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G. HOLST ET AL

X-RAY TUBE

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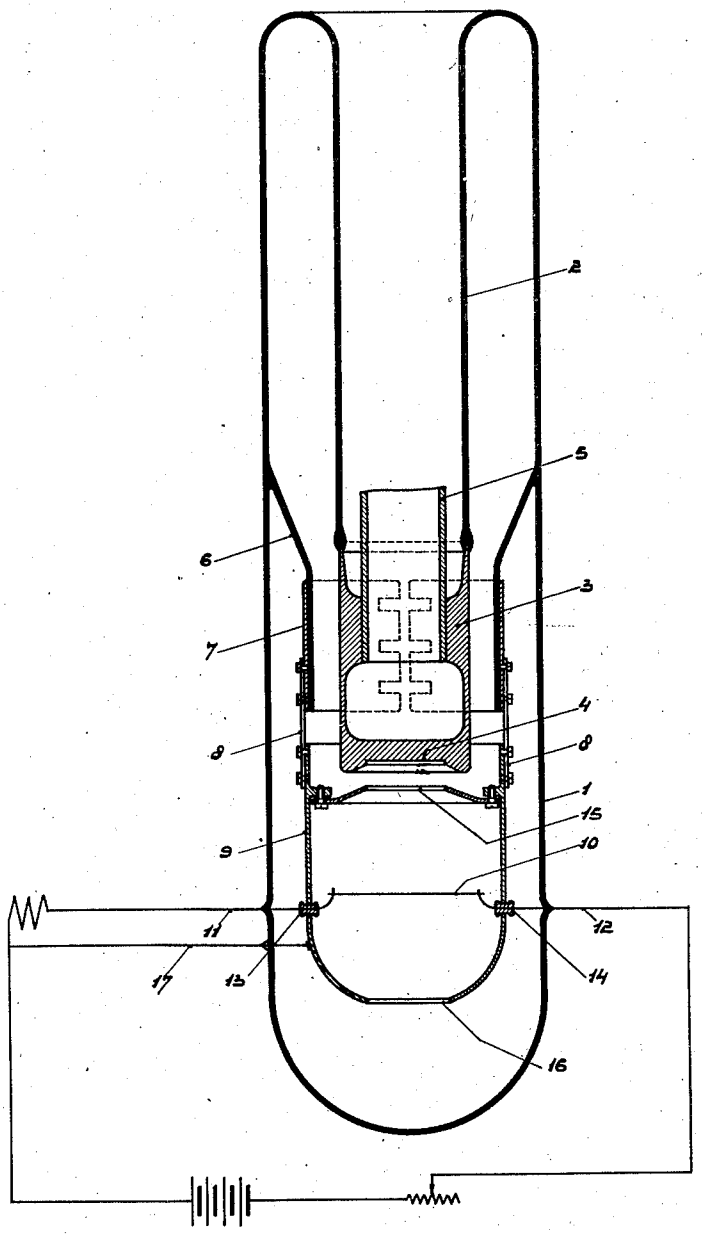

Inventors.

Gilles Holst and Albert Bouwers

By: E. T. & J. F. Brandenburg

Attorneys.

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UNITED STATES PATENT OFFICE.

GILLES HOLST AND ALBERT BOUWERS, OF EINDHOVEN, NETHERLANDS, ASSIGNORS TO N. V. PHILIPS' GLOEILAMPENFABRIEKEN, OF EINDHOVEN, NETHERLANDS.

X-RAY TUBE.

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The present invention relates to X-ray tubes with an incandescent cathode.

In order to obtain that the cathode rays will strike the anti-cathode on a limited surface, the so-called focus, the known Coolidge-X-ray tubes have hitherto been provided with a focussing device which assembled the cathode-rays to a concentrated beam already in the neighborhood of the cathode. In this case the incandescent cathode is arranged in concentrated form, for example in the shape of a spiral, within a cylindrical focussing device.

According to the invention, the incandescent cathode is arranged within a metal vessel extending inside the outer wall of the tube, the anti-cathode being so insulated from the said vessel that this insulation is capable of resisting the operating voltage to be supplied between the incandescent cathode and the anti-cathode. On the side of the anti-cathode the metal vessel is constricted to form an opening for the passage of the cathode-rays, and that part of the anti-cathode on which the cathode-rays strike, is arranged in or near that opening.

The metal vessel may be so constructed as to surround the incandescent cathode almost entirely. It is obvious that apart from the aperture for the passage of the cathode-rays an opening in the vessel must be provided for letting through the X-rays, which opening, however, if desired, may be shut off by means of a metal window or gauze which allows the X-rays to pass.

As the anti-cathode is arranged in the neighborhood of the opening of the metal vessel a considerable part of the X-rays take their way through the metal vessel, another part being, absorbed at any rate partly, by the walls of the said vessel.

In operating the X-ray tube according to the invention, the metal vessel within which the incandescent cathode is arranged, is connected to the incandescent cathode, either electrically or via a source of constant but regulable voltage. It is especially advisable to connect the metal vessel to the incandescent cathode with the interposition of a resistance or a source of voltage in such a manner that the metal vessel has a negative potential relatively to all points of the filament.

The fact that the incandescent cathode for the greater part is enclosed by a metal vessel having a constant, preferably, a negative potential, offers the advantage that the X-ray tube operates constantly, the irregular charging of a glass wall causing no longer any trouble.

Another advantage is that the X-rays emanate merely from the anti-cathode mirror, not from other parts of the anti-cathode.

In X-ray tubes according to the invention the cathode-rays are concentrated on a limited area of the anti-cathode owing to the peculiar shape and the arrangement of the metal vessel and the anti-cathode relatively to each other.

It is no longer necessary to arrange the incandescent cathode in a concentrated shape whilst a focussing device which encloses the incandescent cathode more or less tightly, may likewise be omitted.

By a proper choice of the shape and the arrangement of the metal vessel and the anti-cathode relatively to each other, care can further be taken that the active X-rays leave the surface of the anti-cathode at right angles or substantially right angles thereto, which involves the advantage that unevennesses on the surface of the anti-cathode give less occasion to absorption of the X-rays.

As in X-ray tubes according to the invention it is no longer necessary to give a concentrated form to the incandescent cathode, it becomes possible according to the invention to coaxially arrange the part of the anti-cathode struck by the cathode-rays, the opening in the metal vessel for the passage of the cathode-rays and the aperture or the window for letting through the X-rays.

The accompanying drawing illustrates by way of example a construction of an X-ray tube according to the invention.

In the drawing representing a longitudinal section of the X-ray tube, the outer wall of the X-ray tube is constituted by a glass vessel 1 to which a re-entrant glass tube 2 is hermetically sealed. An anti-cathode 3 consisting, for example, materially of chrome-iron is hermetically sealed to the end of the tube 2. An insertion piece 4 consisting, for example, of tungsten, is secured to the front face of the incandescent cathode

and a metal tube 5 serves to supply a cooling liquid.

A glass-tube 6 is sealed to the inner wall of the vessel 1 and carries a resilient clamp 7 to which a metal body 9 is suspended by means of little supports 8. The said body may consist, for example, of molybdenum or chrome-iron or some other material which can easily be deprived of occluded gases. It may also be made of aluminium or similar material but in this case the advantage that the X-rays, at any rate part of them are absorbed by the metal vessel, is lost.

An incandescent cathode 10, constituted by a straight wire made for example of tungsten, is secured within the metal vessel 9 to leading-in wires 11 and 12 which are hermetically sealed into the wall of the vessel 1 and which are insulated from the metal vessel 9 by means of quartz beads 13 and 14.

On the side of the anti-cathode the metal vessel 9 is constricted to an opening 15 and on the other side an aperture or window 16 is provided in order to allow the X-rays to pass.

When operating the tube a high tension is supplied between the incandescent cathode 10 and the anti-cathode 3 and a potential being preferably slightly negative relatively to all points of the filament, is given to the vessel 9 to which a leading-in wire 17 is connected. The electrons emitted by the filament, are not capable of reaching the metal vessel 9 but owing to the peculiar shape of the metal vessel and to the arrangement of the anti-cathode they are forced to strike the front-face of the anti-cathode on a limited area. It will be observed that the active X-rays leave the surface of the anticathode in a perpendicular or almost perpendicular direction.

X-ray tubes according to the invention may be exhausted in some known manner so that the discharge occurs practically without any gas-ionization. The tubes may likewise be provided with a gaseous filling consisting of hydrogen or helium which has such a pressure that no detrimental gas-ionization occurs. This gas pressure may be above 0.0006 millimetre of mercury and in case of a hydrogenous filling it may amount, for example, to about 0.01 millimetre.

What we claim is:

1. An X-ray tube comprising an incandescent cathode characterized in that the incandescent cathode is arranged within a metal vessel extending inside the outer wall of the tube, the anticathode being so insulated from the said vessel that this insulation is capable of resisting the operating voltage to be supplied between the incandescent cathode and the anticathode, the said vessel at the side of the anticathode being constricted to form an opening for the passage of the cathode rays, the part of the anticathode which is struck by the cathode rays being located near said vessel.

2. An X-ray tube comprising an incandescent cathode, characterized in that the incandescent cathode is arranged within a metal vessel extending inside the outer wall of the tube, the anticathode being so insulated from the said vessel that this insulation is capable of resisting the operating voltage to be supplied between the incandescent cathode and the anticathode, a part of said metal vessel being arranged closely to the anticathode and being so constructed in relation to said anticathode that the cathode rays are assembled and are located on a small part of the anticathode.

In testimony whereof we affix our signatures, at the city of Eindhoven, this 22nd day of December, A. D. 1924.

GILLES HOLST.
ALBERT BOUWERS.