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ELECTRIC DISCHARGE TUBE

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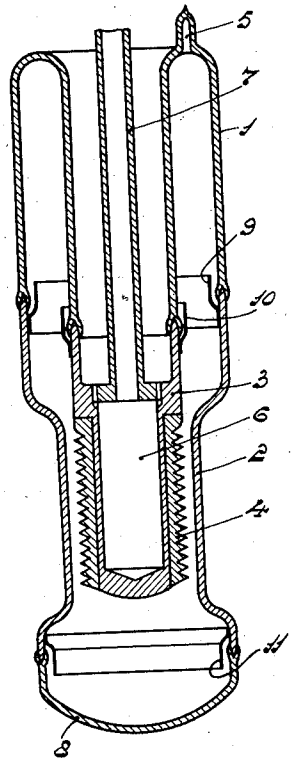

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ELECTRIC DISCHARGE TUBE

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This invention relates to an electric discharge tube having an electron discharge.

In some cases an electric discharge tube is provided with an electrode having sharp protuberances, points or sharp edges. If such an electrode is given an electric load, the electric field is greatly concentrated on the said protuberances. Thus, if the said electrode is negatively loaded, electrons may be dislodged by the electric field from the surface of the electrode and at a sufficiently low gaseous pressure a discharge current may be established between two cold electrodes. A discharge thus initiated between two cold electrodes upon application of the proper voltage across the same, is called an auto-electronic discharge in contradistinction to a thermionic discharge, in which the electrons are dislodged by bringing the cathode to an electron emitting temperature.

An electrode of the kind here involved is referred to hereinafter as a "sharp electrode".

The invention relates to electric discharge tubes provided with a sharp electrode having a surface of revolution the section of which, taken on a plane passing through the axis, is toothed. Such an electrode has the great advantage that it can be made in a simple manner by the aid of the lathe.

Such an electrode can act as a cathode of a rectifier in which it co-operates with an electrode having a non-protuberant surface and a shape which is adapted to the rotational surface of the sharp electrode.

The sharp protuberances of the electrode may encircle the electrode to form individual rings but it is preferable that they should be helically shaped. In the latter case the electrode can be made in a very simple manner by any well known method of screw threading, for example by the use of a lathe with travelling cutting implement.

The outline of the sharp electrode may be cylindrical but may have other shapes, for example a spherical shape.

A conical electrode may be particularly advantageous and in this case the spacing between the two co-operating electrode surfaces may be adjusted by axial shifting relatively to one another.

The discharge tube, according to the invention, is particularly adapted for use in rectifying alternating current if the sharp electrode consists on its surface of a material having a higher electron emissive capacity, at a given temperature, than the electrode which acts as the anode.

In order that the invention may be clearly understood and readily carried into effect, one form of discharge tube constructed in accordance with the invention will be described more fully with reference to the accompanying drawing. This tube comprises a glass part 1 to which are sealed the cylindrical metal electrodes 2 and 3. These cylindrical electrodes are coaxially arranged and form a small gap of some millimetres. The electrode 2, which also forms part of the outer wall of the device consists, for example of a ferrochrome alloy the electron emissive capacity of which is very low as compared with that of most other metals and which can be readily sealed to glass and is but slightly porous. The electrode 3 also has a ferrochrome part which is sealed to the edge of the reentrant part of the glass wall and which is surrounded by a part 4 of aluminium which metal has been found to be a very suitable substance for use as the cathode material and from which electrons are more readily dislodged than from ferrochrome. This aluminium part is provided with a sharp screw-thread which is situated opposite the smooth, at least non-protuberant, inner wall of the electrode 2. Obviously the electrode 3 may be entirely of aluminium, but ferrochrome is used in this case to simplify the connection to the glass.

Under these circumstances an electron discharge is established between the anode and the protuberances of the sharp electrode 3 if a potential difference is applied between the two electrodes. An electron current will flow from 3 to 2 if the former is negatively loaded or if a fluctuating potential difference is applied. In the latter case the tube consequently acts as a rectifier.

After being exhausted to a vacuum sufficiently high to avoid any noticeable ionization, a scavenging gas being used, if desired, for this purpose, the tube is sealed at 5. If necessary, the anode 2 may be provided with a cooling sheath. In the embodiment illustrated the cathode 3 is provided with a hollow 6 to which a tubular current lead 7 is connected. This arrangement is important in connection with the cooling of the cathode which may be effected by introducing a liquid or gas into the hollow 6.

The shape of the electrode 3, which in the example illustrated is cylindrical, may obviously be differently chosen. If the electrodes 2 and 3 are given conical shapes, the intermediate space between the active electrode surfaces may be varied by the axial shifting of the said elec-

trodes relative to one another. The rotational surface of the electrode 3 need not be complete. This electrode may consist, for example, of a half-cylinder of semicircular cross-section which permits two electrodes being made in one operation by dividing a full cylinder into two parts. Alternatively, if desired, part of the circumferential surface may be devoid of screw-thread.

The electrode 2 is sealed at the lower end by a glass hood 8 which permits of observing and inspecting the position of the electrodes relative to each other. The various seals between metal and glass have mounted on them metal coatings 9, 10 and 11 which serve to protect them from an intense electrostatic load.

Discharge tubes of the kind described may be used advantageously for the supply of rectified current to X-ray tubes, as they are suitable for very high voltages.

What I claim is:—

1. An electron discharge tube having an evacuated container, and electrodes mounted therein comprising a smooth-surfaced anode and a cathode having coaxial opposing conical surfaces and forming with the anode a path for pure auto-electronic discharge, the conical surface of the cathode having sharp ribs extending in a lateral direction about the axis of the cathode.

2. An electron discharge tube comprising an evacuated container and a cathode and an anode disposed therein, said cathode being constituted by a solid of revolution having sharp ribs and said anode having a smooth surface located opposing said ribs, the ribs serving as electron emitting elements and being made of a material of higher electron emissive capacity than the material of the opposing anode surface.

3. A discharge tube comprising an evacuated container, the wall of which consists of metallic portions and of insulating portions, one of said metallic portions being smooth on its active surface and forming the anode, a cold cathode comprising a solid of revolution mounted coaxially with the anode in spaced relation therewith, said cathode having electron emitting protuberances in the form of sharp ribs directed towards the anode and laterally to the axis of said anode.

4. An evacuated electron discharge rectifier tube comprising an anode and a cathode in spaced relation, said anode having a smooth active surface and said cathode having sharp electron emitting aluminum ribs, directed towards the cooperating surface of the anode.

5. An evacuated electron discharge tube comprising an anode and a cathode in spaced relation, said electrodes being mechanically connected by glass wall portions, said cathode having sharp protuberances directed towards the cooperating surface of the anode, said protuberances having an electron emitting surface of aluminum, said anode having an active surface of ferrochrome and being sealed by said ferrochrome to said glass portions.

6. A rectifier tube comprising an anode and a cathode in spaced relationship, said cathode being of a metal having higher electron emissivity than the anode and consisting of a solid of revolution having sharp ribs, said anode having a smooth surface located opposite said ribs, said sharp ribs forming portions of high field intensity upon application of the operating voltage to the tube and emitting electrons in a cold state of the cathode.

7. An electron discharge tube with pure electron discharge, comprising a smooth, conductive surface acting as the anode, a cold cathode in spaced relationship with said anode and forming therewith a path for pure auto-electronic discharge, said cathode being constituted by a solid of revolution provided with a plurality of regularly shaped sharp ribs, passing round in a lateral direction.

8. An electron discharge tube comprising a smooth, conductive surface acting as an anode and a cold cathode in spaced relationship with said anode and forming therewith a path for pure auto-electronic discharge, said cathode being constituted by a solid of revolution the surface of which is provided with a plurality of sharp ribs taking the form of rings perpendicular to the axis of revolution.

9. An electron discharge tube comprising a smooth surfaced anode and a cathode, said cathode being in spaced relationship with said anode and forming therewith a path for pure auto-electronic discharge, said cathode being constituted by a solid of revolution the surface of which is provided with sharp ribs passing helically round the axis of revolution.

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