H. F. WAITE.

X-RAY TUBE.

APPLICATION FILED JAN. 25, 1906. RENEWED MAY 13, 1910.

982,552.

Patented Jan. 24, 1911.

Fig. 1

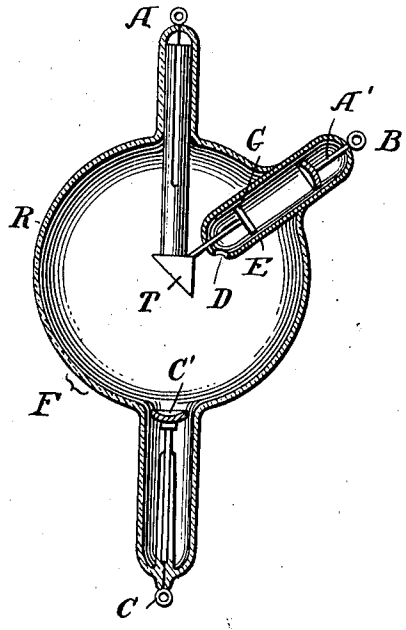
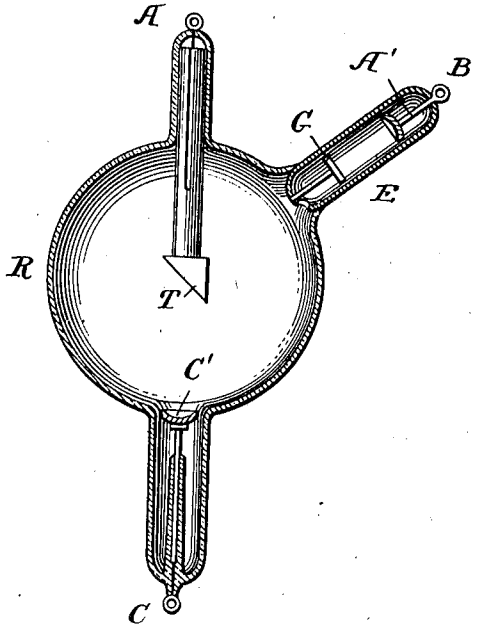


Fig. 2



Witnesses

J. G. Stinkel

B. C. Rust

Inventor

Harry F. Waite

by John Freeman Dodson

Attorneys

UNITED STATES PATENT OFFICE.

HARRY F. WAITE, OF NEW YORK, N. Y.

X-RAY TUBE.

982,552. Specification of Letters Patent. Patented Jan. 24, 1911.

Application filed January 25, 1906, Serial No. 297,834. Renewed May 13, 1910. Serial No. 561,174.

To all whom it may concern:

Be it known that I, HARRY F. WAITE, a citizen of the United States, and resident of the city, county, and State of New York, have invented certain new and useful Improvements in X-Ray Tubes, of which the following is a specification.

My invention relates to improvements in Roentgen or X-ray tubes, and has for its object to improve the construction, arrangement and operation of such tubes, and to these ends my invention consists in a tube embodying the features of construction arranged and operating substantially in the manner hereinafter more particularly set forth.

Referring to the accompanying drawings:—Figure 1 is a view of an X-ray tube embodying my invention, and Fig. 2 is a modification.

In the operation of an X-ray tube or bulb of the ordinary character, especially when it is connected to X-ray coils as a source of energy, it is found that there is more or less inverse current, that is, a part of the time the poles are reversed so that what is ordinarily the anode becomes the cathode and the cathode becomes the anode. When the current is flowing in the proper direction the cathode stream from the cathode cup strikes upon the target, generating the Roentgen or X-rays in the manner well understood. When, however, the current is reversed, as happens in an alternating current machine, the target becomes the negative or cathode and the cup becomes the anode, and the cathode rays stream from the target and strike upon the body of the tube, and bombarding this part of the tube, produce or generate X-rays at this point.

The target T is usually made of metal, and I have found that when X-rays are generated by the cathode stream striking the body of the tube or bulb which is of glass, they are of a different quality from those which are generated when the cathode stream strikes the target T, and this change in the quality of the rays interferes with the use thereof, especially when the X-rays are used in making photographic plates.

One of the principal objects of my invention is to avoid these objections, and to provide a simple and compact X-ray tube which may be operated in the manner indicated, and any disturbance from the difference in the quality or character of the rays generated when the cathode stream impinges upon the target or the body of the tube is eliminated.

One form of my invention is shown in Fig. 1, wherein R represents the main tube or bulb, and formed in or connected with the tube R is what may be termed an interior or secondary tube E. This tube may be mechanically produced in various ways known to those skilled in glass working, and they need not to be described specifically herein. This secondary tube is arranged so that it may be subjected to the same degree of exhaustion as the interior of the main or primary tube R, and a simple way to insure this is to provide the secondary tube with an opening D. This interior or secondary tube is made of some material which is opaque to X-rays, as for instance, it may be made of lead glass, and mounted within the interior or secondary tube is arranged a secondary target G which is preferably of metal, and also arranged therein is the anode A′ which is adapted to be connected to the positive terminal B of the g-ray coil or other source of energy. The cathode or negative terminal C is shown preferably provided with a cup-shaped disk C′, and the target T, which is preferably of metal, is shown as having a flat surface and supported by a bar extending into a neck A.

In operation, the terminal B is connected to the positive terminal of the source and the terminal C to the negative terminal of the source. A′ will thus be the anode and C′ the cathode. The terminal in the neck A is not ordinarily connected to any source. Under normal conditions, that is, when A′ is an anode and C′ the cathode, the cathode stream from cup C′ impinges upon the target T producing X-rays in a manner well understood. If, however, there is a reversal of current, then C′ becomes the anode and A′ the cathode. The cathode stream from A′ will impinge upon the secondary target G, producing X-rays. The direction of this X-rays is, however, away from the X-ray plate that would be exposed and away from the operator using a fluoroscope, and in addition the lead glass wall of the tube E will effectively cut off any X-rays generated. Since the cathode stream is rectilinear and entirely cut off by the target or screen G, target T will be in the shadow and the cathode rays will not impinge upon it. At this time, that is, when C′ is the anode and A′

the cathode, the target T is entirely isolated and does not form a cathode as is the case in the ordinary tube. When, however, A′ is the anode and C′ the cathode, then no X-rays will be produced at G, but only at T. While X-rays would be generated at the secondary target G, their direction is away from the X-ray plate that would be exposed, or would be away from the operator using a fluoroscope. In the ordinary operation of the tube however if there is no reverse current then there will be no X-ray generated at the secondary target, all of the X-rays being generated at the target T.

It will thus be seen that a tube constructed on the general principles above set forth, that is, providing the main tube or bulb with a secondary tube which is opaque to X-rays, and generating the X-rays therein, a simple means is provided for overcoming the disadvantages inherent in the ordinary X-ray tube whenever reversals of the current or changes of direction of the stream of cathode rays take place.

In Fig. 2 I have shown a similar embodiment of my invention except that the secondary tube is external to the main bulb or tube the parts being otherwise arranged substantially as shown in Fig. 1, and being similarly lettered.

While I have shown several embodiments of my invention, it is evident to those skilled in the art that the principles thereof may be otherwise embodied without departing from the spirit of the invention, and the details of construction of X-ray tubes embodying the invention are immaterial.

What I claim is,—

1. An X-ray bulb comprising a main tube and a secondary tube opaque to X-rays and communicating with the interior of the main tube, a main target mounted in said main tube and a secondary target mounted in said secondary tube, and electrodes.

2. An X-ray bulb comprising a main and secondary tube, a target mounted in the main tube, and a secondary target mounted in the secondary tube, and electrodes.

3. An X-ray bulb comprising a main tube and secondary tube, the latter being provided with one of the electrodes and with a target, and another electrode.

4. An X-ray bulb comprising a main tube and a secondary tube, the latter being opaque to X-rays, one of the electrodes being located in the secondary tube and the other being located in the main tube, and two targets one of which is located within the secondary tube.

5. In an X-ray apparatus, a bulb provided with a target and a pair of electrodes, and a screen between one of the electrodes and the target.

6. In an X-ray apparatus, a bulb comprising a main tube, and a communicating secondary tube formed of a material opaque to X-rays, a target and an electrode in the main tube, an electrode in the secondary tube, and a screen in the secondary tube positioned to cut off the cathode rays which proceed from the electrode in the secondary tube.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY F. WAITE.

Witnesses:

HENRY E. WAITE,

CHARLES KALLMEYER.