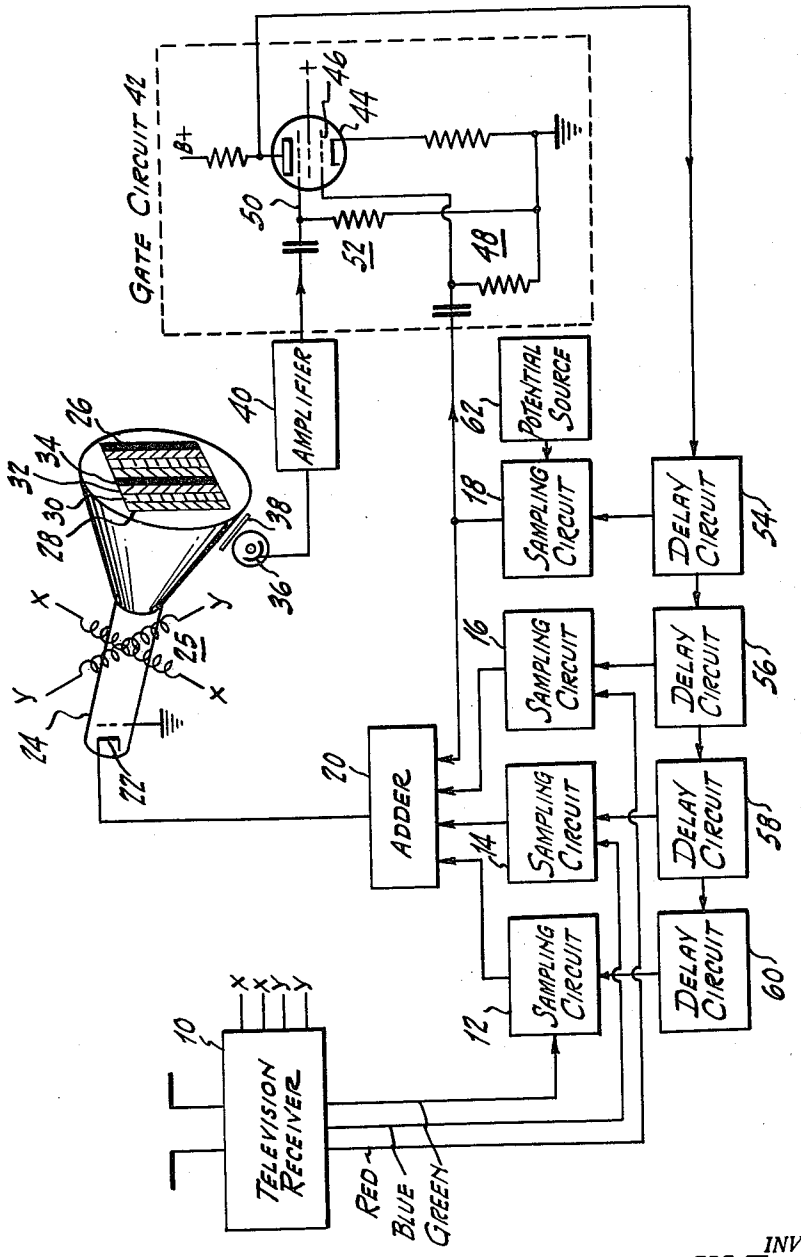
Jan. 12, 1960 J. W. SCHWARTZ 2,921,119

COLOR TUBE, CONTROL SYSTEM

Filed Oct. 26, 1954



INVENTOR.
JAMES W. SCHWARTZ
BY
ATTORNEY

United States Patent Office 2,921,119 Patented Jan. 12, 1960

2,921,119

COLOR TUBE, CONTROL SYSTEM

James W. Schwartz, Princeton, N.J., assignor to Radio Corporation of America, a corporation of Delaware

Application October 26, 1954, Serial No. 464,744

6 Claims. (Cl. 178—5.4)

This invention relates to a color television system and more particularly to methods and arrangements for reproducing images in substantially their natural color.

It has been previously proposed to produce an image in color by causing a single beam of electrons to impinge repeatedly upon different component color light producing elements on a target electrode. The beam of electrons is then sequentially intensity modulated with different color signals, in synchronism with the sequential excitation by the electron beam of the component color light producing elements. To properly reproduce an image in this manner it is necessary that there be color coincidence i.e., synchronization between the intervals of modulation during which the electron beam is intensity modulated with a particular component color signal, and the intervals of excitation, during which the target electrode is producing a particular component color.

It has been proposed to position certain signal generating elements upon the target electrode which will cause a signal to be generated as the target electrode is scanned by an electron beam. The signal generating elements may take any of several forms including arrangements wherein they are composed of secondary emissive material, of photo emissive material, of conducting material, or void of any electron beam responsive material with the remainder of the target composed of material responsive to electron beam energy. The fact that the signal from the signal generating elements is indicative of beam position with respect to the target electrode, enables utilization of this signal to control the relationship between the intervals of modulation and the intervals of excitation. The target generated signal from the signal generating elements may contain random false impulses resulting from the varying electron beam intensity as the electron beam scans the target electrode and from spurious signals injected into the target generated signal.

With the object of creating a more uniform target generated signal it has been previously proposed to cause the electron beam to be substantially constant during the intervals when the signal generating elements are excited. As a result the target generated signal is not dependent upon the magnitude of the video signal intensity modulating the electron beam. Exciting the signal generating elements by a periodically essentially constant intensity electron beam, however, does not entirely remove the spurious and random impulses from the target generated signal, other impulses are, for example, created by pickup from the varying energy content of the electron beam.

In its more general form the present invention contemplates a method and apparatus for the essential elimination of random false impulses from a target generated signal, generated by an electron beam scanning a target electrode, and utilized to control the electron beam. The target generated signal may be formed by causing an electron beam to periodically impinge upon signal generating elements substantially during intervals when the intensity of the electron beam is essentially constant. A gating circuit is placed in the path of the target generated signal

which will allow the passage of the target generated signal only during the intervals when the electron beam intensity is essentially constant which interval coincides with the intervals during which the target signals are formed.

An object of this invention is to provide an improved color television image reproducing system.

Another object of this invention is to provide a system in which a target generated signal generated by causing an electron beam to scan a target electrode, is essentially free of random impulses.

A further object of this invention is to provide a color television system wherein a target signal is generated by an electron beam scanning a target electrode and used to effect correct color reproduction, is substantially free of spurious impulses.

Other and incidental objects of this invention will be apparent to those skilled in the art from reading the following specification and on inspection of the accompanying drawings in which:

The single figure of the invention shows a block and circuit diagrammatic representation of a system of the invention.

In the figure there is shown a color television receiver **10** for generating three color output signals, each representative of a component color, a red signal R, a blue signal B and a green signal G. Such a receiver is shown and described in a series of articles entitled "Fundamentals of Color Television" which appeared in Radio Television News, beginning March 1954, and were written by Milton S. Kiver.

The color output signals from the color television receiver **10** are connected to deliver the green signal G to a sampling circuit **12**, the blue signal B to a sampling circuit **14**, and the red signal R to a sampling circuit **16**. The sampling circuits **12**, **14** and **16** plus an additional sampling circuit **18** are connected so as to sequentially pass signals to an adder circuit **20** in such a manner that the outputs of the sampling circuits **12**, **14**, **16** and **18** will be combined in the adder circuit **20** to form a composite signal. The composite signal from the adder circuit **20** is connected to be applied to a cathode **22** of an image reproducing tube **24**. The image reproducing tube **24** is provided with a target electrode **26**. The target electrode **26** comprises groups of component color light producing strip-like elements **28**, **30**, **32** and **34**. The strip-like elements **28**, **30** and **32** are composed respectively of red light producing phosphor material, blue light producing phosphor material, and green light producing phosphor material. The strip-like control elements **34** are composed of ultra violet light producing phosphor material.

The image reproducing tube **24** is provided with deflection coils **25** for deflecting an electron beam in the tube **24** in a raster fashion. The deflection signals are derived from the television receiver **10**.

Positioned exterior to the image reproducing tube **24** is a photoelectric device **36**. Separating the photoelectric device **36** from radiation sources within the image reproducing tube **24** is an ultra violet light passing filter **38**. The electrical target generated signal output from the photoelectric device **36** is connected to an amplifier **40** and thence, after amplification, to a gate circuit **42**.

The gate circuit **42** consists of a vacuum tube **44** adapted to receive two input signals. One of the input signals to the vacuum tube **44** is applied to a grid **46** through an input circuit **48**, the other input signal i. e., the target generated signal is applied to a grid **50** through an input circuit **52**. The output of the vacuum tube **44** from a plate electrode is serially connected to a group of delay circuits **54**, **56**, **58** and **60**. Each of the delay circuits **54**, **56**, **58** and **60** are respectively connected to control one of the sampling circuits **18**, **16**, **14** and **12**. Whereas

the sampling circuits **12**, **14** and **16** are adapted to gate the color signals R, B, and G to the adder circuit **20**, the sampling circuit **18** is connected to a potential source **62** such that the function of the sampling circuit **18** is to periodically sample i.e., gate a substantially constant voltage to the adder circuit **20**.

In regard to the operation of the system shown in the figure, the three color signals R, G, and B from the color television receiver **10** are each representative of the intensity of component color light to be reproduced in a televised image. The function of the sampling circuits **12**, **14**, **16** and **18** is to sequentially operate to form a composite signal. During different intervals the composite signals is sequentially representative of different of the color signals R, B, G or the substantially constant voltage. The composite signal formed in the adder circuit **20**, is utilized to intensity modulate an electron beam in the image reproducing tube **24**, by application of the composite signal to the cathode **22**.

As the intensity modulated electron beam is deflected over the target electrode by means of the deflection coils **25**, the excitation intervals during which the electron beam impinges upon each of the strip-like elements **28**, **30**, **32** or **34** must coincide with the modulation intervals during which the electron beam is modulated respectively by certain of the signals R, B, G or the substantially constant signal. During the interval when the electron beam is intensity modulated by the red signal R, for example, the electron beam must be impinging upon the strip-like elements **28** which will produce red light when excited by the electron beam. Similarly, during the interval when the blue light is being reproduced, i. e., the electron beam is impinging upon the blue light producing strip-like elements **30**, the electron beam should be modulated by the blue signal B. During the time when the electron beam should be intensity modulated by the green signal G, the electron beam must impinge upon the green light producing strip-like elements **32**. During the excitation intervals when the ultra violet light producing strip-like elements **34** are excited, the electron beam should be held at a substantially constant level thereby eliminating the video signals from the target generated signal generated by the electron beam impinging upon the elements **34**.

The photoelectric device **36** primarily receives the target generated signals of ultra violet light radiated from the strip-like elements **34**. The target generated signals sensed by the photoelectric device **36** are amplified by the amplifier **40** and applied by means of the input circuit **52** to the grid electrode **50** of the electron tube **44**. The input circuit **48** which is connected to receive a gating signal from sampling circuit **18**, will receive such a gating signal only during the interval when the electron beam is at a predetermined substantially constant level, that is, not modulated by video signals. It is during this constant beam interval that the ultra violet light producing elements **34** are to be excited, and therefore during this constant beam interval at the target generated signal sensed by the photoelectric device **36** is desired to be received. It may therefore be seen that the gate circuit **42** with the periodic application of the gating signal to the grid **46** of the electron tube **44**, will periodically allow the passage of the target generated signal. The gating signal will occur only during the interval when the electron beam is essentially constant thus only during this interval will the target generated signal pass the gate circuit **42**. The gated target generated signal passing through the gate circuit **42** is delayed, by various predetermined amounts in the delay circuit **54**, **56**, **58** and **60**. The signal output from each of the delay circuits **54**, **56**, **58** and **60** to the respective sampling circuits **18**, **16**, **14** and **12** are each phase shifted in such a manner as to be essentially 90° apart. Upon receiving the phase shifted signals, the sampling circuits **12**, **14**, **16** and **18** are sequentially opened in phase quadrature to sample i.e., allow the passage of respectively the green signal G, the blue signal B, and the red signal R, and a substantially constant voltage from the potential source **62**. The time delay of the delay circuits **54**, **56**, **58** and **60** is so arranged that the electron beam will be intensity modulated by a color signal which coincides in color with the color of light produced by the light producing elements on which the electron beam is instantaneously impinging.

During the normal operation of an arrangement of this type random impulses will be picked up by the photoelectric device **36** during intervals other than those which are utilized to excite the ultra violet light producing phosphor elements **34**, however, with the provision of the gating circuit **42** a substantial part of such random impulses will be eliminated and the circuit will tend to be less likely to alter the intervals of modulation in response to false impulses occurring in the target generated signal.

It may therefore be seen that the invention provides an improved system for reproducing color television, and further a method and apparatus for generating a target generated signal essentially free of random impulses.

Having thus described the invention, what is claimed is:

1. A system for controlling an electron beam comprising a target electrode having signal generating elements positioned thereon, said signal generating elements for developing a target generated signal as said target electrode is scanned by an electron beam, means for producing an electron beam for scanning said target electrode, means for causing said electron beam to maintain a substantially constant intensity during excitation intervals substantially only when said electron beam excites said signal generating elements, sensing means for sensing said target generated signal to form an electrical target generated signal, gating means for allowing the passage of said electrical target generated signal substantially only during said excitation interval to form a gated electrical target generated signal, and means for utilizing said gated electrical target generated signal to control the phase relation between the modulation of said electron beam and the position of said electron beam.

2. A color television system comprising a target electrode having signal generating elements positioned thereon, said signal generating elements for generating a target generated signal upon being excited by electron beam energy, means for generating an electron beam for scanning said target electrode, means for establishing the intensity of said electron beam at a substantially constant level during predetermined intervals, said predetermined intervals being such as to substantially coincide in time with and occur substantially only during excitation intervals during which said electron beam excites said signal generating elements, sensing means for sensing said target generated signal from said signal generating elements to form an electrical target generated signal, gating means for passing said electrical signal substantially only during said excitation intervals to form a gated electrical target generated signal, and means for utilizing said gated electrical target generated signal to control the phase relation between the modulation of said electron beam and the position of said electron beam.

3. A color television system comprising a target electrode having signal generating elements positioned thereon, said signal generating elements for generating a target generated signal upon being excited by electron beam energy, means for generating an electron beam for scanning said target electrode, means for establishing the intensity of said electron beam at a substantially constant level during predetermined intervals, said predetermined intervals being such as to substantially coincide in time with and occur substantially only during excitation intervals during which said electron beam excites said signal generating elements, sensing means for sensing said target generated signal from said signal generating elements to form an electrical target generated signal, gating means for passing said electrical signal substantially only during said excitation intervals to form a gate electrical target

generated signal, and means for utilizing said gated electrical target generated signal to control said electron beam, said gating means comprising an electron discharge device, biasing means for biasing said electron discharge such as to prevent the flow of current in said electron discharge device, means for applying a gating signal to said electron discharge device to cause said electron discharge device to be conductive during said excitation intervals, and means for varying the current in said electron discharge device during said excitation interval according to said target generated signal.

4. A color television system comprising a target electrode having signal generating elements positioned thereon, said signal generating elements for generating a target generated signal upon being excited by electron beam energy, means for generating an electron beam for scanning said target electrode, means for establishing the intensity of said electron beam at a substantially constant level during predetermined intervals, said predetermined intervals being such as to substantially coincide in time with and occur substantially only during excitation intervals during which said electron beam excites said signal generating elements, sensing means for sensing said target generated signal from said signal generating elements to form an electrical target generated signal, gating means for passing said electrical signal substantially only during said excitation intervals to form a gated electrical target generated signal, and means for utilizing said gated electrical target generated signal to control said electron beam, said means for utilizing said gated electrical signal to control said electron beam comprising a plurality of sampling devices, said sampling devices being connected to means for modulating said electron beam, means for developing a plurality of sampling control signals from said gated electrical signal, and means for connecting said sampling control signals to said sampling devices.

5. A television system comprising a target electrode having a plurality of light producing elements and a plurality of signal generating elements, different of said light producing elements for producing different component colors of light upon being excited by electron beam energy, said plurality of signal generating elements for producing a target generated signal upon being excited by electron beam energy during an excitation interval, means for generating an electron beam for scanning said target electrode, means for intensity modulating said

electron beam, switching means adapted to receive different component color signals and a substantially unvarying signal, said switching means being connected to said modulating means such as to intensity modulate said electron beam sequentially by said color signals and said substantially unvarying signal, means for sensing said target generated signal, gating means adapted to receive said target generated signal for gating said target signal substantially only during said excitation interval to form a gated target generated signal, and means connecting said gated target generated signal to control said switching means such that said intensity modulation of said electron beam by said substantially unvarying signal substantially coincides in time with said excitation interval.

6. A television system comprising a target electrode having a plurality of light producing elements and a plurality of signal generating elements, different of said light producing elements for producing different component colors of light upon being excited by electron beam energy during certain intervals of excitation, said plurality of signal generating elements for producing a target generated signal upon being excited by electron beam energy during other intervals of excitation, means for generating an electron beam for scanning said target electrode, means for intensity modulating said electron beam, switching means adapted to receive different component color signals and a substantially unvarying signal, said switching means being connected to said modulating means such as to intensity modulate said electron beam sequentially by said color signals and said substantially unvarying signal during different intervals of modulation, means for sensing said target generated signal, gating means adapted to receive said target generated signal for gating said target generated signal substantially only during said other intervals of excitation to form a gated target generated signal, and means connecting said gated target generated signal to control said switching means such that particular of said intervals of modulation occur during said certain intervals of excitation.

References Cited in the file of this patent

UNITED STATES PATENTS

2,674,651	Creamer	Apr. 6, 1954
2,681,381	Creamer	June 15, 1954
2,689,269	Bradley	Sept. 14, 1954
2,736,764	Bingley	Feb. 28, 1956