

ROTATING ARC SWITCH

The invention relates to an alternating current switch with magnetic blow-out generating an arc rotation, comprising an insulating housing containing a high dielectric strength gas, a pair of separable contacts, a first ring-shaped electrode connected to one of said contacts to collect the arc root immediately after its formation and a tubular coil coaxial to said first electrode to generate a magnetic field in the formation and extension zone of the arc drawn between said contacts when these last ones get separated and to impose a rotating migration of the root of said arc tied on the first electrode, this one made in a good conducting material.

The french patents n° 2 339 244 and 2 368 792 describe interrupters of the kind mentioned, having a blow-out coil with a front side made as an annular contact forming a ring-shaped track of migration of the arc root. This annular track is made in a good conducting electrical material, has induced currents and important electrodynamic repulsion forces and the performances of these interrupters are limited. The present invention aims at coping with these disadvantages.

The interrupter according to the present invention is characterized in that the ring of said electrode is thick in axial direction, is built on to the inner edge of the coil front side on the side of the arc formation zone, is rigidly fastened to the coil support, and covers only a small fraction of said coil front side and that a metallic shield of narrow width and/or of low conductivity relative to the first electrode is placed between the arc formation zone and the part of the coil front side non covered by the first electrode.

The annular electrode only extends on a small part of the front side of the coil, which enables a limitation of the electrodynamic forces and position the arc root. The metallic

shield, under the action of the magnetic field generated by the coil, has induced currents as well, but their influence can be limited by the use of a low conductivity material and a shield of narrow width. This shield is disposed in deflector of gases ionized. One already knows rotating arc switches in which the annular electrode covers only partially the front surface of the coil (german patent n° 2 511 238 - figure 3 - and french patent n° 2 285 700) but the surface covered by the electrode is superior to half of the front side and the reduction of the repulsion forces is insufficient.

The high cylindrical shape of the annular electrode does not allow a concentration of the induced currents in the electrode near the arc and to the passage to zero of the current, the intensity of the arc blow-out field generated by these induced currents, is weak and insufficient when the arc is extinguished.

In accordance with a feature of the invention, the section of the first ring-shaped electrode is substantially contained in a circle, and the centre of gravity of the induced current lines coincides with the centre of the circle.

In accordance with another feature of the invention, the coil is firmly secured to a metallic bracket to which the ring-shaped electrode is brazed. The metallic bracket forms a binding band of a coil just as a rigid support of the ring-shaped electrode, capable of supporting the important repulsion forces, generated by short-circuit currents running into the coil. The bracket is advantageously made of a ferromagnetic material, such as soft iron, which increases the blow-out magnetic field during breaking of small currents.

The ring-shaped electrode is closely coupled to a blow-out coil and it constitutes a short-circuit dephasing ring situated in the zone of maximum field and allowing a conservation of the blow-out magnetic field to the passage to zero of the current. A

second electrode is disposed in front of said first electrode to position the arc in the zone of maximum field generated by induced currents.

The above and other objects and advantages of the invention will become apparent from the following description of an embodiment of the invention given by way of example only and shown in the annexed drawing which is a vertical partial sectional view of a circuit interrupter with arc-rotating means, the left and right parts showing respectively the closed and opened positions of the interrupter.

With reference to the figure, a sealed elongated housing 10 of a suitable insulating molded material, is filled with dielectric medium, such as sulfur hexafluoride gas (SF₆) at atmospheric pressure or at elevated pressure. The elongated housing 10 includes a stationary contact 12 cooperating in the closed position with a slidable longitudinally movable contact 14, both contacts being arranged in axial alignment inside said housing, and electrically connected to terminals 16, 17. In the realization, shown on the figure, the dielectric gas escapes through the hollow movable contact 14 during arc-extinguishing operation.

It is obvious that either both or neither of the two contacts 12, 14, can be hollow-shaped, these arrangements being well known by specialists.

The stationary contact 12 is coaxially surrounded by a fixed bracket 18 having an annular recess 20 for receiving a blow-out blast coil 22. The lower front face 24 of coil 22 is located near the axial level of the end 26 of stationary contact 12 which comes into engagement with movable contact 14 in the closed position of the interrupter. Coil 22 is firmly inserted within recess 20 between an inner collar 28 and an outer collar 30 of bracket 18. Outer collar 30 forms a binding around coil 22 which is firmly held in position during energization by high currents. An annular intermediate electrode 32 of good conductive and arc resistant material is fastened to the end of inner collar 28 and projects over the end 26 of contact 12. Electrode 32 comprises a protruding flange secured to the inner edge of the front face 24 of coil 22. Electrode 32 is formed by a ring-shaped member having a predetermined thickness and a section which is nearly contained in a circle.

Bracket 18 is a metallic and ferromagnetic material, such as mild steel, and electrode 32 is soldered or brazed to the collar 28 so as to form a unity with bracket 18 and coil 22. Front face 24 has an outer portion which is not covered by the protruding flange of electrode 32 but by an annular disc 34

carrying a shield 36 which deflects the hot gases. A ring 38 of insulating material is interposed between disc 34 and shield 36 which surrounds coaxially electrode 32. Shield 36 comprises an extension 40 having the shape of a truncated cone which surrounds the arcing zone and extends radially towards the inner wall of housing 10. Coil 22 is electrically connected at one end to the stationary contact 12 and to electrode 32 at its other end, (not shown).

An auxiliary and stationary electrode 42 of tubular shape is associated coaxially to movable contact 14 and is provided with an annular upper conductive end 44 disposed in front of electrode 32 having the same diameter and longitudinally spaced from end 44 by a predetermined axial distance corresponding to optimum arc extinguishing condition. An axial slot 46 is centrally arranged within end 26 of the stationary contact 12, and conductive electrode 42 is longitudinally slotted to prevent its appearance as a short-circuited turn.

The interrupter operates as follows :

In the closed position of interrupter shown on the left part of the drawing, the movable contact 14 engages the stationary contact 12, and current flows from upper terminal 16 towards lower terminal 17 through closed contacts 12, 14 which short-circuits the coil 22. In order to open the interrupter, the movable contact 14 is actuated downwardly by an operating mechanism (not shown), and an arc is drawn between the open contacts 12, 14. This arc is rapidly transferred to electrodes 32 and 42, and the arc current flows now through coil 22 producing in the arcing zone a radial magnetic field, which causes the arc to rotate very rapidly around electrodes 32, 42. The arc rotation occurs in the middle zone of housing 10, and electrodes 32, 42 form ring-shaped arc runners having each a small radial breadth. The in-

insulating ring 38 prevents the arc to be transferred to the extension 40 of shield 36. The mutual coupling between coil 22 and the closed electrode 32 induces important circulating currents in electrode 32 since it is a short-circuit winding. These circulating currents are out of phase with the current flowing in coil 22 so as to maintain a sufficient magnetic field between the spaced electrodes 32, 42 as the arc current approaches current zero to ensure rotational movement of the arc current through the dielectric gas. It will be noted that the arc extends near the centre of gravity of the induced current lines in electrode 32 where exists the maximum magnetic field. The arc current is then extinguished as it passes through a current zero.

The electrodynamic repulsion forces between coil 22 and electrode 32 are limited by the reduced radial dimension of electrode 32, and are taken over by the mechanical fastening of electrode 32 to the stationary bracket 18. Only a small inner portion of the front face 24 of coil 22 is covered by electrode 32, the other larger outer portion carrying disc 34 and shield 36 of small thickness and made of a metallic material having a low electrical conductivity, such as stainless steel. The circulating currents induced in disc 34 and shield 36 are very limited, so that bracket 18 is capable of withstanding the electrodynamic repulsion forces produced during arc extinguishing operation. Shield 36 protects the front face 24 of coil 22, and its extension 40 deflects the hot gases and acts also as a condensing wall. The ferromagnetic bracket 18 increases the magnetic field produced by small currents so as to move the rotating arc at sufficient velocity to cause its effective interruption. The axial slot 46 avoids the migration of the arc roots towards the

centre of the stationary contact 12. The longitudinal slot of electrode 42 reduces the induced currents and the electrodynamic repulsion forces. Although the present invention has been described with respect to a preferred embodiment, it should be understood that many variations and modifications will now be obvious to those skilled in the art. The auxiliary tubular electrode 42 may be avoided and the arc is then drawn between electrode 32 and the movable tubular contact 14.



CLAIMS

1. Alternating current switch with magnetic blow-out generating an arc rotation, comprising an insulating housing
5 (10) containing a high dielectric strength gas, a pair of separable contacts (12, 14), a first ring-shaped electrode (32) connected to one (12) of said contacts to collect the arc root immediately after its formation and a tubular
10 coil (22) coaxial to said first electrode (32) to generate a magnetic field in the formation and extension zone of the arc drawn between said contacts when these last ones get separated and to impose a rotating migration of the root of said arc tied on the first electrode (32), this
15 one made in a good conducting material, characterized in that the ring of said first electrode (32) is thick in axial direction, is built on to the inner edge of the coil (22) front side (24) on the side of the arc formation zone, is rigidly fastened to the coil support, and covers only a
20 small fraction of said coil (22) front side (24) and that a metallic shield (34; 36, 40) of narrow width and/or of low conductivity relative to the first electrode is placed between the arc formation zone and the part of the coil (22) front side (24) non covered by the first electrode (32).
- 25 2. Switch according to 1, comprising a second ring-shaped electrode (42) having a diameter almost equivalent to the first electrode (32) one so as to collect the arc root on the side of the second separable contact and to position the arc in the zone of maximum field generated by the in-
30 duced currents in said first electrode, characterized by the fact that said second ring-shaped electrode (42) is split.
- 35 3. Switch according to 1 or 2, characterized by a ferro-magnetic frame (18) having an outer ferrule (30) to bind the coil (22) and an inner ferrule (28) to cover internally coil (22), said first electrode (32) being rigidly fastened to the front edge of the inner ferrule (28).



(17)

4. Switch according to 1, 2 or 3, characterized in that the shield (34, 36) is disposed in deflector of gases ionized by the arc and extends near up to the inner wall of the housing (10).

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5. Switch according to any of the former claims, characterized in that it comprises a long insulating housing (10), a fixed contact (12) coaxially extending inside the coil (22) and having a contact end (26) lightly set back from the front side (24) carrying the first electrode (22), a moving contact (14) cooperating with the fixed contact (12) and capable of axially sliding to draw an arc extending in axial direction, said arc switching on said first electrode (32) to bring the coil (22) into circuit.

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6. Switch according to 5, characterized in that the fixed contact (12) end (26) is hollowed out in its middle (46) to shut the arc up on the outer edge of the contact (12).

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7. Switch according to 2, characterized in that the second electrode (42) is located at a fixed distance from the first electrode (32) corresponding to the optimum distance of the arc extinguishing.