

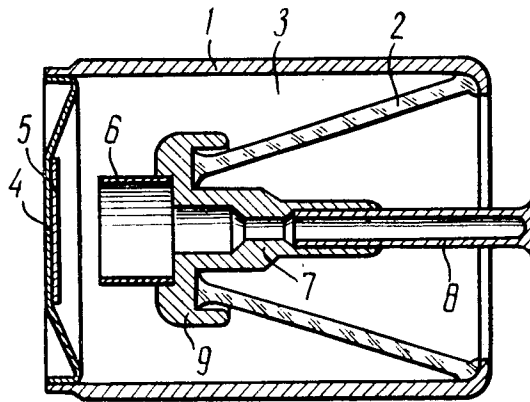
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X-RAY PULSE TUBE

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X-RAY PULSE TUBE

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1 Claim

ABSTRACT OF THE DISCLOSURE

An X-ray pulse tube wherein the envelope is so designed that the insulation element which is one of the structural components of the tube envelope is completely disposed inside, and is connected to the inner surface of the metal element which is the other structural component of the envelope, which makes it possible to reduce the size of the tube, improve its mechanical and electrical strength and increase the intensity of X-ray flashes.

The invention relates to devices producing X-rays, more particularly to X-ray pulse tubes intended for use in small-size X-ray pulse units.

Known in the art are X-ray units wherein the envelope contains a hollow metal element carrying one of the tube electrodes, and an insulation element which is connected to the metal element and to the other tube electrode and serves for electrical isolation of the electrodes from each other.

In such tubes the insulation element juts out of the metal element and is, therefore liable to mechanical damage, which fact appreciably affects the mechanical strength of the tube. The insulation element of such tubes is not protected from exposure to external electrostatic or electromagnetic fields, which may cause breakdown of the dielectric; therefore, the electrical strength of such tubes is rather low. A large size of the insulation element and the need of additional means for protection of the tube result in large dimensions of the tube and, consequently, of the X-ray unit. Owing to a great length of the central lead the discharge circuit of the tube has a high inductance, which markedly limits the amplitude of the current pulse through the tube and, consequently, reduces the intensity of X-ray flashes.

An object of the present invention is to provide an X-ray pulse tube which has a higher mechanical and electrical strength.

A further object of the present invention is to provide an X-ray pulse tube of small size.

A further object of the present invention is to provide an X-ray pulse tube producing X-ray flashes of higher intensity.

With these and other objects in view, the envelope of the X-ray pulse tube containing a hollow metal element which carries one of the tube electrodes, and an insulation element connected to said metal element and to the other tube electrode so as to electrically isolate the electrodes from each other, according to the invention is so designed that said insulation element is completely disposed inside, and is connected to the inner surface of the metal element.

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To simplify manufacture of the insulation element, increase the electrical strength of the tube and reduce its size the insulation element is preferably made in the form of a hollow truncated cone.

Such construction of the X-ray pulse tube herein disclosed makes the insulation element much less liable to mechanical damage. The electrical strength of the tube is increased by the fact that the metal element of the envelope screens the insulation element from external fields. The size of the tube is considerably reduced. The central lead can be made shorter and the intensity of the X-ray flashes can be increased accordingly.

The other objects and advantages of the present invention will be best understood from the following description of its specific embodiment when read in connection with the accompanying drawing.

According to the invention, the X-ray pulse tube herein disclosed comprises an envelope formed by a cylindrical metal element 1 and an insulation element 2 in the form of a hollow glass truncated cone connected along the perimeter of the larger base to the inner surface of the element 1 and serving for electrical isolation of the tube electrodes from each other. The tube envelope is so designed that the insulation element 2 is completely disposed inside the metal element 1 and the elements 1 and 2 are hermetically joined forming a vacuum space 3 inside the metal element 1.

A cover 4 which is a part of the metal element 1 serves as an outlet window of the tube and is coated on the side facing the space 4 by a metal with a large atomic number; in the version of the invention herein described the cover is coated by tungsten in the form of a foil 5. The foil 5 functions as one of the tube electrodes—an anode, while the metal element 1 serves as the anode lead and is correspondingly electrically connected to the anode, i.e., to the foil 5. Besides, the anode may be made in the form of a thin galvanic layer of rhenium or gold.

The other tube electrode, a cold cathode 6, is mounted on a central lead 7 designed as a variable-section tube containing a metal stem 8 which is used for evacuating the space 3. The central lead 7 passes inside the space 3 through the smaller base of the conical insulation element 2 to which it is hermetically joined.

The metal element 1 which is the anode lead and the central lead 7 which is the cathode lead serve for feeding high-voltage electrical pulses to the electrodes of the tube, i.e., to the anode and cathode respectively, as is apparent from an inspection of the drawing.

The central lead 7 has a screen 9 in the form of a flange which protects the insulation element 2 from exposure to charged particles and metal sputtering.

The central lead 7 with the stem 8 together with the metal element 1 form a coaxial electrical line thus reducing the inductance of the tube.

The metal element 1 may be provided with a fixture for attachment of the tube in an X-ray unit, such as a flange or threading (not shown in the drawing).

To obtain isotropic radiation within a wide spatial angle (180° or greater) the cover 4 which serves as an outlet window of the tube may be shaped as, say, a semisphere.

The shape and size of the metal element 1 and the insulation element 2 may be varied to suit the specific requirement to the tube.

The manufacture of the X-ray pulse tube herein disclosed consists of the following operations.

First the separate components of the tubes are manufactured: the metal element 1, the insulation element 2 in the form of a hollow truncated cone made of glass, the cover 4 with the foil 5, the cold cathode 6, the central lead 7 in the form of a variable-section tube with

the screen 9, the stem 8. These components are then subjected to the usual chemical and thermal treatment.

The next operation is the assembly of the tube. First the stem 8 is inserted into the hole in the central lead 7 and the two components are soldered together. Next, the central lead 7 together with the stem 8 is attached to the insulation element 2 by induction heating.

The insulation element 2 is mounted inside the metal element 1 and the two components are also attached to each other by induction heating. Each time after a metal component is attached to glass, annealing is carried out to remove the internal stresses. This is followed by pickling to remove oxides from the metal parts, by washing and drying.

The cold cathode 6 is secured on the central lead 7 by welding. Then the cover 4 is mounted in place and hermetically welded to the metal element 1. The space 3 is evacuated through the stem 2 which is then hermetically sealed by cold welding.

The X-ray pulse tube herein disclosed may be manufactured using other existing methods.

The novel X-ray pulse tube operates as follows.

When a high-voltage pulse is applied to the tube electrodes the cold cathode 6 begins to emit electrons. The electrons accelerated by the anode field collide with the anode (the foil 5) causing an X-ray flash.

The size of the X-ray pulse tube herein disclosed is about 1.5 to 5 times smaller than that of the existing tubes with similar electric characteristics. The reliability of the tube is enhanced by its high mechanical and electrical strength.

The use of the tube makes it possible to produce small-size X-ray units. It enables a part of the components of the high-voltage power supply to be disposed within the inner space of the insulation element of its envelope thus permitting the size of the X-ray unit to be reduced still further.

What is claimed is:

1. An X-ray pulse tube comprising: an envelope defined by a hollow metal element, and an insulation element shaped in the form of a hollow truncated cone and completely disposed inside of said metal element and connected to the inner surface thereof; electrode means disposed inside of said envelope, said electrode means including a first cold cathode electrode for emitting a stream of electrons, and a second anode electrode disposed on the said first electrode for receiving said stream of electrons and emitting a flash of X-ray radiation, one of said electrodes being mounted on said metal element and being electrically connected thereto, the other of said electrodes being mounted on said insulation element and being electrically separated by said insulation element from the other of said electrodes; and wherein said metal element comprises a lead from said electrode which is electrically connected thereto for feeding high-voltage pulses to said electrode; said tube further comprising a lead for the other of said electrodes which passes inside said insulation element and which is arranged coaxially relative to said metal element for feeding high-voltage pulses to its corresponding electrode.

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