

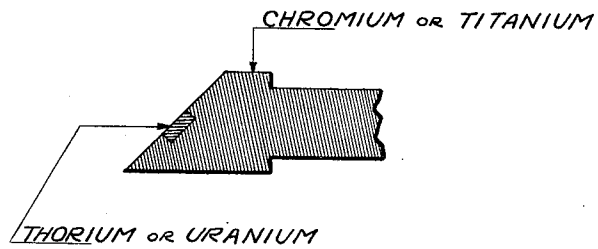
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X-RAY TARGET

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X-RAY TARGET.

Application filed April 13, 1921. Serial No. 461,051.

To all whom it may concern:

Be it known that I, HARVEY C. RENTSCHLER, a citizen of the United States, and a resident of East Orange, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in X-Ray Targets, of which the following is a specification.

This invention relates to X-ray apparatus and more particularly to targets employed in X-ray tubes.

An object of the invention is to provide an X-ray target which efficiently emanates X-rays to produce a clear and sharp shadow in an X-ray picture.

Another object of this invention is to provide a novel X-ray target having the focal spot thereof formed of a material of high ray-radiating capacity and having the remaining portion of the target formed of a material of relatively low ray-radiating ability.

Another object of my invention is to provide a composite target for X-ray tubes in which the metals are joined in intimate contact by sintering.

A further object of my invention is to provide a process for removing the occluded gases from the materials which are to be employed in making an X-ray target while simultaneously sintering the metals together to bring the same into intimate contact.

Other objects of the invention will be apparent from the following description.

During the development of apparatus for producing X-ray pictures, the X-ray tubes have received special consideration, and, particularly have the targets been the subject of special attention. One of the accepted theories of the operation of an X-ray tube is that electrons pass from the cathode, which is sometimes designated as the negative electrode, to the target, and, as a result of their impinging against the target, X-rays are generated and radiated from the tube. The targets may be of any desired shape but the construction is of the well-known form having an inclined surface in which is placed a small insert formed of a highly refractory metal which preferably operates as the focal spot.

Heretofore, in the operation of X-ray apparatus, many of the resulting pictures have not been entirely satisfactory in that they

did not produce a perfectly clear-cut shadow. This indistinctness is largely due to the stray rays generated by portions of the target other than the focal spot, and these rays help in producing the cloudiness of the shadow and thus make an X-ray picture which is not always readily susceptible of a clear and positive diagnosis. Inasmuch as the X-ray apparatus has a very extended use in diagnosing conditions of the human body, it is highly essential that correct deductions may be made from an examination of the X-ray pictures.

This invention will be described in connection with a well known type of target consisting of two metals, one being an insert held within a portion of a second metal which preferably performs the double function of being a supporting body and a heat conductor and heat radiator which latter feature permits a rapid dissipation of heat from the insert. For convenience of description, the insert will be considered as the focal spot of the target, with the operating surface thereof formed at an angle to the major axis of the target in accordance with the usual construction of such targets.

The specific application of this invention will be described in relation to such materials and arrangement thereof as will produce a distinct and clear shadow in an X-ray picture.

Referring to the drawing, the figure therein illustrates an X-ray target or anode of conventional design. The target 1 is constructed of metals having highly refractory characteristics in order that they may withstand the heat developed during the operation of the tube and may also properly conduct the heat from the insert.

In determining the materials to be employed, it is preferred that the atomic weights be considered, as it is well known in X-ray work that the ray-radiating ability of the metals bears a relation to their atomic weights. The preferred construction of the target has the focal spot 2 formed of a metal of high ray-radiating ability and has the surrounding and supporting body 3 formed of a metal which has a relatively low ray-radiating ability. With this combination of metals, it is found that the shadow in the X-ray picture is appreciably more distinct than in pictures heretofore obtained, as the rays

radiated from the supporting body are reduced to the minimum, thus reducing the stray rays which tend to cloud the shadow in the picture.

5 A preferred example of metals employed in forming a target which produces a distinct picture may be stated as consisting of thorium and chromium; the former being the insert and focal spot and the latter being the surrounding and supporting body.
10 Other metals or alloys, which preferably have high and low atomic weights, respectively, may be utilized, as, for instance, uranium may be substituted for thorium,
15 and titanium may be substituted for chromium.

A target formed in accordance with the above example operates in practice to reduce the undesirable X-rays which tend only to
20 make the picture indistinct.

The metals or alloys forming the target may be held together in any desired manner. When the surrounding or supporting body is employed as a heat-radiating unit, it is
25 preferable to join the two metals in intimate contact as, for instance, by sintering. In forming a target of thorium and chromium, it is preferred to place powdered thorium surrounded by a substantial quantity of
30 powdered chromium in a press and to force them together into the form of a slug or ingot. These metals are preferably sintered together by placing the slug in a high-frequency vacuum furnace and operating the
35 same at a high temperature. Such a furnace is described and claimed in my copending application, Serial No. 430,118 filed December 13, 1920, entitled Furnaces, and assigned to the Westinghouse Lamp Company.

40 The vacuum furnace also operates to remove objectionable gases from the metals, whereby the exhausting of the X-ray tube, after the target has been assembled therein, is quickly and readily accomplished.

45 In some instances, it may be desirable to join the metals by other methods, as by casting a metal which is to act as the supporting body around a body of thorium. If desired, the surrounding body may be formed
50 first and the insert metal cast into an opening reserved therefor.

Various metals or combinations thereof may be employed in forming targets for X-ray tubes but it is to be understood that
55 targets, such as contemplated, which reduce the number of undesirable radiated rays are considered as being within the scope of this invention, as defined in the subjoined claims.

60 What is claimed is:

1. An X-ray target having a focal spot of a material of high atomic weight surrounded by a material of low atomic weight and having a melting point above 1500° C.,
65 said materials being sintered together on their contiguous surfaces.

2. An X-ray target of highly refractory metals, one of said metals being adapted to generate effective X-rays and the other metal being a poor ray-generating metal, said metals being sintered together on their
70 contiguous surfaces.

3. An X-ray target comprising two highly refractory metals, said metals having materially different ray-radiation characteristics, said metals being sintered together on
75 their contiguous surfaces.

4. An X-ray target comprising two highly refractory materials having appreciably different atomic weights, said materials having their contiguous surfaces sintered to-
80 gether.

5. An X-ray target comprising a highly refractory material for the focal spot and a highly refractory material for supporting said focal material, said supporting material having low ray-radiating characteristics, said materials having their contiguous surfaces sintered together.
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6. An X-ray target comprising a metal of atomic weight greater than 185 for the focal
90 spot and a supporting metal of relatively low atomic weight and having a melting point above 1500° C., said metals being sintered together on their contiguous surfaces.

7. An X-ray target comprising thorium for the focal spot of the target and chromium as a surrounding supporting body for said thorium, said focal spot and body being in intimate contact on their contiguous
95 surfaces.

8. An X-ray target having a focal spot of high ray-radiating capacity and surrounding metal of relatively low ray-radiating capacity and having a melting point above
100 1500° C., said focal spot and metal being sintered together.

9. An X-ray target having a focal spot consisting of a high ray-radiating metal and a surrounding supporting body of a
105 relatively low ray-radiating metal and having a melting point above 1500° C., said metals being sintered together at their contiguous surfaces.

10. An X-ray target having the center thereof composed of a body of high ray-radiating capacity and the surrounding
110 body of relatively low ray-radiating capacity sintered to said first body.

11. An X-ray target comprising two metals having the characteristics of high
115 melting points and materially different ray-radiating ability, said metals being sintered together at their contiguous surfaces.

12. An X-ray target composed of two metals intimately joined together by sintering along their contiguous surfaces to provide effective means for conducting heat
125 therebetween.

13. An X-ray target composed of two bodies of metal, one of said bodies being
130

inserted in the other, said metal bodies being sintered together to form a path for the conduction of heat therebetween.

14. A target for X-ray tubes comprising
5 a focal spot of a highly refractory metal and a body portion surrounding the same of another highly refractory metal but having a relatively low ray-radiating capacity with respect to said first metal, said metals being
10 sintered together along their contiguous surfaces and free from occluded gases.

15. The process of forming an X-ray target which comprises forming a slug or ingot by pressing together two refractory metals
15 in powder form and sintering the same.

16. The process of forming a composite X-ray target free from occluded gases and having the metals forming the same in intimate contact, which comprises pressing together a powdered refractory metal of high
20 atomic weight and a powdered refractory metal of low atomic weight, the former metal being partially surrounded by the latter metal and sintering the metals together
25 in a high vacuum.

In testimony whereof, I have hereunto subscribed my name this twelfth day of April, 1921.

HARVEY C. RENTSCHLER.