

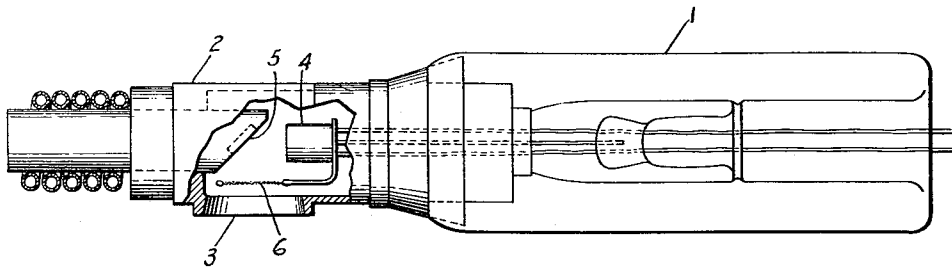
Feb. 6, 1934.

W. D. COOLIDGE

1,946,312

X-RAY TUBE

Original Filed Oct. 18, 1927



Inventor:
William D. Coolidge,
by *Charles E. Tulla*
His Attorney.

UNITED STATES PATENT OFFICE

1,946,312

X-RAY TUBE

William D. Coolidge, Schenectady, N. Y., assignor
to General Electric Company, a corporation of
New York

Original application October 18, 1927, Serial No.
227,027. Divided and this application March
19, 1931. Serial No. 523,823

1 Claim. (Cl. 250—35)

The present invention relates to X-ray tubes and more particularly to X-ray tubes adapted to operate at voltages which are low, compared with the voltages ordinarily employed with X-ray tubes.

The present application is a division of my co-pending application Serial No. 227,027, filed October 18, 1927 and entitled "X-ray tubes".

In the use of low voltage X-ray tubes, it is necessary to employ a window which is more transparent to X-rays than the lime glass employed in the ordinary X-ray tubes. Although glass, such as the so-called Lindemann glass might be employed, it is difficult to make a glass window of the required diameter which is less than 12 mils in thickness and which has uniform thickness. I have found it advantageous, therefore, to employ a thin metal disc consisting of a ferro-chrome alloy as the window of the tube. A window of this type having a thickness of about one-half mil is, for 8000 volt X-rays, slightly more transparent than a 12 mil window of Lindemann glass and for 4000 volt X-rays such a metal window is much more transparent than the Lindemann glass.

A metal window is more desirable than glass since metal can be rolled to a definite and uniform thickness providing in this manner an X-ray output which is uniform in all tubes having equal excitation. Metal windows, however, have the disadvantage that the allowable energy input of the tube may be limited due to the heating of the window by bombardment of electrons reflected from the target.

It is one of the objects of the present invention to provide an X-ray tube having a metal window which is protected from bombardment by reflected electrons.

The novel features which I believe to be characteristic of the invention are set forth in the appended claim. The invention itself, however, will best be understood from reference to the following specification when considered in connection with the accompanying drawing, in which the figure is a view, partly broken away, and showing partly in section and partly in elevation, an X-ray tube embodying the features of my invention.

Referring to the drawing, I have indicated in Fig. 1 an X-ray tube comprising a glass portion 1 and a metal portion 2, the latter portion being provided with a thin metal window 3, very transparent to X-rays and consisting of a ferro-chrome alloy containing about 25% chromium and having a thickness of about one-half mil. Mounted in the metal portion of the tube and adjacent the

window 3 is a cathode 4 and an anode between which a suitable potential may be applied, this anode being provided with a target 5.

In the arrangement as thus far disclosed, if the metal portion 2 of the tube is metallically connected to window 3 and a voltage applied to the electrodes of the tube, electrons will be reflected from target 5 to window 3 causing the latter to become heated and thereby limiting the energy input which may be supplied to the tube. To overcome this difficulty, a metal grid 6 is mounted between the anode or target 5 and the metal window. Grid 6 may be metallically connected to the cathode element or insulated therefrom and from the anode, as desired. If the grid is insulated from the cathode and anode it will at first be bombarded by electrons until it has acquired cathode potential. The grid will thereafter electrostatically prevent electrons from going to the window and will cause electrons which would otherwise go there to be deflected so that they will strike some other portion of the metal envelope 2 or be turned back on the target itself. Substantially the same action takes place when the grid is metallically connected to the cathode. In the latter case the grid is initially at cathode potential and will electrostatically prevent electrons from going from the target to the metal window.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

An X-ray tube including an envelope and containing an anode and a cathode, said tube having a metal window electrically connected to said anode and transparent to X-rays, and means for electrostatically protecting the window from electron bombardment, said means comprising a grid positioned intermediate the target and the window, and a connection between the grid and the cathode.

WILLIAM D. COOLIDGE.