

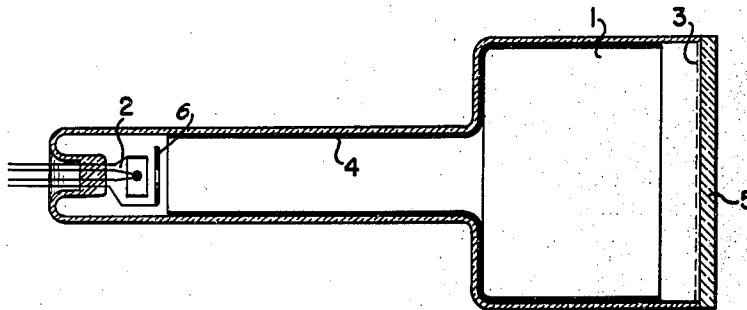
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CATHODE RAY TUBE WITH X-RAY ABSORBING COATING

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CATHODE RAY TUBE WITH X-RAY ABSORBING COATING

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The invention relates to cathode ray tubes, particularly for television and oscillograph purposes, using anode potentials of high voltage so that the production of X-rays must be taken into consideration.

It is an object of the present invention to provide a cathode ray tube particularly of the projection type which, in spite of the high voltage used for accelerating the electrons impinging upon the luminescent screen of the tube, can safely be used with regard to X-rays produced by the electrons impinging upon the screen. It is a further object to provide a tube having an envelope which effectively prevents the passage of X-rays to the outside of the tube in order to avoid detrimental influences on the health of persons operating such tubes. It is known that the repeated influence of even small doses of X-rays over a long period is sufficient to produce detrimental effects and may lead to cancer and other serious illness.

A further object is to provide a tube which is so constructed that the necessity of bulky and heavy external X-ray screens is avoided. Such X-ray screens consist, for instance, of lead in the form of plates, sheets or foils. Also, a use of lead-rubber and of so-called Kämpfe-Lorey's baryt-stones has been suggested. All these substances, however, can only be used on the outside of high vacuum tubes.

It is a further object to avoid the drawbacks which result if the whole tube envelope is made of lead-glass. This glass is not suited for blowing the complete cathode ray tube. Only that part of the tube which must be transparent in order to allow the passage of light out of the tube is made of lead-glass.

According to the invention the envelope of the cathode ray tube is provided with an inner coating consisting of a material having a dark, preferably black non-reflecting surface and being impervious to the X-rays produced by the cathode-ray impacting the light-emitting screen of the tube. The material is of such a nature that it acts at the same time as an electrical shield against electrostatic fields so that wall charges are avoided. A coating of this type has the advantage that no additional shielding or screening means are necessary on the outside of the tube. The production of the tube is greatly simplified and the costs of production are lower. The wall of the tube has a well-defined potential in accordance with the larger or smaller conductivity of the coating. In consequence of the light-absorbing properties of the surface of the coating, reflections of light into the interior of the tube are avoided. The coating consists, for instance, of salts and/or oxides of heavy metals, for instance lead-sulfide (PbS), bismuth sulfide (Bi₂S₃) or bismuth-dioxide (BiO₂).

The coating may either consist entirely of the X-ray absorbing material or it may consist of a mixture containing a binder with adhesive properties, the X-ray absorbing material, and, if required, a blackening agent, for instance finely divided carbon. According to the composition of the wall coating, the method of applying it may be varied as will be described in connection with the drawing.

The drawing shows by way of example a cross section through a tube made in accordance with the invention.

The cathode-ray tube 1 contains an electron gun 2 and a luminescent screen 3. The inner wall of the tube is covered with a coating 4 serving as an electrical shield, having light-absorbing properties and absorbing X-rays coming from the screen. The end wall 5 of the tube is free from the coating material because the light produced by the screen 3 must pass through the wall of the tube. This window 5 is therefore preferably made of lead-glass of sufficient thickness to avoid the passage of X-rays. Also, the part of the tube wall near the electron gun is free from coating because this part is shielded by the anode 6 against the passage of X-rays.

Measurements have shown that a cathode ray tube with a ray current of 0.5 mA. and 20 kV. screen potential would require a lead screen of thickness of 0.03 mm. The corresponding value for 30 kV. screen voltage is 0.14 mm., and for 60 kV. 1.31 mm. This shows that particularly for the medium voltage as, for instance, used in home projection receivers, a coating in the order of 0.1 to 1.0 mm. thickness will suffice.

The coating may be produced in a number of different ways. In case it consists solely of a metal salt it may be felled out of a solution in a similar manner as silver coatings are made.

Another method is the following: The parts of the envelope which shall remain free of the coating are shielded by suitable screens arranged within the tube. Then a portion of lead is introduced into the tube and evaporated by heat. The vaporized metal covers the inner surface of the envelope and is then treated by an electrolytic process in order to give to the surface non-reflecting properties. The coating is oxidized anodically so that a surface of lead superoxide is

formed. It is also possible to use a solution containing phosphorous acids for this purpose.

Another method is to produce the coating completely by electrolysis. In this case it will be preferable to pretreat the glass wall of the tube by producing thereon a thin conducting layer and to deposit on this layer the X-ray absorbing material.

Another way is to mix the X-ray absorbing salt or oxide in finely divided form with an adhesive binder and, if the light-absorbing properties should not be sufficient, also with a blackening agent, for instance finely divided carbon or colloidal graphite. The X-ray absorbing salt is, for instance, lead sulfide which is felled out of a solution by means of sulphurated hydrogen as a brown or black powder. This powder is not soluble in water and is mixed with waterglass so that a suspension of PbS in waterglass is obtained which can be applied to the tube wall in a similar manner as colloidal graphite. It may be preferable to mix this material with colloidal graphite in order to obtain the desired conductivity and non-reflecting properties. PbS does not melt and sublimes below 600° C.

What I claim is:

1. In a cathode ray tube comprising an evacuated envelope having therein an electron gun and a luminescent screen adapted to be impacted by cathode rays, a coating on the inside of the wall of said envelope, said coating consisting of a non-reflecting material impervious to X-rays produced by the cathode rays impacting said luminescent screen, said wall coating covering substantially all of said envelope between said gun and said screen and forming a shield against electrostatic fields.

2. In a cathode ray tube comprising an evacu-

ated envelope having therein an electron gun and a luminescent screen, a coating on the inside of the wall of said envelope, said coating covering substantially all of said envelope between said gun and said screen and consisting of an electrically conducting material which is substantially impervious to X-rays produced by the impact of cathode rays upon said screen and having a black non-reflecting inner surface.

3. In a cathode ray tube comprising an evacuated envelope having therein an electron gun and a light emitting screen adapted to be impacted by cathode rays, a coating on the inside of said envelope consisting at least partly of lead-sulfide, said coating covering substantially all of said envelope between said gun and said screen.

4. In a cathode ray tube for television purposes comprising an evacuated envelope having therein an electron gun and a light emitting screen adapted to be impinged by the cathode ray, a light transparent window in said tube, said window consisting of lead-glass, a coating on the inside of the wall of the envelope between said gun and said screen, said coating consisting of a compound of a heavy metal of sufficient thickness to absorb the X-rays produced on said light emitting screen and having a black non-reflecting inner surface.

5. In a cathode ray tube comprising an evacuated envelope having therein an electron gun and a light emitting screen, a coating on the inside of the wall of the envelope comprising a mixture including an adhesive binder, a blackening agent and an X-ray absorbing agent, said coating covering substantially all of said envelope between said gun and said screen.

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