United States Patent

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[54] **A COOLING GASKET FOR OIL FILLED X-RAY TUBES**
2 Claims, 2 Drawing Figs.

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313/17; 250/90; 287/189, 287/365
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[50] **Field of Search** 313/17, 36,
26, 55; 250/87, 88, 89, 90; 287/189.365

[56] **References Cited**

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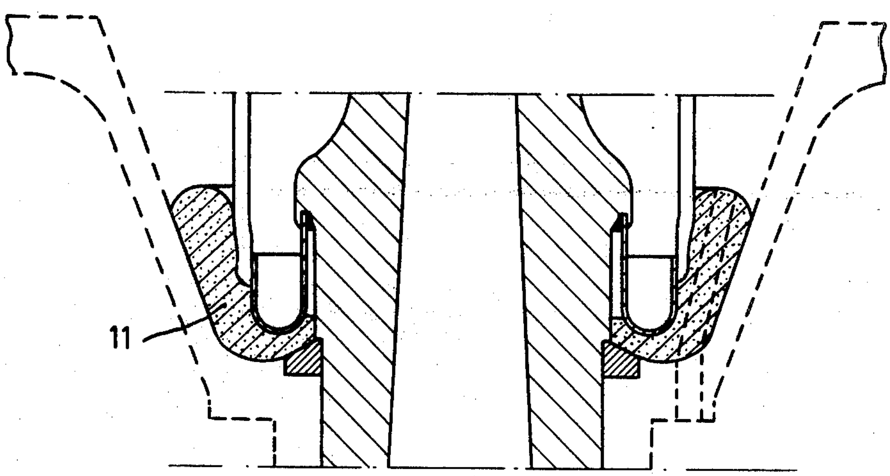
ABSTRACT: An X-ray tube in an oil-filled envelope has a stationary anode projecting beyond a glass envelope and is connected to the glass envelope by a metal alloy ring having a coefficient of expansion matching that of the glass. In order to prevent heat conduction between the metal ring and the oil filling, the ring is surrounded by a narrowly fitting foam layer covering the metal ring and glass envelope.



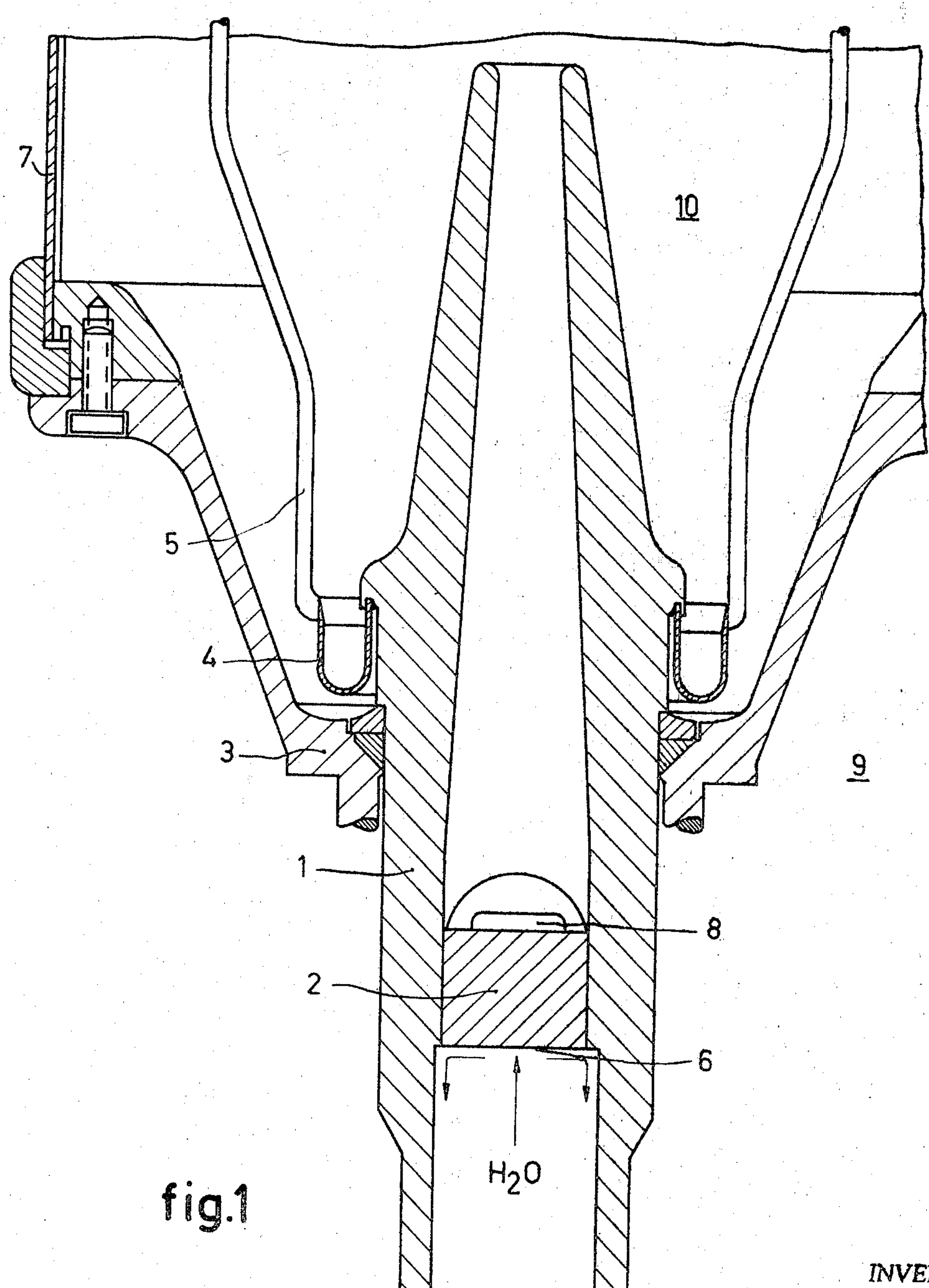


fig.1

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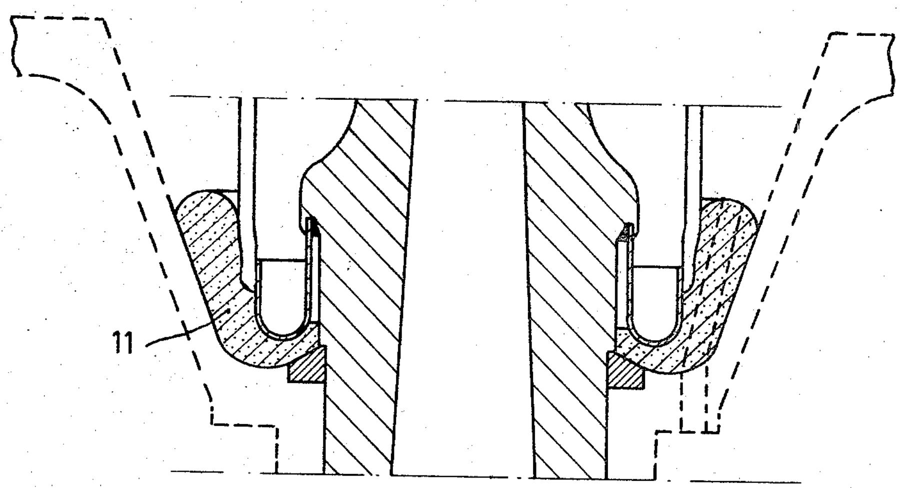

fig.2

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A COOLING GASKET FOR OIL FILLED X-RAY TUBES

The invention relates to a device for an X-ray tube having a stationary anode, the exit window of the rays being located outside the tube envelope and to a method of manufacturing the same.

Tubes having a stationary anode and an exit window for the rays located outside the tube envelope are particularly employed when the radiation must not be attenuated by the glass wall of the tube envelope and by the insulating agent surrounding the same. The radiation emerges at the level of the focal area through a beryllium window arranged in the wall of the hollow cylindrical anode body. For safety reasons the noninsulated anode cylinder must be at earth potential so that cooling of the anode by circulating water is possible.

In this construction the anode is satisfactorily cooled only at the anode area located behind the focal area, whereas the anode parts further remote and particularly the anode projecting in the tube envelope are strongly heated by the heat irradiated by the focal area. The heat of the metal parts of the anode projecting in the envelope is therefore necessarily transferred to the surrounding insulating agent, usually oil, so that the envelope is heated. The electrical energy which can be fed to the anode focal area is restricted independently of the specific loadability of the focal area.

A solution may be found in an additional water cooling of the anode in front of the focal area or of the whole envelope, but this is complicated and considerably raises the weight of the device. A further possibility resides in an enlargement of the volume of the envelope so that the quantity of heat given off by irradiation increases and the power fed to the anode may be increased. The enlargement of the dimensions involves an increase in cost and in weight of the device, whilst the replacement of a tube in an envelope already in use by a tube of higher power requires a new envelope.

The invention has for its object to avoid the aforesaid disadvantages involved in the loadability of an X-ray tube having a stationary anode projecting from the envelope. According to the invention a metal ring connecting the anode with the glass bulb is surrounded by a narrowly fitting layer of foam material so that oil convection is completely avoided.

The invention will be described more fully with reference to an embodiment shown in the drawing, in which:

FIG. 1 shows the part of a sectional view of a known construction of an X-ray tube having a radiation exit outside the tube envelope; and

FIG. 2 illustrates the application of the invention with reference to a detail of FIG. 1.

FIG. 1 shows the anode part of an X-ray tube **10**, the stationary anode **1** of which projects outside the envelope formed by a jacket **7** and a closing cap **3**, the X-ray tube **10** being arranged inside the envelope, while the space between the envelope and the tube is filled with insulating oil. The anode **1** of the X-ray tube **10** is formed by a hollow cylindrical body whose end projecting from the envelope is closed by a copper cylinder **2**. The top end thereof is beveled and a target plate **8**, usually consisting of tungsten, is embedded. In this arrangement the radiation exit window is located on the side of the spectator. The anode cylinder **1** and the glass bulb **5** are interconnected in a vacuum-tight manner by a ring **4** of a hollow alloy, the expansion coefficient of which corresponds approximately with that of the glass. Since the anode is at the same potential as the cap **3** of the envelope, that is to say earth potential, the bottom **6** of the anode can be cooled by circulating water, as is indicated in the drawing by arrows. The cooling is then mainly effective in the proximity of the anode bottom **6**. The anode part projecting in the envelope and the sealing ring connected therewith may, however, attain high temperatures, which are not capable, it is true, of damaging the metal or the sealing areas, but certainly of heating strongly the insulating oil surrounding them. Thus also the temperature of the envelope increases. The electrical permanent power fed to the tube has to be such that a maximum temperature of the envelope prescribed for reasons of safety is not exceeded. In such an arrangement envelope temperatures of 90° C. were measured with a permanent power of 3 kW and at 20° C. room temperature.

FIG. 2 shows that the ring and the anode parts projecting from the glass body are surrounded by a foam lining **11**, which screens said parts against the oil. With the same permanent power an envelope temperature of less than 50° C. was measured, since the oil comes into contact only with colder tube parts. Suitable foam is particularly polyurethane, which is sufficiently resistant to the temperatures of the anode cylinder and to the hot transformer oil. The invention provides a particularly simple solution of the present problem without structural changes being involved in subsequent incorporation.

For applying the invention in an X-ray device in which the insulating oil has to be introduced through the cap of the envelope on the anode side, a channel may be made in the foam substance as is indicated in FIG. 2 by broken lines, which channel communicates with the filling opening.

For manufacturing the foam substance collar **11** it is preferred to use an envelope cap specially made this purpose and having its conical part bored to an approximately 1 mm greater spacing for receiving the X-ray tube. After a layer of wax is applied to the envelope cap and the mixed foam constituents are introduced, the solid thermoplastic foam body is formed, which surrounds the tube in the form of a collar. The tube with the collar can be easily withdrawn from the mould used. When it is introduced into the envelope proper the associated envelope cap has first to be heated so that the slightly broader foam collar can be slightly compressed and a dense joint is formed. Direct contact between the anode cylinder and the foam substance can be avoided by providing between the anode cylinder and the sealing ring **4** an intermediate piece which can be withdrawn after the application of the foam substance so that the space between the anode and the ring is free of the foam substance.

I claim:

1. A device comprising an X-ray tube in an oil-filled envelope having a stationary anode projecting from a glass tube envelope, the anode cylinder being connected with the glass tube envelope by a ring of a metal alloy having an expansion coefficient matching that of the glass, said ring being surrounded by a narrowly fitting foam layer covering the joint between the metal ring and the glass tube to prevent heat conducting communication between the metal ring and the oil filling.

2. A device as claimed in claim **1** wherein a channel is provided in the foam layer which communicates with an opening for the introduction of the insulating oil in the envelope.