June 13, 1967 H. EBHARDT 3,325,281

METHOD OF PRODUCING SINTERED ELECTRODES

Filed July 2, 1965 2 Sheets-Sheet 1

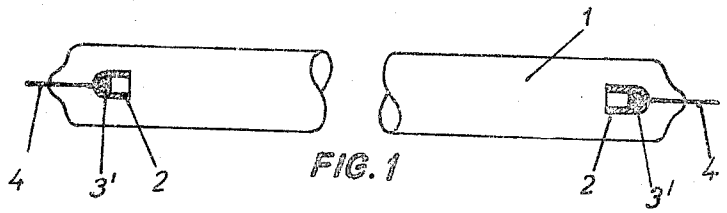

FIG. 1

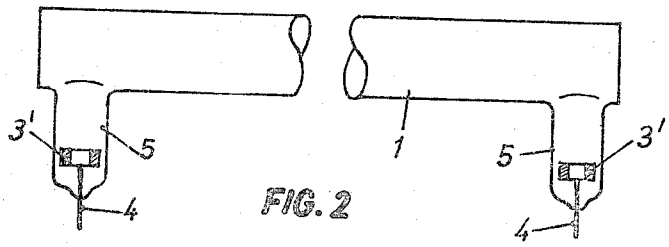

FIG. 2

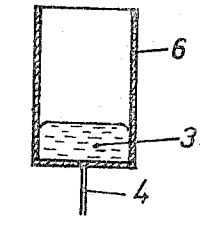

FIG. 3

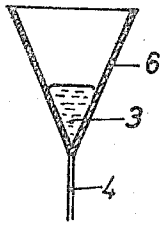

FIG. 4

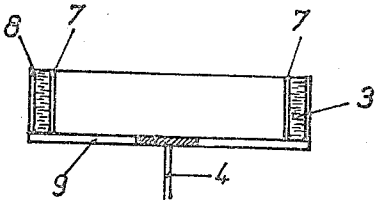

FIG. 7

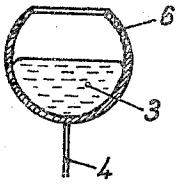

FIG. 5

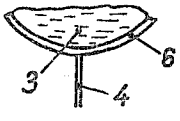

FIG. 6

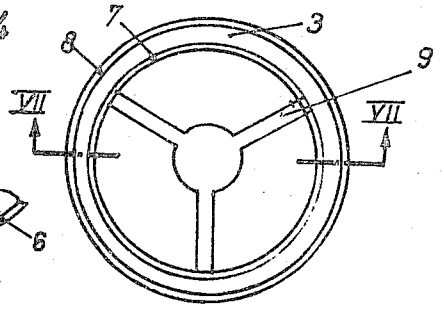

FIG. 8

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METHOD OF PRODUCING SINTERED ELECTRODES

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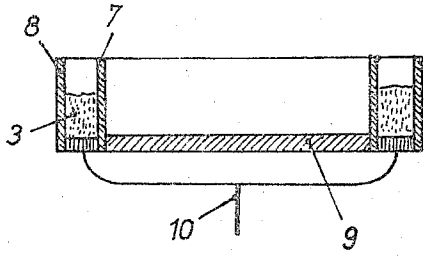

FIG. 9

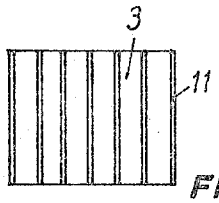

FIG. 10

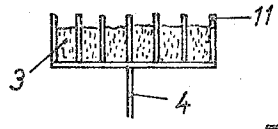

FIG. 11

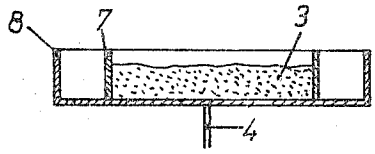

FIG. 12

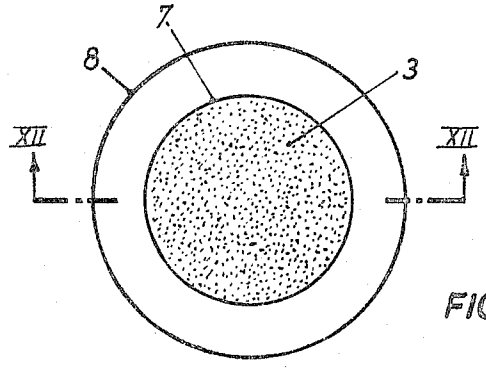

FIG. 13

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United States Patent Office 3,325,281 Patented June 13, 1967

3,325,281

METHOD OF PRODUCING SINTERED ELECTRODES

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Filed July 2, 1965, Ser. No. 469,165
Claims priority, application Austria, July 8, 1964, A 5,864/64
6 Claims. (Cl. 75—206)

ABSTRACT OF THE DISCLOSURE

The invention relates to a method of producing sintered electrodes, particularly for low pressure vapor discharge tubes which are activated with peroxide sand/or oxides of the alkaline-earth metals, if desired with iron, tantalum, tungsten, zirconium, molybdenum, or the like, by applying the mixture under a pressure ranging from 1000 to 2000 kg./cm.^{2} into the body of said electrode and heating the activated mass until a splattering of an insubstantial portion of the activation mass occurs.

Background of the invention

Field of the invention: The invention relates to sintered electrodes for electrical glow discharge lamps in which a metal powder is intimately mixed with an activating substance consisting of a peroxide or oxide of an alkaline earth metal and subsequently heated.

Description of prior art

Prior known low pressure vapor discharge tubes as a rule have electrodes which possess an incandescent coil but although these occupy but little space they are subject, among other numerous disadvantages, to heavy wear. The useful life of these known low pressure vapor discharge tubes is relatively short, being in the neighborhood of at the utmost about 5,000 burning hours.

It is moreover already known to reduce the cathode drop by highly charging a glow discharge cathode, so prepared as to lower the cathode drop, to values below 50 volts, the preparation with a view to lowering the cathode drop being effected by spraying on a paste of carbonates of alkaline earths and by activation.

Vapor discharge tubes are also known in which the electrodes are provided in the shape of cup electrodes which have an activation layer whose emitting substances contain oxides of the metals calcium, strontium or barium.

Generally speaking, the prior known electrodes of the type described above were made by the method in which the activation composition, as the part emitting electrons, was pressed in the form of a compact body, somewhat in the form of a pill, under high pressure into or on to a more or less cylindrical, annular or hemispherical electrode body.

It has been found that the electrodes produced by the known methods did not give the results expected of them either as regards their useful life or as regards the reduction of ignition and operating voltages.

It is the object of the invention to provide a method by which sintered electrodes can be manufactured which have the longest possible useful life, permit the production of vapor discharge tubes of great length in spite of the use of low voltage, and possess the least possible heat dissipation despite high loadability and hence high light intensity.

Summary of the invention

According to the invention, a powder of iron, tantalum, tungsten, zirconium, molybdenum, or the like, is intimately mixed by mechanical means with peroxides and/or oxides of the alkaline-earth metals and the mixture inserted into an electrode body, specifically a metal cup, in such a manner that the activation mass is in conductive connection with the electrode wire, whereupon the activation mass is forced under pressure into the electrode body and is thereafter heated, for example with the aid of a high frequency generator, until a slight explosion occurs; the explosive pressure is so guided in one direction that only an inconsiderable part of the activation mass spurts out of the electrode body and the visible part of the activation mass exhibits after the sintering, a porous and rough surface.

It is evident that the activation mass shows at the moment of explosion a tendency to escape in the direction of least resistance. Owing to the fact that the activation mass spreads out in this direction, the visible part of said mass exhibits a rough and porous surface, which in consequence of its consistency and character substantially facilitates the formation of a discharge glow point, whereby the cathode drop is notably reduced.

The original mixture advantageously consists, in a manner known per se, either of iron, tungsten, zirconium, molybdenum or the like in powder form, which is simply but very thoroughly mixed with barium oxide, or else the mixture is made up of zirconium, tantalum or tungsten and peroxide or of barium oxide and of carbonyl iron and tantalum powder.

The mixture advantageously consists of two parts of oxides or peroxides of alkaline-earth metals, particularly barium peroxide or oxide, and one part of metal powder, particularly iron powder, with an allowance of ±20%.

Especially good results have been found when the pulverulent activation mass is pressed into the electrode body under a pressure of about 1,000 to 2,000 kg./cm.^{2} and the pressed-in mass is heated to produce the explosion.

A further advantageous development of the invention consists in that the electrodes are fused into a glass body, particularly a glass cylinder, and subsequently tempered at a maximum temperature of 450° C.

The electrodes produced by the method of the invention exhibit an extremely high endurance and can be loaded with current intensities of 150 to 180 milliamperes. The endurance is moreover unaffected by switching frequency.

The accompanying drawing illustrates a few conventional forms of electrodes or low pressure vapor discharge tubes, which are particularly well suited for carrying out the method according to the present invention.

Brief description of drawing

FIGURE 1 shows schematically a low pressure vapor discharge tube with cup electrodes made in accordance with the invention, with part of the tube broken away,

FIGURE 2 shows in a similar manner a low pressure vapor discharge tube with attachments for receiving the electrodes,

FIGURES 3 to 6 show different cup-shaped forms of electrodes,

FIGURE 7 shows an especially advantageous annular form of electrode in section along the line VII—VII in FIGURE 8, and

FIGURE 8 shows the same form of electrode in plan view, while

FIGURES 9 to 13 show further forms of electrodes.

Description of the preferred embodiments

In the example illustrated in FIGURE 1, representing a low pressure vapor discharge tube filled, for example, with mercury vapor in a known manner and having on the inside a coating of luminous substance (not shown), the electrodes 2 are arranged in the tube 1 coaxially

therewith. The electrodes 2 are in this case cup electrodes constructed in the form of cylindrical pots provided with bottoms in which the activation layer as the part emitting electrons is arranged in the form of a compact body 3'. The electrodes 2 are provided with connection pins or wires 4 leading from the inside of the tube to the outside. The layer of luminous substance can, in this case extend practically from one end of the tube 1 to the other, so that a tube of this kind, in which the electrodes 2 are arranged at a short distance from its ends is luminous throughout its whole length during operation.

If it is desired to produce long luminous bands without any dark gaps, a number of tubes as in FIGURE 1 can be arranged end to end in series. However, a more suitable solution is represented by the low pressure luminous tube shown in FIGURE 2, in which at the ends of the tube 1, at right-angles to the longitudinal extension thereof, short tubular attachments 5 are arranged in which the electrodes 2 are housed. In this form of construction, electrodes 2 are provided such as are shown in detail in FIGURES 7 and 8. The end faces of the tube 1 are made flat in order that, with the layer of luminous substance extending throughout the entire length of the tube, there is practically no break in the continuity of the luminous band when a number of the tubes are placed end to end in a row.

FIGURE 3 shows a cylindrical cup electrode which in itself may have any desired shape of cross-section. In this example the mixture of composition 3 emitting electrons is disposed at the bottom of a metal beaker 6 provided with a lead-in 4. It is clear that in the carrying out of the method according to the invention with the form of cup electrode 6 shown in the figure the explosive pressure will be directed towards the open end of the cup and only an inconsiderable portion of the activation mass can spurt out of the cup.

The shape of the cup itself can vary as desired. Thus FIGURE 4 illustrates a funnel-shaped cup, the mass 3 emitting electrons being accommodated in the tip of the funnel-shaped cup, which is likewise equipped with a lead-in 4. This cup, too, can be made circular, rectangular, or the like. FIGURE 5 shows a cup shaped like a hollow ball, and FIGURE 6 one shaped like a cap.

An especially useful electrode is illustrated in FIGURES 7 and 8. Here the electron-emitting mass 3 is placed between two cylinders 7 and 8 which are arranged one within the other and the diameters of which differ only slightly, thus leaving a comparatively narrow space for the electron-emitting mass 3. For feeding current by means of the pin or wire 4, and as a means of holding the electrode, support 9 is sufficient, which may have any desired shape. The ring formed by the electron-emitting mass 3 can also have a polygonal shape, for example be rectangular. FIGURE 9 shows an annular electrode, similar to the electrode according to FIGURES 7 and 8 but having in this case a support 9 of, for example, insulatlating material and current lead-in 10 in the form of a wire.

FIGURES 10 and 11 illustrate an example of an electrode which is made up of a few walls 11 extending in parallel which constitute a plurality of chambers filled with the mass 3 emitting electrons, FIGURE 10 being a plan view and FIGURE 11 a side view of this embodiment.

Another electrode suitable for the method of the invention is seen in FIGURES 12 and 13, FIGURE 12 being a section along the line XIII—XIII in FIGURE 13. In this example the cup, provided with the wall 7 and containing the electron-emitting mass 3 in its bottom, is surrounded by a wall 8. Instead of the cup with the wall 7, a disc, a bar, a ring, etc., can be used to carry the electron-emitting mass 3. Moreover, instead of the circular shape, any other geometrical figure can be chosen.

What I claim is:

1. In a process for making sintered electrodes for electrical glow discharge lamps, in which a metal powder is mechanically intimately mixed with an oxidizing substance selected from the group consisting of peroxides and oxides of alkaline earth metals and the mixture applied as an activation mass to the body of the electrode to be sintered under pressure and subsequently heated, the improvement that the mixture is applied to the electrode body under a pressure ranging from 1000 to 2000 kg./cm.^{2}, the mixture consisting of 2 parts of oxidizing substance, 1 part of metal powder and the heating continued for a time sufficient to spatter the activation mass, the pressure causing said spattering being directed in such a manner, by covering the activation mass, that only an insubstantial portion of said mass will be sprayed off from the electrode body, while the bulk of said mass remains applied to said body.

2. The process according to claim 1, wherein the oxidizing substance consists of barium oxide or peroxide and the metal powder of iron with an allowance of 20%.

3. The process according to claim 1, wherein the metal powder is a member selected from the group consisting of iron, tungsten, zirconium and molybdenum power, and the oxidizing substance is barium oxide.

4. The process according to claim 1, wherein the metal powder consists of zirconium, tantalum or tungsten and the oxidizing substance is a peroxide of alkaline earth metal.

5. The process according to claim 1, wherein the metal powder is a mixture of carbonyl-iron and tantalum powder and the oxidizing substance is barium oxide.

6. The process according to claim 1, wherein the electrodes after fusing them into lamp bulbs, are tempered at a maximum temperature of 450° C.

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R. L. GRUDZIECKI, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,325,281 June 13, 1967

Horst Ebhardt

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.

In the heading to the printed specification, line 4, for "Australia" read -- Austria --; column 2, line 43, for "150 to 180" read -- 150 to 800 --.

Signed and sealed this 26th day of November 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents