Dec. 25, 1934. A. McL. NICOLSON 1,985,685

COLOR TELEVISION SYSTEM

Filed Feb. 11, 1931

FIG. 1

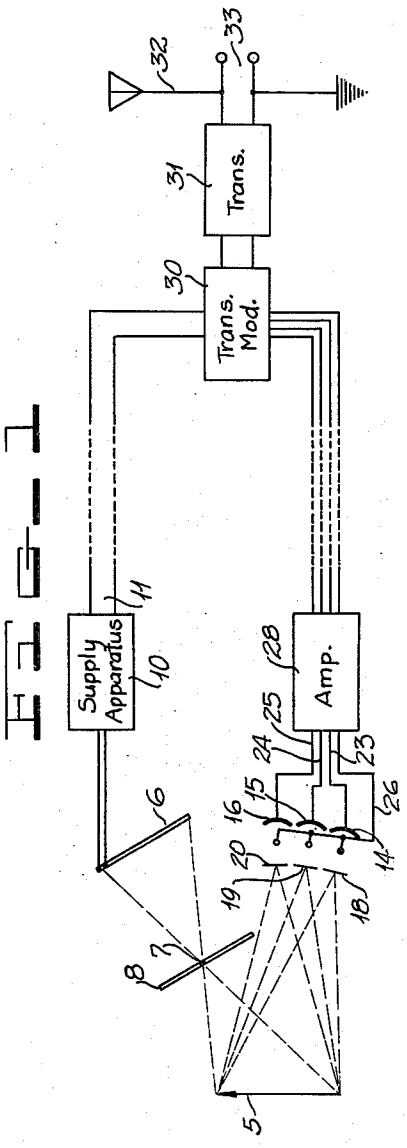
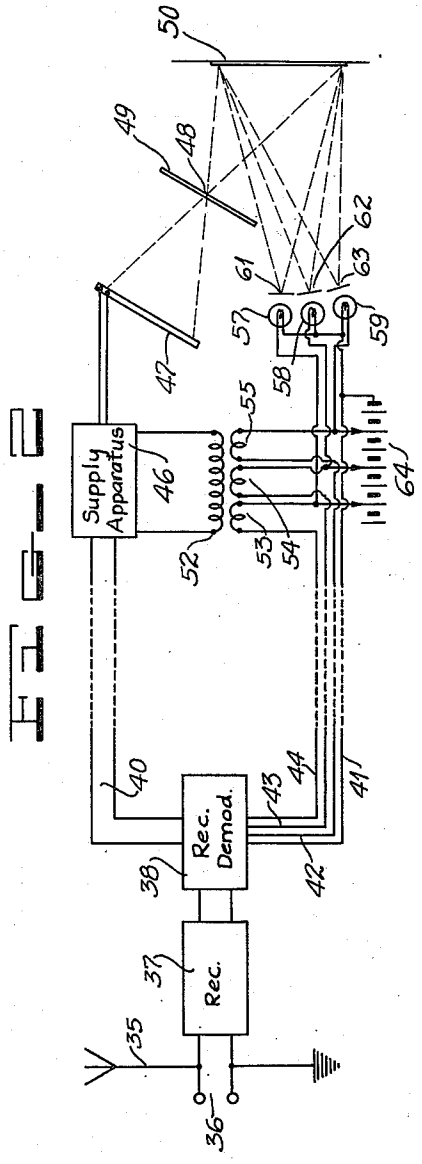


FIG. 2



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COLOR TELEVISION SYSTEM

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11 Claims. (Cl. 178—6)

This invention relates to the art of electro-optical transmission systems, and particularly to the transmission of electro-optical images in colors.

An object of the invention is to transmit images of objects in colors.

Another object of the invention is to transmit and receive electro-optically colored images of objects in a simplified and economic manner.

A further object of the invention is to receive images of objects electro-optically in colors using three color channels to obtain the colored image for observation.

It has been disclosed in my copending application Serial Number 450,630, filed May 8, 1930, now Patent No. 1,901,116, granted March 14, 1933, how to transmit images of objects electrically in their natural colors. One embodiment of this colored television system utilizes a color scanning arc with a receiving arc so constructed that the color is imparted directly to the arc itself, which may be observed directly, or on a screen on which the arc is projected. Other television systems are well known in which colors are presented directly on the receiving screen, color being imparted to each unit area.

In the present invention an outstanding feature of the color transmission system is the manner in which the scanned image obtains its color, while at the same time obtaining exceptional definition and detail. The present invention contemplates utilizing selective photoelectric cells through intrinsic properties or associate color filters at the transmitter and colored lamps at the receiving position. This portion of the apparatus is in addition to the black and white scanning at the receiver. For instance, a transmitting light scanner is employed in the usual way, color selectivity being obtained by the selectivity of a plurality of sensitive photo cells. The reception of the three colors on corresponding colored projecting lamps is supplemented by complementary black and white scanning.

Another feature of importance in the present system is that the method of obtaining color at the receiver may be independent of the transmitter, and furthermore, the application of the color aids in obtaining detail not actually represented by varying degrees of current intensity. In other words, the detail obtained with the present color system would require a much wider frequency range with the usual black and white reproduction.

The transmission medium between the transmitter and receiver of the present invention may be a direct connection, or may be the usual type of carrier channel transmission system well known in the art. That is, each colored element of the transmitter may be directly connected with its corresponding element at the receiver through its own particular wire circuit, or this wire circuit may be replaced by a carrier frequency circuit, each channel having its individual carrier frequency.

The invention will be more comprehensible from the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 shows diagrammatically a transmission system; and

Fig. 2 shows the conjugate receiving system.

In Fig. 1 an object represented by the arrow 5 is explored by a ray or light projected from the scanning screen 6 through the pinhole 7 of camera 8. The arc screen 6 may be supplied from a supply apparatus 10 in accordance with the systems disclosed in several of my copending applications, particularly Ser. No. 397,826, filed October 7, 1928 now Patent No. 1,863,278, issued June 14, 1932. In brief, this supply apparatus may comprise an arc potential and a field supply to propagate the arc over the electrode rails in the screen. An output line 11 is shown for transmitting to the receiver synchronizing impulses to maintain the transmitting and receiving arcs in synchronism, the details of which are disclosed in the above mentioned application. It is to be understood at this point that any scanning system known in the art which employs an exploring ray may be substituted for the system just described, without departing from the fundamental principles of the invention.

In the present system three photoelectric cells 14, 15 and 16 are made selective to the colors blue, green and red, by appropriate color filters 18, 19 and 20, respectively. These cells operate in the usual way, that is, the cell 14 receives blue light reflected from the object 5 when the unit area explored has the color blue; the cell 15 is actuated by light reflected from a unit area having a green color; and likewise the cell 16 is actuated by light reflected from a unit area having a red color. The amplitude of the current generated in these cells will depend, of course, upon the amount of the respective color present in the unit area from which the light is reflected. For instance, each cell may receive equal intensities of light according to the colorization of the unit area which contains the three colors in equal proportions, or, in case the unit area is white, each cell is adjusted to generate equal voltages. These cells

may be intrinsically selective to the colors named or other colors, as well as being made selective by the filters.

The cells are shown having individual output terminals 23, 24 and 25, another terminal 26 being common to all of the cells. The output of these cells is fed into an amplifier 28 for amplification before transmission. The output of the amplifier is shown connected to a transmitter modulator 30 of any type well known in the art, which has either separate oscillators for each modulator, or a common oscillator producing harmonics for segregating the separate color channels. The transmitter modulator 30 is shown connected to transmission apparatus 31, for transmitting the signals over an antenna system 32 or wire line 33. The output circuits from the supply apparatus 10 and amplifying apparatus 28 to the transmitter modulator 30 are shown dotted to indicate that these circuits may be continued as such to the receiving apparatus or may be associated with the carrier frequency apparatus shown.

Referring to Fig. 2, which shows the receiving system, an antenna 35 or wire line 36 impresses the received currents on a receiver 37 followed by a demodulator receiver 38. From the receiver demodulator an output circuit 40 and conductors 41, 42, 43 and 44 transmit the impulses for synchronizing supply apparatus 46 with the transmitter apparatus 10 and the impulses of the individual color signals, respectively, these conductors corresponding with conductors 11, 23, 24, 25 and 26 of Fig. 1. These conductors just mentioned in Fig. 2 are shown partially dotted, to indicate that the apparatus to the right thereof in Fig. 2 may be directly connected to the apparatus shown to the left of the dotted portion of the conductors of Fig. 1.

The supply apparatus 46 feeds and controls the scanning arc on a screen 47, which projects light through a pinhole 48 in a camera 49 to an observation screen 50. The arc receives impulses for changing its intensity through a four winding input transformer 52 having three primaries 53, 54 and 55. In these color circuits are also lamps 57, 58 and 59, in series with the primary windings just recited. Each lamp has a respective color filter 61, 62 and 63 designated as red, green and blue and correspond, respectively, with color filters 20, 19 and 18 of Fig. 1.

Each of the lamps entirely flood the screen 50 whenever energized, with light passing through their respective filters. That is, upon energization of the lamp 57 the screen 50 will be flooded with red light; upon energization of the lamp 58 the screen 50 will be flooded with green light; and upon energization of the lamp 59, the screen 50 will be flooded with blue light. An energy supply 64 permits varying the color level on the screen, each lamp being individually energized at any time and in any amount.

To operate the above described apparatus as a color television transmission and receiving system, the arc screen 6 scans the object 5 with white light. The cells 14, 15 and 16 receive light in accordance with the color pattern of the object 5 through their respective filters, and produce in their respective circuits currents of varying amplitude in accordance with the intensity of the colors. These currents are transmitted through the apparatus shown or directly to the receiving system to the right of the dotted conductors in Fig. 2.

Assuming that the red cell 16 is energized, this impulse will be impressed upon the arc 47 and produce a bright spot of light at a particular position on screen 50 corresponding with the position scanned on the object 5. Simultaneously with the projection of this light spot, the screen will be flooded with red light through energization of the lamp 57 which is in series with the primary 53 of the transformer 52. The light spot will appear red, that is, have a red tinge, while the red color on the rest of the screen will not interfere with the reproduced image being observed by the eye. Should the next impulse be characterized by a green color, this impulse will produce a bright spot of light by being transmitted through the primary winding 54 to the arc screen 47, producing at another position on the screen 50 a bright spot of light. Simultaneously therewith, the lamp 58 will be energized and the screen 50 will receive green light, the spot or unit area being defined by its illumination from the arc 47 and the eye being conscious of the green color by the general illumination. Similarly, a blue element on the object 5 will be received as blue on the screen 50 by the simultaneous projection thereon of the blue flood light and the illumination of the unit area. Should a unit area on object 5 be white, all three cells will send equal impulses, and the simultaneous projection of red, green and blue on the screen 50 will produce a white light area. Shades of the various colors will be transmitted in their true relationship by the varying voltage impulses generated by the selective cells at the transmitter, the receiving lamps projecting on the screen 50 a proportionate amount of color.

It is to be noted in this invention that should a color scheme be particularly mottled, that is, have a great many colors alternating therein, then by the rapid repetition of the red, green and blue colors upon common areas, a nil effect as far as color is concerned will be produced. If any predominant color is desired in a picture, it may be obtained by adjusting the local energization of the lamps 57, 58 and 59 from the local source 64. For instance, if a red glow illuminates the screen continuously, this red tint will be given to the screen by tinting the unit areas without losing definition. Such effect may be desired in the case of fire or fire scenes similar to the production thereof by colored film in the motion picture art. It is possible, therefore, to regulate the color reception to any desired degree by emphasizing any one of the color channels under manual control.

The receiving apparatus is also applicable to non-color transmissions, whereby color is imparted to the received image. For instance, the lamps 57, 58 and 59 may be adjusted to provide unequal illumination for equal received current impulses, in which case the received image will be suffused with a predominant color.

It is obvious that other systems embodying the principle of the invention readily suggest themselves, these systems being defined by the appended claims.

What is claimed is:

1. In an electro-optical transmission system, an exploring ray of light, means for detecting different colors of unit areas of an object, means for transmitting said light characterizations to a receiving point, means for producing an image of an object at said receiving point, and means at said receiving point for flooding an instantaneous field of view with colored light corresponding to the unit area scanned.

2. In an electro-optical transmission system, means for obtaining varying light characterizations according to the color of an object scanned, means for segregating each individual color impulse to a particular channel, means for connecting said channels with scanning apparatus at a receiving point, said receiving apparatus producing an image of said object, and means at said receiving point for characterizing an entire field of view observable at all times with color in accordance with the particular color received.

3. In an electro-optical transmission system, an object whose image is to be transmitted, means for detecting varying light and shade densities on said object in accordance with the color thereof, means for obtaining voltage characteristics corresponding to said light and shade densities in separate circuits, means for transmitting said individual color characterizations to receiving apparatus, said apparatus producing an image of said object, an observation screen observable at all times, and means included in said receiving apparatus for coloring all of said observation screen with color in accordance with the currents in each individual color circuit.

4. An electro-optical transmission system, an object whose image is to be transmitted, means for obtaining variable currents corresponding to the light and shade densities of said objects in accordance with the colors of said objects, means for segregating said currents according to the colors of said object, means for transmitting said currents to a receiving point, means at said receiving point for producing and observing said image on a field of view, and means for entirely illuminating the field of view of said last mentioned means with color in accordance with the unit area scanned at said transmitter, said entire field of view being observable at any instant.

5. An electro-optical transmission system for television and the like, an object whose image is to be transmitted, a plurality of means for generating currents in accordance with the light and shade densities of the object, said means being responsive to a respective plurality of colors in said object, means for maintaining said color channels over a transmission system to a receiving point, means at said receiving point for scanning an observation screen entirely observable at any instant in accordance with the scanning of said object at said transmitter, and means for simultaneously flooding all unit areas of said observation screen with light in accordance with the color of the unit area of the object scanned at any particular instant.

6. In a receiving system for television, a plurality of separate channels for transmitting currents characterized by colors of unit areas of the transmitted object, a receiving screen, means for producing a scanning ray of light across said screen varying in intensity in accordance with the light and shade density of the colors of the transmitted object, and means for illuminating all of said screen with light colored in accordance with the color of a unit area of the object at any particular instant.

7. In a receiving system for colored television, a receiving screen characterized by light intensities corresponding to light and shade densities of the image of a transmitted object, individual color projectors for illuminating said observation screen connected to individual color transmission channels from a transmitter, and means common to said individual channels for scanning said observation screen, said common means being actuated by all impulses received while said individual means are actuated in accordance with the color of the transmitted image of the object.

8. The method of color transmission electro-optically comprising scanning an object with light, obtaining current variations corresponding with light and shade intensities of the object in accordance with the color of unit areas thereof, each color having an individual channel, reproducing an image of said object, and simultaneously flooding all unit areas of an observation screen with color in accordance with the color of the unit area at that instant, all of said unit areas being observable at any instant.

9. The method of receiving colored images comprising receiving impulses characterized by the light and shade intensities of unit areas of an object, reproducing an image from said impulses, and observably imparting to all unit areas the colors of each unit area in accordance with the amplitude of the impulses received.

10. In an electro-optical transmission system, means for creating currents characterized by the light and shade densities of an object, means for receiving said currents on receiving apparatus, means for producing an image from said currents in black and white contrast of light at said receiving point, and means using said currents for characterizing all unit areas of said received image with the color of each unit area.

11. In an electro-optical transmission system for color television, means for scanning an object with light in unit areas, means for producing electrical currents proportional to the intensity of the colors in said object, means for segregating each of said impulses characterized by a specific color, means for transmitting said impulses to a receiving apparatus while maintaining their segregation, means for scanning an observation screen with white light corresponding to the impulses in all of said colored channels, means for synchronizing said scanning apparatus, and means for illuminating all of said observation screen with colors particularized by the impulses in the channels corresponding to the transmitted color impulses.

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