A New Design for an X-Ray Tube

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By

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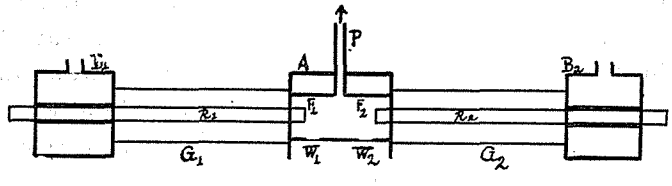
Abstract

A new type of X-ray tube with double targets is described.

The X-ray tube whose construction is described below is initially designed for the purpose of taking stereoscopic micro-radiographs; but it may be used also for X-ray spectroscopy and crystal analysis. The tube is a gas-ion type, consisting essentially of two electrodes standing in the tube at a certain distance apart and opposite each other. Each of these two electrodes serves alternately as the cathode and the target when the current is passed through them from a transformer which is earthed at its middle; and thus its function is like that of a double target tube.

Fig. 1



The construction of the tube is shown schematically in Fig. 1. In this figure R_1 and R_2, two aluminium rods, are the two electrodes described above. At the ends of these two electrodes are respectively attached rigidly two plates of any metal that is suitable for targets, such as molybdenum or tungsten. The faces of the targets F_1 and F_2 are made plane and parallel in the present case, but they may be made slightly concave whenever we want. Three metal parts A, B_1 and B_2 are connected by two glass tubes G_1 and G_2 of proper size.

B_1 and B_2, hollow double walled brass cylinders, serve as water reservoirs to cool the sealing wax joints around the reservoirs, which are necessary to make air tight, and also the electrodes R_1 and R_2, which are fitted tight to pass through the cylinders of the reservoirs. Another metal part A is so constructed that it is a hollow double walled brass cylinder except at its lower side, where two aluminium windows are provided to let the X-rays starting at the targets F_1 and F_2 emerge. By the aid of two side tubes, not shown in the figure, running water is made to pass through the hollow space of the double walled brass cylinder; this serves to cool the whole of A, and the sealing wax joints cementing the glass tubes G_1 and G_2 to this metal part. Another side tube P, for evacuation, is brought out from the inner discharge space to the outside by piercing through the hollow double walled cylinder, as is shown in the figure.

The two water reservoirs B_1 and B_2, which are electrically connected to the two electrodes R_1 and R_2 respectively, are insulated, and the central metal part A is connected to the earth. When two terminals of a centrally earthed transformer are connected to B_1 and B_2 respectively, the X-rays issue from the two targets F_1 and F_2, with proper evacuation. This tube can also be made to function with a transformer earthed at one of its terminals, by simply connecting this earthed terminal of the transformer to the earthed metal part A and to either one of the water reservoirs B_1 B_2 at the same time. But in this case the X-rays are generated only at the earthed target.

As this X-ray tube has two separate targets, it can act for two ordinary tubes having a single target. Though only one pair of windows is shown in the figure, another pair may be easily prepared at the opposite side, by a simple reconstruction of the metal part A. Thus at least four different experiments can be done at the same time with one tube. Another merit of this tube is that it does not need any rectification of the electric current, thus obviating expensive accessories and in some cases much trouble.

The X-ray tube described above is initially designed to be used in stereoscopic micro-radiography as was stated before. The X-rays starting at two separate targets illuminate the specimen to be examined from different directions as is essential for stereoscopic radiography.

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