

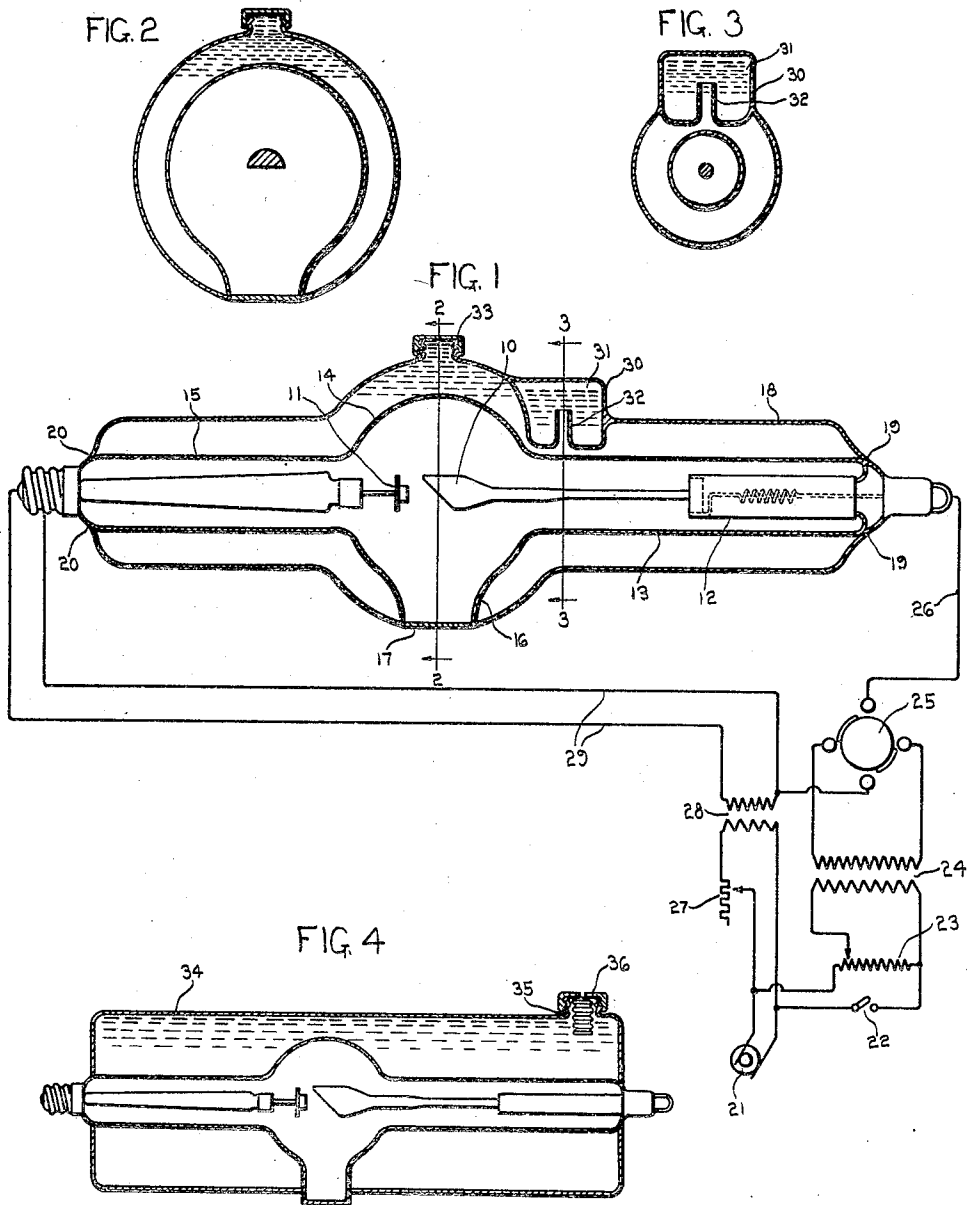
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X-RAY TUBE

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X-RAY TUBE

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The present invention relates to tube structure and has particularly to do with the provision of an insulating sleeve about such tubes.

5 In carrying out the invention, it is usual to provide an X-ray or other tube otherwise normal in structure, operation and function, with a jacket of glass or other material whereby to form a chamber partly or entirely
10 surrounding the tube envelope, and to fill the chamber thus formed between the wall of the jacket and the wall of the envelope with insulating material such as transformer oil. As the oil so disposed absorbs the heat
15 from the tube, it may expand, and it is usual and customary to provide in conjunction with the jacket or tube structure, means for compensating for such oil expansion.

20 The well known expedients for taking care of oil expansion in separate chambers surrounding an X-ray tube, such as tanks, conventional in the X-ray art and capable of transition to the particular structure here disclosed may be adapted to this purpose but
25 special provisions must be made for the mounting of such devices in respect to the jacket surrounding the tube wall or in the tube wall proper. Novel means for compensating for such expansion, such as the one
30 illustrated in the accompanying drawings, may also be used.

Included in the objects of the invention, among others, are the following: the provision of a tube having oil insulation as a unitary part thereof; the provision of a jacket
35 adapted to surround a tube and unitary therewith providing means for the oil insulation of such tube; the provision in a unitary apparatus comprising an X-ray tube, oil insulation therefor, and means for compensating for the expansion of such oil when heated; the provision of a jacket forming a
40 part of an X-ray tube and adapted to contain an insulating medium for such tube having means for compensating for the heat expansion of such insulation; the provision of a new and novel jacket for an X-ray tube, including means for compensating for the
45 expansion of the insulation used in conjunc-

tion with such tube; the provision of a novel insulation jacket adapted to be used in association with and to form a unitary part of an X-ray or similar tube; and the provision of an unitary jacket about an X-ray tube adapted
55 to contain oil insulation for such tube and comprising means for equalizing the expansion of such oil when heated by the tube.

Other objects of the invention will appear from the specification in connection herewith and the claims forming a part hereof.

Two forms of the invention are illustrated in the accompanying drawings, in which:

Figure 1 is a longitudinal section of one form of a tube embodying the invention, and a schematic representation of a circuit for energizing such tube;

Figure 2 is a transverse section taken along the line 2—2 of Figure 1;

Figure 3 is a transverse section taken along the line 3—3 of Figure 1; and

Figure 4 is a longitudinal sectional view of a second form of tube.

The object in combining with an X-ray tube an oil jacket of the character hereinafter described is primarily to prevent puncture of the glass walls of the tube while the tube is in use. Such a jacket also permits of the operation of a tube of given overall dimensions at considerably higher voltages than would otherwise be possible, and in addition prevents local heating of the glass wall of the tube and the liberation or occluded gases therefrom.

The invention is equally applicable to any size of X-ray or other tube, whether it be air cooled or water cooled, or whether it is provided with a hot cathode or is of the cold cathode variety. The novelty resides directly in the addition to the tube itself of a dielectric fluid, and with the provision of means permitting such dielectric fluid to expand without damage to the device as such fluid
55 absorbs the heat from the tube.

In both forms of the invention disclosed, an X-ray tube of the so-called universal hot cathode type is disclosed. Like reference characters are used to designate similar parts

in the drawings and in the specification which follows:

In both forms of the invention illustrated, the entire tube, with the exception of the extreme ends thereof and a window for the passage of X-rays, is jacketed. In some types of tubes a complete jacketing may be desirable. The jacket may of course, be spaced from the envelope different distances with respect to different portions of the tube.

Such jacketing as is illustrated prevents the filtering action of the useful X-rays through the oil and also prevents the generation of secondary radiation as would be the case were the useful radiation to be forced to pass through the oil. Where these objections, if they are objections, need not be considered, the entire tube may be jacketed as previously suggested.

Reference should be had first to Figures 1, 2, and 3, which may be read collectively. The numeral 10 is used to designate an anode, and the numeral 11, a cathode for and in an X-ray tube of the character referred to. As previously indicated, the cathode is of the heated type.

The extension upon which the anode 10 is mounted is designated 12, 13 being the tube arm in which the anode is disposed.

The bulb of the tube is designated 14, while the numeral 15 is used to indicate the cathode arm of said tube. An extension upon the bulb of the tube designated 16 is closed at its extreme end by a window 17 through which the useful X-ray is adapted to pass.

A jacket 18 which may be of glass or other suitable material is sealed upon and about the anode arm 13 of the tube at 19, and sealed to the cathode arm 15 at 20. Other seals between the jacket and tube envelope proper are provided so that there is a compartment for oil formed about the tube envelope.

The compartment thus formed intermediate the wall 14 of the tube and the wall of the jacket 18 comprises a plurality of sections corresponding to the shape of the tube generally, all of sections which communicate one with the other. These are adapted to hold oil such as transformer oil for insulation purposes.

Reference should also be had particularly to the schematic representation of the X-ray energizing circuit forming a part of figure 1. In such circuit 21 is a source of power, 22 is a main switch, 23 is an auto-transformer for determining the electro-motive force impressed across the step-up transformer employed in the circuit which step-up transformer is designated 24. The electromotive force of a high tension character is produced in the secondary of the high tension transformer 24 and is rectified by the synchronous rectifying switch 25 from which there is a lead 26 to the anode of the X-ray tube.

There is also provided a resistance regu-

lator 27 for controlling the electromotive force impressed upon a filament current transformer 28, and from the secondary of said filament current transformer 28, are leads 29 to the cathode of the X-ray tubes. One of said cathode leads is connected to the other side of the rectifying switch 25 so that there is a circuit of high tension unidirectional pulsating current from the rectifying switch 25 across the anode and cathode of tube 14.

The wiring scheme just described is conventional, and needs no further description.

Disposed in any suitable position upon the tube 14 and in this instance adjacent the bulbous portion thereof is an expansion chamber or device 30 comprising an inner chamber 31 opening into the chamber formed between the walls of tube 14 and jacket 18, such opening being marked 32 and being hereinafter referred to as the "oil tube".

At the top of the jacket 18, is a filling hole 33, which may be closed by any suitable cap.

Preparatory to operation of the tube, and through the filling hole 33, the chamber formed between the tube 14 and the jacket 18 is filled with insulating oil. The inner chamber 31 is full of air, and when the chamber formed between the tube 14 and the jacket 18 is filled entirely, a certain portion of the air remains therein, and not enough oil escapes into chamber 31 to completely fill it with oil. There is thus left in said chamber 31 a volume of air that cannot escape therefrom no matter how the tube is tilted, which forms a cushion to compensate for the expansion of the oil in the chamber between the walls of jacket 18 and tube 14, and when such oil is heated, it expands forcing itself into the expansion device 30, where it compresses the confined air. Some oil may flow into chamber 31, such oil in part or in its entirety flowing out when the tube shall have become cooled.

In Figure 4, a somewhat different embodiment of the invention is disclosed. The principle of the tube structure is the same as that illustrated in Figures 1, 2, and 3, and the device is adapted to be operated in the same manner as the previously referred to device and with the same circuit hereinabove mentioned. Instead of the jacket assuming the general configuration of the tube, however, a cylindrical or other shaped jacket 34 is substituted.

At one end, or in any other suitable place upon the jacket or chamber 34 is a threaded glass extension, and in such threaded extension is disposed a plug which device is a closure for the jacket 34 and at the same time an expansion and contraction device, the combination plug is designated 36.

In operation, the device is filled to such a capacity that when the combination cap 36 and its expansion and contraction device is

secured to the threaded neck 35 upon the chamber 34, the vessel will be entirely filled with insulating oil. Upon the expansion of such oil from heat and due to the operation of the tube, the expansion and contraction device will be compressed, such compression taking care of and compensating for the increased volume of the oil.

I claim:

10 1. An electron discharge device comprising an envelope, a surrounding jacket forming with said envelope a chamber for insulating liquid, and means in said chamber for compensating for the expansion of such liquid.

15 2. An electron discharge device comprising an envelope, a surrounding jacket forming with said envelope a chamber for a liquid, and means intermediate said envelope and said jacket for compensating for the expansion of such liquid.

20 3. An X-ray tube comprising an envelope, a vessel integral therewith and forming a chamber for a liquid, and means in said chamber for compensating for the expansion of such liquid.

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