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Loughlin

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[54] **X-RAY TUBE HOUSING**

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[52] **U.S. Cl.** **250/520,** 250/523

[51] **Int. Cl.** **H01j 35/16**

[58] **Field of Search** 250/493, 503, 505, 520, 250/523

[56] **References Cited**

UNITED STATES PATENTS

1,874,672	8/1932	Wappler	250/523
3,134,903	5/1964	Fengler	250/520

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[57] **ABSTRACT**

A housing for an x-ray tube is described in which a tubular liner of higher tensile strength metal, such as steel, is provided on the inner surface of a housing member in order to prevent destruction of the housing member in the event a rotating anode in such tube breaks at high rotation speed. The liner can be a split sleeve of perforated sheet metal which is held in contact with the housing member by pressing a tubular shield of x-ray absorbing material, such as lead, outward to deform the shield until the liner is clamped between such shield and the inner surface of the housing.

9 Claims, 4 Drawing Figures

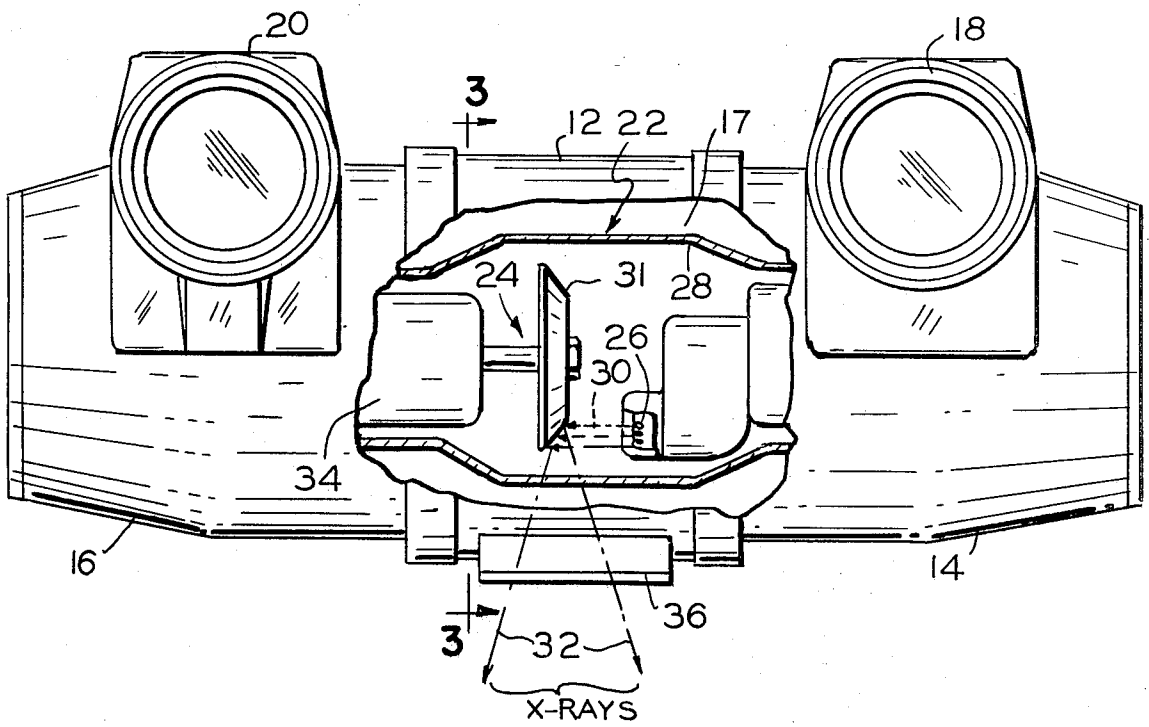


FIG. 1

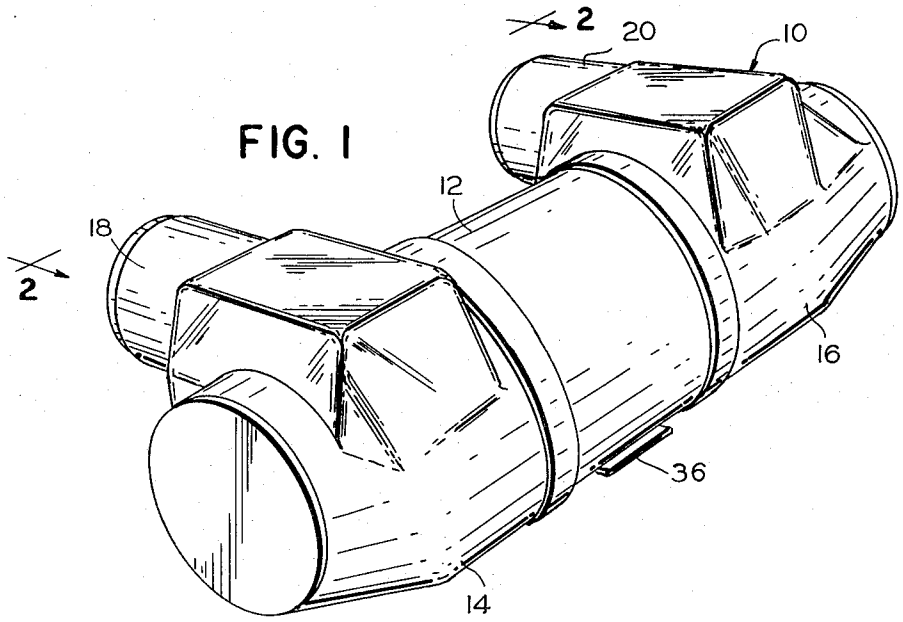


FIG. 2

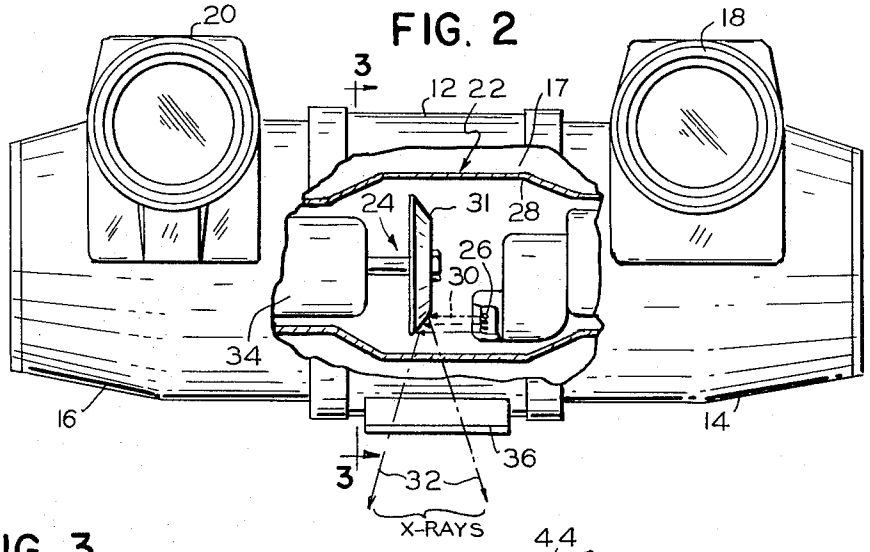
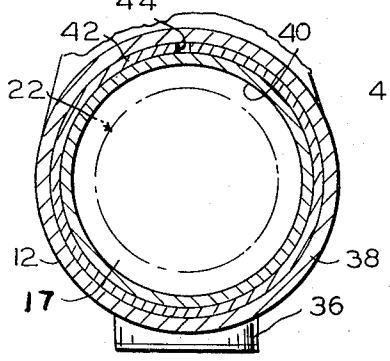


FIG. 3



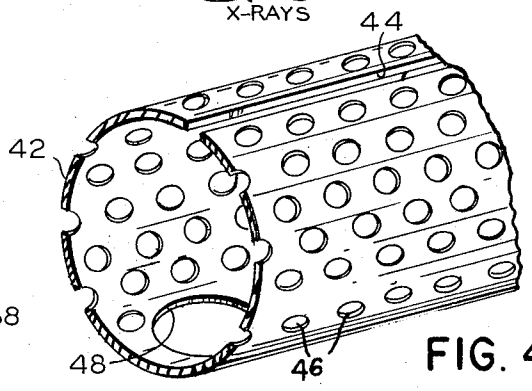


FIG. 4

X-RAY TUBE HOUSING

BACKGROUND OF THE INVENTION

The subject matter of the present invention relates generally to x-ray tube housings and in particular to a housing apparatus containing a tubular liner of metal of a higher tensile strength than the material of the housing member and the x-ray absorbing shield which may be provided as an inner layer over such liner.

The present housing apparatus is especially useful for containing rotating anode x-ray tubes since it prevents destruction of the housing member in the event that the rotating anode breaks at high rotation speed so pieces fly off and shatter the x-ray tube. Previous x-ray tube housings made of aluminum or other lightweight, low tensile strength material and not employing the liner member of the present invention, have broken when the x-ray tube contained in such housings shatters which can cause injury to patients and operating personnel. This is especially hazardous for rotating anode x-ray tubes since, when the anode breaks, it is thrown outward against the housing with great force due to centrifugal force.

It is, therefore, one object of the present invention to provide an improved x-ray tube housing of substantially unbreakable construction which is lightweight and of relatively low cost to manufacture.

Another object of the invention is to provide such a housing which employs a tubular liner of metal of higher tensile strength than the material of the outer housing member and the x-ray absorbing shield contained therein so that such housing member will not be destroyed in the event the x-ray tube breaks.

A further object of the invention is to provide such a housing in which the liner member is in the form of a split sleeve which is held in contact with the inner surface of the housing member by a tubular shield.

Still another object of the invention is to provide an x-ray tube housing for a rotating anode x-ray tube which is not broken when the rotating anode target shatters and pieces fly off against the inside of the housing.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and advantages of the present invention will be apparent from the following detailed description of a preferred embodiment thereof and from the attached drawings of which:

FIG. **1** is an oblique plan view of the x-ray tube housing of the present invention;

FIG. **2** is a plan view taken along the line **2—2** of FIG. **1** with parts broken away to show the x-ray tube mounted within such housing;

FIG. **3** is a vertical section view taken along the line **3—3** of FIG. **2** showing the x-ray tube in phantom lines;

FIG. **4** is an oblique section view of one embodiment of the liner member employed in the housing of FIGS. **1** to **3.**

DESCRIPTION OF PREFERRED EMBODIMENT

As shown in FIGS. **1** and **2,** an x-ray tube housing **10** made in accordance with the present invention includes an intermediate housing portion **12** attached between a pair of end portions **14** and **16** by releasable fluid tight seals to contain an insulating fluid **17** (liquid or gas) within the housing while enabling replacement of the x-ray tube therein. The end portions **14** and **16** have electrical cable connectors **18** and **20,** respectively, provided therein for supplying high voltage and current to an x-ray tube **22** supported within the intermediate housing portion **12.** The x-ray tube **22** may have a rotating anode **24** and a fixed filament cathode **26** provided within an evacuated glass envelope **28** so that electrons **30** emitted by such filament strike a target portion **31** of the anode and cause x-rays **32** to be emitted therefrom. The target anode **24** is rotated in a conventional manner by a rotor and bearing member **34** provided within the envelope **28** in response to an electromagnetic field produced by field windings (not shown) on the exterior of the envelope. The intermediate portion **12** of the housing includes an x-ray transparent window **36** of polycarbonate resin sold under the trademark "Lexan" or other high impact plastic material provided over an opening in a cylindrical housing member **38** of cast aluminum or other lightweight material. The window **36** is in alignment with the focal spot on the target **31** of anode **24** from which the x-rays **32** are emitted so that such x-rays pass through such window to the exterior of the housing.

As shown in FIGS. **3** and **4,** a tubular shield **40** of lead or other x-ray absorbing material is provided within the housing member **38** and covers the inner surface of such housing member except for an opening in alignment with the window **36** to prevent x-rays from being transmitted through the housing member **38** in any areas other than such window. The lead shield **40** may be formed by several layers of lead each on the order of about one-sixteenth inch thick to provide a laminated shield of desired thickness for absorbing x-rays of maximum intensity depending upon the voltage and current of the x-ray tube.

A tubular liner member **42** of steel or other high tensile strength metal is provided within the housing member **38** between the shield **40** and the inner surface of the housing member to provide such housing with greater impact strength. The metal of the liner member **42** has a higher tensile strength than the material of the housing member **38** or the shield **40.** For example, the tensile strength of a low carbon steel liner **42** is about 80,000 lbs. per square inch, while an aluminum housing member **38** is about 31,000 lbs. per square inch and a lead shield member **40** is about 6,800 lbs. per square inch.

As shown in FIG. **4,** the liner member **42** may be a split sleeve of sheet metal having a longitudinal gap **44** between the ends of such sleeve. The sleeve is rolled into the desired shape and inserted into the cylindrical housing member **38.** The tubular lead shield **40** is then inserted inside the liner **42** and pressed outwardly by a roller, pneumatic bag, or other means to deform the lead shield outwardly and thereby urge the liner **42** into intimate contact with the inner surface of the housing member **38.** As a result, the liner **42** is clamped in place between the shield and the housing member. The liner member **42** may be provided with a plurality of small holes about 0.3125 inch in diameter having seven-sixteenths inch spaced centers, to reduce the weight of the liner without greatly effecting its strength. It should be noted that a larger opening **48** is provided in the liner **42** and positioned in alignment with the window **36** to enable the x-rays to be transmitted through such liner without attenuation.

Any suitable high tensile strength metal can be employed for the liner **42** including nickel, titanium, mo-

lybdenum, stainless steel and other alloys, including low carbon steels. Suitable low carbon steels typically have a chemical composition by weight of 0.05 to 0.10 percent carbon, 0.25 to 0.50 percent manganese, 0.04 percent maximum phosphorous, 0.5 percent maximum sulphur and the balance iron. In one embodiment, the lead shield **40** and the aluminum housing **38** had wall thicknesses of 0.125 inch while the steel liner **42** was about one-fourth that thickness or about 0.03125 inch.

It is possible to make the liner **42** out of a unperforated cylinder of steel rather than the split sleeve shown in FIG. **4,** but this would require the outer diameter of the shield to exactly match the inner diameter of the housing member **38.** The advantage of the split sleeve embodiment of the liner **42** is that its diameter can be changed to automatically compensate for manufacturing tolerances in the inner diameter of the housing member **38.** Also, while the liner **42** is shown only provided on the inner surface of the intermediate portion **12** of the housing surrounding the x-ray tube anode, it is also possible to extend the liner and the lead shield into the end portions **14** and **16** so that they extend throughout the entire length of the housing for maximum safety.

It will be obvious to those having ordinary skill in the art that many changes may be made in the above-described preferred embodiment of the present invention without departing from the spirit of the invention. Therefore, the scope of the invention should only be determined by the following claims.

I claim:

1. A rotary anode x-ray tube housing apparatus comprising:

a hollow housing member having an x-ray transparent window portion;

means for mounting an x-ray tube having a rotary anode within said housing member so that x-rays emitted from said tube are transmitted through said window portion;

a tubular shield of x-ray absorbing material provided inside the housing member over the inner surface of said housing member, said shield having an opening aligned with said window portion; and

a tubular liner member of metal different from, and of a higher tensile strength than, the material of said housing member and said shield, said liner member being an integral, one-piece member provided within said housing member in position substantially completely surrounding said x-ray tube except for an opening aligned with said window portion to prevent destruction of the housing member in the event the x-ray tube breaks.

2. A housing apparatus in accordance with claim **1** in which the liner member is provided on the inner surface of the housing member beneath the shield and is of less thickness than the wall of the housing and the shield.

3. A housing apparatus in accordance with claim **2** in which the liner member is made of perforated sheet metal.

4. A housing apparatus in accordance with claim **1** in which the liner member is made of steel.

5. A housing apparatus in accordance with claim **4** in which the shield is made of lead.

6. A housing apparatus in accordance with claim **5** in which the housing member is made of aluminum.

7. A housing apparatus in accordance with claim **6** in which the window portion is made of a plastic material.

8. A housing apparatus in accordance with claim **1** in which the liner member is a split sleeve.

9. A housing apparatus in accordance with claim **8** in which the shield is a layer of lead which holds the split sleeve liner member in contact with the inner surface of the housing member.

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