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BRAKE FOR ROTARY ANODE X-RAY TUBES

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Fig. 1.

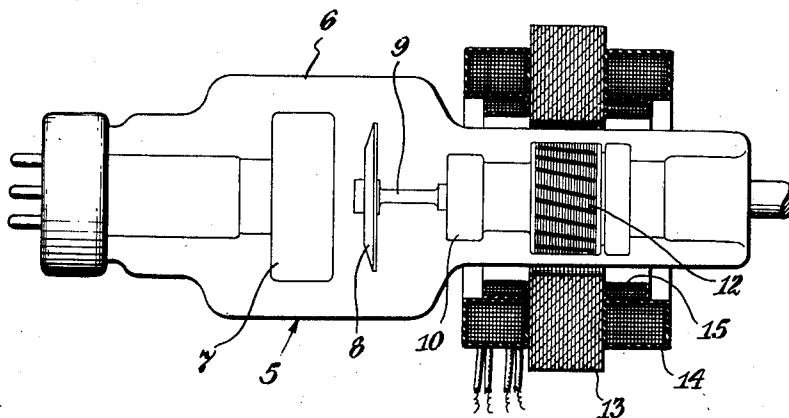
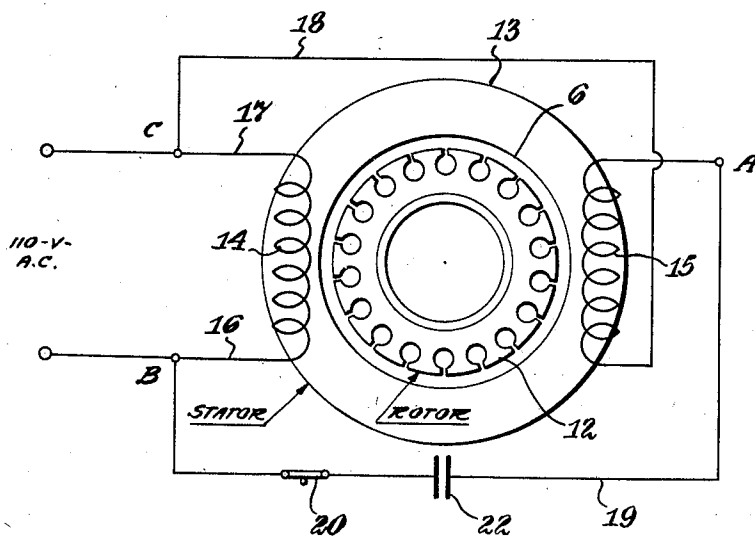


Fig. 2.



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BRAKE FOR ROTARY ANODE X-RAY TUBES

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3 Claims. (Cl. 250-148)

The present invention relates to X-ray tubes and particularly to such tubes of the rotary anode type.

X-ray tubes employing rotary anodes are now well known in the art and are extensively used by the roentgenologist. Inasmuch as the anode is subjected to a relatively high temperature during operation and is disposed in a vacuum, one of the greatest problems in connection with rotary anode X-ray tubes has been that of proper and adequate lubrication of the bearings since such lubricant must not only be capable of reducing friction, but also not deteriorate under evacuated and high temperature conditions.

In U. S. Patent No. 2,280,886, issued April 28, 1942, to P. H. Brace, and assigned to the same assignee as the present invention, a very efficient lubricant for use in a rotary anode X-ray tube is shown and claimed which meets the above noted requirements. At the same time, due to the efficiency of such lubricant, the coasting time of rotation of the anode is greatly increased, resulting in continued rotation of the anode for as long as several minutes after de-energization of the X-ray tube with unnecessary wear on the bearings.

In order to avoid such unnecessary bearing wear it is highly desirable that a brake be employed to stop rotation of the anode and since, as above noted, it functions under vacuum conditions, the most practical type of brake is a magnetic one. It has been suggested in the prior art to stop rotation of the anode by reversing the connections of one of the stator windings, which thus applies a torque tending to reverse the rotor; and after a predetermined interval of time, the current is cut off to prevent actual reverse rotation of the rotor.

A further type of brake consists in disconnecting the stator windings from the alternating current source and immediately applying a direct current to one or both of the stator windings. This creates eddy currents in the rotor which dissipates its energy of rotation bringing it to a stop. Both of these arrangements possess the disadvantage of requiring relatively expensive equipment with the first arrangement necessitating very accurate time adjustment to prevent actual reversal of rotation, while the last-mentioned arrangement requires rectifying equipment of considerable size to provide the direct current.

It is accordingly an object of the present invention to provide a brake for the rotary anode of an X-ray tube which will stop rotation of the

anode within a few seconds following de-energization of the tube and which is of simple and inexpensive construction.

Another object of the present invention is the provision of an exceptionally economical electrical brake for the rotary anode of an X-ray tube which will stop rotation of the anode within a few seconds following de-energization of the X-ray tube.

Another object of the present invention is the provision of an electrical brake which requires a minimum of parts and which automatically operates in response to initiation by an operator to eliminate unnecessary coasting of the rotary anode of an X-ray tube by stopping rotation thereof within a very few seconds following de-energization of the tube.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawing wherein:

Figure 1 is a view partly in section of a rotary anode X-ray tube constructed in accordance with the present invention, and

Figure 2 is a schematic diagram of the electrical arrangement of the various parts which operate to rotate the anode and to brake the same upon de-energization of the X-ray tube.

Referring now to the drawing in detail, an X-ray tube 5 is shown in Fig. 1 which comprises an evacuated envelope 6 provided with the usual filamentary cathode (not shown), and disposed within the customary focusing cup 7. Opposite this focusing cup is an anode 8 formed of a suitable refractory metal such as tungsten and which is bombarded by the electrons from the cathode to produce X-rays. As shown in Fig. 1, this anode is of disc-shape and is secured to a shaft 9 extending from a cylindrical member 10, the latter of which is provided with suitable bearings internally thereof and lubricated by a lubricant, such, for example, as that shown in the above noted patent.

Since the details of the bearing construction as well as the general construction of the anode form no part of the present invention, it is believed unnecessary that the same be herein set forth, but reference may be had to the aforesaid patent for such details. Suffice it to say that the cylindrical member 10 is provided with a rotor 12 which may be formed in the customary manner with alternate laminations of copper and iron. A magnetic iron core 13 surrounds the X-ray tube envelope 6 adjacent the rotor 12 and a pair of stator windings 14 and 15 are likewise wound about the

envelope 6 adjacent the iron core 13 to thus complete an alternating current motor for rotating the anode 8.

As can be more readily seen from Fig. 2, the windings 14 and 15 receive electrical energy from the customary alternating current source of 110-220 volts, the winding 14 being connected thereto by conductors 16 and 17 extending to terminals B and C. The other stator winding 15 is oppositely connected to the source of supply through terminal A and conductors 18 and 19 likewise extending to the terminals B and C and a suitable switch 20 and condenser 22 is interposed in the conductor 19. The condenser 22 operates in the customary manner to shift the phase relation between the two stator windings 14 and 15 while the switch 20 operates to brake rotation of the rotor.

Upon de-energization of the X-ray tube 5 following a radiographic exposure or a fluoroscopic examination, and while an alternating current from the customary domestic source is still applied to the stator windings 14 and 15, the switch 20 is opened by the operator. This disconnects the stator windings 15 from the supply source while the winding 14 remains energized which apparently induces eddy currents in the rotor 12. In any event and whatever the actual cause, the rotor is brought to a negligible speed of approximately 100 R. P. M. in about five seconds and to a complete stop in approximately ten seconds. The stator winding 14 is then disconnected from the domestic source of alternating current supply (by a suitable switch not shown) and the switch 20 closed preparatory to again energizing the X-ray tube for an exposure or another fluoroscopic examination.

It thus becomes obvious to those skilled in the art that an electrical brake for a rotary anode X-ray tube is herein provided which is exceptionally simple and efficient in operation and exceedingly economical in construction. Due to the fact that it will bring rotation of the anode to a complete stop in approximately ten seconds, it is particularly adaptable to rotary anode X-ray tubes employing highly efficient bearing lubricants since it eliminates coasting with unnecessary bearing wear.

Although one specific embodiment of the present invention has been shown and described, it is to be understood that still further modifications thereof may be made without departing from the spirit and scope of the appended claims.

I claim:

1. An X-ray tube comprising a sealed envelope provided with a cathode and a rotary anode including a rotor body journaled upon bearings in said envelope to revolve at high speed, a pair of stator windings surrounding said envelope adjacent said rotor body and energizable from a source of alternating current of the customary domestic potential for rotating said anode, and means for interrupting the supply of energy to one of said stator windings while the other stator winding remains energized to brake rotation of said anode and bring the same to a complete stop in a few seconds to eliminate coasting and unnecessary wear on the rotary anode bearings.

2. An X-ray tube comprising a sealed envelope provided with a cathode and a rotary anode including a rotor body journaled upon bearings in said envelope to revolve at high speed, a pair of stator windings and an iron core surrounding said envelope adjacent said rotor body and energizable from a source of alternating current of the customary domestic potential for rotating said anode, a condenser in series with one of said stator windings and said source for shifting the phase relation between said windings, and means operable to interrupt the supply of energy to one of said stator windings while the other stator winding remains energized to brake rotation of said anode and bring the same to a complete stop in a few seconds to eliminate coasting and unnecessary wear on the rotary anode bearings.

3. An X-ray tube comprising a sealed envelope provided with a cathode and a rotary anode including a rotor body journaled upon bearings in said envelope to revolve at high speed, a pair of stator windings and an iron core surrounding said envelope adjacent said rotor body and energizable from a source of alternating current of the customary domestic potential for rotating said anode, a condenser in series with one of said stator windings and said source for shifting the phase relation between said windings, and a switch connecting said condenser and one end of one of said windings to one side of said source and operable to interrupt the supply of energy to said last-mentioned stator winding while the other stator winding remains energized to brake rotation of said anode and bring the same to a complete stop in a few seconds to eliminate coasting and unnecessary wear on the rotary anode bearings.

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