

Feb. 9, 1943.

J. C. BATCHELOR

2,310,671

IMAGE PRODUCER

Filed Feb. 12, 1941

2 Sheets-Sheet 1

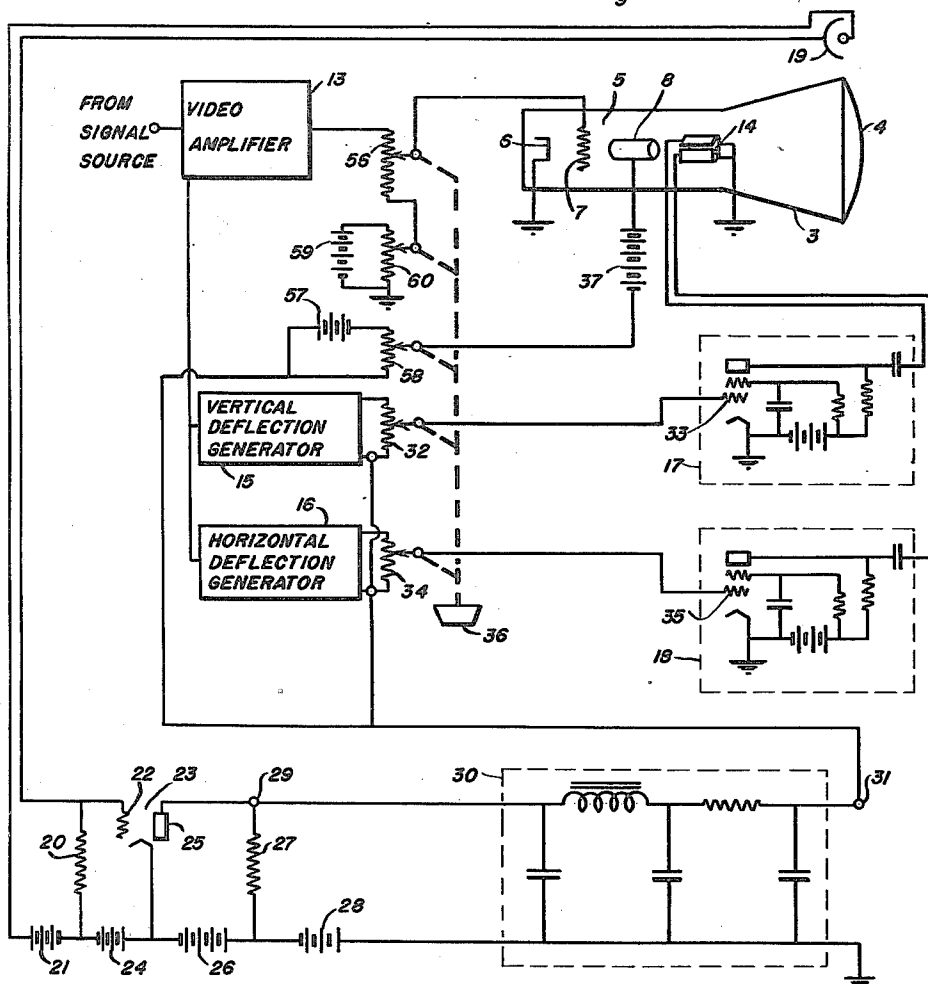
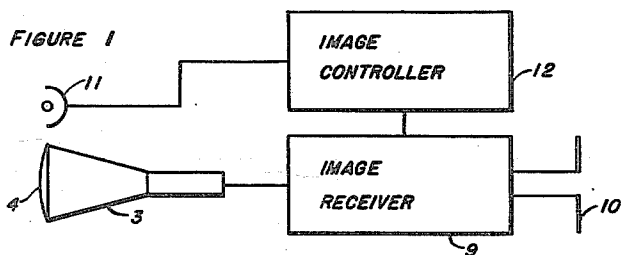


FIGURE 2

Inventor:
John C. Batchelor

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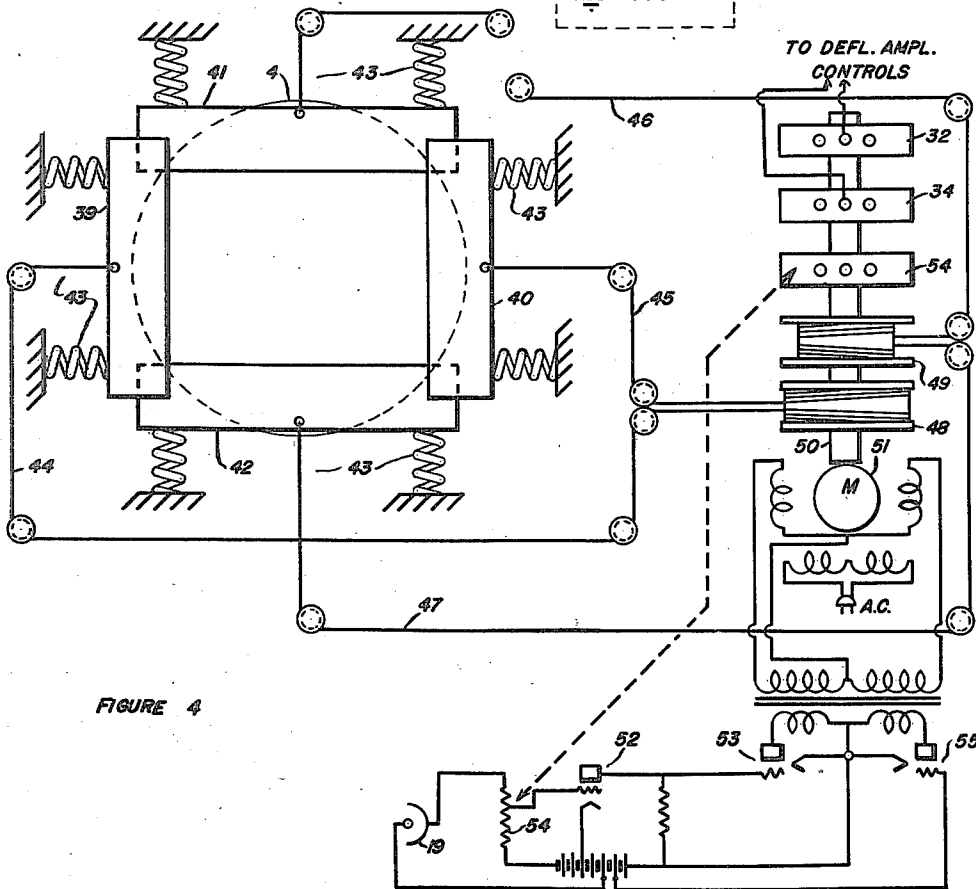
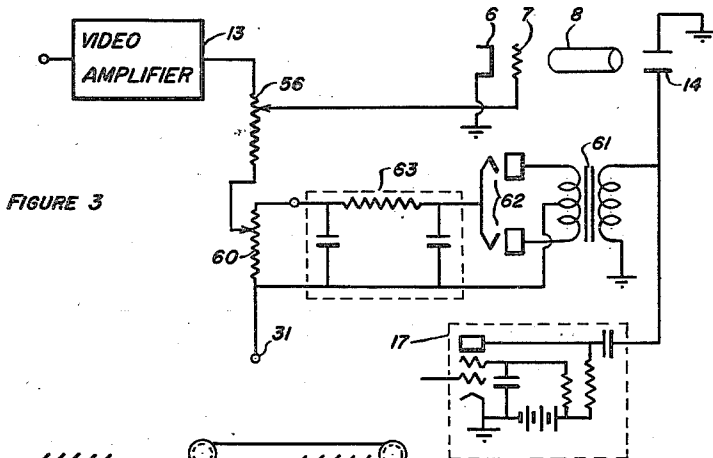
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IMAGE PRODUCER

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2 Sheets-Sheet 2



Inventor:
John C. Batchelor

UNITED STATES PATENT OFFICE

2,310,671

IMAGE PRODUCER

John C. Batchelor, Hastings on Hudson, N. Y.

Application February 12, 1941, Serial No. 378,520

10 Claims. (Cl. 178-7.5)

My invention relates to television receivers, and particularly to a receiver which is capable of giving relatively uniform performance under varying conditions of extraneous light.

In the art of television reproduction, it is frequently necessary to operate an image receiver in a location where the amount of extraneous light falling upon the image screen of the receiver varies from time to time. It has been found desirable when the amount of such extraneous light does change to readjust certain operating parameters of the receiver to maintain the best possible quality of image reproduction. To accomplish this result, I have disclosed in my copending application Serial Number 291,366 filed August 25, 1939, the method of and apparatus for controlling an operating characteristic of an image reproducer automatically in accordance with the intensity of the extraneous light. I have also specifically disclosed the method of and apparatus for automatically controlling the contrast and background level of reproduced images in accordance with extraneous light intensity.

It will be recognized, however, that there are certain limits beyond which the correction of these two operating parameters will no longer be completely feasible. In a cathode ray image receiver, for example, the maximum current which an electron gun is capable of producing in the required small spot size is a practical limit to the feasible image correction.

In view of the fact that the technique disclosed in my above referred to application eventually meets a practical limit beyond which extension is inadvisable, it is an object of this invention to provide certain other means for correcting the aberrations occurring in television images reproduced in the presence of varying amounts of extraneous light, either additionally to or alternately of the methods and apparatus disclosed in my earlier application.

More specifically, it is one object of my invention to provide automatic means for controlling the size of a reproduced optical image in a manner correlated with the amount of extraneous light present at any time.

Another object of my invention is to provide automatic means for controlling the size of the scanning spot in a television image reproducer in accordance with the amount of extraneous light in the location where the reproducer is being operated.

A further object of my invention is to provide an adjustable-aperture image screen mask capa-

ble of adjustment coordinately with changes in the size of the image being reproduced.

Still further objects of my invention lie in the provision of simultaneously operable adjustments for various image characteristics as will be described more fully below.

These and other objects will appear upon examination of the description of my invention which follows.

10 In accordance with one form of my invention, I have provided an image reproducer capable of reproducing visual images of controllable size, light sensitive means responsive to the amount of extraneous light in the location where the reproducer is being operated, and automatic control means for varying the size of the reproduced image under the control of the quantity of extraneous light received by the light sensitive means.

20 In another form of my invention, I have provided a television reproducer of the cathode ray type with light sensitive means responsive to the amount of general illumination which exists in the location where the reproducer is being operated, and automatic control means for varying the size of the scanning spot under the control of the quantity of general illumination received by the light sensitive means.

25 In a further embodiment of my invention, I have provided a single control knob adapted to adjust in accordance with a predetermined law of action at least two variables from the group including image size, image masking aperture size, scanning spot size, image contrast and image background level. This is not, however to be confused with the art taught in United States Patent 2,226,230 in which the scanning spot size is adjusted coordinately with the number of scanning lines in an image of unvarying size.

40 In another form of my invention, I have provided an image reproducer for producing images with varying sizes and an adjustable-aperture image mask adapted to be adjusted automatically in accordance with the size of the image being reproduced at any time.

45 After examining the following detailed description, it will be seen that my principle of image size and scanning spot size control in response to extraneous light may be applied in accordance with any desired law of action to reproduce images of sizes varying in any desired manner in relation to the extraneous light present, and it will be understood that my use of the term "proportional" will include any desired law of action and will in no sense be limited to linear

proportionality, and may be either direct or inverse.

In order to describe my invention more fully, attention is directed to the accompanying drawings in which

Figure 1 represents a block diagram of a television receiver employing my invention,

Figure 2 is a schematic diagram of a typical control circuit adapted for use in my invention.

Figure 3 is a schematic diagram of a modified form which my invention may take, and

Figure 4 is a schematic diagram of a further modified form of my invention.

Referring to Figure 1, an image reproducer 3 is provided which may be of any desired type but is here indicated as being a cathode ray tube on whose image screen 4 an image may be reproduced in accordance with signals provided by the image receiver 9, under the influence of radiation intercepted by the antenna 10. The image receiver 9 will be understood to provide all necessary signals, including intensity and deflection controlling signals, for the image reproducer 3.

A light sensitive device 11 is provided at a point at which it may receive light proportional to the extraneous light in the region about the image screen 4, and a signal is generated thereby which is proportional to the intensity of that extraneous light. The signal so produced is carried to an image controller 12 which generates appropriate control signals in proportion to the amount of light received by the light sensitive device 11. These signals are in turn carried to the image receiver 9 where they are utilized to control the size of the image reproduced on the image screen 4, or the size of the scanning spot, or both.

In order to describe my invention more fully, a more specific embodiment has been shown in Figure 2, but it will be understood that this circuit is shown merely as being a typical application of my invention and does not imply any limitation upon the application of my principle of extraneous light control of image or scanning spot size.

In Figure 2 a cathode ray image reproducer 3 having an image screen 4 is provided with an electron gun 5 comprising a cathode 6, a control element 7 and a focusing element 8.

Signals received from any appropriate signal source are accepted by the video amplifier 13, and, after amplification thereby, are impressed upon the control element 7 of the image reproducer 3 under the control of the potentiometer 56, as will be described hereinafter.

The image reproducer 3 is provided with appropriate deflecting means 14, in the form of deflecting plates in the example shown, which are adapted to be energized by the vertical deflection generator 15 and the horizontal deflection generator 16 through the controllable amplifiers 17 and 18 respectively, the inputs to the latter amplifiers being under the control of the potentiometers 32 and 34, respectively. The deflection generators 15 and 16 are appropriately synchronized by signals derived from the video amplifier 13 in accordance with known practice.

A light sensitive device 19, which may, for example, be a caesium photoelectric cell, is provided at a point directly adjacent the image screen 4 or at some other point where it may receive extraneous light in an amount proportional to the light competing with the image being reproduced on the image screen. The output voltage which appears across the photocell

resistor 20 caused by current from the photocell battery 21 under the control of the light sensitive device 19 is impressed upon the grid 22 of the control tube 23 which may be a triode amplifier, as shown, or any other amplifying device. The bias battery 24 may be provided if desired to maintain a predetermined reference voltage upon the grid 22. The plate 25 of the control tube 23 is energized by the battery 26 through the load resistor 27 to produce therein a current varying in proportion to the current in the photocell resistor 20. Thus, a voltage is available across the resistor 27 which is a function of the amount of light falling upon the light sensitive device 19.

When desired, an additional bias battery 28 may be provided for impressing a reference potential upon the control elements of the controllable amplifiers 17 and 18. Because the current in the plate resistor 27 increases as the voltage on the grid 22 becomes less negative, a voltage with respect to ground will exist on the terminal 29 having a constant negative potential with respect to ground increased by the potential drop across the resistor 27, under the influence of the control circuit. The voltage with respect to ground on the terminal 29 may, if desired, be smoothed by the filter 30 to provide a filtered control voltage on the terminal 31. The potential on this terminal will be negative with respect to ground and will be varying with the intensity of light impinging the light sensitive device 19 in accordance with any required law of action which may be introduced by the control tube 23, the filter 30 or by other means when required.

The output of the vertical deflection generator 15 is impressed across the vertical deflection amplitude control 32 and the control output is impressed upon the control element 33 of the controllable amplifier 17. Similarly, the output of the horizontal deflection generator 16 is impressed upon the horizontal deflection amplitude control 34 whose output is in turn depressed upon the control element 35 of the controllable amplifier 18. The controllable amplifiers 17 and 18 may conveniently be of the type in which the amplification varies as a function of the average voltage on the control element. Thus, the control potential between ground and the terminal 31 when impressed through the controls 32 and 34 upon the control elements 33 and 35 of the amplifiers 17 and 18 will control the amplification of the latter amplifiers in accordance with the intensity of light incident upon the light sensitive device 19.

As indicated, I prefer to provide a single control knob 36 adapted to adjust the controls 32 and 34 simultaneously in order to maintain the aspect ratio of the reproduced image at the proper value. Otherwise, an operator confronted with individual controls will have no way of knowing what aspect ratio to adjust for, and serious distortion of performers' faces and the like may occur.

It will be seen that it is frequently desirable to provide a relatively long time constant in the filter 30 in order to prevent short period fluctuations in the image size when, for example, a person walks about the room, momentarily intercepting the extraneous light incident upon the receiver. Thus, a time constant of several seconds or even a minute or so may frequently be desirable to avoid transitory changes of image size.

As has been pointed out, a focusing element 8 is provided in the electron gun 5 and it is frequently desirable to adjust the degree of cathode ray focusing, for example, when the size of the scanned area is changed. By this expedient, dark lines between the scanning lines, or other operating shortcomings may be prevented. In order to accomplish this change of focusing, in addition to or instead of the change of image size, the focusing element 8 is energized by the battery 37 to whose potential the potential difference between the terminal 31 and ground is algebraically added through the potentiometer 53. Thus, as the intensity of light falling upon the light sensitive device 13 varies producing a varying potential on the terminal 31, the focusing of the electron beam will be correspondingly varied.

It may be seen that automatic focusing responsive to extraneous light may frequently be desirable when the image size is not being changed. For example, because of the varying distribution of luminous intensity across the scanning spot, it is desirable to permit a certain amount of overlap of the scanning lines. When the average intensity of the scanning spot is changed, however, for example in accordance with the teaching of my application Serial Number 291,866, the required amount of overlap may also change. Accordingly, the technique here disclosed of varying the focusing potential responsive to extraneous light may be employed to advantage in conjunction with the control of image contrast or background level as taught in that application, or in any other case as required.

Moreover, it will now be seen that when the image size is modified manually, as by changing the adjustment of the controls 32 and 34 under the influence of the knob 36, it will often be desirable simultaneously to control the scanning spot size. This control should be accurately correlated with the image size and such correlation cannot properly be left to the operator. Accordingly, it is convenient to provide the focusing battery 57, a controlled portion of whose potential may be added to the potential of the battery 37 upon the focusing element 8, under the control of the potentiometer 58. The potentiometer 58 is preferably mechanically associated with the control knob 36 and is provided with a law of action such that the scanning spot size will be modified in such a way as to remain properly correlated with the size of the scanning pattern. Thus, I have provided a single control knob 36 capable of correlated control of the scanning spot size and the scanned pattern size independently of the judgment of an operator, thereby maintaining correct image reproducing conditions.

It will be recognized that when the image size is increased, an increased value of minimum scanning beam current will be required to bring the screen illumination up to the threshold of visible luminosity. Accordingly, I have further provided the auxiliary bias battery 59, a portion of whose potential is impressed upon the control element 7 under the control of the potentiometer 60. Inasmuch as the above identified minimum scanning beam current may to advantage be controlled with particular precise coordination with the image size, I have coordinated the operation of the potentiometer 60 with movement of the control knob 36, and the potentiometer 60 will be provided with the required law of action to maintain proper correlation between the minimum beam current and the image size.

Still further, it will be understood that the best adjustment of image signal strength to be impressed upon the reproducer control element 7 will vary with the size of the scanned pattern. Accordingly, the potentiometer 56 is provided to control this signal strength under the influence of the control knob 36, and its law of action is also chosen to provide proper coordination between the signal strength and the image size.

It will be understood that the correlation between the laws of action of the controls which are actuated by the control knob 36 may be readily computed by those skilled in the art, and may even be made to depart from the best computed values to compensate for system aberrations. Moreover, mechanical interconnection between these controls has been shown merely for convenience and it will be understood that any convenient coupling expedient may be employed as dictated by specific design considerations.

Thus, by way of just one example of a multitude of variants, the control potential, yielded in the embodiment shown by the potentiometer 60, for varying the bias on the control grid 7 can readily be provided by rectifying and filtering a portion of the output of the amplifier 17.

The apparatus by which this result may be accomplished is shown in Figure 3 which resembles the apparatus of Figure 2 in that a video amplifier 13 provides control signals through the potentiometer 56 to the control element 7 in the image reproducer. Deflecting potentials are impressed upon the deflecting plates 14 by the amplifier 17.

The output signal from the amplifier 17, in addition to being impressed upon the deflecting plates 14, is also impressed upon the transformer 61 whose secondary voltage is rectified by the full wave rectifier 62, filtered by the filter 63 and impressed upon the potentiometer 60. It will be seen that a unidirectional voltage will be produced across the potentiometer 60 which is a function of the alternating voltage of the output of the amplifier 17, so that the bias potential on the control element 7 will be varied as the output of the amplifier 17 varies and in a sense such that the bias on the control element 7 will become more positive, or less negative, as the image size increases.

Certain further modifications of apparatus employing the broader concepts of my invention are disclosed in Figure 4, to which reference is now made.

It is common practice in the television receiver art to employ a cathode ray image reproducer whose light producing structure is masked by an opaque mask which hides the marginal portions of the reproduced image from view. Certain distortions which sometimes appear in these marginal areas are thus obscured from view. It will be seen that when my principle of image size control is employed, such a fixed mask would be serviceable only at one size of reproduced image. Accordingly, the embodiment shown in this figure has as one of its objects the provision of an automatically controlled mask the size of whose aperture is controlled in accordance with the size of the reproduced image, the amount of extraneous light surrounding the receiver, or other parameter, as desired.

Referring now particularly to Figure 4, an image screen 4, which may be the end of a cathode ray tube, is provided behind an adjustable mask comprising movable vanes 39, 40, 41 and

42, all urged inwardly by the springs 43. The vanes, however, are held outwardly against the pressure of the springs 43 by the cords 44, 45, 46 and 47 which are wound about the drums 48 and 49 carried on the shaft 50 which is adapted to be rotated by the motor 51. Thus, it will be seen that rotation of the shaft 50 will operate through the drums 48 and 49 to modify the lengths of the cords 44 to 47 to modify the size of the masking window produced by the cooperation of the vanes 39, 40, 41, 42. When the aspect ratio of the reproduced image is different from unity, the diameter of the drums 48 and 49 will be appropriately chosen so that a constant aspect ratio will exist in the masking aperture just described. Thus, in the example shown, with an aspect ratio of 3 to 4, the drum 48 will have a diameter of four-thirds of the diameter of the drum 49 so that the vanes 39, 40 will be moved four-thirds of the distance the vanes 41 and 42 are moved.

Carried on the shaft 50 and operated thereby are the two amplitude controls 32, 34 which act to control the size of the scanned pattern on the image screen 4 when the shaft 50 is rotated. The scanned area will customarily be adjusted to be slightly larger than the size of the masking aperture, but any desired operating relation between these sizes may be used as desired.

The motor 51 for rotating the shaft 50 may be of any desired type, but in the example shown is a reversing induction motor with wound shading poles which is adapted to be energized under the control of the desired variable to adjust the masking aperture size and the scanning pattern size in accordance with the desired variable. This type of motor control is fully described on page 158 of the book "Electron Tubes in Industry" by Keith Henney, second edition, published in 1937 by McGraw-Hill Book Company. In the present application of that type of motor control circuit, the light sensitive device 19 is provided whose output is amplified by the amplifier 52 and is impressed upon the control element of the control tube 53. Another potentiometer 54 is provided on the shaft 50 and controlled thereby and is adapted to adjust the portion of the signal produced by the light sensitive device 19 which is impressed upon the amplifier 52 and in turn upon the control tube 53. In normal operation, the motor 51 will operate in the proper direction until the potentiometer 54 is adjusted to the point where the control voltage on the control tube 53 bears a predetermined relation to that upon the control tube 55 whereupon the motor 51 will rest until the condition at the light sensitive device 19 changes. Thus, it will be seen that the size of the masking aperture and the size of the scanned pattern are controlled in accordance with the amount of extraneous light falling upon the light sensitive device 19.

It will be understood that my invention may frequently be simplified for economy or other reasons by making the size of the masking aperture variable in one direction only. For example, the aberrations in cathode ray image reproduction frequently vary as a function of the amount of deflection, so that a mask whose horizontal dimension only is variable will yield certain operating improvement over an unmasked image.

It will be further seen that various mechanical and electrical expedients may be employed for

adjusting the size of the masking aperture either conjointly with or independently of the size of the scanned pattern. Moreover, my invention contemplates, when desired, the replacement of the motor 51 with a control knob whereby a manual control is provided for adjusting the size of the scanning pattern and of the masking aperture conjointly when desired.

It will be understood that vacuum tube amplifiers or repeaters are not essential to my invention when a light responsive means of appropriate sensitivity is used; thus, the voltage appearing directly across the photocell resistor 20 may be applied directly with the proper polarity to accomplish the required control function or functions.

It will be further understood that by extraneous light in the foregoing specification and in the claims, I mean light which falls upon an image reproducer from a source extraneous to and uncoordinated with the image reproducing system.

I claim:

1. Image producing apparatus adapted to compensate for varying general illumination in the location in which the apparatus is operated comprising an image screen, means for energizing said screen to reproduce an image thereon, said energizing means being so arranged and constructed as to permit the modification of the size of said reproduced image, light sensitive means disposed to receive light at a level corresponding to the general illumination level and arranged to generate control signals varying in accordance with said illumination level, and means for causing said generated signals to decrease the size of said reproduced image as said general illumination level increases.

2. Visual signal producing apparatus for use in a room where the general room illumination varies comprising a cathode ray tube having a light producing screen, adjustable means for energizing said screen to reproduce visual signals thereon, said energizing means being so arranged and constructed as to permit the modification of the size of said reproduced visual signals, light sensitive means responsive to the room illumination level and arranged to generate control signals varying in accordance with said illumination level, and means for adjusting said adjustable energizing means in response to said control signals for increasing the size of said reproduced visual signals as said room illumination level decreases.

3. A television receiver comprising means for receiving television signals, an image reproducer for reproducing images corresponding to said signals, means for controlling the size of the images reproduced by said image reproducer, a light sensitive device positioned and constructed to detect illumination impinging on the receiver from a source exterior thereto and arranged to generate control signals substantially independent of said television signals but corresponding to the level of said exterior illumination, and means for impressing said generated control signals upon said image size controlling means for modifying the size of said reproduced images inversely with changes in the intensity of said exterior illumination.

4. A television receiver adapted for use in a room where the general room illumination varies comprising means for receiving television signals, an image screen associated therewith, means for energizing said screen to reproduce an image thereon, said energizing means being so arranged and constructed as to permit the modification of

the size of said reproduced image, light sensitive means associated with said receiver and disposed to receive light at a level corresponding to the general room illumination falling upon said image screen for producing signals corresponding to said general illumination level, and means for causing said signals to modify the size of said reproduced image independently of said received television signals as an inverse function of said general room illumination.

5. A television image receiver adapted for use in a room where the general room illumination varies comprising an image reproducer adapted to reproduce television images, adjustable means for controlling the size with which said images are reproduced, light sensitive means responsive to the general room illumination level and arranged to generate control signals varying in accordance with said illumination level, and means for adjusting said adjustable means in response to said control signals for modifying said image size as a reciprocal function of said generated control signals.

6. A television image receiver adapted for use in a room where the general room illumination varies comprising a cathode ray tube having an image screen and means for generating an electron beam, means for receiving television signals, means for controlling the intensity of said electron beam in accordance with received television signals, adjustable means for causing said electron beam to scan said image screen under the partial control of said received signals, light sensitive means responsive to the room illumination level and arranged to generate control signals varying in accordance with said illumination level, and means responsive to said control signals for adjusting said adjustable scanning means to modify the size of the image reproduced on said image screen as an inverse function of said illumination level.

7. A television image receiver for use in a location of varying general illumination comprising an image reproducer having an image screen and arranged to reproduce images by scanning said screen with a scanning spot to produce a multiplicity of scanning lines, means for adjusting the size of said scanning spot, means for con-

trolling the average intensity of said scanning spot, and means responsive to the varying general illumination for increasing said spot size and intensity adjusting means in accordance with increases in the intensity of the varying general illumination.

8. A television image receiver for use in a location of varying general illumination comprising an image screen, means for generating and causing a scanning spot to explore said image screen, means responsive to the general illumination about said image screen for generating control signals in accordance therewith, and means for causing said control signals to adjust the size and intensity of said scanning spot as direct functions of the intensity of said general illumination.

9. In an image reproducer for use in a location of varying general illumination, adjustable means for modifying the size of a reproduced image, controllable masking means for obscuring predetermined marginal portions of the reproduced image from view, means responsive to the general illumination about said image reproducer for generating control signals in accordance therewith, and adjusting means responsive to said control signals for conjointly modifying the adjustments of said adjustable means and said controllable masking means in accordance with the intensity of said general illumination.

10. Television image producing apparatus comprising: a cathode ray tube having a light producing screen, means for generating an electron beam, and means for controlling the intensity of said beam; deflecting signal generating means for producing signals cooperative with said cathode ray tube for causing said electron beam to explore said light producing screen, said generating means being so arranged and constructed as to permit adjustment of the output thereof; and means for developing from said generated signals a steady potential proportional to the strength of said signals and for impressing said steady potential upon the control element of said cathode ray tube to modify the average intensity of said electron beam as a function thereof.

JOHN C. BATCHELOR.