

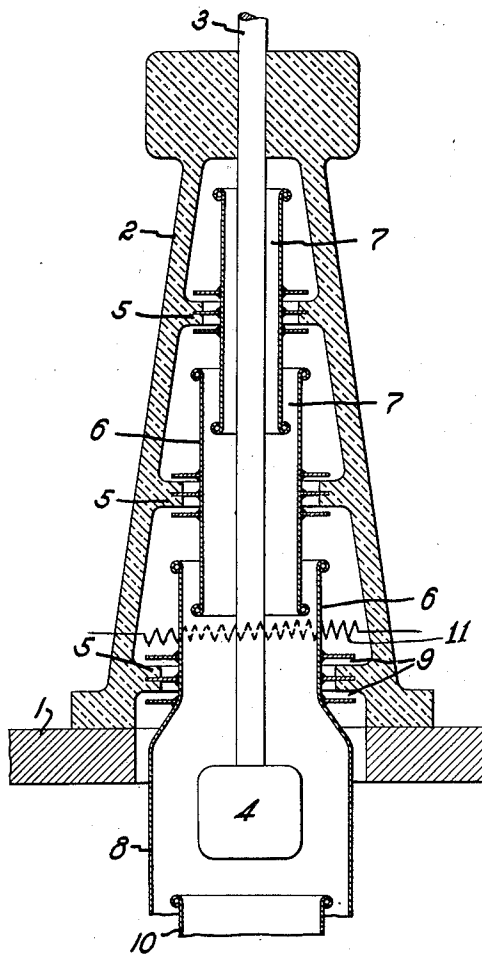
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F. BELDI

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ANODE LEAD FOR HIGH VOLTAGE RECTIFIERS

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Inventor:

Fritz Beldi,

By

Potter, Pierce & Scheffler,

Attorneys.

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ANODE LEAD FOR HIGH VOLTAGE
RECTIFIERSFritz Beldi, Baden, Switzerland, assignor to
Aktiengesellschaft Brown, Boveri & Cie, Baden,
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9 Claims. (Cl. 250—27.5)

It is well known that very severe conditions have to be fulfilled by the anode leads of rectifiers. When it is a question of using industrial frequencies, normal current values and blocking voltages of not too high a value, then the usual kind of anode leads can be employed which practically all possess a so-called bushing insulator. As soon as it is necessary to operate with higher frequencies or higher currents and voltages, however, it is found that the usual leads are no longer adequate. The main cause of failure are the dielectric losses which result in a breakdown of the insulating material. When large currents have to be dealt with the lower part of the insulator becomes so hot, due to the high anode and ambient temperature, that a breakdown occurs. To prevent this occurring an attempt has been made to replace the porcelain insulators by insulators produced from some other insulating material which has only a small dielectric loss at high temperatures. A disadvantage of these materials is, however, that they can only be used for the production of simple insulator shapes and comparatively small sizes owing to technical difficulties of manufacture.

When very high operating voltages are employed it is not only the terminal stresses occurring in the insulator which are the decisive factor but considerable difficulty is also experienced as regards leading in the high voltages. In order to prevent electric flash-overs along the lower part of the insulator bushing attempts have been made to arrange condenser layers inside the insulator, such as is usual with bushing insulators for high voltages. It has, however, been determined that the usual designs of controlled insulators as hitherto used for high voltages cannot be simply applied to rectifiers to prevent flash-overs in the gas-filled space when the arc burns. On the contrary, these are often the cause of the back-arcing which it is desired to eliminate.

It is therefore one of the objects of the present invention to provide an anode lead for rectifier discharge tubes and the like which does not possess the disadvantages referred to above. This is achieved according to the invention by an arrangement whereby a hollow supporting insulator for carrying the anode is located outside the discharge space, the anode being fixed to the head of the insulator by means of the anode bolt or supporting stem and extending freely into the discharge space, a plurality of metal shields for controlling the electric field being provided inside the insulator and so arranged that they

overlap each other, their radial distance apart and the magnitude of their overlap being so selected that charge carriers coming from the discharge space are caught by these shields and at the same time discharges along the insulating surfaces in the hollow space of the insulator are suppressed.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing in which the figure shows a rectifier anode lead in sectional elevation.

Referring more particularly to the drawing by characters of reference, reference numeral 1 designates the metallic rectifier casing on which the anode insulator 2 is mounted. The anode bolt 3 which is arranged in the head of the insulator 2 is designed in the form of a lead which extends freely without further support into the discharge space and carries the anode 4 at its lower end. On the inside wall of the conical insulator 2 annular shaped flanges 5 are provided to which the shield electrodes 6 are fixed. The electrodes 6 are arranged concentric with the axis of the insulator and are so disposed one within another in an axial direction that annular intermediate spaces 7 are formed between adjacent electrodes. As shown in the drawing the diameter of the electrode nearest to the head of the insulator is the smallest, whilst the diameter increases from electrode to electrode towards the foot of the insulator. All electrodes are provided with rounded edges at both ends. The usual guiding sleeve 8 for the arc is preferably fixed to or, as shown, an integral extension of the lowest shield electrode 6. It is advisable to fix the electrodes in position in such a manner that protective spaces 9 are formed between the electrodes and those parts of the flanges 5 which are adjacent to the inside wall of the insulator, these spaces serving as an electrostatic shield for the points of contact. Special means should preferably also be provided which heat the insulator 2 and the metal electrodes 6 to such a degree that condensation inside the insulator is prevented. This can be achieved by dimensioning the anode bolt 3 so that with normal operating current strength the resulting current heating losses produce the desired heating effect. In special cases a heating device 11 can also be used which is located inside the hollow space in the insulator in the region of the lowest flange. Below the anode 4 but inside the arc guiding sleeve 8 a control grid 10 and one or more control grids of the usual kind, not shown are arranged.

When the arc burns, the electrodes 6 each assume a certain potential which is mainly determined by the charge carriers which originate in the discharge space and terminate on the electrodes. These potentials can be very different from the potential distribution due solely to the capacitive voltage divider that is formed by the overlapped ends of the shield electrodes 6. The arrangement of the electrodes 6 described above and also their mutual distance apart is so selected that powerful electric fields occur in the intermediate annular spaces, thus preventing the charge carriers from passing through these spaces and reaching the insulator. The charge carriers cannot therefore be deposited on the inside wall of the insulator. The distance between two successive electrodes is preferably made somewhat greater than the operating conditions would require according to Paschen's law; on the other hand, however, the possible discharge paths must not be made too long. In order to control the electric field along the insulator the electrodes 6 are fixed to successive flanges 5 in the order of their operating potential.

The insulating portions of this new anode assembly are only subjected to very slight electrical stresses and are entirely free from thermal stresses. Even under the heaviest anode loads a thermal breakdown is impossible with the aforesaid construction. It is therefore possible to employ ordinary porcelain for the insulator. A very favourable feature of this construction is that the anode is nowhere in direct contact with any insulating parts and furthermore the points of contact between the metal parts and the porcelain are outside the influence of the arc. Those places which in the usual anode constructions are known to be particularly dangerous as regards back arcing are thus avoided and in consequence a higher degree of safety in operation can be obtained. The anode assembly according to the invention is thus an essential feature of all rectifiers where voltages of over 50 kw. are used.

I claim:

1. An anode assembly for high voltage electric converters of the type including a metal casing within which vapor or gas discharge paths are established between cathode and anode elements, said assembly comprising a hollow insulator outside of and mounted upon the converter casing, an anode within the casing, an anode supporting stem extending freely through said hollow insulator, said stem projecting

through and being supported by the head of said hollow insulator, a plurality of axially and radially displaced metal shields supported within said insulator and substantially coaxial with said anode supporting stem, adjacent pairs of shields being telescoped within each other to form condenser elements for establishing a potential gradient along the interior of the hollow insulator.

2. An anode assembly as claimed in claim 1, wherein the extent of the telescoped overlapping of adjacent shields is so related to the radial spacing of said shield that the resulting electrical field between said shields prevents axial movement of charge carriers through the annular spaces between adjacent shields and into the space between said shields and the inner wall of said insulator.

3. An anode assembly as claimed in claim 1, wherein said hollow insulator has an interior space of conical form, and said shields are of progressively increasing diameter in the order of their axial spacing from the top of said insulator.

4. An anode assembly as claimed in claim 1, wherein said hollow insulator has interior radial flanges, and said shields include means for mounting the same upon the respective radial flanges.

5. An anode assembly as claimed in claim 1, wherein said hollow insulator has interior radial flanges, and said shields include means for mounting the same upon the respective radial flanges, in combination with means forming electrostatic shield means for the points of connection between said shields and the respective interior radial flanges of said insulator.

6. An anode assembly as claimed in claim 1, in combination with an arc guiding sleeve surrounding said anode and fixed to the shield at the foot of said insulator.

7. An anode assembly as claimed in claim 1, in combination with means to heat the interior of said hollow insulator.

8. An anode assembly as claimed in claim 1, in combination with means to heat the interior of said hollow insulator, said heating means comprising said anode supporting stem.

9. An anode assembly as claimed in claim 1, in combination with means to heat the interior of said hollow insulator, said heating means comprising a heating resistor within the insulator adjacent the base thereof.

FRITZ BELDI.