Oct. 16, 1934. G. HOLST ET AL 1,977,275

X-RAY TUBE

Filed March 13, 1930

Fig. 1.

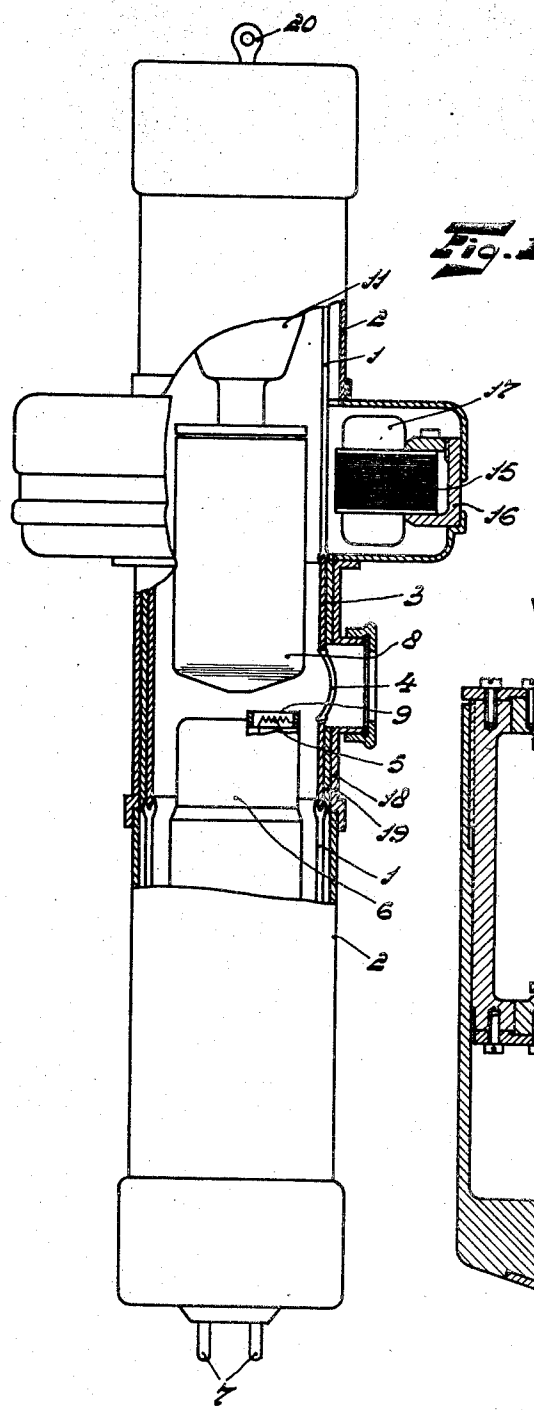
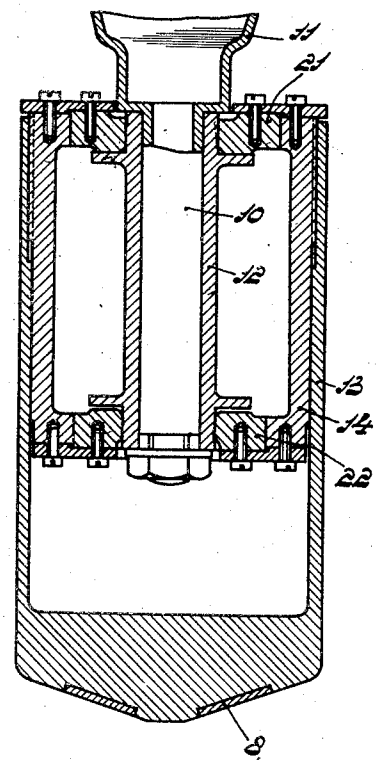


Fig. 2.



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Att'ys.

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X-RAY TUBE

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17 Claims. (Cl. 250—35)

This invention relates to an improvement in or modification of vacuum chambers, generally of the type comprising X-ray tubes with rotary anticathode as described and claimed in application Ser. No. 186,522 filed April 25, 1927, now Patent No. 1,893,759.

Tubes arranged on the principle therein described have the advantage that the focal spot is not formed at the same point of the anticathode for the entire duration of the load, but shifts constantly. Thus, the heating of the anticathode's mirror or target is not concentrated on a definite point but is distributed over a large surface area which permits the load to be of greater intensity or of longer duration.

The arrangement of a rotary part within a space, having as high a vacuum as does prevail, for instance, in X-ray tubes, entails great difficulty. According to the above patent, the rotation is obtained by the use of an anticathode constituting the rotor of an electric motor and, in the form of construction described in the said patent, the rotor is journalled on a pair of ball-bearings. This form of construction has, however, been found to present disadvantages.

The various metal parts arranged within the tube must be substantially deprived of occluded gases. The driving off of the occluded gases is effected by heating these parts to a very high temperature. Such heating is, however, injurious to the ball bearings on which the rotary part revolves. Furthermore, the heating of the device during its operation causes the rotation to take place less evenly and less lightly than might be expected when using ball bearings.

It has now been found that more favorable results are obtained if, instead of using ball bearings for the support of the anticathodic body, one or more slide-blocks are used, in which case an apertured bearing-disk secured to the rotor surrounds a stationary member which member has a smaller coefficient of expansion and, preferably, a greater hardness than the bearing-disk. A suitable disk for this purpose consists of a copper-graphite alloy containing about 1% of carbon. The content of carbon may vary between about 0.5 and 3%. The material on which this disk bears is preferably tungsten, molybdenum, or a metal of similar hardness. It is preferable that, of the surfaces sliding in contact with each other, the surface of the harder material extends beyond the other. Thereby it is prevented that, by wear, the harder material grinds grooves into the softer material which might hinder an easy rotation.

In order that the invention may be clearly understood and readily carried into effect one form of construction of a vacuum chamber according to the invention, represented by an X-ray tube, will be described more fully with reference to the accompanying drawing, in which;

Figure 1 is a partly sectionized side view of an X-ray tube according to the invention.

Figure 2 is a sectional side view, on an enlarged scale, of the anticathode of the tube.

In the two figures, like parts are designated by similar reference numerals.

Referring to Figure 1, the wall of the tube has two glass parts 1—1 and a cylindrical metal part 3, preferably of ferrochrome, sealed between the glass parts. The glass parts 1 and 1 are surrounded by envelopes 2—2 consisting of an insulating material which is hardly transparent to X-rays. The cylindrical metal part 3 comprises a window 4 which allows active X-rays to emerge. The tube has an incandescent cathode 5 arranged within a metal receptacle 6 comprising an aperture 9 which allows the electrons emitted by the incandescent cathode to pass to an anticathode 8. The two ends of the incandescent cathode are connected to contact pins 7; one by means of a pole wire, the other through the metal receptacle 6 (not shown). The lead wires for the power supply to the cathode may be connected to the said contact pins.

The cathode rays are concentrated on a small part of the end surface of the anticathode 8 by the focussing device 6.

The anticathode 8 is adapted to rotate within the X-ray tube and for this purpose it constitutes the rotor of an electric motor and is pivoted to a stationary shaft. This shaft is formed of a spindle 10 and a sleeve 12 clamped around it. The spindle 10 is integral with a member 11 hermetically sealed to the glass wall 1 of the tube. The member 11 preferably consists of ferrochrome and is connected to a connecting member 20. The anticathode has a sheath 13 formed of good conducting material, preferably of copper, which surrounds a cylinder 14 of metal of high permeability, such as soft iron.

The tube is surrounded by the stator 15 of the motor. The latter is secured to a housing 16 which mechanically and electrically connects the magnet system to the metal part 3 of the X-ray tube. The stator 15 carries magnet windings 17, which may be connected to a supply circuit of polyphase alternating current or, when means to establish a phase difference are provided, to an ordinary source of alternating current. Thus, the anticathode 8, as the rotor of an asynchro-

nous induction motor, will be given a rotary movement.

The metal cylinder 14 has secured to it a pair of apertured bearing-disks 21 and 22 which may consist of a copper-graphite alloy. These disks bear on the sleeve 12 which preferably consists of tungsten or molybdenum, or at least of a metal or an alloy which is harder and has a lower coefficient of expansion than the metals of the disks 21 and 22. The sliding surfaces of the member 12 extend beyond those of the disks 21 and 22. Thus the latter have an even wear and the harder material does not grind in them grooves which in course of time are injurious to the proper working. In the alloy of which the metals 21 and 22 consist, the graphite provides for lubrication which ensures a very light and noiseless running, even after long use.

It is, of course, obvious that the invention, once disclosed, has numerous applications in vacuum chamber practice, even where a space discharge does not occur. Accordingly, it is intended that the invention be limited only by the scope of the appended claims.

What we claim is:—

1. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said shaft, and rotatable thereabout, at least one bearing member on the said anode cooperating with the said shaft, the shaft having a surface formed of harder material than said member.

2. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said shaft, and rotatable thereabout, at least one bearing member on the said anode cooperating with the said shaft, the shaft having a surface formed of material of lower coefficient of expansion than the said member.

3. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, and at least one bearing member on the anode and cooperating with the said shaft, the shaft having a surface formed of harder material than the said member, and the bearing member being formed of an alloy containing a lubricating material.

4. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, and at least one bearing member on the anode and cooperating with the said shaft, the shaft having a surface formed of harder material than the said member, and the bearing member being formed of an alloy of copper and carbon.

5. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, and at least one bearing member on the anode and cooperating with the said shaft, the shaft having a surface formed of harder material than the said member, and the bearing member being formed of an alloy of copper and approximately 0.5 to 3% carbon.

6. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, and at least one bearing member on the anode and cooperating with the said shaft, the shaft having a surface formed of harder material than the said member, and the bearing member being formed of an alloy containing approximately 1% carbon.

7. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft, and rotatable thereabout, and at least one bearing member on the said anode and cooperating with the said shaft, the shaft having a surface formed of material harder than and having a lower coefficient of expansion than that from which the said bearing member is formed.

8. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft, and rotatable thereabout, and at least one bearing member on the said anode and cooperating with the said shaft, the shaft having a surface formed of material harder than and having a lower coefficient of expansion than that from which the said bearing member is formed, the said bearing member being formed of a self-lubricating alloy.

9. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said shaft and rotatable thereabout, and at least one bearing member on the anode cooperating with and bearing against the said shaft, the said shaft extending outwardly beyond the said bearing member and its surface being formed of harder material than the said member.

10. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft, and a plurality of bearing members on the said anode and cooperating with and bearing against the said shaft, the said shaft extending outwardly beyond the said bearing members and its surface being formed of harder material than the said members.

11. As part of a vacum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, at least one bearing member on the said anode and cooperating with and bearing against the said shaft, and an annular shoulder above the said shaft and bearing against and limiting the longitudinal movement of the bearing member and the anode secured thereto, the shaft having a surface formed of harder material than the said bearing member.

12. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, two bearing members secured to the said anode and cooperating with and bearing against the said shaft, two annular shoulders on the said shaft and adapted to substantially abut the inner faces of the said bearing members to limit the longitudinal movement thereof, the said shaft having a surface formed of harder material than the said bearing members, and the said bearing members being formed of a self-lubricating alloy.

13. As part of a vacuum tube, a stationary shaft, a hollow anode concentric with and encircling the said stationary shaft and rotatable thereabout, two bearing members secured to the said anode and cooperating with and bearing against the said shaft, two annular shoulders on the said shaft and adapted to substantially abut the inner faces of the said bearing members to limit the longitudinal movement thereof, the said shaft extending outwardly from and beyond the said bearing members, and having a surface formed of harder material than the said bearing members, and the said bearing members being formed of a self-lubricating alloy.

14. In a vacuum tube, a hollow anode formed of a layer of material of high heat conductivity

placed over a hollow core of magnetically permeable material, a target seated in the said anode, concentric, apertured disks fixed in the said anode, a stationary shaft about which the said disks are adapted to rotate adjacent the ends thereof, and shoulders on the said shaft limiting the position of the disks by abutment against their inner faces, the shaft having a surface formed of harder material than the said disks, and the shaft extending outwardly beyond each disk.

15. In a vacuum tube, a rotor member supported by a sliding bearing comprising a bushing which consists of an alloy of copper and graphite, secured to said member and surrounding a stationary member of lower coefficient of expansion and greater hardness than said bushing.

16. In a vacuum tube, a stationary shaft and a rotor member supported by means of a sliding bearing comprising a sliding bushing cooperating with said shaft, said bushing consisting of an alloy of copper and graphite, the carbon content being approximately 1%.

17. In a vacuum tube, a rotor member and a sliding bearing therefor comprising a bushing consisting of an alloy containing copper and graphite and bearing on a surface of metal having a hardness substantially equal to that of tungsten.

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