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# Arc splitter stack for an electric switching device

## Description

The invention relates to an arc splitter stack for an electric switching device, in particular for a circuit breaker or the like, in accordance with the preamble of Claim 1.

A circuit breaker, motor protecting switch or the like has the task of switching the so-called nominal load; moreover, it is also necessary to disconnect a short-circuit current, a circuit breaker also having the task, in particular, of limiting the short-circuit current so that the so-called prospective short-circuit current does not stress the system.

In the case of circuit breakers or motor protecting switches, during disconnection there is struck between a movable and a fixed contact piece an arc which, because of the particular configuration of the contact point or because of particular measures such as, for example, an electric field generated by a so-called blowout loop, is driven away from the contact point into an arc splitter stack which is assembled from a plurality of mutually parallel laminations arranged at a specific spacing from one another. When the arc runs into such an arc splitter stack, also termed a deionizing laminate core stack, it is subdivided into a number of partial arcs which burn between two adjacent arc splitters in each case. The current is limited and quenched because of the voltage drop at the respective arc base points.

There is a series of measures for increasing the breaking power; the abovementioned blowout loop is one

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of these measures. It is also possible to arrange on both sides of the so-called prechamber, in which the arc is struck, chamber plates which can, if appropriate, consist of gas-emitting materials. However, it holds in principle that the breaking power is higher the more that arc splitters are accommodated in the relevant stack. Since the spacing of the arc splitters is not permitted to fall below a specific minimum value, because otherwise melting gives rise to small beads, and because the de-ionizing voltage is not permitted to fall below a specific value, the number of the arc splitters can be increased only by virtue of the fact that the arc splitter stack as a whole also occupies a larger volume. Since the housing of a circuit breaker is not permitted to exceed a specific height owing to stipulated standards in order for the circuit breaker still to fit into the distribution board intended for it, the size of the arc splitter stack is limited, particularly when the arc splitters run parallel to the fastening surface of the circuit breaker, which is mostly the case.

The power can also be increased by providing two contact points instead of a single contact point; with these, the same problem arises as in the case of corresponding higher breaking powers.

It is the object of the invention to create an arc splitter stack for an electric switch, in particular for a circuit breaker, in the case of which the number of arc splitters is increased in conjunction with the same stack volume.

This object is achieved according to the invention by means of the features of Claim 1.

According to the invention, the arc splitters which are arranged in the stack are offset along a line running

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in the arc running direction so as to form two offset lamination sections running in parallel; the laminations are then laid on one another, an insulating layer being accommodated between the sections in mutual contact, whereas the other sections of two adjacent laminations in each case enclose between them the spacing required for arc quenching.

Because of this offset configuration of the arc splitters, and because of the insulating interlayer between the laminations, which can be very thin, the advantage results that it is possible to insert more laminations into an arc splitter stack than in one in which the arc splitters are flat-surfaced. The breaking power of a circuit breaker or a motor protecting switch can be increased by increasing the number of the arc splitters in conjunction with the same stack volume.

In this case, an offset lamination and a flat-surfaced lamination can be arranged alternately next to or above one another in mutual contact. It is possible for the contact surfaces to be contiguous only at a longitudinal edge of the laminations, whereas the sections which have the normal spacing adjoin the other longitudinal edge; it is also possible for the contact surfaces to be alternately contiguous at opposite longitudinal edges.

A further refinement of the invention can provide that all the laminations are offset, and that the offsetting line of all the offset laminations lies in the middle of the stack or eccentrically.

The insulation can be formed by an insulating coating of the individual laminations in the contact regions; it is also possible for the insulation to be formed by webs in the housing of the switching device holding the

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stack. In this case, the laminations are guided directly in the housing.

It is also possible to create a stack housing for the arc splitter stack such that the insulation can be formed by appropriate webs on the stack housing.

Further advantageous refinements and improvements of the invention are to be gathered from the further subclaims.

The invention, as well as further advantageous refinements and improvements and further advantages, are to be explained and described in more detail with the aid of the drawing, in which a few exemplary embodiments of the invention are illustrated. In the drawing:

Figure 1 shows a view into a circuit breaker, in a diagrammatic illustration, and

Figures 2 to 4 show various refinements of the laminations in an arc splitter stack.

Figure 1 shows a view into a circuit breaker 10, which has, in a housing 11, a breaker mechanism 12, an electromagnetic release 13, a thermal release 14, a movable switching lever 15 and a fixed contact piece 16. Assigned to the fixed contact piece 16 is a first arc runner rail 17, and assigned to the movable contact piece 15a arranged on the switching lever 15 is a second arc runner rail 18, which rails enclose between them an arc splitter stack 19 consisting of a plurality of arc splitters.

When an arc is struck in the case of a disconnection operation between the movable contact piece 15a, integrally formed on the contact lever or switching

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lever 15, and the fixed contact piece 16, one base point of the arc migrates along the runner rail 17, and the other base point of the arc migrates along the runner rail 18 into the arc splitter stack 19 in which it is subdivided into a plurality of partial arcs and quenched, in a known way.

For specific, physical reasons, the spacing between the individual arc splitters is not permitted to fall below a specific value, since otherwise the arc quenching ability is disturbed.

Figure 2 shows a first embodiment of such offset arc splitters. The arc splitter stack described here alternately has a smooth, flat-surfaced arc splitter 20 adjoined by an offset arc splitter 21; adjoining the latter is a smooth arc splitter 22, and adjoining the latter, again, is an offset arc splitter 23, etc. In the case of the design in accordance with Figure 2, the arc splitter 21, 23 ... is offset in the middle, along an offsetting line which runs in the arc running direction. The offset 24 forms two sections 25, 26 which run in a mutually parallel fashion, one surface 27 of one section 25 lying in the same plane as the oppositely situated surface 28 of the other section. The flat arc splitter 20 is laid directly on the section 26, and the next flat-surfaced arc splitter 22 is laid on the section 25, etc. Arranged between the regions in mutual contact, that is to say between the section 26 and the lamination 20, is a thin insulating layer 29 which covers the offset 24 on the arc splitter 21, on the one hand, and covers the longitudinal edge, adjacent to the section 26, of the arc splitter 20 with the aid of a stack 30, on the other hand. Likewise located between the arc splitter 21 and the arc splitter 22 is a thin insulating layer 31 which covers the offset 24, on the one hand, and covers the opposite longitudinal edge of the section 25, on the other hand.

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As a result, interspaces 32, 33, 34, 35 which occupy the required spacing of the non-insulated sections are created alternately to the left and right of the offsetting line.

In the design in accordance with Figure 3, each arc splitter stack 36, 37 ... is offset on its midline, two flat-surfaced arc splitters 38 and 39 being located on the mutually opposite outer surfaces of the arc splitter stack; these arc splitters can also be formed by the arc runner rails 17, 18. In the case of the arrangement in accordance with Figure 3, the contact surfaces between the arc splitters 36, 37 are arranged alternately on either side of the offsetting line, thus forming corresponding interspaces 40, 41, 42 which form a required spacing between the non-insulated sections and are respectively situated alternately to the left and right of the offsetting line 43.

The refinement in accordance with Figure 4 is similar to the arrangement in accordance with Figure 2. The only difference is that the contact surfaces of in each case two offset laminations 50, 51 with the flat-surfaced lamination 52 located therebetween are located on one side, whereas the corresponding sections of the offset laminations 51, 53, which make contact with the arc splitter located between them, are located on the other side of the offsetting line 55. The pairs of contact surfaces formed thereby are situated alternately to the left and right of the offsetting line.

The insulating layer 29, 30, 31 etc. can be provided by coating the corresponding sections of the arc splitters. It is also possible to provide in the housing 11 of the circuit breaker 10 corresponding wall projections between which the individual arc splitters are guided. It is also possible to create a dedicated

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stack housing which is constructed, in principle, in the same way as the region, holding the arc splitters, of the housing 10 of the circuit breaker, and which holds the individual arc splitters in the mutual arrangement illustrated in Figures 2 to 4.

The invention is illustrated with the aid of three exemplary embodiments. It goes without saying that modifications of these arrangements also fall under the scope of protection of the invention; it is assumed that the individual arc splitters are laid directly on one another in specific regions with the interposition of an insulation, whereas in other regions they have a spacing suitable for the purpose of conducting and quenching an arc. Thus, in the designs in accordance with Figures 2 to 4, the offsetting line is arranged in the middle; it is also possible, of course, to position the offsetting line of one offset splitter stack closer to one longitudinal edge, and to position that of the following arc splitter closer to the other longitudinal edge of the splitter stack, the result being formation, as it were, of two offsetting lines or offsetting planes, and that the interspaces in which the arc is located over-reach the midline. The offsetting plane is understood as that plane which is defined by the offsetting lines situated one on top of another. In the case of the designs in accordance with Figures 2 to 4, only one offsetting plane is present; if two offsetting planes are present, they adopt a mutual spacing which does not prevent effective quenching.

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## Patent claims

1. Arc splitter stack for an electric switching device (10), in particular for a circuit breaker and motor protecting switch, having a plurality of arc splitters which are arranged at a spacing from one another and between which an arc is subdivided into a plurality of partial arcs, characterized in that there are arranged in the stack arc splitters (20, 21, 22, 23; 38, 36, 37; 50 to 54) which are offset along a line (24, 43, 55) running in the arc running direction so as to form two lamination sections (25, 26) running in parallel, and in that the laminations are laid on one another, an insulating layer (29, 31) being accommodated between the sections in mutual contact, whereas the other sections of two adjacent laminations in each case enclose between them the usual spacing required for arc quenching.

2. Arc splitter stack according to Claim 1, characterized in that an offset lamination and a smooth, flat-surfaced one are situated upon one another in mutual contact (Figure 2, Figure 4).

3. Arc splitter stack according to Claim 2, characterized in that the contact surfaces are contiguous only at a longitudinal edge.

4. Arc splitter stack according to Claim 2, characterized in that the contact surfaces are alternately contiguous at opposite longitudinal edges (Figure 2, Figure 4).

5. Arc splitter stack according to one of the preceding claims, characterized in that the offsetting lines (24, 43, 55) of all the offset laminations lie in a plane which lies in the

middle of the stack in the stacking direction of the laminations and in the arc running direction.

6. Arc splitter stack according to one of Claims 1 to 4, characterized in that the offsetting lines are arranged eccentrically.

7. Arc splitter stack according to one of the preceding claims, characterized in that the insulation between sections of the arc splitters in mutual contact is formed by an insulating coating.

8. Arc splitter stack according to one of Claims 1 to 6, characterized in that the insulation is formed by webs in the housing of the circuit breaker holding the stack, the arc splitters being inserted into the interspaces of these webs.

9. Arc splitter stack according to one of Claims 1 to 6, characterized in that a dedicated stack housing is provided which holds the arc splitters and in which webs are located which are guided so as to insulate the arc splitters located in the stack housing.

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