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Amsler

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[54] **ARC ELECTRODE, ESPECIALLY FOR VACUUM SWITCHES**

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[51] **Int. Cl.** **H01h 33/66**

[58] **Field of Search** ..... 200/144 B, 166 BH

[56] **References Cited**

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Primary Examiner—Robert S. Macon

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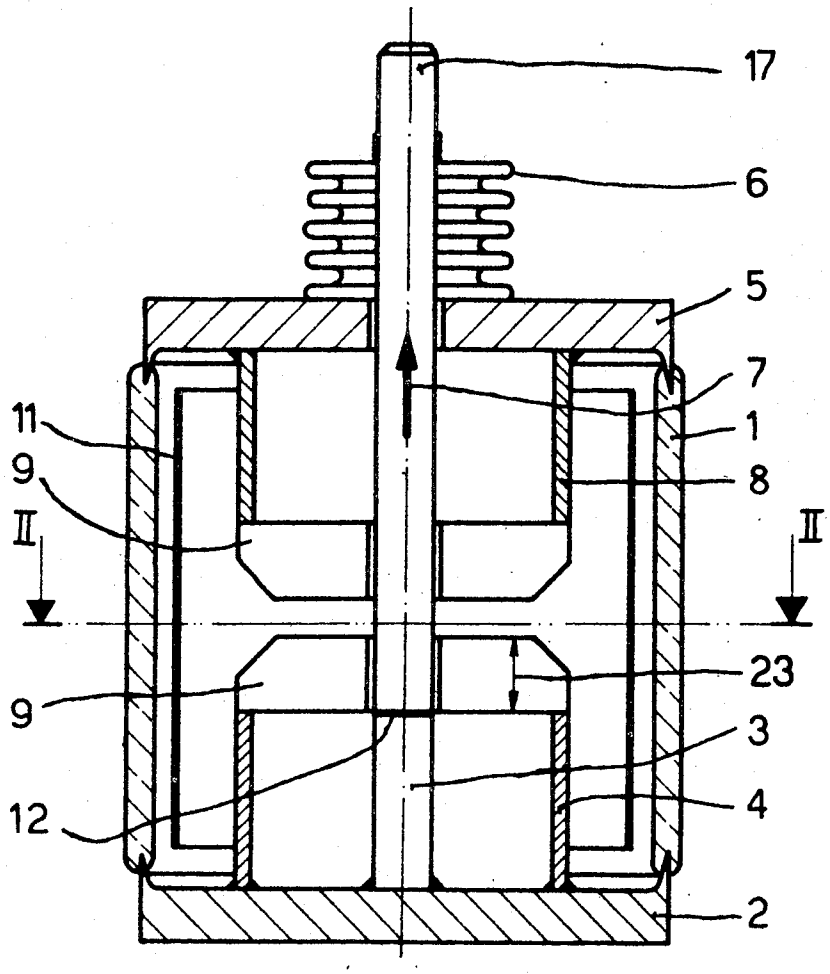
[57] **ABSTRACT**

An arc electrode, especially for vacuum switches, comprising two oppositely situated electrodes for taking-up the base points of the arcs and formed of a number of plates. The narrow surfaces of the plates are disposed to confront the oppositely situated electrodes. Gaps or spaces are maintained free between the individual plates, the width of such gaps being at least equal to the thickness of a plate.

7 Claims, 6 Drawing Figures



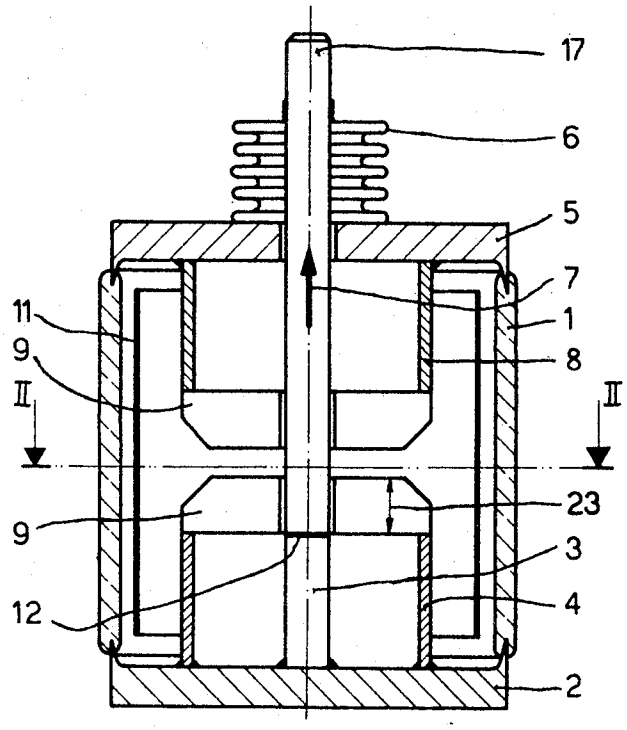


Fig. 1

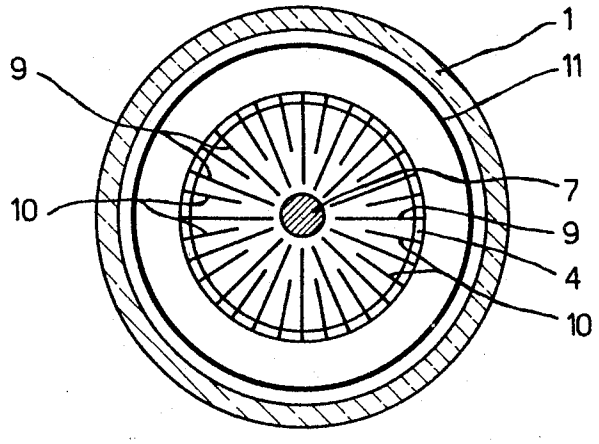


Fig. 2

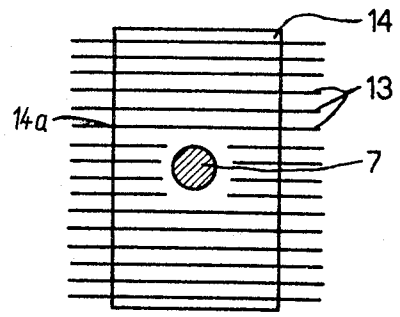


Fig. 3

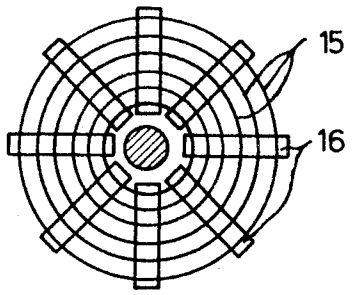


Fig. 4

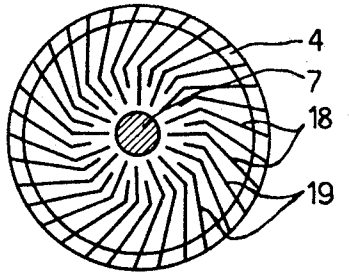


Fig. 5

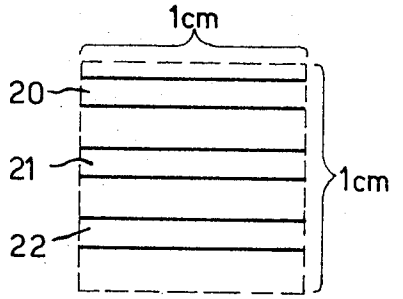


Fig. 6

ARC ELECTRODE, ESPECIALLY FOR VACUUM SWITCHES

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved construction of arc electrode, especially for vacuum switches, which is of the type incorporating two oppositely situated electrodes formed of a plurality of plates and destined to take-up the arc base points, the narrow surfaces of the plates confronting the oppositely situated electrodes.

A contact mechanism, especially for vacuum switches, is known to the art wherein each switching element or piece is enclosed by an arc electrode. With this arrangement the arc electrode is composed of involute-shaped flexed plates disposed parallel to the axis of the switching element, the plates being assembled together into a rigid package and these plates alternately consist of two materials of different electrical conductivity. The infeed of current to the base points of the arc displaced radially outwardly at the arc electrode preferably occurs at the plates possessing the better electrical conductivity so that the thus produced arc-shaped current paths exert a tangential acceleration force upon the arc. As a result the arc rotates at the outer periphery of the arc electrode about the contact axis until it is extinguished. Owing to the rapid movement of the base points of the arc there is prevented an undesired, high local heating of the contact surfaces. A drawback with this arrangement is that for cut-off or interruption currents exceeding about 5 – 10 kA the contact burn-off is relatively great so that the longevity of the vacuum switch is reduced for high cut-off currents.

Experiments have shown that the arc between large-surface electrodes, such as for instance between the previously mentioned arc electrodes, can burn in two different conditions. Below 5kA the arc burns in a diffuse or scattered manner. If this current boundary or limit is exceeded then there prevails a column or pillar arc. The contact burn-off for column arcs is considerable and therefore the longevity of the vacuum switch is also reduced. A diffuse arc does not cause any two appreciable contact burn-off. For the purpose of obtaining the diffuse region of the arc there is known to the art a solution in which the arc burns and travels between two coaxial cylinders. A drawback of this solution is, however, that the ionized gas during cut-off of the switch remains between both oppositely situated electrodes and it is difficult to extinguish the arc.

According to a further known proposal in the art there is provided two bowl-shaped constructed electrodes disposed in confronting arrangement, each electrode being provided with an inwardly turned or flanged lip portion bounding an opening, the openings of the bowl-shaped electrodes confronting one another. With this proposal the ionized gas from the space between the electrodes is collected in the spaces of the bowl-shaped electrodes which are not electrically loaded, cooled and condensed. A drawback of this arrangement is that between the bowl-shaped electrodes there also appears a column arc when exceeding approximately 10 kA cut-off currents, bringing about marked contact burn-off.

SUMMARY OF THE INVENTION

Hence, from what has been discussed above it will be

recognized that the technology in this particular field is still in need of an arc electrode, especially for vacuum switches, which is not associated with the aforementioned drawbacks and limitations of the prior art proposals. It is therefore a primary object of the present invention to fulfill the existing need in the art.

Another and more specific object of the present invention relates to a new and improved construction of arc electrode rendering possible maintenance of the diffuse range of the arc also when exceeding approximately 5 – 10 kA cut-off current values.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the invention contemplates leaving spaces or gaps free between the individual plates, the width of such spaces or gaps being at least equal to the thickness of a plate. A particularly advantageous arrangement of the plates is then realized if the plates are radially arranged about an axis common to both oppositely situated electrodes.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a longitudinal sectional view through a preferred constructional form of inventive vacuum switch embodying the teachings of this development;

FIG. 2 is a transverse cross-sectional view taken through the center of the vacuum switch depicted in FIG. 1, taken substantially along the line II—II thereof;

FIG. 3 illustrates details of an electrode construction consisting of parallel plates;

FIG. 4 illustrates details of an electrode construction consisting of coaxial cylinders;

FIG. 5 illustrates details of an electrode construction formed of flexed or angled plates; and

FIG. 6 schematically illustrates a portion of the surface of an electrode.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, in the illustration of the exemplary embodiment of vacuum switch as depicted in FIG. 1, the vacuum tight or sealed housing of the switch consists of a cylindrical portion 1 formed of electrically insulating material, a metallic cover member 2 with the switching element or piece 3 fixedly seated therein and the tubular-shaped elecrode support or carrier 4 mounted thereon, and a second metallic cover member 5 which carries a switching element or piece 7 and the electrode support 8, the switching element 7 being secured so as to be movable via a diaphragm or bellows 6 with the metallic cover member 5. The movable switching element 7 has been illustrated in its switching-in or connection position and can be moved to-and-fro in the direction of the arrow by means of any suitable and therefore non-illustrated actuation mechanism. The electrode supports 4 and 8 carry the radially arranged plates 9 and 10 of the arc electrode. In this connection reference should also be made to FIG. 2. The inner surface of the cylindrical portion 1 is protected against condensation of the metal vapors which are present by means of a tubular-shaped metal shield 11 which is only secured to the

center of the cylindrical part 1 and thus completely insulated from both metallic cover members 2 and 5.

The switching elements or pieces 3 and 7 possess a truncated or blunt contact support surface 12. During disconnection of the current the switching elements 3 and 7 separate and the arc initially burns therebetween. The base points of the arc then wander over to the plates 9 and 10, wherein the delivery of current occurs by means of both electrode supports 4 and 8. The arc burning between the electrodes formed of the plates arranged so as to have therebetween intermediate compartments or spaces is practically not able to build-up an axial pressure of force because the axially accelerated ionized gases in the spaces between the plates arrives at a compartment or space which is not electrically loaded. The hot gases flowing through the spaces between the plates 9 and 10 are cooled and condensed.

The arc burns in a diffuse or scattered manner between the inventively constructed electrodes up to very large values of the cut-off or interruption current, considerably exceeding 5 – 10 kA. The gaps or spaces formed between the plates 9 and 10 and the very narrow surfaces of the plates 9 and 10 confronting the opposed electrodes prevent the formation of column arcs and therefore increase the longevity of the vacuum switch.

Now as best seen by referring to FIG. 3 it should be recognized that the oppositely situated electrodes could also be formed of parallelly arrnaged plates 13. As is to be further understood the plates 13 of the arrangement of FIG. 3 are inserted into slots 14*a* of the electrode support 14 and welded or riveted thereat.

In FIG. 4 there is shown a further construction of the electrodes wherein the latter are assembled together from concentric cylinders 15 secured to electrode supports 16.

In the arrangement of FIG. 5 the flexed or angled plates 18 and 19, which are situated parallel to the axis 17 (FIG. 1) which is common to both oppositely situated electrodes, are mounted at the electrode support 4. This construction also brings about a tangential acceleration of the burning arc between the electrodes.

An essential criteria for maintaining a diffuse arc between the electrodes consisting of adjacently arranged plates with free intermediate spaces therebetween concerns the sum of the length of the edges appearing at one square centimeter of electrode surface. Experience has shown that the sum of the edge length should at least amount to 3 cm. per square centimeter of electrode surface. In FIG. 6 there is illustrated an embodiment wherein the sum of the edge lengths of the plates 20, 21 and 22 amounts to 6 cm. for a square centimeter of electrode surface.

The diffuse arc not only has its arc projection surface at the narrow surfaces of the plates confronting the oppositely situated electrodes, rather also at the wide surfaces of the plates bounding the spaces or gaps between the plates. In order to maintain the diffuse region of the arc for cut-off currents exceeding 5 – 10 kA experience has shown that the dimensions 23 (FIG. 1) of the plates below the narrow surfaces confronting the oppositely situated electrodes must amount to at least 1 cm.

The use of the inventively constructed arc electrodes is not solely limited to merely vacuum switches, although such constitutes a particularly useful environment.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. An arc electrode arrangement particularly for vacuum switches, comprising two oppositely located electrode rods, arcing means for each electrode rod and having a plurality of plates separated from another by gaps therebetween, said plates extending substantially parallel to the axis of the respective electrode rod, said arcing means having an arcing face defined by edges of the plates to take up the base points of the arc, the width of said gaps being at least equal to the thickness of a plate.

2. The arc electrode as defined in claim 1, wherein the plates are rotationally symmetrically arranged about an axis common to both oppositely situated electrode rods.

3. The arc electrode as defined in claim 2, wherein the plates are radially arranged about an axis common to both oppositely situated electrode rods.

4. The arc electrode as defined in claim 1, wherein the plates are flexed and parallelly arranged with regard to an axis common to both oppositely situated electrode rods.

5. The arc electrode as defined in claim 1, wherein the plates are arranged in substantially parallel planes.

6. The arc electrode as defined in claim 1, wherein the sum of the length of the edges of the plates at the electrode surfaces confronting the oppositely located electrode rods amounts to at least 3 cm. per square centimeter.

7. The arc electrode as defined in claim 1, wherein the dimensions of the plates below said plate edges confronting the oppositely located electrode rods amounts to at least one centimeter.

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