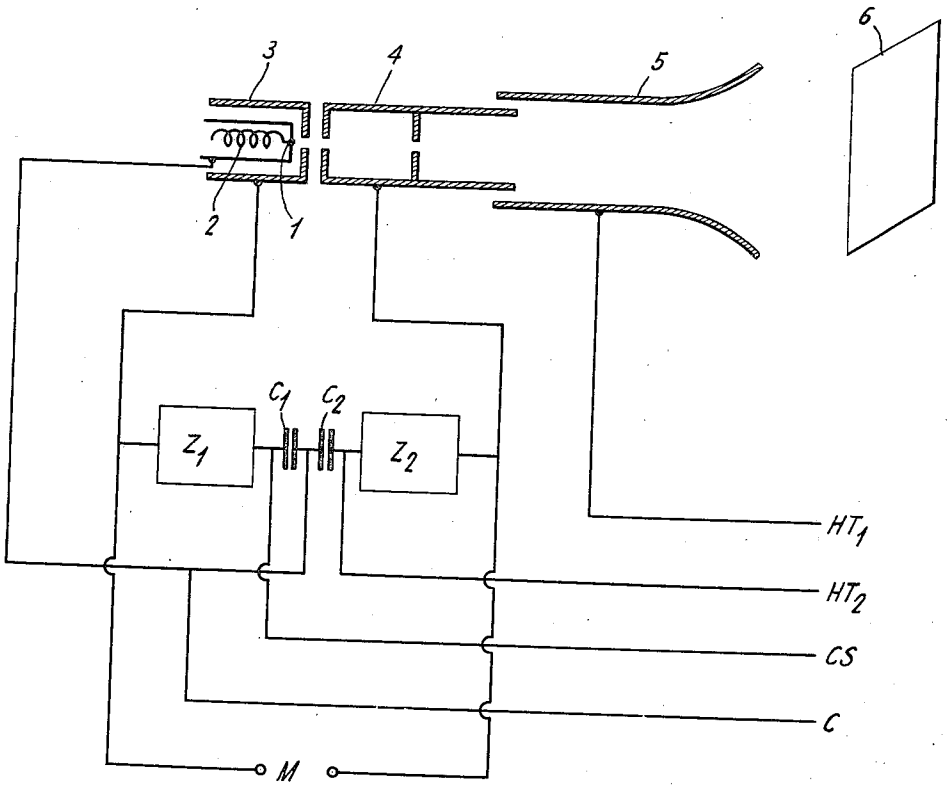
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TELEVISION RECEIVING SYSTEM

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TELEVISION RECEIVING SYSTEM

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This invention relates to television and like receiving systems and more specifically to systems of the kind wherein a received picture is built up by means of a ray or narrow beam which is caused to scan a picture area.

An important application of the invention is to television and like receivers of the cathode ray tube type wherein a cathode ray is caused to scan a predetermined area upon a picture surface constituted by a fluorescent screen provided on the inside of the end wall of the tube envelope and adapted to fluoresce with visible light where it is struck by the ray.

Known cathode ray tube television receivers may be broadly subdivided into two classes (1) that in which the cathode ray is caused to scan the fluorescent screen or other picture area at a substantially constant speed and wherein the intensity of the ray is modulated in dependence upon received picture signals and (2) that in which a cathode ray is maintained at substantially constant intensity and is caused to scan the fluorescent screen or other picture area at a speed which is varied in dependence upon received picture signals. The former type of cathode ray tube television receiver system may be termed the variable intensity modulation type and the latter type may be termed the variable velocity modulation type.

According to this invention a television or like receiver of the kind wherein the received picture is built up by means of a ray or narrow beam which is caused to scan a picture area comprises means, actuated in dependence upon received television or like signals, for causing the area of the spot formed where the ray impinges on the screen to vary in dependence upon the said received signals.

A cathode ray tube television or like receiver according to this invention which comprises means, actuated in dependence upon received television or like signals, for causing the area of the spot formed where the cathode ray strikes the fluorescent screen or other picture area to be varied in dependence upon said received signals.

It is, of course, well known that there is a tendency in cathode ray tube television and like receivers of the intensity modulation type for slight variations to occur in the area of the scanning spot as a result of modulation applied to vary the intensity of the ray, but such variation as has occurred is very small, quite insufficient to result in picture reproduction and, in fact, has generally been regarded as a highly undesirable defect the usual practice hitherto in the design of known cathode ray tube television and like receivers being so to arrange matters that such spot area variations as do occur shall be reduced to so small an amount as to be negligible.

As will be seen later, in carrying out this invention spot area modulation is deliberately resorted to. Whilst spot area modulation only has disadvantages where the number of scanning lines per picture is small—say less than 100 lines per picture—where the number of lines is large, for example 200 lines or more per picture modulation by varying substantially only the spot area is quite advantageous. In carrying out this invention in cases where spot area modulation alone is not satisfactory spot area modulation may be combined with spot intensity modulation.

In one way of carrying out this invention a cathode ray tube television or like receiver comprises a cathode ray tube having the usual fluorescent screen at one end and having associated therewith the usual deflector plates or electromagnetic coils and associated circuits for causing the ray within the tube to scan the fluorescent screen at a substantially constant predetermined speed and with a predetermined number of lines per picture a predetermined number of times per second. The ray within the tube is maintained at substantially constant intensity and received television or like signals, after such amplification as may be desired, are applied, for example, to a focusing electrode within the tube, so as to cause the spot which is formed where the ray strikes the screen to vary in area in correspondence with the received picture signals. Thus the resulting scanning lines on the fluorescent screen will be of substantially constant brightness throughout per unit of scanning line area but they will be of varying width. For "black" parts of the picture, i. e., parts where the light intensity is low, the scanning line width will be reduced (in the limit to zero) while for "white" parts of the picture, i. e., for parts where the light intensity is at a maximum, the scanning line width will be increased (in the limit to a value such that adjacent scanning lines touch one another without substantial overlap). Where the scanning lines, owing to their reduced width do not actually touch one another, there will be left "black" areas on the screen and the thinner the scanning lines at any particular part of the screen the greater the amount of "black" area which will appear, the dark background due to the "unscanned" screen area giving the required picture shading.

Although the invention as above described has assumed that the intensity of the ray and the speed of its movement remains constant, modulation being effected solely by variation of the spot area, it is also within the scope of this invention to combine the variable area method of modulation provided by this invention with the known variable intensity modulation method and/or with the known variable spot velocity modulation method; that is to say, in carrying out this invention the received picture signals may be utilized

to cause variations not only of the area of the scanning spot but also of the intensity of the spot and/or of the speed of movement of the spot, the total modulation effected by whatever methods are employed being, of course, such as to result in a reproduced picture in which the total resulting instantaneous values of light and shade correspond as closely as possible with the received television or like signals. It is, however, possible, and at present it is preferred to effect modulation by varying the area only of the scanning spot leaving its brightness approximately constant and there will now be described, with reference to the drawing at present preferred specific means for doing this.

For the purpose of describing the present embodiment of the invention it will be assumed that it is required to carry the invention into practice with the employment of a known hard vacuum cathode ray tube (so-called electron optical tube) having an electrode system as shown in the drawing and comprising in addition to a cathode 1 which is heated by a heater 2 and shielded by a shield 3, a first anode 4, a second anode 5 and a fluorescent screen 6. Received television signals for modulation are applied at terminals M across two series connected impedances Z_1 Z_2 which may in practice be simple ohmic resistances, Z_1 and Z_2 being connected in series with one another through blocking condensers C_1 C_2. The cathode 1 is connected to the junction point of C_1 and C_2; the modulating terminals are connected one to the shield 3 and the other to the first anode 4; and the terminals for the application of operating or bias potentials to the second anode 5 first anode 4 shield 3 and cathode 1 are marked HT_1 HT_2 CS and C respectively. Let V_1 be the potential of the first anode relative to the cathode and V_2 be that of the second anode relative to the cathode, I being the electron ray current and d the diameter of the (circular) spot on the screen 6. Then the following equation should be satisfied if the brightness of the spot is to be independent of its diameter:

$$\frac{I(V_2-V_0)}{d^2}=\text{constant}$$

where V_0 is the minimum value of the second anode voltage for excitation of the screen 6 to fluorescence. As will be seen V_1 does not enter into this expression directly, but alteration of V_1 will alter I. However, I may be expressed sufficiently accurately by a parabolic form of characteristic thus:

$$I=K\left(\frac{V_1}{\mu}+V_s\right)^2$$

where K is a constant, V_s the voltage on the cathode shield 3 and μ a quantity analogous to the amplification factor of a triode. Accordingly, the condition for constancy of spot brightness independent of spot area becomes:

$$(V_2-V_0)(V_1+V_s)^2\mu=Ad^2$$

where A is a constant. This condition can be satisfied by simultaneously varying any two of the three voltages V_1 V_2 and V_s.

In some designs of cathode ray tube it has been found possible to approach the desired results by varying V_s alone, maintaining V_1 and V_2 constant. In order to insure that the area of the spot and substantially not its intensity will be varied by variation of V_s only, the value of V_1 should be adjusted so that it is either just above or just below that which results in a substantially perfectly focused beam; i. e. V_1 should be just above or just below the value for proper focusing. In this case the maximum spot diameter will be somewhat larger than the smallest spot obtainable. In order to satisfy the formula

$$(V_2-V_0)(V_1+\mu V_s)^2=Ad^2$$

above given, it must be assumed that μ can vary with V_s in such manner as to maintain the product μV_s substantially constant. Some such variation is to be expected on analogy with triode valves in which μ is not really quite a constant and in some designs varies hyperbolically with grid bias in such manner as to maintain the product μ times grid bias substantially constant over a considerable range of grid bias.

Having now described the invention, what is claimed and desired to secure by Letters Patent is the following:

1. A television receiver comprising a cathode ray tube having an electron-gun and a luminescent screen, means to focus electrons from the gun into a beam, means to project the focused beam upon said screen, and means to maintain the beam at constant intensity, and means to vary the area of the beam independently of the intensity thereof.

2. A television receiver comprising a cathode ray tube having an electron-gun and a luminescent screen, means to focus electrons from the gun into a beam, means to project the focused beam upon said screen, means to receive television signals, means to deflect the beam simultaneously in two mutually perpendicular directions, and means to vary the area of the beam by varying only the outer boundary thereof in accordance with the received signals.

3. A television receiver comprising a cathode ray tube having an electron-gun and a luminescent screen, means to focus electrons from said gun into a beam, means to project the focused beam upon said screen, means to receive television signals, means to deflect the beam simultaneously in two mutually perpendicular directions, and means to simultaneously vary the rates of deflection and the area of the beam by varying only the outer boundary thereof in accordance with the received signals.

4. In the method of reproducing pictures wherein is provided a focused beam of electrons impinging upon a luminescent screen, the step of varying the area of the beam by varying only the outer boundary thereof at the point of impingement on the screen in accordance with signals representative of the picture to be reproduced.

5. In the method of reproducing pictures wherein is provided a focused beam of electrons impinging upon a luminescent screen, the steps of simultaneously deflecting the beam in two mutually perpendicular directions, and varying the rates of deflection and only the area of the beam in accordance with signals representative of the picture to be reproduced.

6. The method of reproducing television pictures comprising the steps of producing a beam of electrons, directing said beam against a viewing member, supplying picture signal impulses, moving said beam both vertically and horizontally, and simultaneously varying only the area of the beam and the rate of moving of said beam in accordance with the supplied signal impulses.

7. A television receiver comprising a cathode ray tube, embodying a cathode, a cathode shield, a first anode, and a second anode, means to supply voltages to said cathode, shield, first anode, and

second anode, means to receive signals representative of a picture to be reproduced, and means to vary two of the voltages supplied to the shield, the first anode, and the second anode, in accordance with the received signals whereby the equation

$$(V_2-V_o)(V_1-V_s)=Ad^2$$

wherein

V_1 is the first anode voltage

V_2 is the second anode voltage

V_s is the shield voltage

d is the diameter of the ray,

and

V_o and A are constants

is satisfied.

8. A television receiver comprising a cathode ray tube embodying a cathode, a shield, a first anode, and a second anode, means to receive signals representative of the picture to be reproduced, means to supply constant voltage only slightly different from optimum ray focusing voltage to said first anode, means to supply constant voltage to said second anode, means to supply voltage to said shield, and means to supply the signals between the shield and first electrode.

9. The method of reproducing television pictures comprising the steps of producing a beam of electrons, directing said beam against a viewing member, supplying picture signal impulses, moving said beam both vertically and horizontally, and simultaneously varying the area of said beam by varying only the outer boundary thereof in accordance with said signal impulses.

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