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Dietz et al.

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[54] **ROTARY ANODE AND AN X-RAY TUBE PROVIDED THEREWITH**

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[51] **Int. Cl.** **H01j 35/10**

[58] **Field of Search** 313/60, 330

[56] **References Cited**

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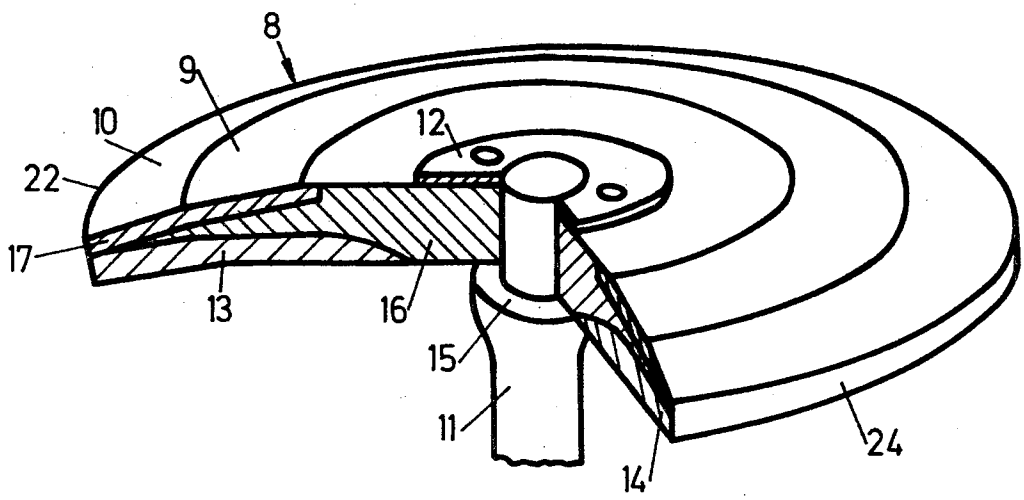
[57] **ABSTRACT**

A rotary anode for an X-ray tube containing an anode plate of difficultly meltable material upon which lies the focal spot path, is characterized by the provision of radial cuts in the plate.

7 Claims, 4 Drawing Figures



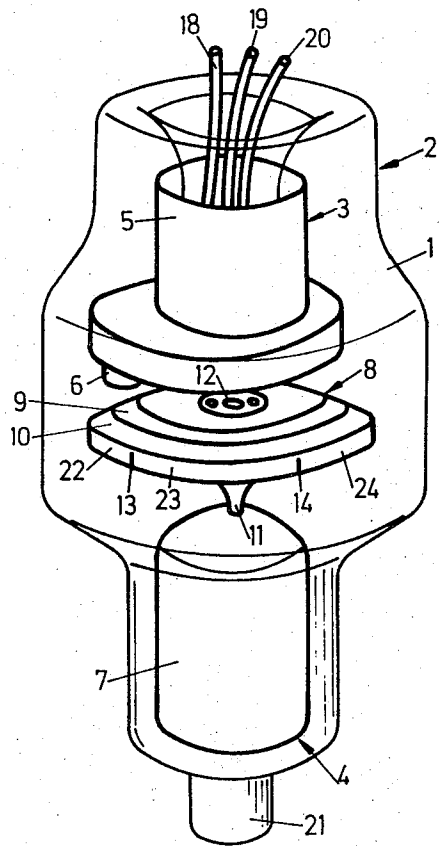

18
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Fig.1

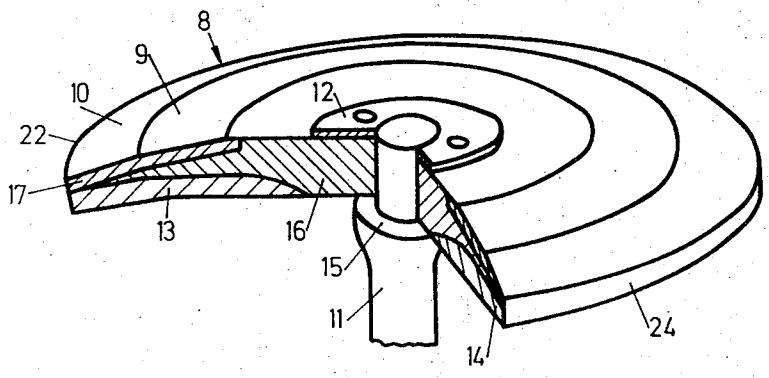
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Fig. 2

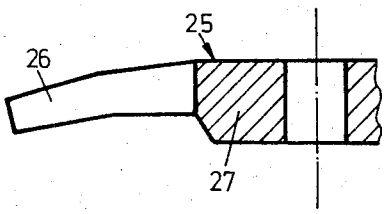

Fig.3

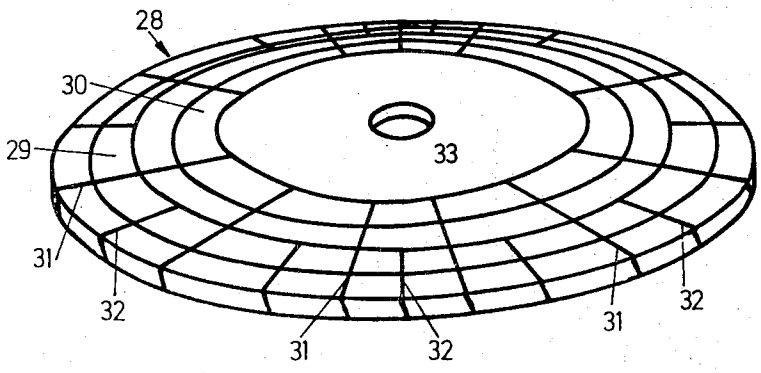

Fig.4

ROTARY ANODE AND AN X-RAY TUBE PROVIDED THEREWITH

This invention relates to a rotary anode for an X-ray tube containing an anode plate made of material which melts with difficulty and upon which lies the focal spot path.

As is known, the surface of the X-ray tubes with rotary anodes, which is struck by electrons and is the focal spot path, is heated locally to a great extent. The result is that it expands greatly and produces tensions which can cause the breakage of the anode. It has been suggested already to avoid this by making a rotary anode of several parts which are interconnected mechanically. Thermic expansions and tensions are then smaller, since the parts are smaller, and are then balanced relatively to each other.

An object of the present invention is to simplify and improve existing constructions of this nature.

Other objects will become apparent in the course of the following specification.

In the accomplishment of the objectives of the present invention it was found possible to simplify the connection of the parts by providing the anode body with radial cuts. Since in this construction the parts of the anode are not completely separated from each other no special connection is necessary. The remaining central uncut part of the anode constitutes the connection. This central part can be additionally made thicker to improve the strength. There is also the additional advantage that a good heat exchange can take place between all parts of the anode.

According to a preferred embodiment of the present invention the anode plate is cut only on the locations upon which lies the focal path. The inner part remains intact and acts as the connection. It is necessary to provide at least three cuts at equal distances from each other in order that the forces thus produced will be divided at least approximately without tensions. However, the number of divisions can be increased so that the plate can have, for example, 10 or more cuts and will be still a sufficiently compact anode. If there are too many cuts the surface of the anode will be too narrow.

It is possible to avoid completely the narrowing of the anode surface struck by the electrons when the cuts are directed from the bottom side of the plate and only partially extend through the plate. Adequate movement facility remains when the cuts extend at least through one half of the thickness of the anode. Furthermore, it is advantageous to provide the greatest depth to the cuts at the edge of the anode and then extend them toward the axis. This shape can be easily ground with thin dividing discs. The depth of the ground discs will moreover diminish inwardly if the axis of the round disc is located under the edge of the anode during the cutting. In this construction, the number of cuts can exceed 10 if the heat capacity of the anode is balanced by the greater thickness of the material, so that the loss in material resulting from the cuts is compensated.

In case of anodes with two concentrical focal point paths it is advantageous to extend the cuts in one part up to the inner end of the outer focal point path and in another part up to the inner end of the inner focal point path. Then despite sufficient elasticity of the anode the loss in anode material is small.

It is known that during operation of X-ray tubes it is necessary to a great extent to prevent the electrons from striking other parts of the tube than the anode. It is therefore advantageous to extend the cuts at least partly in a direction which deviates from that of the electron ray. This avoids the possibility that the electrons will pass through the anode plate without being stopped and will strike the tube wall or the rotor, etc.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example only, preferred embodiments of the inventive idea.

In the drawings:

FIG. **1** is a perspective view partly in section of an X-ray tube constructed in accordance with the present invention.

FIG. **2** is a perspective view on an enlarged scale of a rotary anode used in the X-ray tube shown in FIG. **1**, one quarter of the anode being removed to illustrate the cuts.

FIG. **3** is a section through one half of a differently constructed anode.

FIG. **4** is a perspective view of a rotary anode having radial cuts of different depths and extensions.

FIG. **1** shows an X-ray tube **2** having a cylindrical casing **1** at the two ends of which are arranged opposite each other in a known manner the cathode combination **3** and the anode combination **4.** The cathode combination **3** includes a cover **5** with a screen **6** containing the glow cathode (not shown). The anode combination **4** consists of a rotor **7** and an anode plate **8** having a diameter of 100 mm. and a thickness of 6 mm. The plate **8** has focal point paths **9** and **10** in a manner known for anode plates. The plate **8** is attached to the axle **11** by a screw **12** and is pressed against a flange **15** (FIG. **2**). FIG. **2** also shows the layer-like construction of the plate **8** which consists of a base body **16** of molybdenum and a layer **17** which is 1.5 mm. thick of a rhenium-tungsten alloy for the focal point paths **9** and **10.** Four cuts are provided to increase heat elasticity. Only two of these cuts **13** and **14** are shown in the drawings. The cuts are ground at equal distances from each other from the bottom side of the plate **8.** At the edge they are 4 mm. deep and extend to a zero depth at a distance of 10 mm. from the axle **11.**

The required operating and heating voltages are supplied to the X-ray tube for ray production in the usual manner through the conduits **18, 19** and **20** and the anode base **21.** The sections **22, 23** and **24** of the anode plate can move relatively to each other when they expand by heat without producing any tears.

FIG. **3** shows a section through a part of an anode **25** wherein the cuts extend through the entire thickness of the plate **26** and reach radially to an inner part **27** which is made thicker to improve the attachment.

FIG. **4** shows a plate **28** having two focal spot paths **29** and **30** and provided with cuts **31** and **32** of different depths. The cuts **31** extend radially to the inner edge of the inner focal spot path **30** and the cuts **32** which are located intermediately between the cuts **31,** extend to the inner edge of the outer focal spot path **29.** The axial extension of all cuts **31, 32** deviates from the direction of the axle fitting into the opening **33** and which extends parallel to the electron ray producing the X-ray radiation. This construction prevents the passing of

electrons which come directly from the cathode; it can be recognized particularly by the inclined location of the cuts **31** and **32** at the edge of the plate **28**, consisting like plates **8** and **26** of difficultly meltable material (refractory material).

What is claimed is:

1. A rotary anode for an X-ray tube, comprising an anode plate of refractory material upon which lies the focal point path, said plate having a radial cut upon that part of the radius which extends from an outer edge to close to the center of the plate, but terminates outside of the center.

2. A rotary anode according to claim **1**, wherein said plate has at least three spaced radial cuts, the radial lengths of these cuts at least including surfaces struck by the electrons.

3. A rotary anode according to claim **1**, wherein said plate has two focal spot paths, some of said cuts extending to the inner edge of the outer focal spot path, other cuts extending to the inner edge of the inner focal spot path.

4. A rotary anode according to claim **1**, wherein the direction of the cut at least partly deviates from he axial direction of the plate.

5. A rotary anode according to claim **1**, wherein said plate has a central portion which is thicker than the edge portion.

6. A rotary anode according to claim **1**, wherein said cuts extend from the bottom of the plate and penetrate at least to one half of the plate.

7. An X-ray tube having an anode described in claim **1**.

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