

[54] **BEARING STRUCTURE FOR X-RAY
TUBE WITH ROTATING ANODE**

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[22] Filed: March 2, 1971

[21] Appl. No.: 120,212

[52] U.S. Cl. 313/60, 29/148.4 B

[51] Int. Cl. H01j 35/10

[58] Field of Search 313/60; 29/148.4 B

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References Cited

UNITED STATES PATENTS

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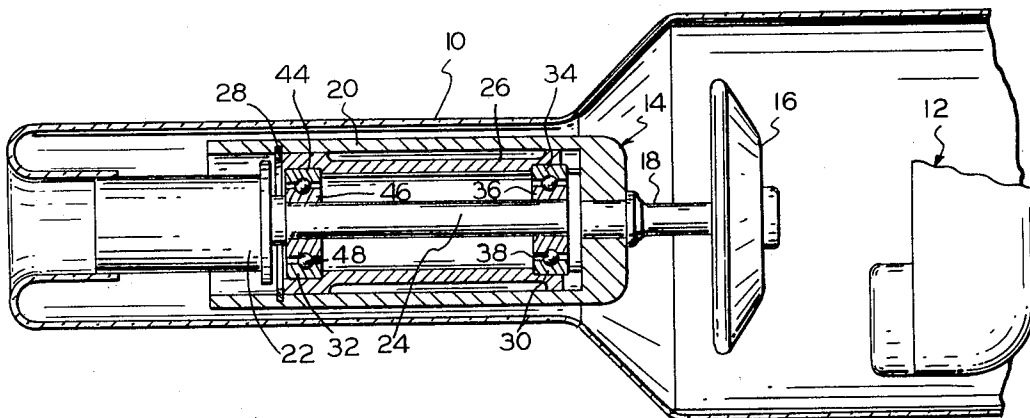
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ABSTRACT

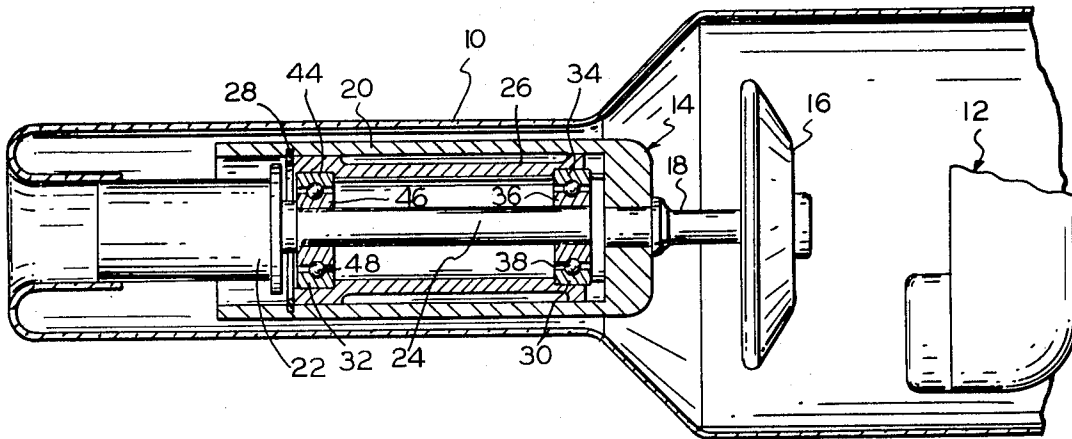
An X-ray tube having a rotating anode supported by a refractory carbide ball bearing structure.

4 Claims, 1 Drawing Figure



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FIG. 1



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BEARING STRUCTURE FOR X-RAY TUBE WITH ROTATING ANODE

BACKGROUND OF INVENTION

A continuing and difficult problem which has faced the designers of rotating type anode X-ray tubes has been the support of the anode. Since the anode is usually a relatively heavy structure and is supported within a vacuum and in a confined space, difficulty has been encountered in providing a bearing structure that will have a usefully long life. X-ray tube anodes are subjected to extremely high temperature during normal operation which contributes to the problem of finding suitable materials.

Various bearing material such as high strength and high hardness stainless steels have been employed heretofore. Some of the most successful lubricants have been the metallic type made from lead, gold and silver.

SUMMARY OF INVENTION

It is an object of the present invention to provide a new and improved bearing structure which will have a longer useful life than the bearing structures as provided heretofore without requiring substantial modification of the X-ray tube.

An X-ray tube constructed in accordance with the present invention comprises an envelope of glass or ceramic within which is sealed a cathode structure and a facing anode. The anode includes a spindle sealed to and supported from the envelope and a sleeve structure surrounding the spindle and supporting an anode target. The sleeve is supported from the spindle by a pair of longitudinally spaced bearing structures each of which includes opposed races and ball bearings. The bearing assembly which is positioned closest to the hot anode target and operates at the highest temperature is formed totally or partially of a refractory carbide, such as, for example, tungsten carbide. The bearing assembly is still lubricated by one of the previously mentioned materials presently known in the art.

The bearing structure most remote from the anode target may comprise opposed races and ball bearings of steel. This structure is not subjected to as high a temperature and load as the "front" bearing structure and the provision of conventional steel races gives satisfactory performance and provides for an efficient electrical connection from the spindle to the metal sleeve of the anode.

For a more detailed description of the invention, reference is made to the accompanying drawings and the following specification.

DRAWING

The FIGURE is a fragmentary, sectional view of an X-ray tube embodying the invention; and

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, an X-ray tube constructed in accordance with the invention comprises an envelope 10 which may be formed of glass or ceramic material or other suitable material. Mounted within the envelope 10 in a suitable known manner (not shown) is a cathode 12 and an anode 14. The cathode 12 contains a suitable filamentary structure (not shown) for generating electrons.

The anode 14 includes a target member 16 formed of tungsten or other suitable material and upon which the electrons generated at the cathode impinge to generate X-rays in the known manner. The target member 16 is supported on a shaft 18, which, in turn is mounted upon a target supporting member or sleeve 20. The sleeve 20 is rotatably supported and telescoped over a support structure 22 which includes a spindle 24. Surrounding the spindle 24 is a sleeve 26 which is held in place within the sleeve 20 by a snap-ring 28. Positioned between the sleeve 26 and the spindle 24 is a pair of bearing structures, one structure 30 being located adjacent the free end of the spindle and the other 32 being located adjacent the opposite end of the spindle and remote from the target 16.

In accordance with the invention, the bearing structure 30 includes an outer race 34 and an inner race 36 between which are positioned a plurality of ball bearings 38 which are formed of a refractory metal carbide such as, for example, tantalum carbide, titanium carbide or molybdenum carbide, but preferably tungsten carbide. The races 34, 36 may be formed of steel.

The bearing structure 32 includes an outer race 44, an inner race 46, and a plurality of ball bearings 48 which may be preferably formed of steel. The ball bearings 38, 48 may each be coated with lead or other suitable lubricant. The races 44, 46 are formed of steel as is the sleeve 26 and the sleeve 20 so as to provide a path of a relatively high electrical conductivity from the spindle or support structure 22 to the shaft and thence the target 16.

It will be appreciated that the greater load is imposed upon the bearing structure 30. We have discovered that by utilizing ball bearings of tungsten carbide that the life of this bearing structure and hence the life of the tube may be substantially increased over the construction which has been used heretofore. Moreover, the tube may be operated under conditions, for example, longer exposure periods, which increase the operating temperature above that heretofore permissible for the front bearing structure. It was entirely unexpected to us that this result would be obtained for presently used steel, T-5 etc., have been considered the ultimate in bearing material. It was further surprising to us that lead would function as a lubricant at these higher operating temperatures.

Having illustrated and described a preferred embodiment of the invention, it should be apparent that the invention permits of modification in arrangement and detail.

We claim:

1. An X-ray tube comprising:
an envelope,

a cathode and an anode in said envelope,

means supporting said anode for rotation within said envelope including ball bearings and opposing races,

said ball bearing being formed of a refractory metal carbide, said races being formed of steel.

2. An X-ray tube according to claim 1 wherein said ball bearings are formed of tungsten carbide.

3. An X-ray tube according to claim 1 wherein said ball bearings and races are lubricated with lead or gold.

4. An X-ray tube comprising:

an envelope, a cathode and an anode means in said envelope, the anode means comprising an elongated

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gated support structure cantilevered from said envelope and a target supporting member rotatably supported upon said support structure, a pair of bearing means positioned between said support structure and said target supporting member, 5
one of said bearing means being positioned adjacent the free end of said structure and comprising a pair of opposed races and ball bearings between such races,
said ball bearings of said one bearing means being 10
formed of tungsten carbide, and the races thereof

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being formed of steel,
the other of said bearing means being positioned remote from said free end of said structure and comprising a pair of opposed races and ball bearings between such races,
said ball bearings and races of said other bearing means being formed of steel so as to provide a path of relatively high electrical conductivity from said structure to said sleeve.

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