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Bennett

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[54] **METHOD AND APPARATUS FOR FOCUSING AN ELECTRON BEAM**

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[52] **U.S. Cl.** **313/230;** 250/396; 313/313

[51] **Int. Cl.²** **H01J 29/46**

[58] **Field of Search** 313/323, 441–443, 313/DIG. 2–DIG. 3, 230, 352, 313; 250/396–400

[56] **References Cited**

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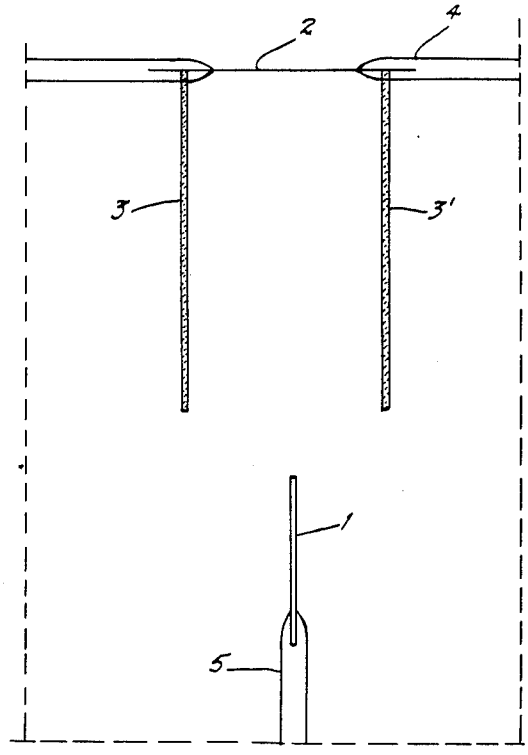
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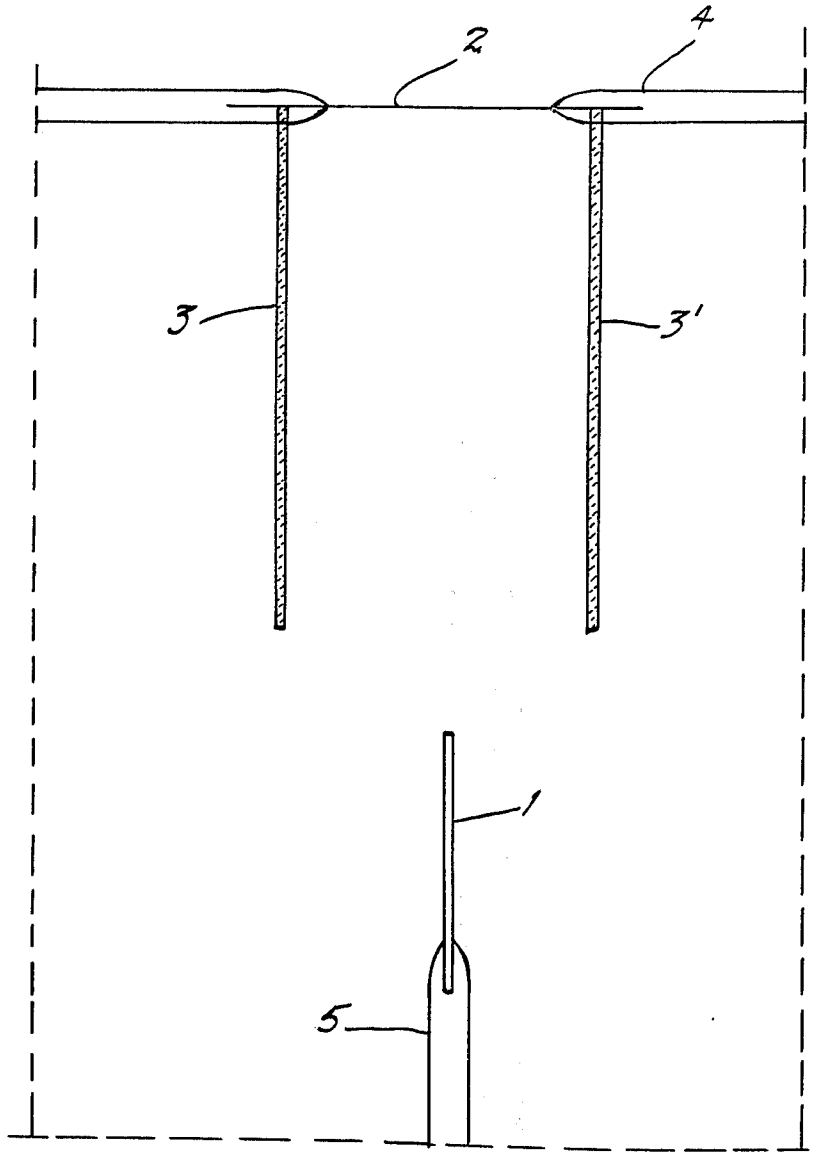
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[57] **ABSTRACT**

A method and apparatus for focusing and projecting a beam from the end of a cathode into an anode of an electron discharge device. A multiplicity of dielectric members are arranged approximately symmetrically around the axis of symmetry. Each of the dielectric members are held at one end in the anode. The initial discharge from the cathode which spreads out radially striking the multiplicity of dielectric members thus supply ions in all directions from the dielectric members, some of which supplies ions near the axis of symmetry for the magnetic self-focusing of the electron beam.

1 Claim, 1 Drawing Figure




2
4
3
3'
1
5

METHOD AND APPARATUS FOR FOCUSING AN ELECTRON BEAM

BACKGROUND OF THE INVENTION

In some electronic discharge devices, it is required that an electron beam travel from the cathode and arrive at the anode in a small diameter channel. In the prior art, with only a cathode and an anode at high currents and voltage, the electron beam expands rapidly due to space charge unless there are sufficient ions present and unless other conditions are met by which the electron beam is caused to be magnetically self-focusing. The present invention provides method and apparatus for utilizing ions supplied by dielectric members for self-focusing of an electron beam which neutralizes the space charge field of an electron beam for the purpose of concentrating the beam.

SUMMARY OF THE INVENTION

A method and apparatus for self focusing an electron beam of an electron discharge device which travels from the cathode and arrives at the anode in a small diameter channel. A multiplicity of dielectric members are arranged approximately symmetrically around the axis of symmetry of the beam and each of the members is held at one end in the anode. The dielectric members provide ions near the axis of symmetry of the beam when struck by electrons from the unfocused beam. The ions neutralize the space charge field of the beam which, consequently, concentrates the beam.

DESCRIPTION OF THE DRAWINGS

There is shown a single FIGURE of the preferred embodiment showing the cathode and anode for an electron discharge device including the dielectric members arranged to provide the self focusing of the electron beam traveling between the aforementioned cathode and anode.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Now referring to the single FIGURE of the present invention, there is shown the apparatus utilized in an electron discharge device for self focusing of an electron beam. It is noted that the enclosure for the electron device is not shown but may be any conventional enclosure which includes therein an anode and cathode providing an electron beam therebetween. The method and apparatus of the present invention is particularly useful with cathode and anode at high currents and voltages wherein the electron beam expands rapidly due to space charge effects.

Cathode **1** is supported by insulating member **5.** Cathode **1** may be any type of conventional cathode which supplies electrons for electron beam purposes. The cathode may be either metallic or dielectric from which a discharge is to be projected toward anode **2.** Anode **2** may be of any conventional form including a solid plate or a thin foil. Anode **2** is supported by insulating member **4** which may be attached to the housing of the electron discharge device. Dielectric rods **3** and **3'** are shown arranged symmetrically around the axis of symmetry and each of the rods are shown being held at one end in anode **2.** It is noted that dielectric rods **3** and **3'** are shown but there are several more rods arranged in the identical manner as dielectric rods **3** and **3'** around the axis of symmetry. The rods are approximately evenly spaced and the number is not critical.

The initial electron discharge from cathode **2** which spreads out radially supplying ions in all directions from the dielectric rods, some of which supplies the required ions near the axis of symmetry for the magnetic self-focusing of the primary high energy, high current electron beam from cathode **1.** The electron beam then travels from cathode **1** and arrives at anode **2** in a small diameter channel.

Other forms can be used besides rods and the size and shape of each depends upon the number of these which are mounted. The angle between these dielectric members and the axis of symmetry can also be varied in a manner to optimize the desired pinch effect in the beam. Doping of the dielectric members at certain preselected positions along them may be used to enhance the ion supply at desired distances from the cathode.

What is claimed is:

1. In an electron discharge device a cathode and anode with an electron beam flowing therebetween, apparatus for automatically self-focusing the electron beam, comprising an anode and a cathode in said electron discharge device, said cathode projecting a discharge toward said anode in the form of an electron beam, only said anode and cathode being at high currents and voltages, and a multiplicity of elongated ion producing dielectric rods arranged symmetrically around the axis of symmetry with each of said dielectric rods being selectively doped and each being held at one end in said anode, the initial discharge from said cathode spreading out radially to strike said multiplicity of elongated ion producing dielectric rods resulting in the supplying of ions in all directions from the multiplicity of dielectric rods to supply ions near the axis of symmetry for the magnetic self-focusing of the primary high energy, high current beam from said cathode.

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