Jan. 22, 1946. M. CAWEIN 2,393,235

COLOR FLICKER REDUCING APPARATUS

Filed Feb. 28, 1944 2 Sheets-Sheet 1

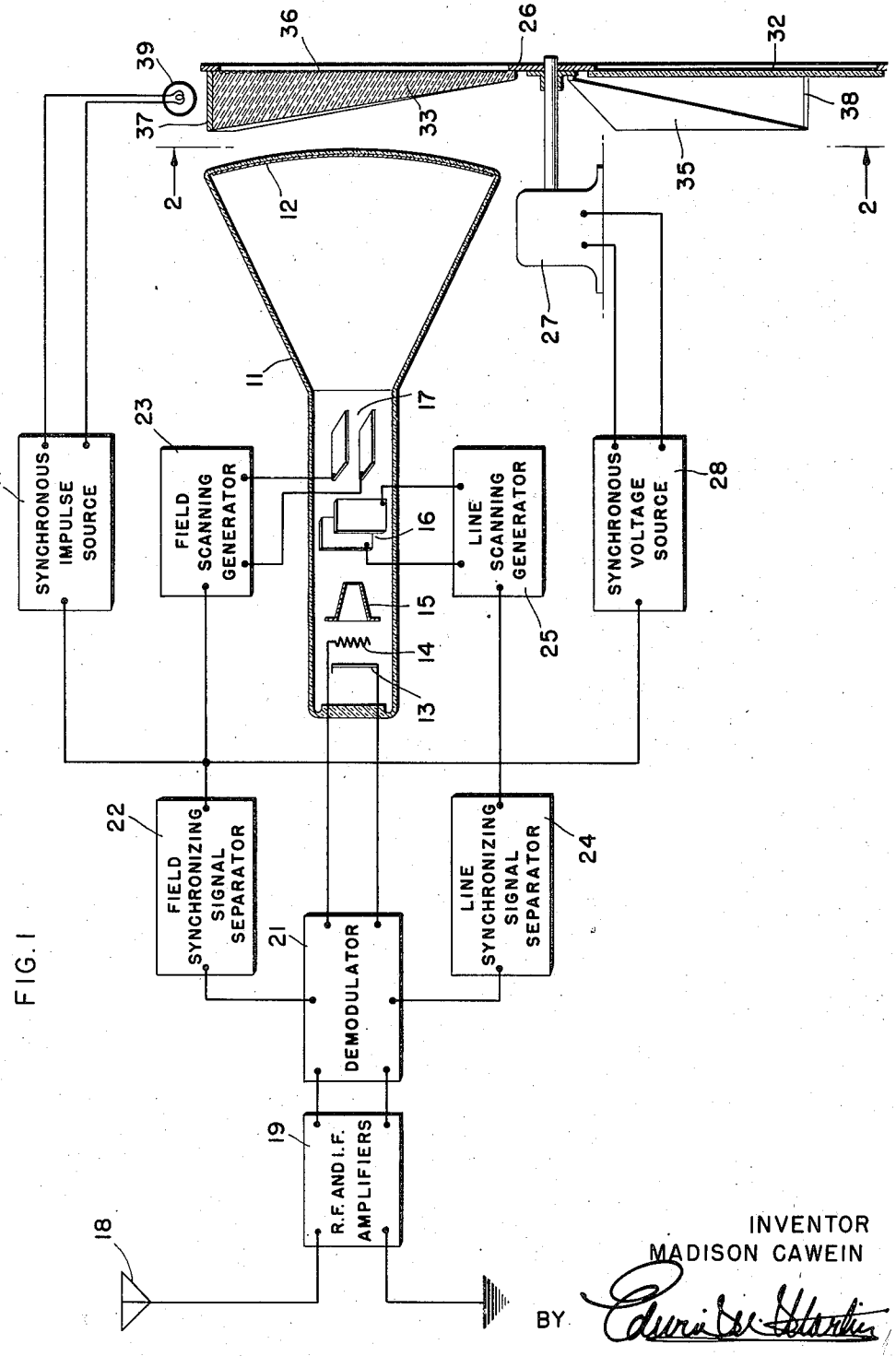


FIG. 1

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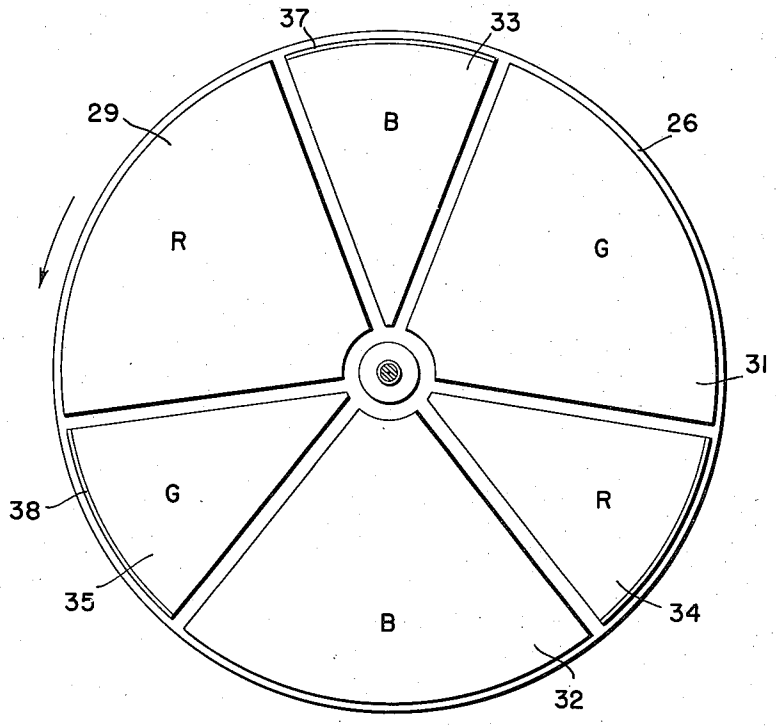
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FIG. 2



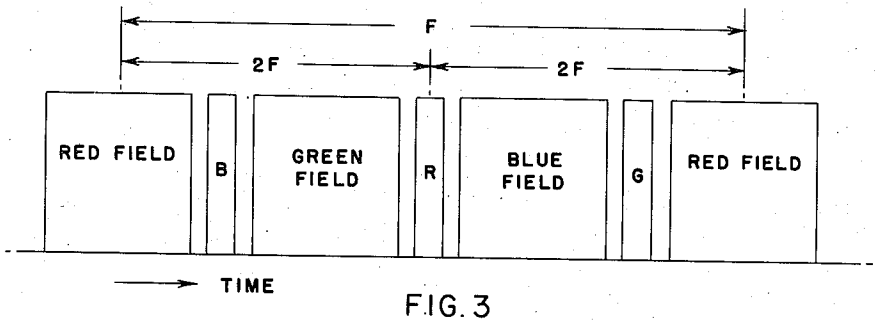


FIG. 3

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COLOR FLICKER REDUCING APPARATUS

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13 Claims. (Cl. 178—5.4)

This invention relates to color television receiving systems and particularly to a method of and means for reducing color flicker effects in systems of this character.

According to conventional practice a simulation of a colored television image is produced by forming a succession of partial television images upon the screen of a signal reproducing device. Each partial image which is formed upon the screen in black and white represents the portions of the television subject having one of a plurality of primary colors. The succession of images thus produced is viewed through color filters each corresponding to the primary color which the partial image represents. It is customary to embody the color filters in such a manner that they are successively moved into position between the screen of the reproducing device and the observer.

As is well known in the art, however, considerations, such as maintaining the band of transmitted frequencies to a minimum commensurate with the reproduction of television images of adequate entertainment value, limit the number of partial images or color fields, as they are sometimes called, which may be transmitted in a given time. In a frequently employed system of this character there are transmitted sixty double interlaced picture fields per second. If it is desired to reproduce the picture in three colors, the succession of sixty fields will include twenty fields of each color. In other words, each color repetition is at the rate of twenty cycles per second. At such a relatively low frequency a noticeable and somewhat annoying color flicker effect is produced.

It is an object of the present invention, therefore, to provide a method of and apparatus for rendering color flicker in a color television signal receiving system less noticeable without increasing the band width requirements of the transmission channel.

In accordance with the invention the method of reducing the objectionable effects of color flicker in a color television signal receiving system resides in the production of additional color effects corresponding to the respective colors of the reproduced image, whereby to increase the frequency of occurrence of the different colors. In this manner the observer is less conscious of the intermittent viewing of the various colors.

Apparatus embodying the invention capable of employing the novel method includes a member supporting the various color filters through which the screen of a signal reproducing device may be viewed. Additionally, there is provided apparatus for producing, at suitable times during the formation of the complete colored image, a plurality of colored light impulses in such manner to be capable of perception by an observer concurrently with the viewing of the television picture.

In apparatus, which at present is considered to be a preferred form, the color filters are disposed in spaced relation to one another. The space between adjacent color filters is of a character such that the screen of the reproducing device is obscured to the observer. During the periods when this portion of the filter apparatus is interposed between the observer and the screen of the tube, there is provided apparatus for producing locally a short impulse of colored light which is displayed to the observer. Such apparatus is rendered operative during each field blanking period whereby to present to the observer a succession of light impulses corresponding in colors to the colors in which the television image is reproduced. By this means the repetition rate of any color is multiplied so that color flicker is less noticeable to an observer.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 is a diagrammatic representation of apparatus embodying one form of the invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1, showing one form of color flicker apparatus incorporating facilities for providing the additional colored light impulses; and,

Fig. 3 is a graphical illustration of the operation of the apparatus of Figs. 1 and 2.

Having reference now particularly to Fig. 1, there is shown in diagrammatic form a television receiving system which includes a signal reproducing device such as a cathode ray tube 11. This tube includes a fluorescent picture reproducing screen 12 formed on the inside of one end wall thereof. The tube also includes apparatus for scanning the fluorescent screen with an intensity modulated beam of electrons. This latter apparatus comprises an electron emitting cathode 13, an intensity control electrode 14, a beam forming electrode 15 and horizontal and vertical deflecting elements 16 and 17, respectively.

The television signals which are modulated on a radio frequency carrier wave are received by

an antenna 18. The received signals are amplified by conventional amplifying apparatus 19 and detected by a conventional demodulator 21. The output circuit of the demodulator is coupled to the input circuit electrodes 13 and 14 of the cathode ray tube 11. The output circuit of the demodulator also is coupled to a field synchronizing signal separator 22 by which the low frequency synchronizing signals are separated from the video signals. The output circuit of the signal separator 22 is coupled to the frequency control circuit of a field scanning generator 23 which is adapted to develop, in a conventional manner, a suitable scanning voltage which is impressed upon the vertical deflecting element 17. The output of the demodulator 21 also is coupled to a line synchronizing signal separator 24 which functions in a well known manner to separate the high frequency synchronizing signals from the video signals. The output circuit of the signal separator 24 is coupled to the frequency control circuit of a line scanning generator 25 which may be of conventional construction. The scanning voltage developed by this generator is impressed upon the horizontal deflecting element 16.

The receiving system also includes a color filter disk 26 which is mounted in such a position that the fluorescent picture reproducing screen 12 of the cathode ray tube may be viewed by an observer only through certain portions of the filter disk. The disk is arranged to be rotated in front of the reproducing screen of the cathode ray tube in any conventional manner such as by a synchronously driven motor 27 as illustrated. The power supply for the filter disk motor may be derived from any synchronous voltage source such as 28. The frequency of the voltage developed by this source is maintained in a predetermined frequency relation to the picture field frequency by means of a coupling to the output circuit of the field synchronizing signal separator 22.

By referring additionally to Fig. 2, one arrangement of the color filter disk 26 which embodies the present invention will be described. Where it is desired to reproduce the television picture in three colors such as red, green and blue, the filter disk consists of a red filter 29, a green filter 31 and a blue filter 32. Each of these filters occupies a sector of the circular area of the disk. In addition, there are provided in accordance with this invention in the intervening space between adjacent color filters, auxiliary light transmitting members having certain special properties as described hereinafter. These members are indicated at 33, 34 and 35, and also may be sector-shaped if desired.

The character of each of these special light transmitting members may be described best with reference to a sectional view of the element 33 as illustrated in Fig. 1. In this form of the invention each of the auxiliary members is wedge-shaped with the thickest portion thereof disposed adjacent the periphery of the disk 26. The member 33, for example, may be formed of any light transmitting material such as glass, certain plastics, etc. The face of the member remote from the fluorescent screen 12 of the cathode ray tube is roughened as indicated at 36. One manner of producing a roughened surface of the character desired is by etching. The face opposite to the roughened surface 36 may be left smooth or, if desired, may be provided with a coating suitable to render this surface light-reflecting from the interior of the member 33. The arcuate edge of this member adjacent the periphery of the disk 26 is provided with a color filter 37. In the case of the light transmitting member 33 the filter 37 is blue. The color filter 38, with which the member 35 is provided, is green and the color filter for the member 34 is red.

A source of white light 39 is disposed adjacent the periphery of the filter disk 26 in substantial alignment with the auxiliary color filters such as 37 with which the light transmitting members such as 33 are provided. In the illustrated form of the invention the light source 39 preferably should be of a type, of which numerous examples are known in the art, capable of emitting white light in spaced impulses of relatively short duration. It also is necessary to suitably shield the light source 39 from an observer in a manner that the light emitted thereby is directed substantially entirely in the direction of the color filters such as 37. The light source is energized by an impulsive voltage source 41 which is capable of developing voltage impulses of short duration synchronously with the field synchronizing signals. Accordingly, for the purpose of maintaining this synchronous relation the frequency control circuit of the voltage source 41 is coupled to the output circuit of the field synchronizing signal separator 22.

Referring now to the operation of the described apparatus, it is assumed that the system is to operate by reproducing sixty fields per second with a two-to-one interlace and that the television image is to be reproduced in three colors such as red, green and blue. In this case there will be transmitted signals representing twenty fields of each color per second. The color filter disk 26 is arranged to rotate at a speed of twenty revolutions per second in the case where the disk is provided with one filter of each color. Obviously, where a disk having more than one filter of each color is employed, the rotational speed of the disk will be correspondingly lower. During the reproduction upon the fluorescent screen 12 of the cathode ray tube of the field representing a partial image of one color the corresponding color filter is placed between the screen and the observer. As successive fields of different colors are reproduced upon the screen the disk rotation interposes the corresponding color filters in succession between the observer and the screen. The required synchronism between the various fields reproduced upon the screen and the movement of the color filter disk is attained by any suitable means such as the control of the speed of the disk driving motor by the television synchronizing signals.

In the interval between the reproduction of any two successive partial images upon the screen 12, the scanning beam is blanked under the control of the blanking signals which are intermixed with the video signals impressed upon the beam intensity control electrode 14. While the scanning beam is blanked in this manner the scanning voltages impressed upon the deflecting elements 16 and 17 are altered in a well known manner to return the scanning beam to its initial scanning point. It is during this blanking interval that one color filter such as the red filter 29 is moved from in front of the screen, and the succeeding filter such as the green one 31 is moved into this position. Ordinarily, in devices of this character, the filter disk is provided with an opaque portion between the successive color filters 29 and 31 in order to obscure the screen from an observer.

In accordance with this invention the auxiliary light transmitting member 33 occupies at least a

part of the intervening space between the red and green color filters 29 and 31. By reason of the roughened front surface 36 of the member and the mirrored rear surface, if such is provided, the screen 12 is obscured from an observer. During the time that the auxiliary member 33 is in front of the tube screen, a voltage impulse for energizing the light source 39 is developed by the generator 41 concurrently with the reception of a blanking signal. The white light emitted from the source 39 is transmitted through the blue color filter 37 and enters the body of the auxiliary member 33. It is characteristic of a light transmitting member of the character described that the light admitted thereto in the manner described is reflected within the member by all smooth surfaces thereof. It is only when the light impinges upon a roughened surface of this type of light transmitting member that it emerges therefrom in any substantial intensity. Therefore, since all surfaces of the auxiliary member 33 are smooth, with the exception of the front face 36, the blue light which is admitted through the upper peripheral edge thereof emerges from the front face where it may be observed.

In like manner, during the blanking interval between the reproduction upon the screen 12 of a green field and a blue field while the green filter 31 is moved from in front of the screen and the blue filter 32 is substituted therefor, the auxiliary light transmitting member 34 is momentarily placed in front of the screen. This member is provided with a red color filter along the outer peripheral edge thereof so that, when the light source 39 is energized, a short impulse of red light is presented to an observer's view. Similarly, during the transition period between the interposition of the blue filter 32 and the red filter 29 between an observer and the screen, the auxiliary light transmitting member 35 is placed in the observer's line of view. This member is provided with a green color filter so that, when the light source 39 is energized during the blanking period, a green light impulse is injected into the observer's line of view.

By referring to Fig. 3, the manner in which the described apparatus functions to reduce the undesirable effects of color flicker is graphically illustrated. The fields of different colors are produced in repeated succession. If the rotation of the color filter disk is assumed to be in the direction of the arrow of Fig. 2, the complete color television image is produced by forming partial images in the order of red, green and blue. Considering the red fields, the frequency of formation thereof is indicated by F in Fig. 3.

During the blanking intervals between successive fields of different colors the injected colored light impulses are represented by the narrow rectangular areas B, R and G. It will be noted that the blue impulse B occurs between the red and green fields, the red impulse R between the green and blue fields and the green impulse G between the blue and red fields. It is understood, of course, that this sequence of operation is continuously repeated. It will be noted that the frequency of occurrence of red colored light is represented in this figure by 2F. In other words, the frequency of observable red colored effects is doubled by the provision of apparatus for injecting the red impulse R between the green and blue fields. It is obvious that the same condition obtains for the other two colors. Inasmuch as the flicker rate is increased, an observer is less conscious of the intermittent character of the production of any one color.

Inasmuch as the colored impulses introduced between picture fields of different colors have no picture content the overall contrast of the complete colored television image will be reduced somewhat. However, suitable compensation for this effect may be made by increasing the intensity of the video signals appropriately.

The manner in which the additional colored light impulses are introduced between picture fields of different colors is not at all limited to that illustrated and described herein. For example, apparatus similar to that described may be modified suitably by providing each of the auxiliary light transmitting members 33, 34 and 35 with filters of all three colors so that, when the light source 39 is energized, there will be produced successive light impulses of each of the three colors. In this manner the production rate of each color may be increased materially whereby to decrease correspondingly the undesirable effects of color flicker.

Also, it is not at all necessary to employ auxiliary light transmitting members of the particular forms of those shown and described. The use of suitable reflecting systems and the proper positioning of the auxiliary light source 39 will enable the employment of the color filters 29, 31 and 32 for the additional production of the colored light impulses.

The energization of the light source 39 also may be different from that described. In apparatus such as that illustrated herein, the provision of light shielding means along the peripheral edges of the color filters will prevent light from a source 39 from interfering with the operation of the filters. In such a case then the source 39 may be continuously energized and thereby eliminate the impulsive voltage generator 41 and the synchronous control apparatus used in conjunction therewith. In such a case any source of white light may be utilized.

Also, if desired, a separate source of light for each color may be employed, in which case the synchronously moving color filters such as those with which the auxiliary light transmitting members 33, 34 and 35 are provided, will be unnecessary.

While there has been described what, at present, is considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and therefore it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a color television signal receiving system, means for reproducing a television image in a plurality of separately and intermittently produced different colors, and means for producing intermittent light impulses of said different colors in alternation with the production of said image colors.

2. In a color television signal receiving system, a signal reproducing device having a picture reproducing screen, a source of light, and means including a plurality of different colored filters for transmitting light intermittently from said screen and from said source in alternation.

3. In a color television signal receiving system, a signal reproducing device having a picture reproducing screen, a source of light, means in-

cluding a plurality of different colored filters for transmitting light intermittently from said screen, and means including an additional plurality of different colored filters for transmitting light intermittently from said source in alternation with the light transmitted from said screen.

4. In a color television signal receiving system, a signal reproducing device having a picture reproducing screen, a rotatable member having a plurality of spaced color filters disposed symmetrically thereon and a plurality of auxiliary light transmitting members mounted between adjacent filters, each of said auxiliary members being provided with a light transmission filter corresponding in color to one of said rotatable color filters, means associated with said auxiliary members to obscure the screen of said reproducing device from an observer, and a source of light disposed adjacent the color filter portions of said auxiliary members.

5. In a color television signal receiving system, a signal reproducing device having a picture reproducing screen, means for forming a succession of partial television images upon said screen, said partial images representing respective portions of a television subject of a plurality of colors, means for placing a succession of color filters in front of said screen, said filters corresponding in color to and coinciding with the colors represented by said partial images, and means for generating colored light impulses during the blanking intervals between the formation of said succession of partial images, said light impulses corresponding in color to the colors represented by said partial images.

6. In a color television signal receiving system, a signal reproducing device having a picture reproducing screen, a rotatable disk having three spaced color filters disposed symmetrically thereon and three auxiliary light transmitting members mounted between adjacent filters, each of said auxiliary members being provided adjacent one edge thereof with a light transmission filter corresponding in color to one of said disk-mounted color filters, said auxiliary members being of such characters to obscure the screen of said reproducing device from an observer, a source of white light disposed adjacent the color filter supporting ends of said auxiliary members, and means for energizing said light source concurrently with the passage of said auxiliary members by said light source.

7. In a color television receiving system, the method of increasing the frequency of occurrence of the color effects in which a television picture is to be reproduced which comprises the steps of, forming a plurality of partial television images of said colors, and producing intermittently between images a plurality of light impulses of said different colors.

8. In a color television receiving system, the method of increasing the frequency of occurrence of the color effects in which a television picture is to be reproduced which comprises the steps of, forming a plurality of partial television images of said different colors during each frame period, and producing in alternation with said television images a plurality of light impulses of said different colors during each frame period.

9. In a color television receiving system, the method of reducing the observable effects of color flicker which comprises the steps of, producing a succession of partial television images of different colors at a predetermined frequency, and producing in alternation with said television images a succession of light impulses of said different colors at a frequency related to said predetermined frequency.

10. In a color television receiving system, the method of increasing the frequency of occurrence of the color effects in which a television picture is to be reproduced which comprises the steps of, forming a plurality of partial television images of said different colors in a predetermined period, and producing in alternation with said television images a number of light impulses of said different colors during said predetermined period.

11. In a color television receiving system, the method of increasing the frequency of occurrence of the color effects in which a television picture is to be reproduced which comprises, the production in alternation of partial television images of said different colors and of light impulses of said different colors.

12. In a color television receiving system, the method of increasing the frequency of occurrence of the color effects in which a television picture is to be reproduced which comprises the steps of, forming successively a plurality of partial television images of said colors, and interspersing said partial images with a plurality of light impulses of said different colors.

13. In a color television receiving system, the method of reducing the observable effects of color flicker which comprises the steps of, producing a series of time-spaced partial television images of different colors, and producing in the intervals between the production of said partial images a series of light impulses of said different colors.

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