Nov. 5, 1935. B. C. GARDNER 2,020,025

CATHODE RAY TUBE

Filed Jan. 28, 1933

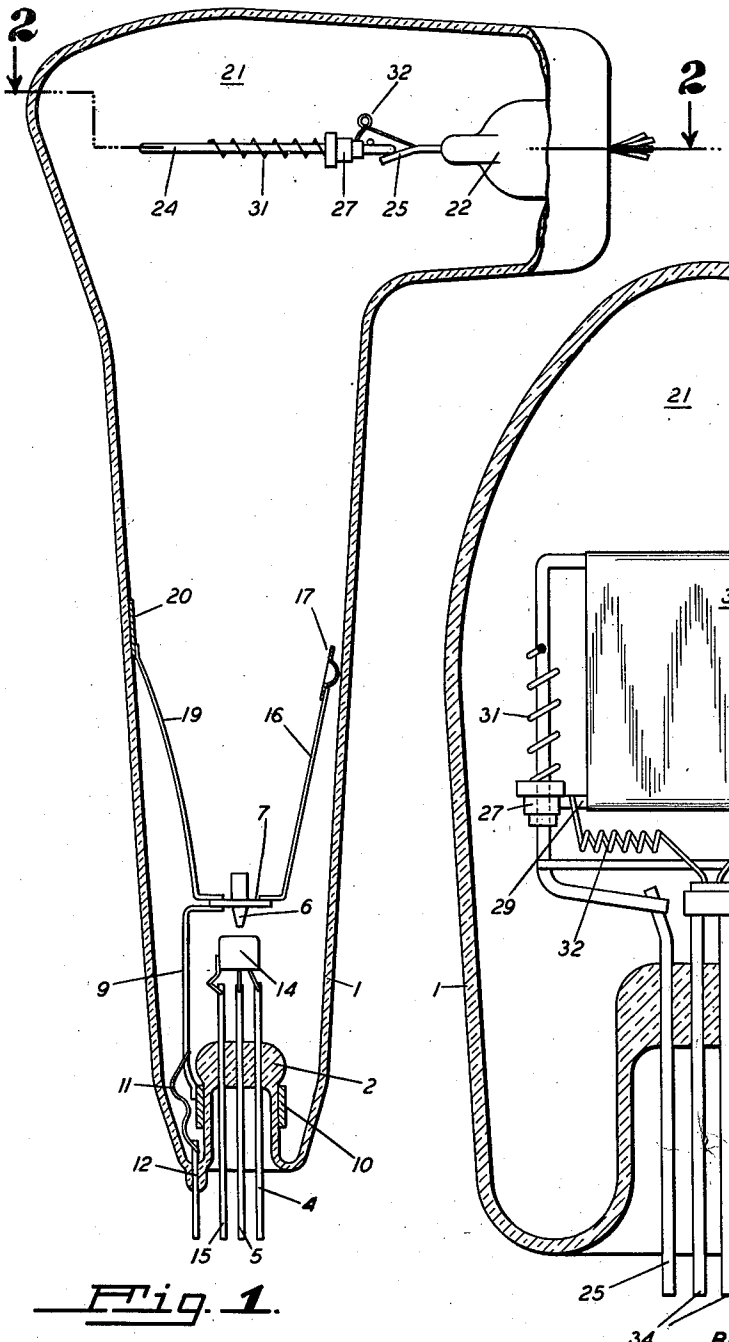


Fig. 1.

Fig. 2.

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Patented Nov. 5, 1935

2,020,025

UNITED STATES PATENT OFFICE

2,020,025

CATHODE RAY TUBE

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Application January 28, 1933, Serial No. 654,008

7 Claims. (Cl. 250—27.5)

My invention relates to luminescent means for use in cathode ray apparatus, such as oscilloscope or oscillographic tubes, and oscillights or television receiver tubes, this application being a continuation in part of the invention disclosed in the application of Philo T. Farnsworth, Serial No. 655,784, filed February 8, 1933.

Among the objects of my invention are:

To provide a luminescent screen giving a pure white light, said screen being in the form of a thin, flexible metal foil.

To provide means for placing a metal foil luminescent screen under tension.

To provide means for maintaining a flexible metal foil under tension while being used as a target for a beam of cathode rays.

To provide a mounting for a cathode ray screen, said screen comprising a flat sheet of flexible metal foil.

To provide means for compensating for the expansion and contraction of a flexible metal foil when used as a target for a beam of cathode rays.

To provide a mounting for a metal foil screen for cathode ray tubes which may be used to conduct current from an exterior source through said foil.

To provide means for compensating for dimensional changes due to heat in a flexible metal foil used as a target for a beam of cathode rays.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of my invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawing:

Figure 1 is a longitudinal sectional view through an oscillight or cathode ray tube embodying this invention.

Figure 2 is a cross sectional view taken as indicated by the line 2—2 in Figure 1.

It has been shown in application, Serial No. 655,784, filed February 8, 1933, referred to above, that a thin sheet of refractory metal foil may be bombarded by a moving beam of cathode rays to raise successive elementary areas of the foil to incandescence, thus giving rise to a visible trace on the screen, this trace having extreme brilliancy and highly desirable color values, particularly for the formation of effective oscillographic and television images.

It has also been pointed out in the application above referred to that it is desirable to polarize the foil by supplying a steady heat to the screen during the traversal by the cathode ray beam, this heat being preferably obtained by resistively heating the metal foil by passing an electrical current through it.

This invention is directed toward the mounting of such metal foil screens, the mounting being disclosed in the above mentioned application, but not claimed therein.

In the operation of a cathode ray tube equipped with a metal foil target, when the target is polarized by steady heat in addition to the heat produced by the cathode ray beam, there will be expansions and contractions of the foil due to the applied heat, the amount of change in physical dimensions being of course dependent upon the amount of heat and the particular metal used. There will be a change in dimension due to the steady polarization, and a further change, constantly varying in amount, due to the usual variations in the power contained in the moving beam. Such changes in dimension, will, if not compensated for, buckle the foil and distort the resultant image. Furthermore, as cathode ray beams are usually focused on the target in a fine spot, any change in distance between the source of the beam and the target will tend to enlarge the spot and thus reduce element definition in the image.

My invention comprises broadly the placing of a metal foil cathode ray screen under tension, preferably by applying a stress across a major dimension of the screen when cold, so that the foil surface will remain substantially flat when heated by the polarizing source, and also when still further heated by the cathode ray beam. The screen therefore cannot buckle, and always remains substantially in the plane of focus of the cathode ray beam. The means for placing the foil under tension are also preferably designed so that a current from an exterior source may be brought to the screen for resistive heating. It is to be understood, however, that the need for tension exists entirely apart from the polarizing heat, because if no polarizing heat be separately applied, an amount of power equivalent to a separate polarizing power must be included in the cathode ray beam to bring the screen up to the proper operating temperature, and the total amount of dimensional change in the screen will be the same in both cases.

The use of a separate polarizing heat however with the screen under tension is desirable, not only from the point of view of saving power in the cathode ray beam, but also in partially expanding the screen before the cathode ray beam starts to operate. For example, if the screen is to be used to produce oscillographic traces without

modulation or with rectified beam impulses, without polarization, the screen will be raised from cold to incandescence with full physical distortion of the foil, due to the action of the beam alone, whereas when polarization is used a much smaller distortion will take place during the formation of the image by the beam. Although the tensioning means will fully compensate both distortions if prolonged, it is obvious that more faithful reproduction will be obtained when the foil is first partially expanded, because of the time element involved. It is often possible when the screen is heated from cold to incandescence by the beam alone that aplanar distortion may occur and end before the tension device can operate. Partially expanding the screen greatly reduces such fleeting aplanar distortion by greatly reducing the amount of expansion possible due to the heat of the beam alone.

The form of the invention illustrated in the drawing comprises the usual evacuated envelope 1 having at one end a reentrant stem 2 which carries an electron gun. The type of gun used is preferably that shown in detail in the copending application of Gardner and Brolly, Serial Number 614,500, filed May 31, 1932, this form of cathode ray projector being capable of producing a cathode ray beam of high intensity. The cathode (not shown) is heated by current supplied by a source, through leads 4 and 5, emitting electrons which are attracted by a conical projection 6 on a circular anode 7 and pass through a beam canal in the anode to form the required beam of cathode rays. The anode is welded to a support 9, this in turn being supported from a clamp ring 10. A lead wire 11 connects to the anode support and is brought out through a side seal 12 to which may be connected the source of anode potential.

The intensity of the beam is regulated by a control electrode or grid 14 mounted on lead 15 sealed through the stem.

Welded to one side of the anode 7 is an arm 16 extending away from the anode at an angle and terminating in a cup 17, which is used to vaporize a volatile metal on the walls of the tube. A spring contact arm 19 extends from the opposite side of the anode, and terminates in a contact 20 which is held by the pressure of the arm against the wall of the tube, and is therefore in contact with the film of metal deposited from the cup 17. This film being energized at anode potential and covering the barrel of the tube, protects the beam from the influence of extraneous potentials.

The end of the envelope opposite the gun is slightly expanded to form a screen chamber 21 into which is sealed a heat screen assembly supported by a screen stem 22. This screen assembly preferably comprises a rectangular wire frame 24 mounted on frame leads 25. A cross bar 26 provides additional strength. Insulating sliders 27 of lava or similar material are connected by a mounting bar 29 and are movable along the frame work. A target comprising a heat screen 30 of any desired shape, preferably rectangular, is welded to the top of the frame, and to the mounting bar. Springs 31 welded at one end to the frame press against the sliders 27 and maintain the screen 30 under tension. Flexible leads 32 connect the mounting bar to screen leads 34 sealed through the stem 22. A circuit is thus established so that a source of current exterior to the tube may be used to heat the screen, and expand it to a predetermined amount, the springs forcing the mounting bar to take up the expansion and greatly reduce the aplanar distortion.

The screen itself should preferably be of a refractory metal capable of being raised to incandescence by the impact of the beam, and it has been found that tantalum foil formed as described in the application of Gardner and Varian, Serial Number 637,772, filed October 14, 1932, is entirely satisfactory. A suitable thickness of foil has been found to be from 50 to 100 x 10^{-6} inches. but the invention here described is applicable to any foil which is flexible and capable of being heated to incandescence by the cathode ray beam.

When such a screen as has been described is heated it will change its physical dimensions, usually, in the case of most refractory metals, it will expand. If the expansion is not compensated for, the screen will buckle, either toward or away from the electron gun, and the point of impact of the beam, focused to a predetermined size, usually very fine, will be closer or farther away from the gun. Such a variation in distance reduces detail, often changes the size of the spot and in general is undesirable. By placing the foil under tension this aplanar distortion may be reduced to such an extent as to be a negligible factor in the production of an effective image.

When a polarizing heat is used on an untensioned foil, the application of the polarizing heat alone will distort the screen from its flat shape, and the cathode ray beam will cause still greater distortion. By placing the foil under tension the distortion caused by the polarizing heat is largely taken up before the cathode ray begins to operate, and after the beam does start, the springs compensate for the additional expansion and contraction due to the beam heat.

In the tube shown, only the expansion in one direction is compensated for. It has been found that while no compensation will give unsatisfactory results, compensation along one dimension will be sufficient in most cases. It is believed that the foil, being of such extreme thinness is sufficiently elastic to allow the tension as applied to compensate, at least partially for lateral expansion. It will, however, be obvious that tension may also be applied at right angles to the direction as shown, or as will be apparent to one skilled in the art, tension may be applied to a circular foil to compensate for expansion along all radii, without departing from the spirit of the invention.

I claim:

1. A cathode ray apparatus comprising an envelope, an electron gun, a target for said gun formed from thin metallic foil of substantially rectangular dimensions, means for supporting said foil in a definite plane comprising a framework to which one edge of said foil is attached, a movable member positioned by said framework to which the opposite edge of said foil is attached, and means for applying stress between said framework and said movable member to compensate for expansion and contraction of said foil.

2. A cathode ray apparatus comprising an envelope, an electron gun, a target for said gun formed from thin metallic foil of substantially rectangular dimensions, means for supporting said foil in a definite plane comprising a framework to which one edge of said foil is attached, a movable member positioned by said framework to which the opposite edge of said foil is attached, means for applying stress between said framework and said movable member to compensate for expansion and contraction of said foil, means for insulating said movable member from

said framework, and means for conducting current from outside said envelope to said foil through said framework and said movable member.

3. The method of reducing aplanar distortion of a substantially planar sheet of thermally expansive material when used as a target of a beam of cathode rays which comprises applying a tensioning stress in the plane of the sheet, expanding said material a predetermined amount, and exposing said partially expanded material to said beam.

4. A cathode ray tube comprising an envelope, a cathode and anode cooperating to form a beam of catnode rays therein, a luminescent screen for said beam consisting of a thin sheet of flexible metal foil, and means for applying a stretching stress to opposite edges of said foil to maintain said foil in a plane during bombardment by said beam.

5. A cathode ray tube comprising an envelope, a cathode and anode cooperating to form a beam of cathode rays therein, a luminescent screen for said beam consisting of a thin sheet of flexible metal foil, means for stiffening opposite edges of said foil, and means for applying a stress between said stiffening means to place said foil under tension in a plane.

6. A cathode ray tube comprising an envelope, a cathode and anode cooperating to form a beam of cathode rays therein, a luminescent screen for said beam consisting of a thin sheet of flexible metal foil, means for stiffening opposite edges of said foil, means for applying a stress between said stiffening means to place said foil under tension in a plane, means for insulating said stiffening means from each other, and means for passing a current through said stiffening means and said foil.

7. A cathode ray tube comprising an envelope, a cathode and anode cooperating to form a beam of cathode rays therein, a luminescent screen for said beam consisting of a thin sheet of flexible metal foil, means for stiffening opposite edges of said foil, means for applying a stress between said stiffening means to place said foil under tension in a plane, means for insulating said stiffening means from each other, and an electrical connection from without said envelope to each of said stiffening means.

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