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X-RAY GENERATOR WITH A KNIFE EDGED COLD CATHODE EMITTER

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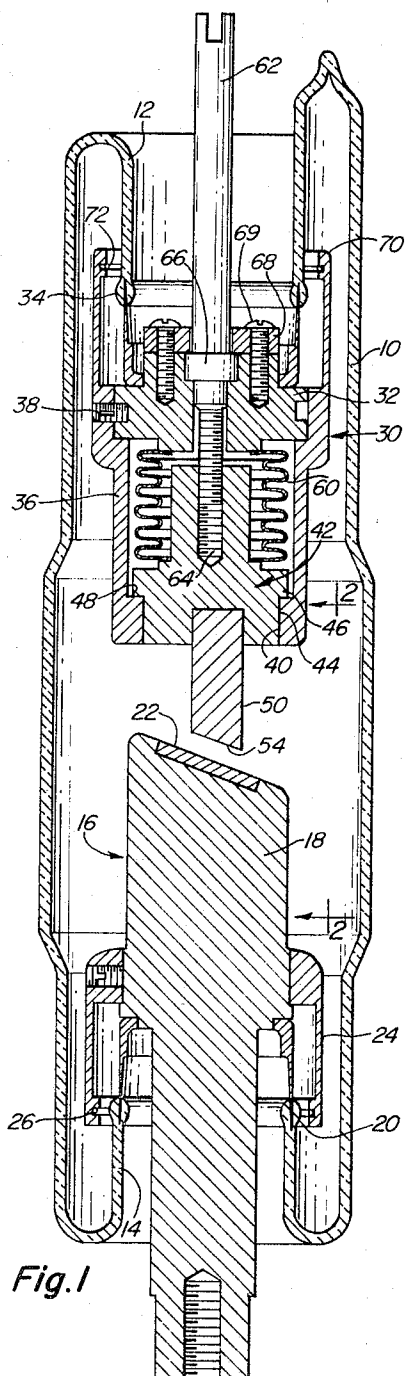


Fig. 1

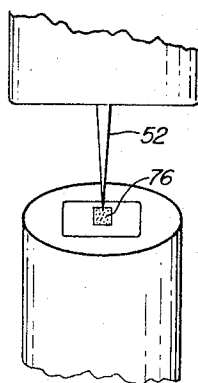


Fig. 2

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2 Claims. (Cl. 313-60)

The present invention relates to X-ray generators, and more particularly to an X-ray generator of the cold cathode type.

It is a particular object of the present invention to provide an X-ray generator which may utilize a solid state crystal type voltage generator as an energy source.

Still another object of the invention is to provide an X-ray generator of the cold cathode type utilizing the line-focus principle.

Still another object of the invention is to provide a cold cathode type X-ray generator having means for varying the spacing between the cathode and the anode so as to permit the generator to be used with sources of differing voltage generating capacities and also to permit operation of the generator over various emission ranges.

These and other objects and advantages of the invention will become more apparent hereinafter.

For a more detailed description of the invention, reference is made to the accompanying drawings wherein:

FIG. 1 is a longitudinal sectional view taken through a generator constructed in accordance with the invention; and

FIG. 2 is a view of the anode and cathode of the generator taken along line 2-2 of FIG. 1.

The generator illustrated herein comprises an envelope 10 in the form of an elongated cylinder preferably formed of glass or other suitable insulating material and having reentrant end portions 12, 14. Supported from the reentrant portion 14 is an anode means 16 comprising a cylindrical copper body 18 suitably supported from the reentrant portion 14 by a glass-to-metal seal 20. Mounted in the end of the body 18 is a planar face target element 22 of tungsten or other suitable material, the face of which is inclined to the longitudinal axis of the envelope 10 at a small acute angle of between about 15°-20°. Suitably supported on the body 18 is a cylindrical skirt 24 which extends over the glass-to-metal seal 20 and has formed therein a groove for holding a ring 26 of getter material which may be flashed, as more particularly described in Atlee Patent No. 2,502,070, after the envelope has been sealed.

Mounted in the opposite end of the envelope is a cathode assembly 30 comprising a mounting block 32 rigidly secured from the reentrant portion 12 by a glass-to-metal seal 34. The mounting block 32 is provided with a tubular extension 36 rigidly secured to the mounting block by a plurality of screws 38 or by other suitable means. The end of the extension 36 adjacent the anode means 16 is formed with an opening 40 defining a bearing surface coaxial with the axis of the envelope 10. Mounted in the extension 36 for movement axially of the envelope is a cylindrical member 42 including a portion 44 slidably engaging the bearing surface 40. A flange 46 is preferably formed on the cylindrical member 42 to engage the inwardly turned lip 48 of the extension 36 so as to limit movement of the cylindrical member toward the anode means.

Mounted in the cylindrical member 42 and extending toward the anode target element 22 is an emitter element 50 comprising a blade-like member having planar converging side surfaces 52 which intersect to define an elongated knife edge 54 extending substantially parallel to the surface of the target element 22.

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Extending between the cylindrical member 42 and the mounting block 32 and sealed at its respective ends to the same is a bellows 60 thus to provide a complete vacuum enclosure about the target 22 and cathode emitter element 50.

Means are provided for effecting movement of the emitter element 50 toward and away from the target element 22. Such means comprises a shaft 62 threadedly engaged in a cooperatively threaded opening 64 in the cylindrical member 42. The shaft is provided with a collar 66 which is engaged between a shoulder formed in the mounting block 32 and a ring 68 secured to the mounting block 32 by screws 69 or other suitable means. The extension 36 may be provided with a rearwardly extending sleeve portion 70 which likewise may be provided with a groove for retaining a getter ring 72.

The illustrated X-ray generator is adapted to be utilized with a pulse type voltage generator, such as, for example, a solid state crystal type voltage generator which by physical ramming of the crystal will cause creation of a voltage pulse for the generator. Upon imposition of a pulse of sufficient voltage across the cathode and anode of the generator, electrons will be emitted from the emitter edge 54 to form an elongated rectangular focal spot 25 upon the target element 22, which focal spot will appear substantially square when viewed in the direction of the arrows 2-2 of FIG. 1, and as indicated at 76 in the drawings. The ability to vary the spacing between the emitter element 50 and target element 22 permits the spacing to be adjusted to accommodate the X-ray generator to the capacity of the voltage generator available. It also permits the X-ray generator to be adjusted to create X-ray pulses of differing energies. It is, of course, critical that the emitter element be rigidly held in position with respect to the anode and that it be accurately positioned and the mounting means illustrated permits such rigid and accurate spacing.

Having illustrated and described a preferred embodiment of the invention, it should be apparent that it permits of modification in arrangement and detail. I claim all such modifications as come within the scope of the appended claims.

I claim:

1. An X-ray generator comprising
 - an elongated tubular envelope,
 - an anode means mounted in one end of said envelope,
 - a cathode means mounted in the opposite end of said envelope,
 - said cathode means including a mounting block rigidly sealed to said envelope and having a rigid tubular extension extending coaxially of said envelope toward said anode, the end of said extension toward said anode defining a tubular bearing surface,
 - a cylindrical member mounted in said extension for movement axially of said envelope and including a portion slidably engaging said bearing surface,
 - a bellows sealed at one end thereof to said cylindrical member and at the other end thereof to said mounting block,
 - a shaft threadedly engaging said cylindrical member and extending outwardly of said envelope coaxially of said bellows,
 - means on said shaft and said mounting block operatively engaging one another to prevent axial movement of said shaft whereby rotation of said shaft effects axial movement of said cylindrical member,
 - said anode means comprising a plane faced target element disposed at an acute angle with respect to a plane normal to the axis of said envelope,
 - and an emitter element mounted on said cylindrical member and extending toward said target element,

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said emitter element comprising a thin, blade-like member having converging side surfaces defining an elongated knife edge extending parallel to said target element.

2. An X-ray generator comprising

an elongated tubular envelope,

an anode means mounted in one end of said envelope and including a target element,

a cathode means including an electron emitter element mounted in the opposite end of said envelope,

said cathode means including a mounting block rigidly sealed to said envelope and having a rigid tubular extension extending coaxially of said envelope toward said anode, the end of said extension toward said anode defining a tubular bearing surface,

a cylindrical member mounted in said extension for movement axially of said envelope and including a portion slidably engaging said bearing surface,

a bellows sealed at one end thereof to said cylindrical member and at the other end thereof to said mounting block,

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a shaft threadedly engaging said cylindrical member and extending outwardly of said envelope coaxially of said bellows,

means on said shaft and said mounting block operatively engaging to prevent axial movement of said shaft whereby rotation of said shaft effects axial movement of said cylindrical member to permit movement of said emitter element toward and away from said target element.

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