuously move into the apertures of smaller cross section. Because of the decrease of the cross section of the arc, the voltage and power will continuously rise until, at instant t_3, the arc will form base points on the baffles and will travel along the baffles.

The energy conversion during the movement of the arc over the series of perforations is represented by area $A_{2,3}$. However, this latter energy conversion does not cause damaging of the baffles during the conversion because the arc keeps moving and constantly sweeps over new points along the baffles.

FIGURES 3 through 7 illustrate a few of the many possible embodiments of the baffles which may be constructed in accordance with the present invention. These baffles which may be constructed, for example, of iron, are provided on their respective end **2** which faces the incoming arc, with sieve-like perforations which provide openings or apertures **3** in which the arc may burn in parallel branches. The openings **3** are distributed in the baffles in such a manner that there is a stepwise decreasing opening cross section available for the arc, and the number and area of the apertures are designed accordingly. In this manner, this aforementioned stepwise decrease in the available cross section of the openings for the arc is in the direction of travel indicated by arrow A. In the extreme or limit case, the perforations may comprise a single opening in the form of a triangle as illustrated in FIGURE 7 and having lugs **9** projecting into the opening.

The remaining portion of each baffle which is disposed between or about the openings provides good deionization of the ionized gas which remains behind the arc proper so that reignitions in the area which the arc has already passed no longer occur. With the generally used, relatively thin, baffles, it is expedient to provide the cross sectional area of the openings as being approximately equal to the area of the baffle material remaining between or about the openings.

FIGURE 8 is a diagrammatic sectional view of an embodiment wherein an arc extinguishing baffle assembly is provided. For purposes of clarity, only a few of these baffles are shown. The baffles **4** are provided with the type of perforations described above in accordance with the present invention. The openings are indicated by numeral **3**, and the ends **5** of all of the baffles, which ends are remote from the arc, are bent at an angle of 180° with respect to the body of the baffles. The arms **6** between the two parallel legs of the baffles are provided with outlet openings **7**. This is a particularly favorable embodiment of the baffles. Due to the perforations, a reliable and rapid entry of the arc into the extinguishing assembly is provided. As soon as the arc reaches the short legs **5** of the baffles, its rapid travel is slowed due to an electro-dynamic counter extinguishing effect, thereby preventing the arc from flashing out of the extinguishing assembly. The openings **7** and the narrow slots **8** between the end of the baffles provide for rapid restabilization of the chamber space and prevent reignition of the arc after its natural extinction at the zero point of the current.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. An arc extinguishing device for electric switchgear having contacts or other arc generating elements, comprising a plurality of electrically conducting arc extinguishing baffles arranged at right angles to arcs which are generated, at least some of the ends of the baffles facing the place where the arc is generated bearing perforated by at least one opening, with an opening area provided thereby being available to the arc for passage therealong, and decreasing in the direction of motion of the arc.

2. A device as defined in claim **1** wherein the number of openings decrease in the direction of motion of the arc.

3. A device as defined in claim **1** wherein several series of openings are arranged in the direction of motion of the arc, each series of openings having at least one perforation with an opening cross section which decreases in the direction of motion.

4. A device as defined in claim **3** wherein the openings are triangular in shape and the vertex of the triangle points in the direction of motion of the arc.

5. A device as defined in claim **1** wherein a single opening is provided in each baffle.

6. A device as defined in claim 5 wherein the single opening is triangular and lugs project into the triangular opening.

7. A device as defined in claim 1 wherein the opening area and the solid area of the baffle material remaining around the opening area are approximately equal.

8. A device as defined in claim 1 wherein at least some of the baffle ends remote from the point where the arc is generated, are bent to face the direction of the incoming arc with the facing end being perforated in at least one row.

9. In an arc extinguishing device for electric switchgear which generates arcs, the device being of the type having electrically conducting arc extinguishing baffles arranged at right angles to the arc which is generated, the improvement that: at least some of the ends of the baffles nearer the location of arc generation have multiple perforations arranged in zones so that a plurality of aperture areas are defined by the perforations and available to the arc for passage, and the aperture area in each successive zone in the direction in which the arc travels decreases with respect to the aperture area in the preceding zone.

10. In an arc extiguishing device for electric switchgear which generates arcs, the device being of the type having electrically conducting arc extinguishing baffles arranged at right angles to the arc which is generated, the improvement that: the baffles are formed for an easy entering of the arc into the baffle combined with the increase of the tension of the arc to let the arc have arc burning bases on the baffles whereby the arc is inhibited for re-ignition in the portion of the baffle where the arc

enters the baffle because the form of the baffle gives a deionization of the entering way of the arc into the baffle.

11. An arc extinguishing device for electric switchgear having arc generating elements, comprising a plurality of electrically conducting arc extinguishing baffles arranged at right angles to arcs which will be generated, at least one opening surrounded by the solid material of the baffle and formed in the ends of at least some of the baffles thereby to define perforate portions on at least some of the baffles, said ends facing the place where arcs will be generated, said perforate portions each having an opening area available to the arc for passage therealong, said area decreasing in the direction of motion of the arc.

12. A device as defined in claim 11 wherein said opening area continuously decreases in the direction of motion of the arc.

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ROBERT K. SCHAEFER, *Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,192,348 June 29, 1965

Karl-Ludwig Gessner

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 57, for "bearing" read -- being --.

Signed and sealed this 28th day of December 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents