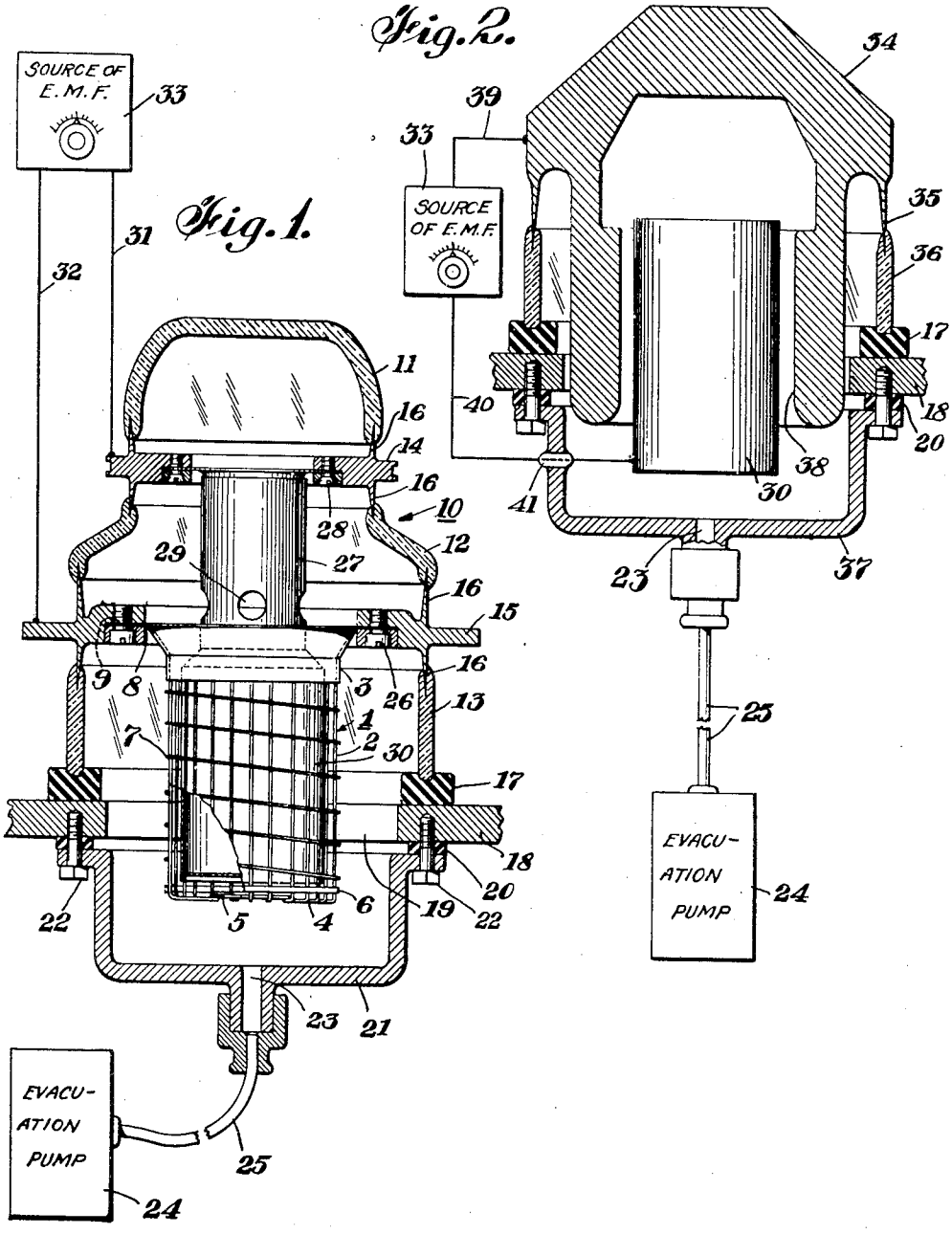
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PREPARATION OF ELECTRODES

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PREPARATION OF ELECTRODES

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This invention relates to a method of preparing electrodes, particularly electrodes to be used in electron discharge devices.

In certain uses of electrodes, such as in electron discharge devices, it has long been recognized that sparking and arcing to and from said electrodes may be injurious. For example, in electron discharge devices employing coated cathodes, sparking from the grid or anode to the cathode may irreparably damage the emissive coating and make said devices useless.

Sparking tends to occur in such devices whenever a relatively high potential gradient exists between two adjacent electrodes. It will therefore be seen that sparking tends to occur most frequently at high frequencies where the spacing between electrodes is small and/or whenever high potentials are employed. This tendency to sparking is also particularly noticeable when electron discharge devices are used with pulsing potentials for the rapid build-up of said potentials tends to break down the gap between the electrodes in the form of a spark, or even more injuriously in the form of a steady arc, the latter condition usually rendering the device useless immediately.

Injury due to sparking very frequently occurs during the formation or aging of an electron discharge device. During the pretreatment of an electron discharge device before it is put into actual operation, it is customary with certain types of said devices to age them by applying potentials to the various electrodes such as the anode and grid which are higher than the normal operating potentials applied to said electrodes. This pretreatment or aging process is necessary in order to obtain stable or satisfactory operation of said devices subsequently but these higher potentials used during aging tend to produce injurious sparking.

It has been determined that the sparking is to a large extent caused by minute projections or sharp angles existing on the surface of the various electrodes such as, for example, projections on the grid due to spot welding of cross wires thereto, and projections on both the grid and the anode due to the coating applied thereto to prevent secondary emission from said electrodes.

An object of the present invention is the provision of an improved method for removing minute projections and sharp angles from electrodes.

Another object of the present invention is the provision of a method for pretreating electrodes

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to minimize the tendency of said electrodes to spark or arc when subsequently inserted in an operative device.

Other and further objects and advantages of the present invention will become apparent and the foregoing will be best understood from the following description of embodiments thereof, reference being had to the drawing in which:

Fig. 1 is a view, partly in cross-section, and partly diagrammatic, of one arrangement of apparatus for carrying out my invention in connection with a grid; and

Fig. 2 is a similar view of another arrangement for carrying out my invention in connection with an anode of the reentrant type.

In carrying out my invention, minute projections and sharp angles are removed from the electrodes prior to their insertion in their operative devices. In removing said projections and angles, the electrode to be pretreated is arranged adjacent a metallic member preferably in a vacuum and voltages are applied between said member and said electrode to produce sparking therebetween and thereby burn off the projections and the angles.

It is preferred to carry out the foregoing process in a vacuum since where gas is present to any appreciable extent, the sparking tends to become a steady arc which might injure the electrode. Moreover if oxygen is present, oxidation will occur and injurious burning of the electrode might occur. It is preferred to use a high vacuum preferably having a pressure of the order of 10^{-6} millimeters of mercury or even less. At such high vacuums, the process is more readily controllable and better results are obtained.

It is preferred that the metallic member have a roughened surface so as to facilitate sparking from said metallic member to the electrode. The roughened surface may be obtained by sandblasting the surface of said metallic member so as to produce a surface having minute projections thereon. The metallic member is also preferably one that will not rapidly deteriorate during the course of the sparking so that the same metallic member may be used repeatedly for the treatment of many electrodes. A nickel member has been found satisfactory for this purpose.

While not essential, the metallic member is preferably arranged at a distance from the electrode equal to the distance between said electrode and cathode when the electrode is subsequently arranged in a completed device. The metallic member preferably has a shape similar to the shape of the cathode in the completed

device and is preferably arranged relative to the electrode in the same way as the cathode is arranged relative to said electrode in the completed device. Thus if said electrodes are an anode or grid, the metallic member need only be arranged adjacent the active surfaces thereof. Obviously it is only necessary that the active surface of the electrode be within the vacuum, as for example in the case of a reentrant type of anode.

In applying voltages between the metallic member and the electrode to burn off the projections and angles, it is preferred to apply a gradually increasing potential. Initially, sparking will occur at a relatively low potential. After the sparking abates, the potential is increased until further sparking occurs. The potential is thus gradually increased step by step. If, however, steady arcing starts to occur, the potential is preferably immediately reduced or completely shut off. It is important to control the applied voltage to prevent steady arcing as such arcing is injurious. In carrying out my invention, I have employed with satisfactory results, maximum potentials of from 10,000 to 100,000 volts without injury to the electrode. A voltage of low frequency, such as for example 60 cycles, is preferred for this purpose. It is desirable to utilize a poorly regulated source of potential so that when sparking occurs and current tends to flow the potential will rapidly drop, thus tending to limit arcing and prevent the establishment of a steady arc which might injure the electrodes.

Referring now to Fig. 1, an arrangement is there shown for pretreating a grid 1 of the type having a plurality of parallel bars 2 connected at their upper ends to a roughly funnel-shaped metallic member 3 and bent at their lower ends as indicated at 4 so that they may be welded to an annular member 5. The bars 2 are held in angular position by a reinforcing ring 6 and are prevented from buckling by a reinforcing spiral wire 7. The funnel-shaped member 3 is provided with a flange 8 having openings 9 therein for the reception of screws which fasten said funnel-shaped member to a grid ring provided in the completed electron discharge device.

This grid structure is to be treated in the apparatus of Fig. 1 so as to remove any sharp projections or angles on the active surfaces of the grid particularly the surfaces of the grid facing the cathode in the completed electron discharge device. For this purpose the grid structure 1 is arranged within an air-tight envelope generally designated by the numeral 10.

The envelope 10 includes three glass portions 11, 12 and 13. Between glass portions 11 and 12 and between glass portions 12 and 13 are respectively arranged metallic rings 14 and 15 each including a pair of knife edges 16 sealed to the glass. The bottom of glass portion 13 rests on an annular air-tight sealing washer 17 which in turn rests on a suitable support such as a table 18 (only a small portion of which is shown) having an opening 19 therein. The envelope is completed by another annular washer 20 and a deep dish-shaped metallic member 21 arranged under the table and secured to the bottom thereof by any suitable means such as bolts 22.

The dish-shaped metallic member 21 is provided with an opening 23 to which is connected an evacuation pump 24 by means of a hose, etc., 25.

The grid 1 is suspended inside envelope 10 from ring 15 by means of screws 26. A generally cylindrical metallic member 27 is similarly suspended from ring 14 by means of screws 28. The metallic member 27 may be provided with openings 29 therein to facilitate evacuation of the envelope. From the lower end of metallic member 27, there is suspended a sand-blasted nickel cylinder 30. The cylinder 30 is spaced from grid 1 a distance substantially equal to the distance of said grid from the cathode when subsequently arranged in a complete electron discharge device. It also occupies the same position in relation to the grid as does the cathode in the completed electron discharge device. Grid rings 14 and 15 are connected to the two leads 31 and 32 respectively from a source of E. M. F. 33. As stated hereinbefore, said source is preferably a poorly regulated one so that when sparking occurs between the nickel cylinder 30, and grid 1, the voltage will drop and thus there will be less tendency for a steady arc to be produced.

In assembling the apparatus, the metallic member 27, together with the nickel cylinder 30, are attached to ring 14 by means of screws 28, the grid 1 is attached to ring 15 by screws 26, and the portion of the envelope from glass portion 13 upward is then arranged on the sealing washer 17. The pump 24 is started to evacuate air from the inside of the envelope and when the desired high vacuum is obtained, voltage from the source 33 is applied to the rings 14 and 15, in the manner heretofore described. The pump is preferably continued in operation to maintain said high vacuum.

Referring now to Fig. 2, a somewhat similar arrangement is shown for pretreating an anode of the reentrant type. Anode 34 has a feather edge 35 sealed in a glass portion 36 which rests on the air-tight sealing washer 17, which in turn is supported on table 18. The remainder of the envelope is completed by a deep dish-shaped metallic member 37 similar to member 21 of Fig. 1 and another washer 20. The nickel cylinder 30 is supported in any suitable manner (not shown) adjacent the active surface 38 of the anode and is preferably spaced therefrom and positioned relatively thereto in the same manner as the cathode is in the completed electron discharge device. The vacuum pump 24 is connected to the opening 23 as described in connection with Fig. 1. The source of E. M. F. 33 has one of its leads 39 connected to the anode and the other of its leads 40 sealed through a glass bead 41 in said deep dish-shaped metallic member 37 and connected to the sandblasted nickel cylinder 30. The sharp ends or projections on the active surface 38 of the anode are burned off by the process heretofore described.

While I have described two specific arrangements for carrying out my process, it is to be understood that this description is purely by way of illustration and is not intended as a limitation of the scope of my invention except as set forth in the appended claims. It will likewise be obvious that while I have described certain values and a given sequence in carrying out my process, in certain instances these may be varied without departing from the principles of my invention and, accordingly, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects of my invention and the accompanying claims.

I claim:

1. The process of preparing an electrode comprising arranging said electrode adjacent a metallic member in a vacuum and applying a voltage

between said electrode and said member of such value as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

2. The process of preparing an electrode comprising arranging said electrode adjacent the roughened surface of a metallic member in a vacuum and applying a voltage between said electrode and said member of such value as to produce sparking between said surface and said electrode and to burn off minute projections on the surface of said electrode.

3. The process of preparing an electrode comprising arranging said electrode adjacent a metallic member in a vacuum, applying a voltage between said electrode and said member, increasing said voltage to produce sparking between said electrode and said member and to burn off minute projections on the surface of said electrode, and controlling said voltage to prevent steady arcing between said electrode and said member.

4. The process according to claim 3 wherein the applied voltage is reduced to zero when steady arcing begins.

5. The process of pretreating an electrode comprising arranging said electrode adjacent a metallic member in a vacuum having a pressure of not greater than the order of 10^{-6} millimeters of mercury and applying a gradually increasing voltage between said electrode and said member so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

6. The process of pretreating an electrode comprising arranging said electrode adjacent a metallic member in a vacuum and applying a voltage gradually increasing to a voltage of the order of 10,000 volts to 100,000 volts alternating current between said electrode and said member so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

7. The process of pretreating an electrode to be used in an electron discharge device so as to lessen the tendency for arcing to said electrode in said device during operation thereof comprising arranging said electrode adjacent a metallic member in a vacuum and applying a gradually increasing voltage between said electrode and said member so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

8. The process of pretreating an electrode to be used in an electron discharge device so as to lessen the tendency for arcing to said electrode in said device during operation thereof comprising arranging said electrode adjacent the roughened surface of a metallic member in a vacuum,

and applying a gradually increasing voltage between said electrode and said surface so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

9. The process of pretreating an electrode to be used in an electron discharge device so as to lessen the tendency for arcing to said electrode in said device during operation thereof comprising arranging said electrode adjacent the sandblasted surface of a nickel member and applying a gradually increasing voltage between said electrode and the sandblasted surface of said nickel member so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

10. The process of pretreating an electrode to be used as a cold electrode in an electron discharge device so as to lessen the tendency for arcing to said electrode in said device during operation thereof comprising arranging in a vacuum said electrode adjacent a metallic member at a distance substantially equal to the distance between said electrode and the anode when arranged in said electron discharge device, and applying a gradually increasing voltage between said electrode and said member so as to produce sparking therebetween and to burn off minute projections on the surface of said electrode.

11. The process of pretreating a grid to be used in an electron discharge device so as to lessen the tendency for arcing to said grid in said device during operation thereof comprising arranging said grid adjacent the roughened surface of a metallic member in a high vacuum spaced a short distance from the grid, applying a gradually increasing voltage between said grid and said surface so as to produce sparking between the surface of said grid and said member and to burn off minute projections on the surface of said grid.

12. The process of pretreating an anode to be used in an electron discharge device so as to lessen the tendency for arcing to said anode in said device during operation thereof comprising arranging the active surface of said anode in a vacuum adjacent a metallic member at a distance substantially equal to the distance between the active surface of said anode and cathode when arranged in the completed tube, with said surface occupying a position relative to said member similar to the position said surface will occupy relative to the cathode in the completed tube, and applying a voltage between said anode and said member of such value as to produce sparking therebetween and to burn off minute projections on said surface of said anode.

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