E. BENSON.

X-RAY APPARATUS.

APPLICATION FILED MAY 5, 1915.

1,174,044. Patented Mar. 7, 1916.

Fig. 1.

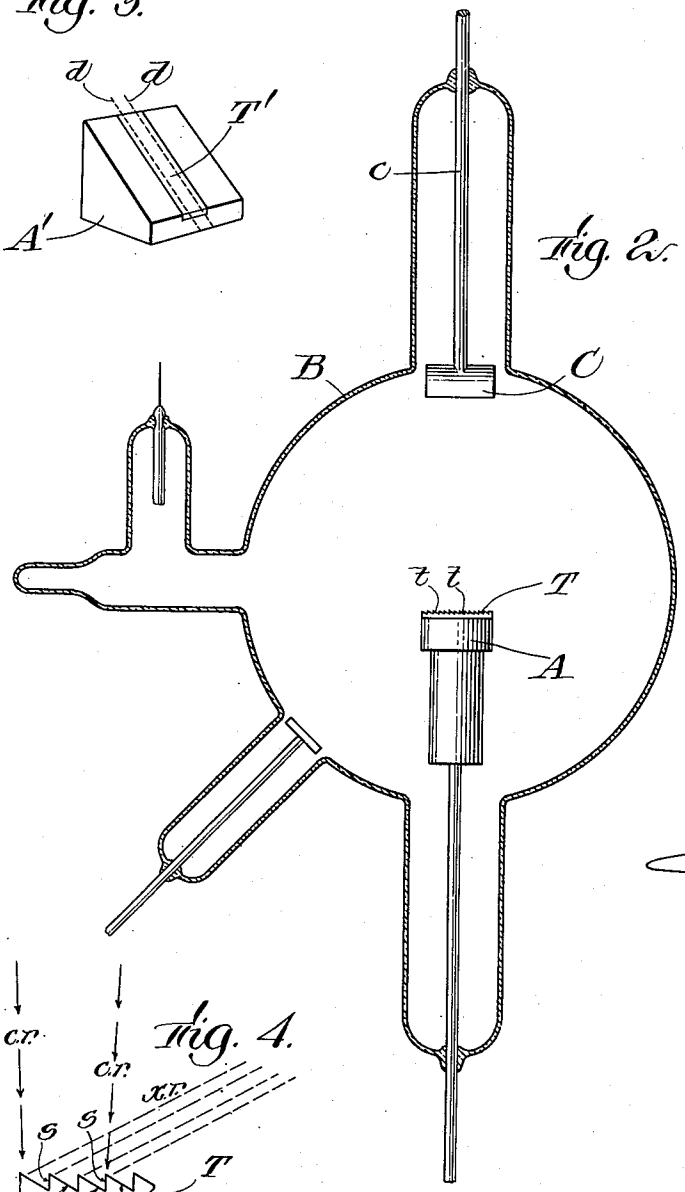


Fig. 2.

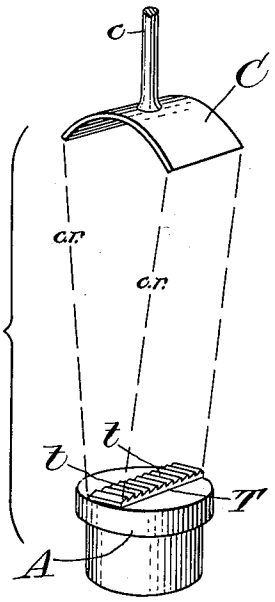


Fig. 3.

Fig. 4.

Fig. 5.

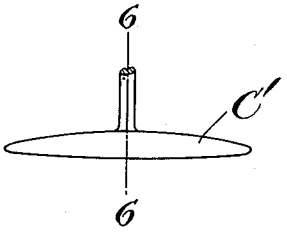


Fig. 6.



Witnesses:

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UNITED STATES PATENT OFFICE.

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X-RAY APPARATUS.

1,174,044. Specification of Letters Patent. Patented Mar. 7, 1916.

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To all whom it may concern:

Be it known that I, ELOF BENSON, a citizen of the United States, and resident of Newton Highlands, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in X-Ray Apparatus, of which the following is a specification.

My invention relates to X-ray apparatus, and consists in improvements in the structure and mode of operation of the electrodes thereof and has for its object the production of a cathode and target which will render the apparatus more effective and more durable.

As is well known, X-ray apparatus, heretofore constructed, involves the employment of a cathode having a substantially spherical surface which focuses the cathode rays upon a spot on the target which forms a part of the anode. The intense heating effect of cathode rays thus focused upon a small spot has rendered it necessary to employ a metal of very high melting point, such as tungsten, which nevertheless frequently disintegrates under the heat produced by the focused cathode rays. For photographic purposes the X-rays emitted by a tungsten target are undesirably "hard", having such speed of projection that they tend to penetrate not only an object being photographed but also the photographic plate itself.

My invention is characterized, first, by the employment of a cathode ray projector which focuses the rays on an elongated focal area instead of concentrating them upon a focal spot of limited area substantially circular in form.

My invention is further characterized by the employment of a target which, as a whole, is elongated to correspond to the length of the elongated focal area and which also in the preferred form consists of a plurality of parallel surfaces inclined at a suitable angle to the axis of the cathode ray.

In the drawings hereto annexed which illustrate my invention,—Figure 1 shows a cathode ray apparatus in section; Fig. 2 illustrates in perspective the cathode projector and target; Fig. 3 shows in perspective a target having single emitting surface; Fig. 4 shows in cross section on an enlarged scale a portion of the preferred serrated form of target; Fig. 5 is a side view of another form of cathode projector; Fig. 6 is a cross section of the cathode projector shown in Fig. 5 at the line 6—6.

Referring to Fig. 1: The transparent bulb B is of the usual form. The cathode C attached to the cathode lead *c* is a cylindrical segment of metal, and the target T affixed to the anode A is a serrated metallic strip having a plurality of inclined parallel surfaces *t*—*t*. This serrated target constitutes the form which I prefer; its inclined surfaces *t* may, if desired, be made so small that there are one hundred of them to the linear inch.

The cylindrical projecting surface of the cathode C focuses the cathode rays *c*—*r* upon an elongated focal area; the total length of the target T′ should be approximately the same as the width of the cathode projecting surface C as measured along an element of its cylindrical surface, so that the focal area upon the target T will constitute a narrow band extending from one end to the other of the target. The target may be made with a single plane emitting surface, as shown in Fig. 3, where T′ represents a strip of emitting metal let into the end of the anode A. The dotted lines *d*—*d* represent the margins of the elongated focal area.

For photographic purposes particularly, a target such as shown in Fig. 3 will be found inferior to the target shown in the other figures, which is characterized by a plurality of parallel emitting surfaces *t*—*t*. The surfaces *s* at the back of the serrations of the target T being substantially parallel to the direction in which the cathode rays *c*—*r* are projected, do not act as producers of X-rays; X-rays emitted by the surfaces *t* and falling on the surfaces *s*, are absorbed thereby. Although the X-rays are emitted through the transparent bulb B in all directions from the surfaces *t*, except those which are masked or intercepted by the rear surfaces *s*, any object to be photographed will receive as the effective X-rays a sheaf of substantially parallel rays such as those marked *xr* in Fig. 4. Radiographs made with an apparatus such as above described are clear in definition.

I have made and operated an X-ray apparatus characterized by a cylindrical cathode projector and serrated target in which the target is made of silver. The distribution of the focused cathode rays over an elongated focal area reduces the heating effect so that a target made of silver is sufficiently refrac-

tory to stand up under protracted service. I believe, however, that platinum or tungsten, or any metal having high melting point will be found to be a better metal for the target. The speed of projection of cathode rays and emission of X-rays, may be reduced in such an apparatus so that the "hard" character of X-rays emitted by a tungsten target may be obviated if desired.

While I believe that the cylindrical surface is the best form in which to make the cathode projector, other surfaces of prolate curvature may be employed with qualitatively similar results, namely, to produce concentration of cathode rays over an elongated focal area. For instance, a cathode projector C′ such as shown in Figs. 5 and 6, might be employed in which the projecting surface is that of a prolate spheroid of which the axis of curvature is finite. The cylindrical surface as of the cathode C is, geometrically considered, the limiting form of surface of prolate curvature wherein the axis of curvature is of infinite length.

The emitting surfaces *t* in the serrated form of target T are parallel and extend in a direction at right angles to the axis of curvature of the cathode surface.

I claim:

1. A cathode for X-ray or analogous apparatus, characterized by a projecting surface of prolate curvature, adapted to project rays to an elongated focal area.

2. A cathode for X-ray or analogous apparatus, characterized by a cylindrical projecting surface, adapted to project rays to an elongated focal area.

3. The combination in X-ray or analogous apparatus, of a cathode having its projecting surface adapted to project rays to an elongated focal area, and a target comprising a plurality of inclined emitting surfaces.

4. The combination in X-ray or analogous apparatus, of a cathode having a cylindrical projecting surface adapted to project rays to an elongated focal area, and a target having a serrated emitting surface presenting a plurality of substantially parallel surfaces to the cathode ray.

5. The combination in X-ray or analogous apparatus, of a cathode having a projecting surface of prolate curvature adapted to project rays to an elongated focal area, and a target having a plurality of parallel emitting surfaces in said focal area, inclined to the axis of the cathode ray, said surfaces extending at right angles to the axis of curvature of the cathode surface.

6. The combination in X-ray or analogous apparatus, of a cathode having a cylindrical surface adapted to project rays to an elongated focal area, and a target having a plurality of parallel emitting surfaces in said focal area inclined to the axis of the cathode ray, said surfaces extending at right angles to the axis of the cylindrical surface of the cathode.

7. A target for X-ray or analogous apparatus, characterized by a plurality of parallel emitting surfaces.

8. A target for X-ray or analogous apparatus having a surface composed of a plurality of serrations.

Signed by me at Boston, Massachusetts this 26th day of April, 1915.

ELOF BENSON.

Witnesses:
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