

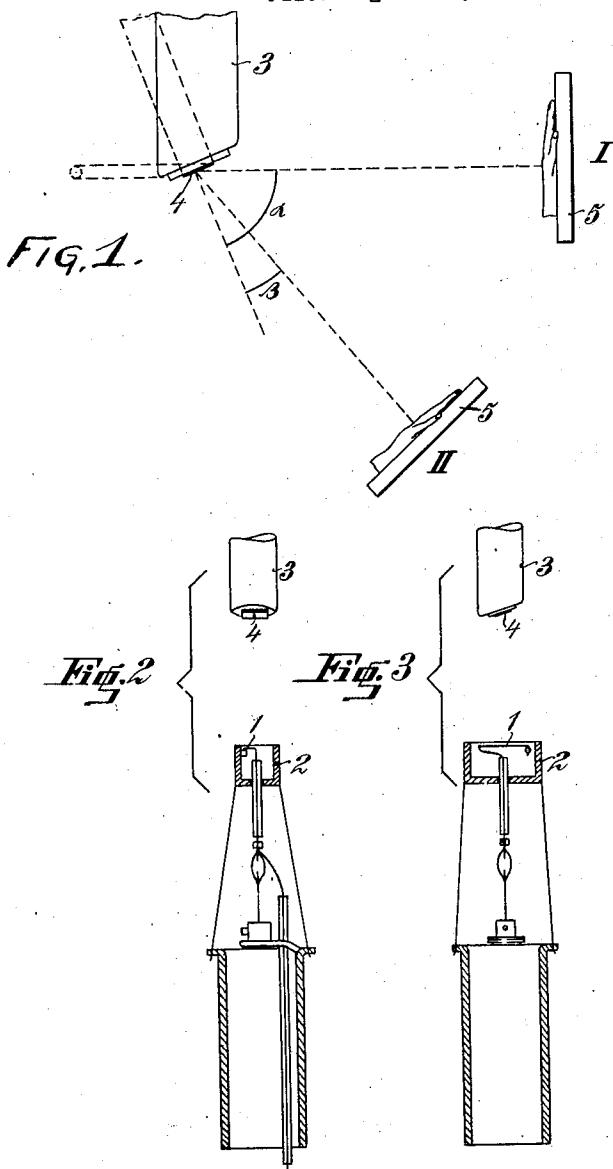
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METHOD OF AND APPARATUS FOR PRODUCING SHARP RÖNTGEN IMAGES

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METHOD OF AND APPARATUS FOR PRODUCING SHARP RÖNTGEN IMAGES.

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(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L, 1318.)

My invention relates to improvements in the method of and system for producing sharp Röntgen images. It has heretofore been proposed to use Röntgen tubes with unsharp sources of rays for diagnostic purposes which require sharp images. For this purpose the Röntgen projection has not been made by means of the rays which emanate from the anticathode at an angle of about 10 45° but by means of rays which are emitted from the anticathode in a substantially parallel direction. Thereby at least in one direction the source of rays appears to be shortened to a very small area, and the tube has an effect similar to that of a tube having a sharp focus.

The object of the present improvements is to provide a method which makes use of a Röntgen tube having an incandescent cathode and an unsharp focal spot and yet produces images which are sharp in any direction. With this object in view my invention consists in using a Röntgen tube having an incandescent cathode producing on the anticathode a focal spot in the form of a band and mainly using in the production of the image those rays which are emitted in the direction of the length of the band which by reason of their perspective reduction in length have the same effect as rays emanating from a sharp point.

For the purpose of explaining the invention an example embodying the same has been shown in the accompanying drawing, in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawing,—

Fig. 1 is a diagrammatic view illustrating my improved method as compared to the old one.

Fig. 2 is a vertical section of the part of the Röntgen tube containing the incandescent cathode and showing said incandescent cathode and the anticathode, and

Fig. 3 is a similar section taken at right angles to Fig. 2.

Referring now to Fig. 1, it will be assumed that the target or band providing the source of the rays and located on the front side of the anticathode 3 follows the heavy line 4 from the left to the right. The dimension of the band perpendicularly to the plane of the drawing is assumed to be

very small. For taking a photograph of an object, for example of a hand on a sensitized plate 5 I use only such rays as are emitted substantially in the direction of the line 4 and which therefore form very small angles with the plane of the anticathode 3. For this purpose the object to be projected and the plate 5 are set in the position I. When viewed from this point the line 4 appears to have been reduced to a very small length as compared to its actual length. If the actual length of the line is L and the rays meeting the object are emitted at a median angle α (this being the angle between the median ray and a line perpendicular to the anticathode), the length as seen from the point I appears to be $L \cos \alpha$. If α is large, this value is small, and the elongated source of light acts as a focus in the form of a point.

In Fig. 1, the angle α is about 70° . It will be evident that this is also the angle which the anticathode portion or source of rays 4 forms with the longitudinal axis of the anticathode (anode), which axis in this embodiment coincides with the longitudinal axis of the tube, see Figs. 2 and 3. Thus, the angle which the anticathode surface 4 forms with the axis of the tube, and therefore with the axis of the pencil of cathode rays, is an acute angle greater than the angle of 45° customarily employed hitherto, and as a result of this new arrangement, I obtain, in the equatorial zone of the tube, an approximately point-like projection of the elongated focal spot upon the plane in which the image is to be produced.

The difference between my improved method and the one now in use will be understood when setting the object and the sensitized plate 5 in the position II. In this position of the object and the plate, the elongated source of rays 4 acts with a length $L \cos \beta$. The angle β is about 15° . Therefore with the object and plate in the position II or in a position near thereto sharp reproductions can not be had, and when seen from point II the source of rays 4 will appear as a line of substantial length and from which only an unsharp image can be had.

Therefore, my improved method permits the use of a tube having an unsharp source of rays in the form of a band for diagnostic

purposes for producing sharp Röntgen images, the result being the same as that of a tube having a sharp source of rays.

In Figs. 2 and 3 I have shown a preferred example of the essential parts of a Röntgen tube having an incandescent cathode and collecting means (Coolidge-tube), which in a simple way permits the production of a source of rays in the form 10 of a band. For this purpose the incandescent wire 1 is not disposed in the usual way and in the form of a coil, but I prefer to arrange the same along a straight line and in one direction, and it is surrounded 15 by a collector 2, having the form of an elongated box. By means of this collector the cathode rays are distributed over a space the cross-section of which is likewise in the form of a narrow rectangle, so that the rays 20 produce on the anticathode 3 a focal spot 4 in the form of a rectangle.

It will be noted that in the specific embodiment illustrated, the heated filament or cathode extends in a substantially straight 25 line located in a plane perpendicular to the plane of the anticathode, and that the cathode and the anticathode converge in such perpendicular plane. It will be further noted the collector co-operating with the said cathode is in the form of an elongated box open toward the anticathode, the longitudinal axis of said box being parallel to that of the cathode.

In a Röntgen tube with incandescent 35 cathode provided with an intermediate electrode the focal spot in the form of a band is produced in a simple way by forming the intermediate electrode with an opening in the form of a rectangle for the passage 40 of the rays therethrough.

To permit the use of the Röntgen tube with incandescent cathode the direction of the linear focus should be such that it can be put to use without materially changing 45 the usual tripods. For this reason all the parts projecting from the tube are arranged in the usual way, and in some cases the anti-cathode must be inclined relatively to the axis of the tube at a greater angle than 50 is usual in other tubes, as will be understood from an inspection of the drawing.

I claim:

1. The herein described method of producing Röntgen images which consists in 55 causing emission of Röntgen rays from an elongated focal spot, and using, for the production of the images, the rays emanating from said spot substantially in the direction of the length of the spot.

60 2. The method herein described of pro-

ducing Röntgen images, which consists in causing the emission of Röntgen rays from a focal spot having a length great as compared with its width, and producing an image from such of the rays emanating 65 from said spot as are projected therefrom in a direction nearly coinciding with the general direction of the length of said focal spot.

3. An X-ray tube having a plane anti-cathode, an incandescent cathode constructed to produce, in conjunction with said anti-cathode, a band-like or elongated focal spot, and a collecting device associated with said cathode, the active surface of the anti-cathode forming an acute angle of more 70 than 45° with the longitudinal axis of the tube, so as to obtain, in the equatorial zone of the tube, an approximately point-like 75 projection of the elongated focal spot upon the plane in which the image is to be produced.

4. In an X-ray tube, means for obtaining, in the equatorial zone of the tube, a projection of the target which is foreshortened to less than half the actual length of said target, said means comprising a plane target shaped as a narrow band, a cathode consisting of a straight incandescent filament, said target and filament lying in a common plane 80 at an angle of less than 45 degrees to each other, and a collector partially surrounding the cathode.

5. In an X-ray tube, means for obtaining, in the equatorial zone of the tube, a projection of the target which is foreshortened to less than half the actual length of said target, said means comprising a target in the form of a narrow band, a cathode consisting of an incandescent filament extending 95 in a substantially straight line, said target and cathode being positioned in a common plane at an angle of less than 45 degrees to each other, and a collector partially surrounding the cathode.

6. An X-ray tube having a plane target in the form of a narrow band, an elongated incandescent cathode, said target and cathode being disposed in a common plane, a collector associated with said cathode, the active surface of said target being inclined at an angle of more than 45 degrees to the longitudinal axis of the tube, so as to obtain, in the equatorial zone of the tube, a projection of the target which is foreshortened to less than half the actual length 110 of said target.

In testimony whereof I hereunto affix my signature.

DR. OTTO GOETZE.