Aug. 5, 1941. L. F. BLACK 2,251,265

METHOD AND MEANS FOR TESTING X-RAY TUBES

Filed Aug. 31, 1939

Fig. 2.

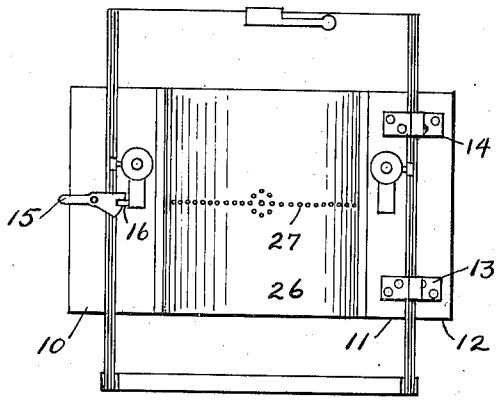


Fig. 6.

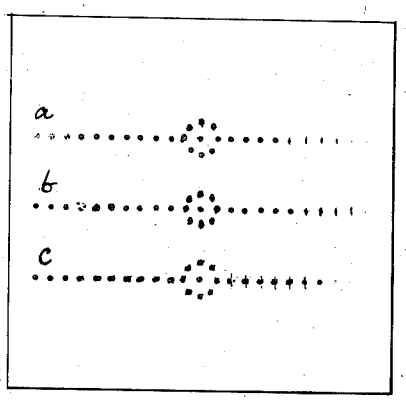


Fig. 1.

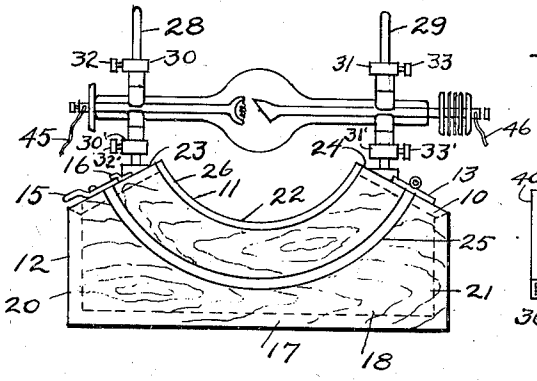


Fig. 3.

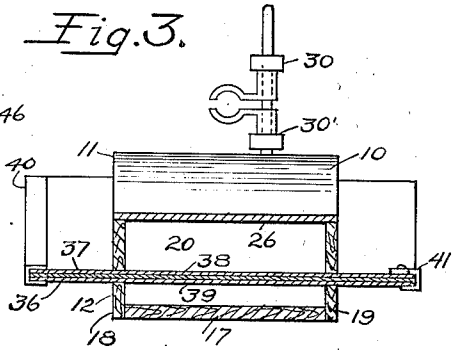


Fig. 4.

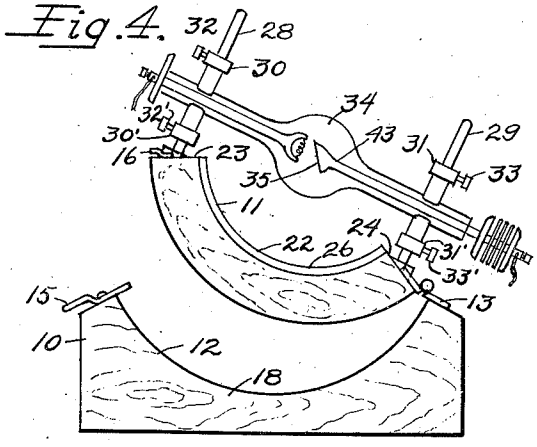
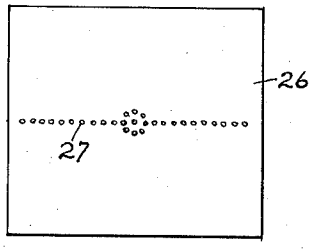


Fig. 5.



INVENTOR
Lawrence F. Black,
By Thomas H. Reese.
ATTORNEY.

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METHOD AND MEANS FOR TESTING X-RAY TUBES

Lawrence F. Black, Washington, D. C.

Application August 31, 1939, Serial No. 292,867

8 Claims. (Cl. 250—65)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates generally to a device and method for examining the targets of X-ray tubes, but more particularly to a means and method for determining the intensity of the diverging rays of said tubes at various angles from a central axis, at a fixed distance from the locus of emanation.

One object of the invention is to provide a device adapted to obtain a permanent record of the appearance of the target of a Roentgen tube.

Another object of the invention is to provide a device adapted to demonstrate the effect of angular position of the target of the Roentgen tube upon the effective ray.

A further object is to provide a means for checking the effective area, actual area and minimum projected area of the focal spot of a Roentgen tube. This is especially valuable in checking performance of tubes against specification claims.

Still another object is to provide a means for determining the maximum ray divergence and the minimum focal film distance for various types of tubes as they are affected by the angle of the target face.

With these and other objects in view this invention relates to certain novel details of construction, combination and arrangement of parts to be more fully herein described and claimed.

Referring to the figures in which like parts are designated by similar reference characters:

Fig. 1 is a front elevation of the device with the casing closed;

Fig. 2 is a top plan view of the device as shown in Fig. 1, with Roentgen tube removed to show the holes in the grid;

Fig. 3 shows a sectional view taken on the line 3—3 of Fig. 1, with tube removed;

Fig. 4 is a front elevation of the device showing the casing in open position with film holder removed;

Fig. 5 is a plan view of the arcuate grid uncurved into a flat surface; and

Fig. 6 is a plan view of a sheet of film after development.

The apparatus consists of a hollow boxlike casing 10 which may be made of wood or any other suitable material, and is formed in upper and lower portions 11 and 12 respectively, which are connected by hinges 13 and 14 and which may be clamped in juxtaposition to each other by latch members 15 and 16.

When the upper member or lid 11 is closed on the lower member or base 12 the structure forms a covered box having a rectangular floor 17, front and rear walls 18 and 19, side walls 20 and 21, and a top 22 having a concave arcuate surface with sloping lateral ends 23 and 24 which terminate at their junctions with the side walls 20 and 21.

Parallel to the concave arcuate surface of the top and spaced below the same at a predetermined distance is cut a slit 25 which passes entirely through the boxlike structure separating the same into the base 12 and the lid 11. This slit is for the retention of a film holder, as will further be described.

The concave arcuate surface is formed by a circularly curved lead grid 26 which is provided with a centrally aligned row of equally spaced holes 27 at right angles to its longitudinal axis, the center hole of the row being surrounded by holes, equal in diameter to those of the row, to designate it as the center.

On the sloping lateral ends 23 and 24 of the upper section are affixed uprights 28 and 29 having slidably adjustable tube clamping members 30, 30' and 31, 31' mounted thereon which may be fixed in any position along the extent of the uprights by means of the set screws 32, 32' and 33, 33'.

The adjustable tube brackets are adapted to support an X-ray tube 34 so that the center of X-ray radiations from the target 35 will be at the center of curvature of the grid 26 and of a film 36 which is interposed between the side sheets of a cardboard film holder 37.

The film holder 37 consists of two pieces of cardboard 38 and 39 of like dimension one superimposed upon the other and hingeably connected along the adjoining edges of one side by a piece of binding tape 40. The sides opposite the hinged edges are held together by a latch member 41, as shown in Fig. 3.

A sheet of sensitized photographic film 36 is placed between the sheets of cardboard and clamped therein by the latch member 41. Cardboard is used as cover sheets for the film, since due to its flexibility, the film holder will readily follow the contour of the arcuate edges of the top and bottom portions of the casing. However, any other suitable flexible material may be used for the purpose required.

In the operation of the device the X-ray tube 34 is first placed between the clamp members

30, 31 and 31, 31' and adjusted longitudinally and angularly therein, and vertically on the standards or uprights 28 and 29, so that the center or emanating area of the target 35 on the anode 43 is above the center hole 44 of the lead grid 26.

The lid or upper portion of the casing is then lifted and the film holder 37 into which a film 36 has been inserted, placed on the upper arcuate edges of the lower portion or base 12 of the casing 10. The lid is then closed and latched and the tube connected to a regular X-ray energizing apparatus (not shown) through the conductors 45 and 46, in the usual manner and current passed through the tube to put the same into operation for a predetermined period, dependent on the length of exposure desired.

After the exposure is made the energy to the tube is then cut off and the film holder pulled slightly through the arcuate slot between the upper and lower portion of the casing until an unexposed portion of the film is beneath the grid holes, another tube may then be placed in the test tube brackets and adjusted as before and another exposure through the grid holes made. Several tubes may thus be placed in the device, one after another and the exposures through the grid holes photographically recorded on the film to show the characteristic of the tube respecting its effective radiation over a predetermined angle, the condition of its target, etc.

The apparatus described consists of a simple wood constructed tube holder for the Roentgen tube with a special accurately perforated lead sheet curved on an arc between the tube and a concentrically curved film which is exposed for record as described above, however many deviations in the construction of the film holder and many forms of grids may be used therewith without departing from the scope and spirit of the invention.

The grid shown is well suited for comparison studies, as it is possible to obtain several exposures on the same film. The tube is energized from a regular X-ray machine in the usual manner. The arc of the film and of the lead sheet or grid is so constructed that the appearance of the film exposed is the same as the composite image obtained by many horizontally placed films exposed with the target placed at various angles. The saving in film for experimental purposes in this procedure is obvious.

In the operation of the device the following technique is used in making the photographic records: kilovolt peak, 40; milliamperes, 10; sec. 10. The distance of the target to the lead grid may not exceed 4 inches; the usual film distance is set by the apparatus, cardboard film holders, as described above, are used due to their simplicity of construction, flexibility, wearing qualities and low cost. Enlargements may be made by increasing the distance to the film. The peak is retained below 40 kilowatts to eliminate any danger of spark-over through the lead grid.

The photographic records made by the device will show if there are craters or melted raised areas on the surface of the target by the contour of the photographic image, or if the target is split or otherwise defective, and the density of the spot is a measure of the drop in kilovolt peak caused by resistance in the circuit.

A comparison of the three different tubes is shown by the photographic images indicated at *a*, *b*, and *c*, Fig. 6, which illustrate the effectiveness of studying permanent photographic records in determining the qualities and deficiencies of the various tubes.

(*a*) By comparison this tube appears to have a target with a platinum face and copper back. This density of the spots is not the same as in other tubes due to the drop in kilovolt peak caused by the amount of resistance in the circuit;

(*b*) Shows a tube of universal medium focus, solid tungsten anode; good condition: Dark portion on film shows image of actual focal spot. Halo shows image of anode;

(*c*) Shows the image formed by a defective tube having a split target.

Having described my invention what I claim as new and wish to secure by Letters Patent is:

1. A testing device for X-ray tubes comprising a hollow boxlike casing formed of complementary sections composing a base and a lid, said casing having arcuately-shaped slotted openings between said sections, a concave arcuately-shaped grid concentrically arranged with respect to the curvature of said slotted openings and forming the top of said lid, means in connection with said lid for supporting an X-ray tube above said grid with its target at the center of curvature of said grid, and means for inclosing a film to slidably mount the same within said arcuate slots.

2. A testing device for X-ray tubes comprising a hollow boxlike casing having a bottom, a top, side walls, and end walls, said casing being divided to form complementary sections composing a base and a lid, the respective side walls of which terminate in spaced relation to each other to form an arcuate slot on each side of said casing, a concave-arcuately-shaped grid concentrically arranged with respect to the curvature of said slots and forming the top of said lid, means in connection with said lid for supporting an X-ray tube above said grid with its target at the center of curvature of said grid, and means for inclosing a film to slidably mount the same within said arcuate slots.

3. A testing device for X-ray tubes comprising a hollow boxlike casing having a bottom, a top, side walls and end walls, said casing being divided to form complementary sections composing a base and a lid, the respective side walls of which terminate in spaced relation to each other to form an arcuate slot in each side wall of said casing, means for hingeably connecting said lid to said base and means for latching the same in closed position, a concave arcuately-shaped grid concentrically arranged with respect to the curvature of said slots and forming the top of said lid, means in connection with said lid for supporting an X-ray tube above said grid with its target at the center of curvature of said grid, and means comprising a flexible film holder adapted to be slidably mounted within said arcuate slots.

4. A device of the class described comprising a base provided with a top formed of an arcuately shaped grid provided with a single arcuate row of equally spaced exposure apertures, supports mounted upon said base for retaining an X-ray tube with its target at the center of curvature of said grid, and means in connection with said base for slidably supporting a flexible film holder parallel to the curvature of said grid, whereby successive arcuate sections thereof may be exposed to said apertures.

5. A device of the class described comprising a base provided with a top formed of an arcu-

ately shaped grid provided with a single arcuate row of equally spaced exposure apertures, supports mounted upon said base for retaining an X-ray tube with its target at the center of curvature of said grid, and within the plane of said apertures, and means in connection with said base for slidably supporting an arcuate film holder parallel to the curvature of said grid, whereby successive arcuate sections thereof may be exposed to said apertures.

6. A method of obtaining adjacently arranged photographic records showing the relative effectiveness of diverging rays emanating from the targets of X-ray tubes for comparison thereof, comprising successively passing rays from each of said tubes through equally spaced arcuately aligned exposure apertures in an arcuately shaped grid having its center of curvature at the point of emanation of said rays, and exposing adjacent arcuate areas of a concentrically curved film to the rays, of each of said tubes, passing through said apertures.

7. A device of the class described comprising a base provided with a top formed of an arcuately shaped grid provided with exposure apertures, supports mounted upon said base for retaining an X-ray tube with its target at the center of curvature of said grid, and means in connection with said base for supporting a flexible film holder parallel to the curvature of said grid and capable of being moved longitudinally with respect to the axis of said grid, whereby successive arcuate sections thereof may be exposed to said apertures.

8. A method of obtaining adjacently arranged photographic records showing the relative effectiveness of diverging rays emanating from targets of X-ray tubes for comparison thereof, comprising successively passing rays from each of said tubes through exposure apertures in an arcuately shaped grid having its center of curvature at the point of emanation of said rays, and exposing adjacent arcuate areas of a concentrically curved film to the rays, of each of said tubes, passing through said apertures.

LAWRENCE F. BLACK.