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(54) **Rotating-anode X-ray tube.**

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Description

The present invention relates to a rotating anode X-ray tube, and more specifically to a rotating anode X-ray tube in which a rotating shaft rotated together with its rotating anode is supported by a magnetic bearing.

In a rotating-anode X-ray tube of this type, thermions emitted from a cathode are caused to strike against the target surface of a rotating anode so that the energy of the thermions is discharged as X-rays. Thus, in such a rotating-anode X-ray tube, the substantial target surface area of the rotating anode struck by thermions can be made wider than that of a stationary anode of a stationary-anode tube, so that heat load applied to the rotating anode can be reduced. To maximize this advantage of the rotating-anode X-ray tube, therefore, the rotating anode should preferably be rotated as fast as possible.

However, in the rotating-anode X-ray tube in which a rotating shaft rotated together with the rotating anode is supported by a mechanical bearing of a contact type, the inside of the X-ray tube is kept at a vacuum, so that the mechanical bearing cannot be effectively supplied with lubricating oil. If the anode is rotated at a high speed, therefore, the amount of heat applied to the mechanical bearing will increase. Moreover, although the amount of heat on the rotating anode may be smaller than that applied to the stationary anode of the stationary-anode tube, the target surface of the rotating anode is heated to more than a thousand degrees centigrade during use. Thus, the mechanical bearing of the stationary-anode tube will be heated further due to the external factor of heat being conducted from the target surface of the rotating anode.

In order to avoid overheating which is intrinsic to mechanical bearings, a rotating-anode X-ray tube is proposed in which a magnetic bearing is used in place of the mechanical bearing, whereby the rotating shaft of the rotating anode is supported uncontacted. As is generally known, the magnetic bearing can support the rotating shaft uncontacted in its axial and radial directions, so that only a very small amount of heat is generated from the magnetic bearing during use. Therefore, the amount of heat applied to the magnetic bearing can be greatly reduced. As the magnetic bearing has many advantages in a vacuum, the rotating shaft can be rotated faster by a magnetic bearing than in the case where the rotating shaft is supported by the mechanical bearing.

Like the rotating-anode X-ray tube using the mechanical bearing, however' the rotating-anode X-ray tube using the magnetic bearing has inevitable drawbacks. For stable uncontacted supporting of the rotating shaft, the magnetic bearing is provided with position detectors for detecting the axial and radial displacement of the rotating shaft. Magnetic sensors are generally used as position detectors. Basically, the magnetic sensors electromagnetically detect the displacement of the rotating shaft, so that their outputs may greatly be influenced by X-rays or other electromagnetic waves. Also, samarium-cobalt or other rare-earth magnets used in the magnetic bearing will deteriorate if exposed to X-rays or other electromagnetic waves. Thus, when supporting the rotating shaft of the rotating-anode X-ray tube by means of a magnetic bearing using magnetic sensors and rare-earth magnets, X-rays emitted from the rotating anode will be scattered and applied to the magnetic sensors and rare-earth magnets. Accordingly, the outputs of the magnetic sensors will be adversely affected, and the rare-earth magnets will deteriorate in time. Thus, it is difficult to securely support the rotating shaft with stability, that is, to rotate the rotating anode stably.

A magnetic bearing supported, rotating anode, evacuated X-ray tube is disclosed in EP 71456 A1, the bearing including magnetic sensors and permanent magnets.

GB 1557338 discloses an X-ray rotating-anode magnetic tube in accordance with the pre-characterising part of claim 1.

The object of the present invention is to provide a rotating-anode X-ray tube capable of alleviating the bad influences of heat and electromagnetic waves from the rotating anode on the driving members for rotating the rotating anode, thereby ensuring stable rotation of the rotating anode.

According to the invention, there is provided a rotating-anode X-ray tube comprising a housing provided at one end side thereof with an X-ray radiating window for transmitting X-rays therethrough, a cathode disposed in the housing on one end side thereof, a rotating anode rotatably disposed close to the cathode in the housing and adapted to emit X-rays when struck by thermions radiated from the cathode. the X-rays from the rotating anode being radiated from the housing through the X-ray radiating window, and driving means disposed in the housing on the other end side thereof, whereby the rotating anode is rotated, the rotating anode being connected to one end of a shaft, a shielding wall arranged in the housing for dividing the inside space of the housing into a first chamber containing the cathode and the rotating anode and a second chamber containing the driving means, said shaft extending through a hole formed in the shielding wall characterized by further comprising at least two mechanical bearings arranged separately from each other and coaxially with the shaft for supporting the shaft in case of emergency, one of said at least two bearings being arranged in the hole of the shielding wall for closing the same, whereby the first chamber is thermally shielded by the shielding wall and said one of the bearings.

In the described embodiments of the present invention, heat radiated from the rotating anode may be intercepted by the shielding means, preventing the driving means from being heated by the heat from the rotating anode, that is, the amount of heat from the driving means can greatly be reduced.

If the driving means is provided with a magnetic bearing to support the rotating shaft of the rotating anode, the shielding means can also intercept X-rays from the rotating anode which are to be applied to the magnetic sensors and rare-earth magnets of the magnetic bearing. Thus, the magnetic bearing can stably support the rotating shaft, i.e., the rotating anode.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig, 1 a sectional view of a rotating-anode X-ray tube which is not an embodiment of the invention;

Fig. 2 is a sectional view taken along line II-II of Fig. 1 and

Fig. 3 is a partial sectional view of a rotating-anode X-ray tube according to an embodiment of the invention.

Referring now to Figs. 1 and 2there is shown a rotating-anode X-ray tube with a shielding wall of the type according to the prior art and which tube is not an embodiment of the invention. The rotating-anode X-ray tube is provided with a hollow cylindrical vacuum housing 10. The vacuum housing 10 comprises first and second metallic shells 12 and 14 each opening at one end. The first and second shells 12 and 14 are airtightly coupled by means of a plurality of connecting screws 20 so that flange portions 16 and 18 formed on the respective open ends of the first and second shells 12 and 14 are joined together. An exhaust tube (not shown in Fig. 1) is connected to the vacuum housing 10. The exhaust tube is connected to, e.g., a vacuum pump, and is sealed after the vacuum housing 10 is evacuated to a predetermined degree of vacuum. In this first embodiment, the vacuum housing 10 is made of metal. Alternatively, however, it may be formed of glass.

Inside the first shell 12 of the vacuum housing 10, a cathode 22 having a tungsten coil filament and focusing electrodes (not shown) is disposed close to the peripheral wall of the first shell 12. The cathode 22 is electrically connected to and supported by a stem 24. The stem 24 first extends inward from the cathode 22 in the radial direction of the first shell 12, and is then bent to extend along the axis of the first shell 12. The upper end of the stem 24 penetrates the closed end wall of the first shell 12 in an airtight manner to extend to the outside.

Inside the first shell 12, moreover, a rotating anode 26 in the form of a flat, circular truncated cone is disposed coaxially with the first shell 12 facing the cathode 22. The rotating anode 26 is formed of tungsten, and the tapered peripheral surface of the rotating anode 26 defines what is called the target surface 28 which is struck by thermions emitted from the cathode 22. The angle between the target surface 28 of the rotating anode 26 and the axis of the first shell 12 is set so that X-rays produced when the thermions from the cathode strike against the target surface 28 are radiated through a glass X-ray window 30 which is attached to the peripheral wall of the first shell 12.

The rotating anode 26 is connected to a supporting shaft 32 made of, e.g., molybdenum. The supporting shaft 32, which is coaxial with the first shell 12 or the vacuum housing 10, extends into the second shell 14 through an opening in a shielding wall 34 which divides the inside space of the vacuum housing 10 in two.

The shielding wall 34 is fitted in an annular groove 36 which is defined by a pair of step portions formed along the joined inner peripheries of the respective open ends of the first and second housing shells 12 and 14. Thus, when the first and second shells 12 and 14 are coupled together in the aforesaid manner, the shielding wall 34 is fixed between the first and second shells 12 and 14. The shielding wall 34 is formed of a highly conductive material with a high thermal reflection factor. For example, the shielding wall 34 may be formed by a coating plate made of tungsten, molybdenum or another conductive material with a high thermal-reflection material. The shielding wall 34 is grounded through the vacuum housing 10. Thus, the respective insides of the first and second shells 12 and 14 are thermally and electromagnetically shielded from each other.

The shaft 32 of the rotating anode 26 extending into the second shell 14 is coupled to a rotating cylinder 40 of a rotating mechanism 38.

The second shell 14 will now be briefly described. A hollow intermediate cylinder portion 14b coaxial with an outer peripheral wall 14a of the second shell 14 protrudes from the closed end wall of the second shell 14 toward the first shell 12. Also, a hollow inner cylinder portion 14c coaxial with the intermediate cylinder portion 14b protrudes inward from the end wall of the intermediate cylinder portion 14b near the first shell 12. Thus, the second shell 14 has a triple-wall structure, as shown in Fig, 1.

The rotating cylinder 40 is in the form of a hollow cylinder opened at one end, and is contained in an annular space defined between the outer peripheral wall 14a and the intermediate cylinder portion 14b of the second shell 14, allowing a radial clearance in the space, The shaft 32 of the rotating anode 26 is supported on the end wall of the rotating cylinder 40 beside the shielding wall 34 by means of an electric insulating member 42, axially extending in the inner cylinder portion 14c. Here it is to be noted that mechanical bearings 44 of a contact type are arranged at an axial interval on the inner peripheral surface of the inner cylinder portion 14c. The bearings 44, which are not in contact with the supporting shaft 32 in the normal operating state, serve to support the supporting shaft 32 in case of an emergency.

A contact pin 90 protrudes downward from the lower end (Fig. 1) of the supporting shaft 32. A contact plate 92 which cooperates with the contact pin 90 is disposed inside the inner cylinder portion 14c, axially spaced from the contact pin

90. The contact plate 92 is electrically connected to a conductive rod 94 which penetrates the bottom wall of the inner cylinder portion 14c in an airtight manner, The conductive rod 94 and the stem 24 of the cathode 22 are electrically connected to a power source for applying a predetermined voltage between the rotating anode 26 and the cathode 22.

The second shell 14 is covered by an outer housing portion 50 of the rotating mechanism 38 with an annular gap between them. A stator 54 of an induction motor 52 is attached to the inside of the peripheral wall of the outer housing portion 50. The armature coil of the stator 54 is electrically connected to a power source (not shown) to drive a motor. A rotor 56 of the motor 52 is fixed to the outer peripheral surface of the rotating cylinder 40 so as to face the stator 54.

The rotating cylinder 40, which is contained in the annular space between the outer peripheral wall 14a and the intermediate cylinder portion 14b of the second shell 14 with the radial clearance, as stated before, is supported in the radial direction by a magnetic bearing 60 so that it is neither in contact with the outer peripheral wall 14a of the second shell 14 nor with the outer peripheral surface of the intermediate cylinder portion 14b. The rotating cylinder 40 is supported uncontacted also in the axial direction.

The magnetic bearing 60 is provided with a yoke 62 which is fitted in a space defined between the inner peripheral surface of the intermediate cylinder portion 14b and the outer peripheral surface of the inner cylinder portion 14c. The yoke 62 is made of, e.g., a magnetic material, and, generally, is in the form of a hollow cylinder which is formed by joining rings with an inside diameter equal to the outside diameter of the inner cylinder portion 14c. Four magnetic poles 64a, 64b, 64c and 64d, and 66a, 66b, 66c and 66d protrude radially outward from each of the upper and lower end portions (Fig. 1) of the yoke 62, respectively. Fig. 2 shows the magnetic poles 64a to 64d at the upper end of the yoke 62. Since the magnetic poles at the upper and lower ends of the yoke 62 have the same construction, only the upper magnetic poles 64a to 64d will be described in detail. The magnetic poles 64a to 64d are arranged at rectangular intervals along the circumference. The outside diameter measured between the peripheral surfaces of the two opposite magnetic poles 64a and 64c or between those of the other two magnetic poles 64b and 64d is equal to the inside diameter of the intermediate cylinder 14b. Conductive coils 80 are individually wound around the magnetic poles 64a to 64d.

A radially projecting ring-shaped magnetic pole 68 is formed on the central portion of the yoke 62 between the magnetic poles 64 and 66 at the upper and lower ends, The outside diameter of the magnetic pole 68 is equal to the inside diameter of the intermediate cylinder portion 14b. A pair of ring-shaped conductive coils 70a and 70b is wound around the outer peripheral surface of the yoke 62 so as to hold the magnetic pole 68 between the two coils 70a and 70b along the axial direction of the yoke 62. The conductive coils 80, 70a and 70b are electrically connected to a power source (not shown).

Ring-shaped permanent magnets 72 and 74 are fixed on the yoke 62 located between the magnetic poles 64 and 68, and between the magnetic poles 68 and 66, respectively. The permanent magnets 72 and 74 are magnetized in the radial direction. Annular grooves are formed in the inner peripheral surface of the intermediate cylinder portion 14b, corresponding to the regions between the magnetic poles 64 and the conductive coil 70a, and between the conductive coil 70b and the magnetic poles 66, individually. Laminated magnetic rings 76 and 78 with high permeability are fixedly fitted in the annular grooves, individually.

A plurality of displacement sensors 82 for detecting the radial displacement of the rotating cylinder 40 is fixed to the inside of the peripheral wall of the outer housing portion 50, facing the magnetic poles 64a to 64d and 66a to 66d. For example, magnetic sensors are used for the displacement sensors 82 which convert the radial displacement of the rotating cylinder 40 into a quantity of electricity. Also, a plurality of magnetic sensors 84 similar to the sensors 82 and adapted to detect the axial displacement of the rotating cylinder 40 is fixed to the lower portion (Fig. 1) of the inner peripheral surface of the outer housing portion 50. The output ends of the magnetic sensors 82 and 84 are electrically connected to a stabilization control circuit (not shown) which controls the values of currents supplied to the conductive coils 80, 70a and 70b. The stabilization control circuit naturally includes the power source for the conductive coils 80, 70a and 70b.

According to the magnetic bearing 60 described above, magnetic fluxes delivered from the one permanent magnet 72 form a magnetic circuit M1 which corresponds to a loop connecting the permanent magnet 72, the magnetic ring 76, the magnetic poles 64, and the yoke 62; and a magnetic circuit M2 which corresponds to a loop connecting the permanent magnet 72, the magnetic ring 76, the magnetic pole 68, and the yoke 62, Likewise, magnetic fluxes delivered from the other permanent magnet 74 form a magnetic circuit M3 which corresponds to a loop connecting the permanent magnet 74, the magnetic ring 78, the magnetic pole 68, and the yoke 62; and a magnetic circuit M4 which corresponds to a loop connecting the permanent magnet 74, the magnetic ring 78, the magnetic poles 66, and the yoke 62. In Fig. 1, magnetic circuits M1 to M4 are shown by broken lines, respectively. Please note that they are shown only on the right side in the figure for convenience's sake. Thus, the rotating cylinder 40 is supported uncontacted in both radial and axial directions by the magnetic forces of the magnetic circuits Ml to M4 of the magnetic bearing 60 controlled by adjusting the current supplied to the conductive coils 80, 70a and 70b, If the stator 54 of the motor 52 is energized in this state, the rotor 56 of the motor 52 or the rotating cylinder 40 is rotated uncontacted in the radial and axial directions.

If the radial position of the rotating cylinder 40 is shifted, that is, if the axis of the rotating cylinder 40 is deviated from that of the vacuum housing 10 by any external force or other factor while the rotating cylinder 40 is being rotated in the uncontacted state, the magnetic sensors 82 can detect the radial displacement of the rotating cylinder 40. Thus, the radial deviation of the rotating cylinder 40 can be corrected to align the axis of the rotating cylinder 40 with that of the vacuum housing 10 by controlling the amount of current flowing through the conductive coils 80 on the magnetic poles 64 and 66 to properly vary the magnetic forces of the magnetic circuits M1 and M4 of the magnetic bearing 60 by means of the stabilization control circuit in accordance with output signals from the magnetic sensors 82. In consequence, the rotating cylinder 40 can stably be supported uncontacted in the radial direction.

While the rotating cylinder 40 is being rotated while it is stably supported in the radial direction, it can be moved downward (Fig. 1) by the force of attraction by controlling the current supplied to the conductive coils 70a and 70b of the magnetic bearing 60 which in turn varies the magnetic forces from the magnetic circuits M2 and M3, that is, by increasing the magnetic force of the magnetic circuit M3. As a result, the supporting shaft 32 of the rotating anode 26 supported by the rotating cylinder 40 is also moved downward, so that the contact pin 90 of the supporting shaft 32 abuts against the contact plate 92 to be electrically connected therewith. Accordingly, a predetermined electric potential difference is caused between the cathode 22 and the rotating anode 26, so that thermions emitted from the filament of the cathode 22 are accelerated to strike against the target surface 28 of the rotating anode 26. As a consequence, X-rays produced by the collision of the thermions are radiated from the target surface 28 of the rotating anode 26 toward the X-ray window 30 of the first shell 12, and are discharged to the outside through the X-ray window 30.

The magnetic sensors 84 can detect the axial displacement of the rotating cylinder 40 from the position where the contact pin 90 and the contact plate 92 are electrically connected. The axial displacement or deviation can be corrected by suitably controlling the current supplied to the conductive coils 70a and 70b in accordance with the output signals from the magnetic sensors 84, Thus, the electrical connection between the contact pin 90 and the contact plate 92 is prevented from being unexpectedly cut off. Also, the contact pin 90 is prevented from being unduly pressed against the contact plate 92 with excessive force, Here it is to be noted that the connection or disconnection between the contact pin 90 and the contact plate 92 is controlled by controlling the current supply to the conductive coils 70a and 70b.

In the X-ray tube as described above, the support of the rotating cylinder 40 by the magnetic bearing 60 will never be adversely affected by heat or X-rays radiated from the rotating anode 26. Part of the X-rays emitted from the target surface 28 of the rotating anode 26 are normally scattered within the first shell 12 without being radiated through the X-ray window 30. However, since the first and second shell 12 and 14 are divided by the conductive shielding wall 34, the scattered X-rays moving from the first shell 12 into the second shell 14 can effectively be absorbed by the shielding wall 34, Accordingly, the magnetic sensors 82 and 84 of the magnetic bearing 60 will never be exposed to X-rays, and so their outputs are protected against the adverse effects of X-rays. Thus, the rotating cylinder 40 can stably be supported in the radial and axial directions by the magnetic bearing 60.

Since the shielding wall 34 is coated with a material with a high thermal reflection factor, the heat radiated from the rotating anode 26 is intercepted by the shielding wall 34, In other words, the shielding wall 34 can restrain the magnetic bearing 60 in the second shell 14 from being heated by the heat radiated from the rotating anode 26, so that the increase of the temperature of the magnetic bearing 60 can be minimized to reduce the heat load on the magnetic bearing 60.

Referring now to Fig. 3 there is shown an embodiment of the invention. In the embodiment shown in Fig, 3, one of the mechanical bearings 44 is attached to the shielding wall 34. By doing this, the axial dimension or length of the supporting shaft 32 can be shortened without changing the axial distance between the two mechanical bearings 44, In other words, the supporting shaft 32 can more securely be supported in an emergency, and besides, the inner cylinder portion 14c can be axially shortened due to the reduction in size of the supporting shaft 32. Thus, the inner cylinder portion 14c places no restrictions on the inside diameter of the yoke 62. If the area of the yoke 62 which allows magnetic fluxes of the magnetic circuits is regarded as fixed, the inside and outside diameters of the yoke 62, and hence the diameter of the whole X-ray tube, can be made smaller than those of the yoke shown in Fig. 1.

In the embodiment described above, the shielding wall 34 has both thermal and electromagnetic screening functions If a mechanical bearing is used in place of the magnetic bearing 60, however, the shielding wall 34 need have only the thermal shielding function.

Claims

1. A rotating-anode X-ray tube comprising a housing (10) provided at one end side thereof with an X-ray radiating window (30) for transmitting X-rays therethrough, a cathode (22) disposed in the housing on one end side thereof, a rotating anode (26) rotatably disposed close to the cathode (22) in the housing (10) and adapted to emit X-rays when struck by thermions radiated

from the cathode (22), the X-rays from the rotating anode (26) being radiated from the housing through the X-ray radiating window, and driving means disposed in the housing on the other end side thereof whereby the rotating anode is rotated, the rotating anode (26) being connected to one end of a shaft (32), a shielding wall (34) arranged in the housing for dividing the inside space of the housing into a first chamber containing the cathode and the rotating anode and a second chamber containing the driving means, said shaft (320) extending through a hole formed in the shielding wall (34), characterised by further comprising at least two mechanical bearings (44) arranged separately from each other and coaxially with the shaft (32), for supporting the shaft (32) in case of emergency, one of said at least two bearings (44) being arranged in the hole of the shielding wall (34) for closing the same, whereby the first chamber is thermally shielded by the shielding wall (34) and said one of the bearings (44).

2. A rotating anode X-ray tube as claimed in claim 1 wherein the first chamber is electromagnetically shielded from the second chamber by the shielding means.

3. A rotating-anode X-ray tube according to claim 1 or claim 2. characterised in that the driving means includes a rotating shaft (40) supporting the rotating anode, an electric motor (52) unit for rotating the rotating shaft, and a magnetic bearing (60) for supporting the rotating shaft uncontacted in the radial and axial directions thereof.

4. A rotating-anode X-ray tube according to claim 3, characterised in that the shielding wall (34) is formed of a material such that heat radiated from the rotating anode is prevented from being transmitted to the interior of the second chamber by thermal absorption and conduction by the material.

5. A rotating-anode X-ray tube according to claim 3 or claim 4, characterised in that the shielding wall (34) has a surface formed so that heat radiated from the rotating anode is prevented from being transmitted to the interior of the second chamber by heat reflection from such surface.

6. A rotating-anode X-ray tube according to claim characterised in that the surface of the shielding wall on the first chamber side is covered with a material whereby said heat radiated from the rotating anode is prevented from being transmitted to the interior of the second chamber by heat reflection from said material.

7. A rotating-anode X-ray tube according to claim 4, characterised in that the shielding wall (34) is electrically conductive.

8. A rotating-anode X-ray tube according to claim 4, characterised in that the shielding wall (34) is formed by coating at least that surface of a plate made of an electrically conductive material which faces the first chamber with a material such that heat radiated from the rotating anode is prevented from being submitted to the interior of the second chamber by heat reflection from said material.

Patentansprüche

1. Drehanoden-Röntgenröhre mit einem Gehäuse (10), das an seiner einen Seite mit einem Röntgenstrahlung-Abstrahlfenster (30) zum Durchlassen von Röntgenstrahlung versehen ist, einer im Gehäuse an der Seite seines einen Endes vorgesehenen Kathode (22), einer im Gehäuse (10) dicht neben der Kathode (22) drehbar angeordneten Drehanode (26), die bei Beaufschlagung mit von der Kathode (22) abgestrahlten Thermionen Röntgenstrahlung zu emittieren vermag, wobei die Röntgenstrahlung von der Drehanode (26) über das Röntgenstrahlung-Abstrahlfenster aus dem Gehäuse abgestrahlt wird, und einer im Gehäuse an der Seite seines anderen Endes angeordneten Antriebseinheit, durch welche die Drehanode drehbar ist, wobei die Drehanode (26) mit dem einen Ende einer Welle (32) verbunden ist, im Gehäuse eine Abschirmwand (34) zur Unterteilung des Innenraums des Gehäuses in eine erste, die Kathode und die Drehanode enthaltende Kammer und eine die Antriebseinheit enthaltende zweite Kammer angeordnet ist, (und) die Welle (320) eine Bohrung in der Abschirmwand (34) durchsetzt, gekennzeichnet durch mindestens zwei getrennt voneinander und koaxial zur Welle (32) angeordnete mechanische Lager (44) für die Lagerung der Welle (32) in einem Notfall, wobei das eine der mindestens zwei Lager (44) in der Bohrung der Abschirmwand (34) angeordnet ist und diese verschließt, so daß die erste Kammer durch die Abschirmwand (34) und das eine der Lager (44) thermisch abgeschirmt ist.

2. Drehanoden-Röntgenröhre nach Anspruch 1, dadurch gekennzeichnet, daß die erste Kammer durch die Abschirmeinrichtung gegenüber der zweiten Kammer elektromagnetisch abgeschirmt ist.

3. Drehanoden-Röntgenröhre nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Antriebseinheit eine die Drehanode tragende Dreh-Welle (40), einen Elektromotor (52) zum Drehen der Dreh-Welle und ein Magnetlager (60) zur kontaktfreien Lagerung der Dreh-Welle in Radial- und Axialrichtung derselben aufweist.

4. Drehanoden-Röntgenröhre nach Anspruch 3, dadurch gekennzeichnet, daß die Abschirmwand (34) aus einem solchen Werkstoff geformt ist, daß die von der Drehanode abgestrahlte Wärme durch Wärmeabsorption und -ableitung durch diesen Werkstoff an einer Ubertragung zum Inneren der zweiten Kammer gehindert wird.

5. Drehanoden-Röntgenröhre nach Anspruch 3 oder 4, dadurch gekennzeichnet, daß die Abschirmwand (34) eine Fläche aufweist, die so geformt ist, daß die von der Drehanode abgestrahlte Wärme durch Wärmereflexion von dieser Fläche an einer Übertragung zum Inneren der zweiten Kammer gehindert wird.

6. Drehanoden-Röntgenröhre nach Anspruch 5, dadurch gekennzeichnet, daß die Fläche der

Abschirmwand an der Seite der ersten Kammer mit einem solchen Werkstoff überzogen ist, daß eine Übertragung der von der Drehanode abgestrahlten Wärme zum Inneren der zweiten Kammer durch Wärmereflexion von diesem Werkstoff verhindert wird.

7. Drehanoden-Röntgenröhre nach Anspruch 4, dadurch gekennzeichnet, daß die Abschirmwand (34) elektrisch leitfähig ist.

8. Drehanoden-Röntgenröhre nach Anspruch 4, dadurch gekennzeichnet, daß die Abschirmwand (34) durch Beschichten zumindest der der ersten Kammer zugewandten Fläche einer aus einem elektrisch leitfähigen Werkstoff hergestellten Platte mit einem solchen Werkstoff gebildet ist, daß eine Übertragung der von der Drehanode abgestrahlten Wärme zum Inneren der zweiten Kammer durch Wärmereflexion von diesem Werkstoff verhindert wird.

Revendications

1. Tube radiographique à anode rotative comprenant un boîtier (10) muni, du côté d'une première extrémité, d'une fenêtre radiographique (30) destinée à émettre des rayons X, une cathode (22) disposée dans le boîtier du côté d'une première extrémité de celui-ci, une anode rotative (26) disposée près de la cathode (22) afin qu'elle puisse tourner dans le boîtier (10) et destinée à émettre des rayons X lorsqu'elle est frappée par des thermions émis par la cathode (22), les rayons X provenant de l'anode rotative (26) étant émis par le boîtier par l'intermédiaire de la fenêtre radiographique, et un dispositif d'entraînement placé dans le boîtier du côté de son autre extrémité, si bien que l'anode rotative est entraînée en rotation, l'anode rotative (26) étant connectée à une première extrémité d'un arbre (32), une paroi protectrice (34) disposée dans le boîtier et destinée à séparer l'espace interne du boîtier en une première chambre contenant la cathode et l'anode rotative et une seconde chambre contenant le dispositif d'entraînement, l'arbre (32) passant par un trou formé dans la paroi protectrice (34), caractérisé en ce qu'il comprend en outre au moins deux paliers mécaniques (44) disposés séparément l'un de l'autre et coaxialement à l'arbre (32) de manière qu'ils supportent l'arbre (32) en cas d'urgence, l'un des deux paliers au moins (44) étant disposé dans le trou de la paroi protectrice (34) afin qu'il ferme celui-ci, si bien que la première chambre est protégée thermiquement par la paroi protectrice (34) et le premier palier (44).

2. Tube radiographique à anode rotative selon la revendication 1, dans lequel la première chambre est protégée électromagnétiquement par rapport à la seconde chambre par le dispositif protecteur.

3. Tube radiographique à anode rotative selon la revendication 1 ou 2, caractérisé en ce que le dispositif d'entraînement comporte un arbre rotatif (40) supportant l'anode rotative, un ensemble à moteur électrique (52) destiné à faire tourner l'arbre rotatif, et un palier magnétique (60) destiné à supporter l'arbre rotatif afin qu'il ne présente pas de contact dans les directions radiales et axiales.

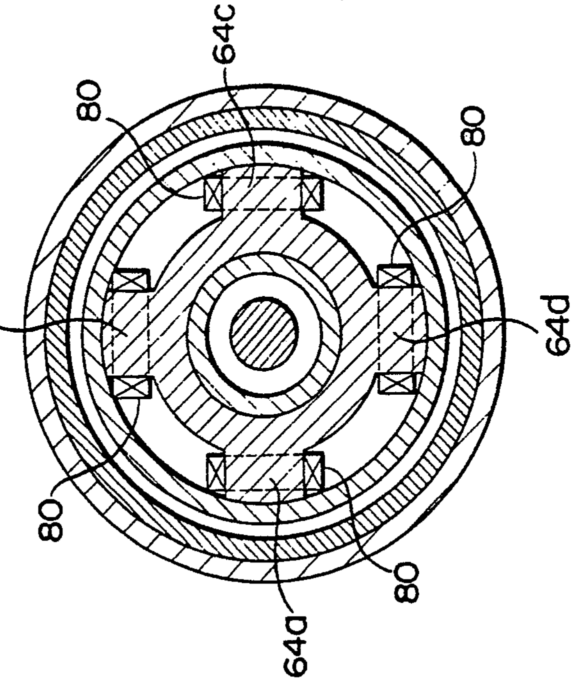
4. Tube radiographique à anode rotative selon la revendication 3, caractérisé en ce que la paroi protectrice (34) est formée d'un matériau tel que la chaleur émise par l'anode rotative ne peut pas être transmise à l'intérieur de la seconde chambre par absorption thermique et conduction de la chaleur par le matériau.

5. Tube radiographique à anode rotative selon la revendication 3 ou 4, caractérisé en ce que la paroi protectrice (34) a une surface formée de manière que la chaleur émise par l'anode rotative ne puisse pas être transmise à l'intérieur de la seconde chambre par réflexion thermique par cette surface.

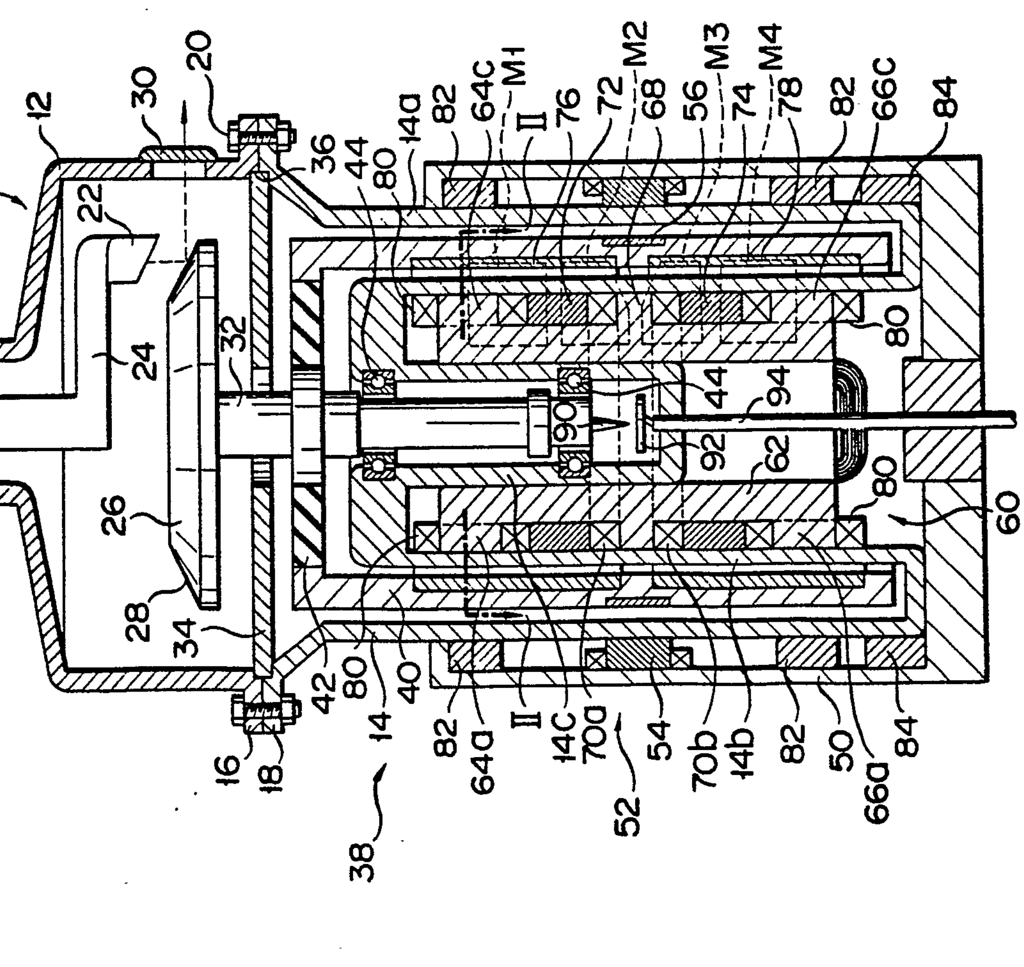
6. Tube radiographique à anode rotative selon les revendications 3 à 5, caractérisé en ce que la surface de la paroi protectrice du côté de la première chambre est couverte d'un matériau tel que la chaleur émise par l'anode rotative ne peut pas être transmise vers l'intérieur de la seconde chambre, par réflexion de la chaleur par ledit matériau.

7. Tube radiographique à anode rotative selon la revendication 4, caractérisé en ce que la paroi protectrice (34) est conductrice de l'électricité.

8. Tube radiographique à anode rotative selon la revendication 4, caractérisé en ce que la paroi protectrice (34) est formée par revêtement au moins de la surface d'une plaque formée d'un matériau conducteur de l'électricité qui est tournée vers la première chambre, avec un matériau tel que la chaleur émise par l'anode rotative ne peut pas être transmise à l'intérieur de la seconde chambre par réflexion de la chaleur par ledit matériau.


64c
80
80
64b
64d
80
80
80
64a

F I G. 2


10
12
30
20
22
24
26
28
32
34
36
16
18
42
80
44
14a
82
64c
M1
II
76
72
M2
68
56
M3
74
M4
78
82
66c
84
80
44
94
90
92
62
80
60
40
14
14c
70a
54
70b
14b
50
66a
64a
52
38

F I G. 1

FIG. 3