

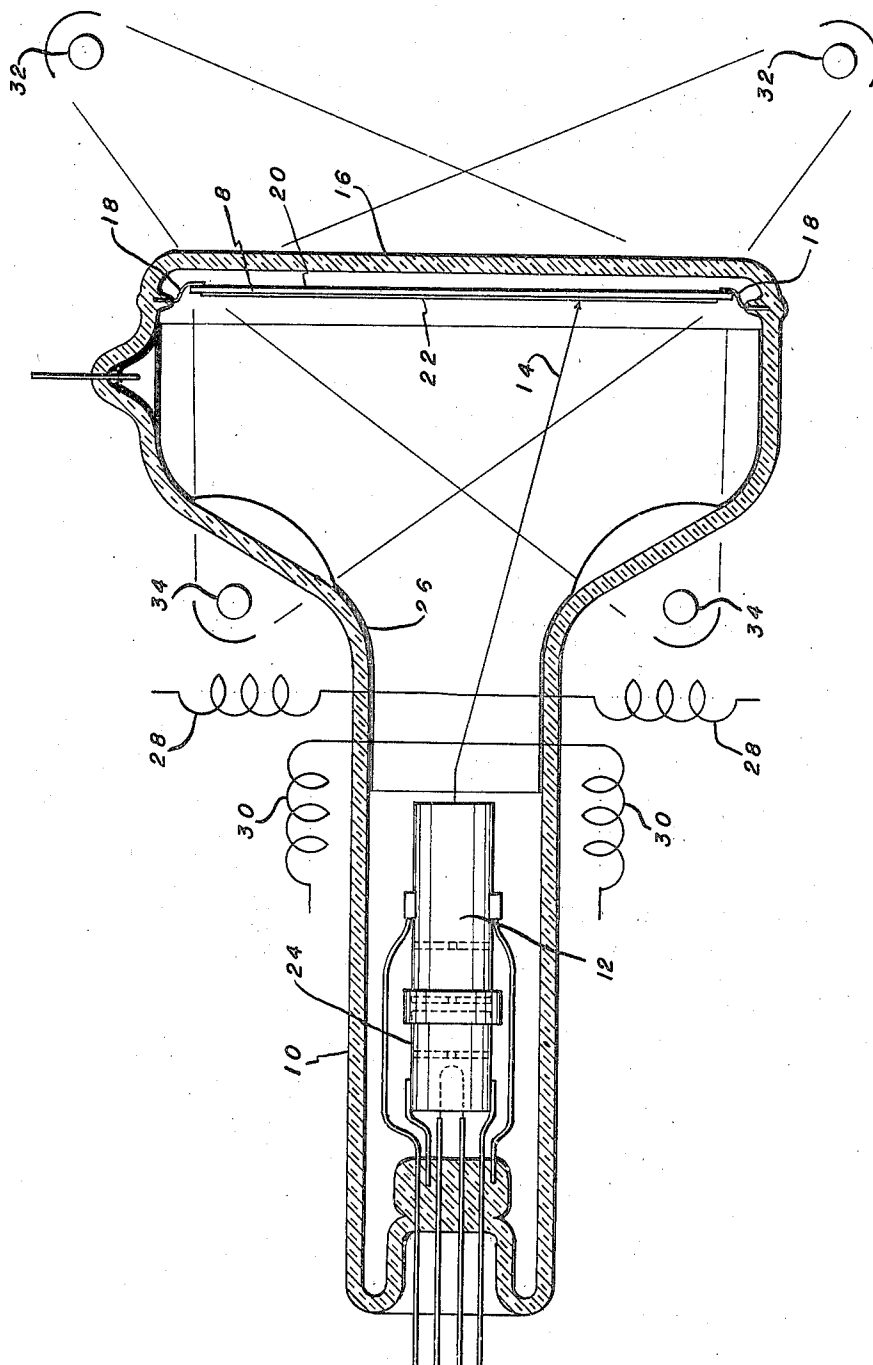
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IMAGE REPRODUCER

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INVENTOR

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IMAGE REPRODUCER

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5 Claims. (Cl. 250—27.5)

My invention relates to improvements in electronic devices and the method of operation thereof, and more particularly to such devices as are used, for example, for producing an image in television reception.

Electronic devices of the general type used heretofore for television reception comprise, essentially, an evacuated tube provided with a fluorescent screen and with a gun for developing a ray of electrons and directing the ray at the screen, and means for deflecting the ray to cause it to scan the screen, the gun being provided with a control electrode to which the received picture signals are applied for varying the ray intensity in accordance therewith, whereby an image is produced on the fluorescent screen. While the brightness of the image produced on the screens of these cathode ray tubes has been generally satisfactory, particularly when the screen area is relatively small and the image is viewed directly, it would be more desirable to obtain greater brilliancy than has been possible heretofore, particularly in cases where the image is projected through an optical system to a larger, external screen. Moreover, the efficiency of image production by this method is quite low, and improvement in this respect is therefore desirable.

The problem of obtaining greater brilliancy of the image produced on the fluorescent screen has been a real one for the reason that there is a limit to which the intensity of the ray can be increased to obtain greater brilliancy, this being the result of the fact that, beyond a certain point, the intense bombardment of the fluorescent material by the electrons causes its temperature to rise to a point where the material begins to lose its property of cathodo-luminescence, or to burn. Development work for the purpose of obtaining greater brilliancy of the image has accordingly been proceeding along the lines of developing a fluorescent screen which would withstand a cathode ray of substantially greater intensity than has been possible heretofore, and some success along this line has been obtained. However, the increased brilliancy obtained still falls short of that required for projection work particularly, for before this latter condition is approached, the fluorescent material begins to lose its property of cathodo-luminescence, as before.

With the foregoing in mind, it is an object of my invention to provide an improved electronic device of the character referred to by which, under the same and corresponding conditions used heretofore, an image of substantially greater brilliancy can be obtained.

Another object of my invention is the provision of an improved electronic device of the character referred to which has advantages over the various constructions proposed heretofore in the way of elimination of flicker, ease of control, and efficiency.

Other objects and advantages will hereinafter appear.

In practicing my invention, use is made of the facts that fluorescent material becomes luminous upon being exposed to ultra-violet radiation and that such radiation, even though very intense, will not cause the material to burn or to lose any of its desirable properties. Such materials are often such that they exhibit no fluorescence under the impact of cathode rays. However, if any elemental area of the fluorescent material is bombarded by a ray of electrons varying in intensity over a given range, the intensity of fluorescence at such area will vary substantially inversely proportionally to the ray intensity as a result of the fact that the fluorescent material loses its ability to fluoresce at elevated temperatures caused by the impact of the electron ray.

In accordance with my invention, a fluorescent screen is exposed to ultra-violet radiation of substantially uniform and substantially constant intensity over its surface, and the screen is also scanned with a ray of electrons the intensity of which is made to vary in accordance with occurring variations in the received picture signals. The intensity of the ultra-violet radiation is such that, with the cathode ray cut off, the entire effective area of the fluorescent screen emits fluorescent light at the maximum required intensity. The adjustments and arrangements are such that a picture signal for maximum illumination cuts off the ray, while a picture signal for a dark screen causes increase in the ray intensity to a point at which the particular elemental area of the fluorescent screen being scanned at the instant is heated to a temperature at which it loses its ability to luminesce, and ceases to emit light of fluorescence although it is still being exposed to the ultra-violet radiation. Thus, by varying the intensity of the cathode ray over a given range, and in accordance with occurring variations in the picture signals, an image is caused to be produced on the fluorescent screen. The luminescence of the screen in producing the image, however, is caused directly by the ultra-violet radiation, rather than by the bombardment of the fluorescent material by the electrons of the scanning ray, as in the constructions used heretofore, and the brightness of the respective ele-

mental areas of the screen is controlled by the temperature to which those areas are raised by the impact of the scanning ray.

For the purpose of illustrating my invention, one embodiment is shown in the drawing, which is a simplified, diagrammatic showing of an electronic device constructed and operating in accordance with my invention.

In the drawing, the reference numeral 10 designates an evacuated tube provided with a fluorescent screen 8 and with means in the form of a gun 12 for developing a ray 14 of electrons and directing the ray at the adjacent side of the screen on which the fluorescent material is deposited. In the specific construction disclosed, the screen 8 is supported in spaced relation with respect to the end wall 16 of the tube by short pieces of wire 18 fused in the wall of the tube, and comprises a supporting sheet 20 of mica provided on the side thereof adjacent the gun 12 with a relatively thin layer or coating 22 of fluorescent material, such as Willemite.

The electron gun 12 is provided with a grid or control electrode 24 to which the incoming picture signals are applied for the purpose of varying the intensity of the ray in accordance with occurring variations in the picture signals. An anode 26, in the form of a carbon or other coating on the inside surface of the tube, is at a relatively high positive potential with respect to the adjacent anode of the gun, and operates to focus the ray of electrons on the fluorescent surface 22, to accelerate the electrons so that they bombard the fluorescent surface at a relatively high velocity, and to remove electrons of secondary emission coming from the screen. By means of electro-magnetic coils 28 and 30, the ray 14 is deflected to cause it to scan a given area of the screen, as will be well understood.

Supported exterior of the tube, are means in the form of lamps 32 providing a source of ultra-violet radiation to which the screen is exposed, such radiation being at substantially uniform and substantially constant intensity over the surface of the screen.

In operation, the intensity of the ultra-violet radiation is such that, with the cathode ray cut off, such as would be the case when a picture signal representing maximum illumination is applied to the grid 24, the entire effective area of the fluorescent screen emits light at maximum intensity. When a picture signal representing a dark screen is applied to the grid 24, the intensity of the ray 14 is at its maximum, and this intensity of the ray is sufficient to heat the respective elemental areas of the fluorescent screen to a temperature at least beyond that at which the fluorescent material, on account of its intrinsic characteristic, loses the ability to luminesce, and ceases to emit any light of fluorescence although it is still being exposed to or excited by the ultra-violet radiation.

From the foregoing it will be seen that, as the intensity of the cathode ray is made to vary in accordance with the received picture signals over a given range between zero and maximum intensity, an image will be produced on the fluorescent screen. Furthermore, it will be seen that an important difference between the operating action of the present electronic device and those constructed heretofore lies in the fact that the fluctuating fluorescence of the screen in producing the image is caused directly by the ultra-violet radiation, rather than by the bombardment of the fluorescent material by the elec-

trons of the scanning ray, as in the prior constructions. In other words, the present construction provides a uniform and substantially constant source of ultra-violet radiation which supplies the energy for causing the screen to fluoresce to produce a very brilliant image, the cathode ray 14 operating to control the effectiveness of such radiation with respect to the individual elemental areas of the screen as the ray is caused to scan these in succession.

In the practical application of my invention, it may be desirable to maintain a uniform base temperature over the fluorescent screen at the point of the characteristic curve at which it almost begins to lose the ability to luminesce. The intensity of the cathode ray 14 at the lower end of the intensity range for complete control, will therefore be relatively low. As a matter of fact, if the initial thermal bias on the screen is such as to maintain an initial uniform temperature at the point in the characteristic curve where the fluorescent material just begins to lose its ability to luminesce, the individual elemental areas of the screen will give maximum illumination when the ray is completely cut off, or is at zero intensity. The response of the screen to any increase above zero in intensity of the ray by the picture signals will therefore be immediate.

For the purpose just explained, means in the form of infra-red lamps 34 may be disposed as shown to subject the fluorescent surface to substantially uniform and constant infra-red radiation of sufficient intensity to bias the screen to an initial temperature at which the fluorescent material almost begins to lose its ability to luminesce.

It will be understood that the end wall 16 of the tube and the supporting sheet 20 is of a material substantially transparent to ultra-violet radiation of the wavelength used. If the infra-red lamps 34 are used, the material of the side wall of the tube is then made transparent to infra-red radiation.

Although but one embodiment of my invention has been disclosed, it will be understood that various modifications are possible without departing from the spirit of my invention or the scope of the claims.

I claim as my invention:

1. A television image reproducer comprising a luminescent screen capable of transforming relatively invisible energy into visible radiation and characterized by the fact that the efficiency of said transformation is decreased from a finite value to substantially zero as the temperature of said screen is increased between a predetermined lower limit and a predetermined upper limit, means for uniformly flooding said screen with such invisible energy to be so transformed, and means for selectively decreasing said efficiency of transformation of portions of said screen to values below said finite value by increasing the temperature of said portions of said screen.

2. In the art of television image reproduction, the method which comprises inducing a predetermined luminosity of an image screen by the application thereto of ultra-violet radiation, and reducing said predetermined luminosity of portions of said screen by the action of a ray of electrons.

3. In the art of television image reproduction, the method which comprises exciting an image screen to a predetermined and uniform luminosity by irradiating said screen with ultra-violet radia-

tion, and causing at least a portion of said screen to lose its ability to luminesce under the influence of ultra-violet radiation by heating said portions of said screen.

4. In the art of television image reproduction, the method which comprises inducing a predetermined visible luminosity of an image screen by the application of ultra-violet radiation thereto, and reducing the luminous efficiency of portions of said image screen by the bombardment thereof with electrons.

5. An image reproducer comprising a luminescent screen capable of transforming relatively invisible energy into visible radiation and char-

acterized by the fact that the efficiency of said transformation is substantially continuously decreased from a finite value to substantially zero as the temperature of said screen is increased between a predetermined lower limit and a predetermined upper limit, means for uniformly flooding said screen with such invisible energy to be so transformed, and means for modulating the temperature of portions of said screen to selectively decrease the efficiency of transformation of said energy for producing effective modulation of the luminosity of said portions of said screen.

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