

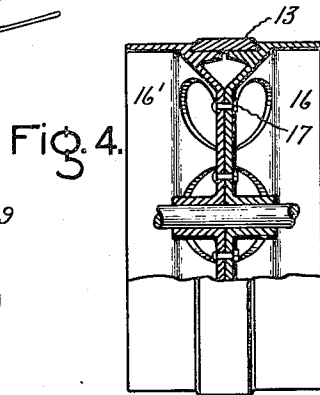
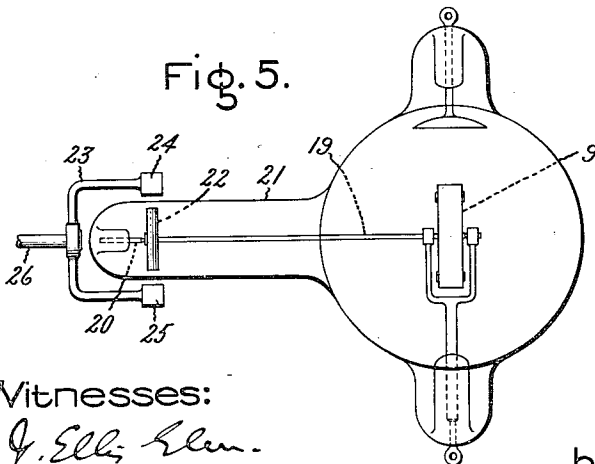
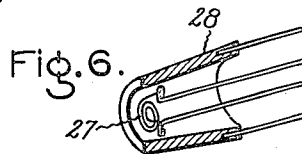
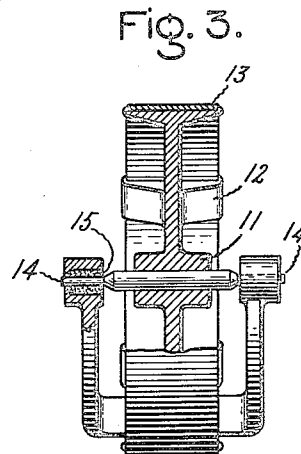
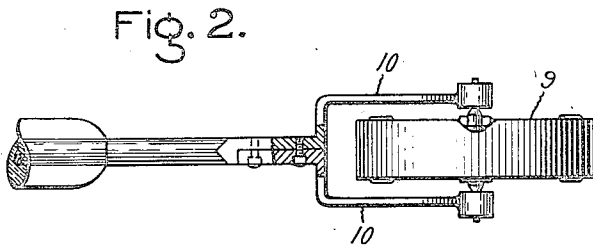
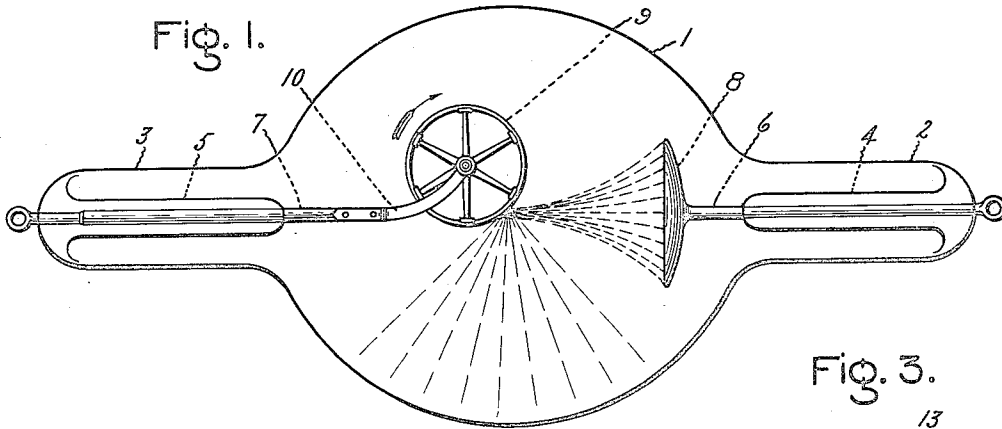
E. THOMSON.

X-RAY TUBE.

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1,192,706.

Patented July 25, 1916.



Witnesses:

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UNITED STATES PATENT OFFICE.

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X-RAY TUBE.

1,192,703.

Specification of Letters Patent.

Patented July 25, 1916.

Application filed September 14, 1914. Serial No. 861,519.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in X-Ray Tubes, of which the following is a description.

The present invention relates to X-ray devices and its object is to prevent local overheating and melting of the metal on the surface of the target or electrode subjected to the bombardment of cathode rays.

In accordance with my invention overheating of the focal spot, the part of the surface of the target or anticathode subjected to the bombardment of the cathode rays is prevented by successively renewing the target surface during the operation of the tube, for example, by making the target in the shape of a wheel or disk and rotating the same in any way, for example, by external means or by the reaction of the rays striking the rim of the target tangentially.

The novel features of my invention are pointed out with greater particularity in the appended claims.

My invention will be better understood by reference to the following description taken in connection with the accompanying drawings in which—

Figure 1 shows an X-ray tube containing a rotatable target revolved by the impact of the cathode rays; Fig. 2 is a detail plan view of the rotatable target; Fig. 3 is a side elevation of the target partly in section; Fig. 4 is a detailed sectional view of a modified form of target; Fig. 5 shows in outline an X-ray tube having the target rotated by external means, and Fig. 6 is a detail sectional view of a cathode operable at incandescence in a highly evacuated tube in which the cathode or beta rays are produced by pure electron emission.

The X-ray tube shown in Fig. 1 consists as usual of a glass envelop 1 having side arms 2, 3, into the stem 4, 5 of which are respectively sealed the cathode conductor 6 and the anode conductor 7. The cathode 8 which may consist of aluminum is of the usual concave or dished type proportioned to focus the cathode rays upon a limited surface area of the target. The target 9 is fashioned in the shape of a wheel so positioned by means of the carriers 10 that the cathode rays will be directed tangentially to

its surface so as to produce rotation in the direction of the arrow. Although the active surface upon which the cathode rays are received is thereby continuously renewed, the X-rays as shown by dotted lines are continuously directed downwardly as the relative position of the cathode spot remains the same. As the surface of the target has a regular contour, as indicated in the drawing, the position of the cathode spot remains substantially fixed in space and, therefore, the X-rays are continuously emitted and the direction of the rays with respect to the object to be treated or examined remains substantially the same.

The wheel 9, as shown in Figs. 2 and 3, may consist of a frame work of copper or like metal of good heat conductivity comprising a hub 11 and outwardly extending spokes 12 between the flared ends of which is pinched or otherwise joined a peripheral band 13 of tungsten, or other highly refractory metal. The shaft 14 rests upon graphite bearings 15 so as to give dry lubrication and enable the wheel when carefully balanced to be easily rotated. In another construction, shown in Fig. 4, a peripheral segment 13 of tungsten or the like is inclosed by two thin disks 16, 16', of copper or similar metal, these disks being held together by small rivets 17 as indicated. The band of tungsten or refractory metal in Figs. 3 and 4 need not be a complete ring, but to allow for expansion on heating it can be composed of separate segments as if the ring were cut parallel or approximately so to its axis. If these segments are spaced apart slightly they give room for expansion under heat so as not to throw the band out of circular form.

Instead of depending upon a component of the repulsive effect of the cathode stream to rotate the target I may, as shown in Fig. 5, rotate the target by magnetic means. The target 9 is connected with a metal rod 19 supported by one end on the same bearings as the target and at the other end upon the bearing 20 in a side arm 21 of the X-ray tube. Upon this rod 19 in the side arm 21 is mounted a magnetic member 22 which in the simplest form may be a small rod of iron. Immediately outside of the side arm 21 is a rotating magnet 23, the poles 24, 25 of which are closely adjacent to the magnetic member 22. By rotating this magnet upon

a shaft 26 in any convenient manner the target 9 may be rotated at any desired speed. Of course instead of using a rotating magnet, a rotating magnetic field may be produced by other convenient means.

Both Figs. 1 and 5 show an X-ray tube having an unheated target and therefore contain a small amount of gas and operate by positive ionization, but my invention is easily applicable to a tube containing an incandescent cathode 27, as shown in Fig. 6, surrounded by focusing member 28, the vacuum in the tube being so high that positive ionization is substantially absent and the cathode rays being produced by substantially pure electron emission from the heated cathode.

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

1. The method of increasing the capacity of an X-ray tube which consists in directing cathode rays upon a limited area of the surface of a refractory target and renewing said target surface while said rays are impinging on the target.

2. The method of preventing overheating of the focal spot in an X-ray tube which consists in renewing the target surface during the operation of the tube.

3. An X-ray device comprising a gas-tight envelop, a cathode, a target of regular contour, and means for successively renewing the surface subjected directly to the cathode discharge.

4. An X-ray tube comprising an envelop,

means for generating cathode rays and a rotatable anti-cathode comprising a circular band of tungsten.

5. In an X-ray device, the combination of means for producing cathode rays, a target comprising a band of refractory metal upon which said rays impinge, and means movably supporting said target to permit a change of surface subjected to the bombardment of the cathode rays.

6. In an X-ray device the combination of means for producing a converging bundle of cathode rays, a refractory target of regular contour located near the focus of said rays, and means movably supporting said target in a position to permit motion of said target by the impact of said cathode rays.

7. In an X-ray device, the combination of a rotatable refractory target of regular contour, a mounting therefor, and means for directing a stream of cathode rays tangentially upon said target.

8. An X-ray device, comprising the combination of means for generating cathode rays, a target surface located in the path of said rays and means for changing the target surface receiving said rays while said rays are impinging on said target.

In witness whereof, I have hereunto set my hand this eighth day of September, 1914.

ELIHU THOMSON.

Witnesses:

JOHN A. McMANUS, Jr.,
FRANK G. HATTIE.