

Oct. 3, 1944.

A. N. GOLDSMITH

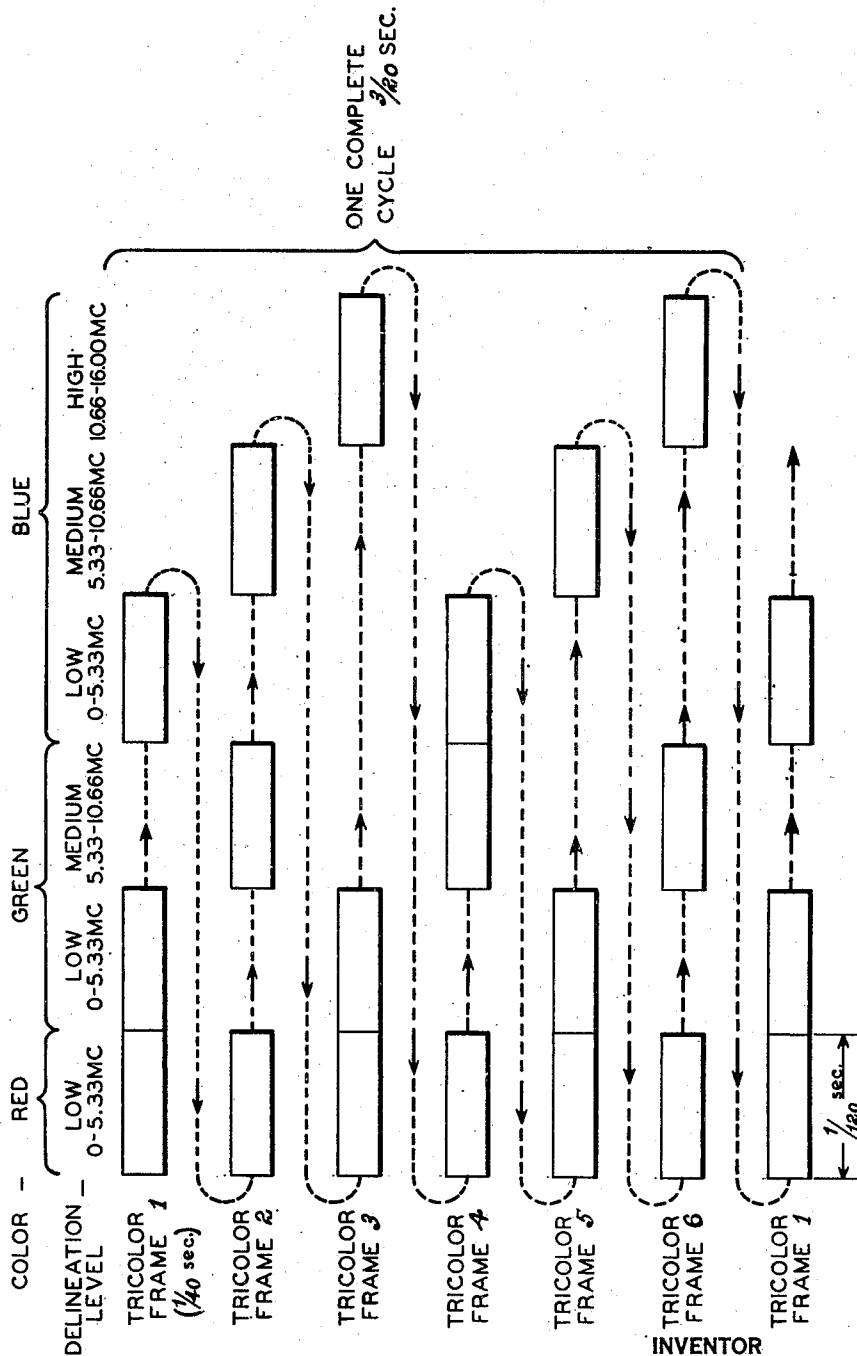
2,359,637

TELEVISION SYSTEM

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2 Sheets-Sheet 1

Fig. 1.



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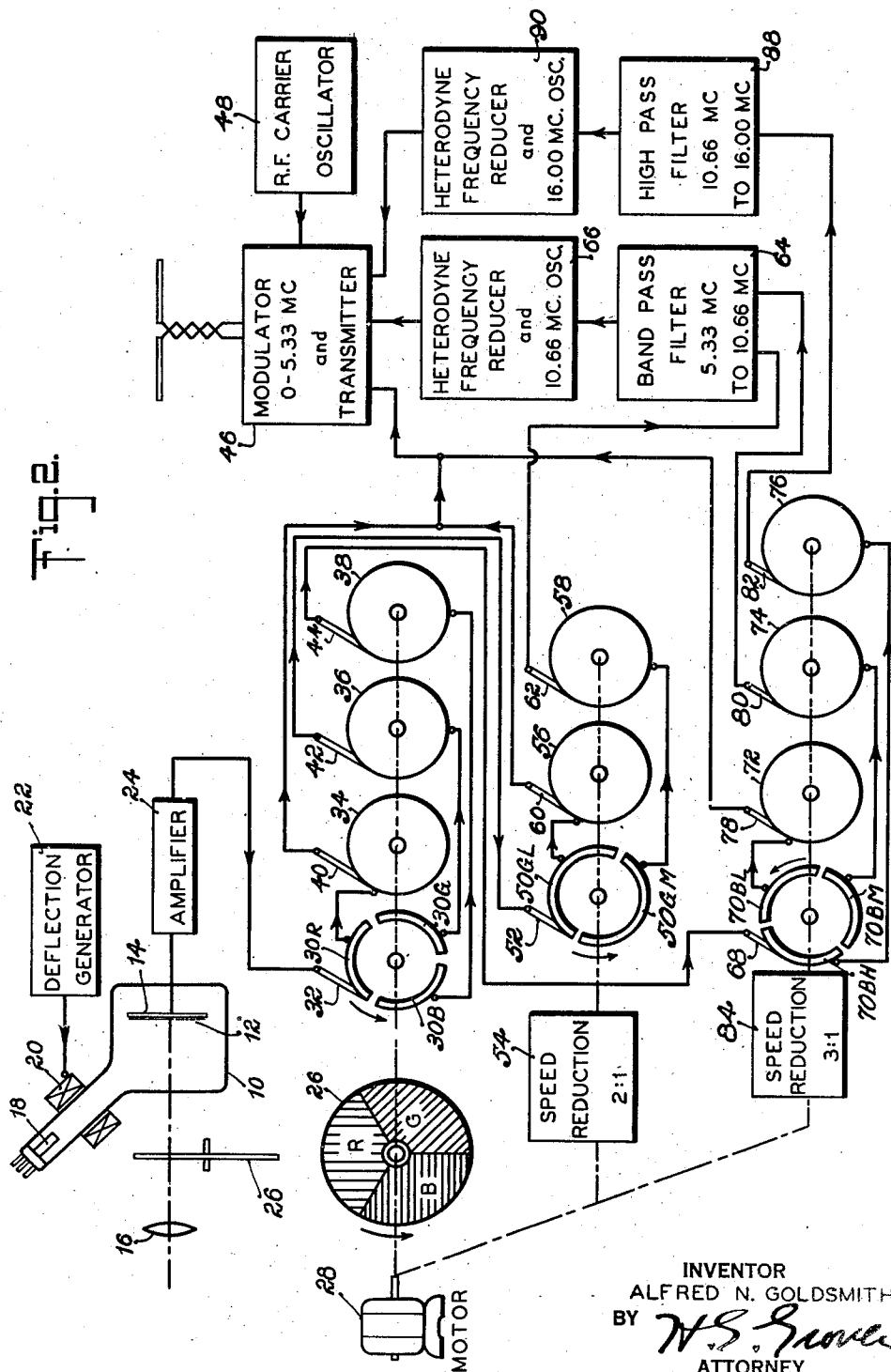
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,359,637

TELEVISION SYSTEM

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8 Claims. (Cl. 178—5.4)

This invention relates to an improvement in television transmitters, and more particularly to color transmitting systems whereby it is possible to transmit television images in color and in considerable detail without requiring the usual excessive transmission space or band width.

For color television transmission it is desirable that at least three colors be transmitted, and in a sequential transmission system, the sequential transmission of the signals, representative of the three colors, will cause flicker at the receiver unless some means are provided to increase the number of fields or frames transmitted for each second.

When the number of fields or frames per second is increased, or when the number of lines per field or frame is increased, naturally the band width of the transmitted signal is increased considerably, with the result that the transmission of high fidelity color television pictures, which are substantially free from flicker, would occupy a band width approximating four or more times the band width presently occupied by black and white television transmission.

In the present invention, provision is made whereby color television images may be transmitted in a plurality of colors, preferably three, the transmission being so carried out that the received images are relatively free from flicker, and furthermore, the transmission of the signals is so arranged that the band width occupied for the transmission of the color television images is not appreciably greater than the band width presently occupied in the transmission of black and white images.

One purpose of the present invention, therefore, resides in the provision of an arrangement whereby color television images may be transmitted in a plurality of sequential components at such a rate as substantially to eliminate or materially to minimize the degree of flicker produced at the receiver.

Another purpose of the present invention resides in the provision of means in a color television transmission system whereby high fidelity color television images may be transmitted, while at the same time the band width occupied in the transmission of the signals will not appreciably exceed the band width necessary for the transmission of equally high fidelity black and white pictures.

Still another purpose of the present invention resides in the provision of means in a color television transmitting system wherein the transmitted signals are transmitted in variable detail

in accordance with the particular color component transmitted at the particular instant.

A still further purpose of the present invention resides in the provision of means in a color television transmitting system wherein the degree of delineation transmitted is a function of the particular color component of the original image.

A further purpose of the present invention resides in the provision of means whereby picture signals of high modulation frequency, that are necessary to produce high fidelity, are heterodyned in order that they may be transmitted as lower modulation frequency signals, the heterodyne signals being used at the receiver to produce the desired detail in one or another of a plurality of colors.

Various other purposes and advantages of the present invention will become more apparent to those skilled in the art from the following detailed description wherein

Figure 1 represents graphically the order of transmission of the various color components and the degree of delineation transmitted in that particular portion of a complete transmission cycle; and

Figure 2 shows, by way of example, a preferred form of the present invention for accomplishing the above purposes.

To assist in explaining the operation and principles of the present invention, it will be assumed that 500 lines are scanned for each television frame, and that the frames occur at the rate of 120 per second. The frames are scanned without interlacing, so that for each frame occupying $\frac{1}{120}$ of a second, 500 picture lines are scanned.

It will also be assumed that a three color television transmitting system is utilized, and that the primary or component colors are chosen as red, green and blue.

It is to be understood, however, that various other scanning rates and frame frequencies may be used without departing from the spirit of the invention, and it is further to be understood that a different number of color components may be used, for example, two colors or four or more colors, without departing from the spirit of the present invention.

In a black and white television system, wherein 500 lines are scanned at the rate of 30 frames per second, interlaced two to one, a band width of approximately four megacycles is required for a predetermined degree of fidelity and for a predetermined resolution in both horizontal and vertical directions.

If, in a similar system, color television images were to be transmitted and 500 sequential lines were scanned for each frame, the band width required for the same delineation and for the same resolution, horizontally and vertically, as in the black and white picture, would be approximately of the order of sixteen megacycles, assuming also that 120 color frames per second are scanned. At this vertical scanning rate, each individual color component of a three color system would therefore have a repetition rate of 40 per second. At such a repetition rate, flicker would be substantially imperceptible within a certain picture brightness range, and the resolution of the picture would be acceptable for the production of high fidelity television images.

The fact that such a system would occupy a band of approximately sixteen megacycles is objectionable, since it is not feasible to require a band width of this order for the transmission of television images within otherwise desirable carrier frequency ranges. Even the excessive band width of sixteen megacycles is on the assumption that one of the side bands is substantially completely suppressed and that only the other side band is transmitted. Actually, if both side bands were to be transmitted, a band width of the order of thirty-two megacycles would be required.

The present invention, therefore, provides a system and an arrangement whereby it is possible to transmit color television images having an effective resolution of 500 lines per frame and 120 complete frames per second, the transmission being such that a band width of the order of only 5.33 megacycles is required.

Referring now to the drawings, and particularly to Figure 2, a television pickup tube 10 is provided which includes a mosaic electrode 12 and a signal plate 14. A lens system 16 is also provided for focusing an optical image upon the mosaic electrode 12 in order to produce an electrostatic charge image. This electrostatic charge image is scanned by a cathode ray beam generated by the gun structure 18 in order to produce picture signals at the signal plate 14.

The scanning cathode ray beam is deflected in mutually perpendicular directions in order to produce the desired scanning action by means of a deflection yoke 20 to which are supplied deflection voltage variations which are generated by a deflection generator 22. The picture signals which are derived from the signal plate 14 are then applied to an amplifier 24 in order that their intensity may be increased.

Interposed in the optical axis of a television pickup tube is a filter disc 26 which includes, as assumed above, three differently colored filters, namely, red, green and blue. The color filter disc is rotated in synchronism with the vertical deflection of the cathode ray beam, and the phase of the color disc is such that a differently colored image component of the object is projected on the mosaic electrode 12 for each vertical deflection cycle. Such an arrangement for producing color television signals is well known to those skilled in the art, and a further description of such a pickup device is not believed to be necessary.

For the purpose of more clearly explaining the operation of the present invention, the color disc 26, the color sectors of which function in the optical axis of the television pickup lens, is reproduced immediately therebelow in order that the three filter segments, designated R, G and B,

representing respectively the red, green and blue filters, may be more clearly seen. This color filter disc is rotated by means of a motor 28 and, as stated above, the speed of rotation of the motor 28 is controlled in accordance with the vertical deflection of the scanning cathode ray beam.

If three color filters are used in the color disc 26, and if the color repetition rate is 40 per second, then naturally the speed of rotation of the filter disc 26 will be 2400 R. P. M. If, for example, however, six filters are provided, two of each particular color and each occupying approximately 60° around the periphery of the color filter disc, then naturally the motor need operate only at a speed of 1200 R. P. M. With such a system, television signals sequentially representative of three different color components will be produced at the signal plate 14 and will be amplified by the amplifier 24.

A switching arrangement is also associated with the motor 28 and, for reasons of simplicity, is driven by a shaft connected directly to the motor and to the color filter disc 26. This switching arrangement includes a plurality of segments 30R, 30G and 30B. A stationary brush or contact 32 is associated with the three commutator segments. The commutator segment 30R is connected directly to a slip ring 34, while the commutator segments 30G and 30B are connected directly to slip rings 36 and 38 respectively. The slip rings 34, 36 and 38 have associated therewith brush contacts 40, 42 and 44.

Inasmuch as the commutator including the segments 30R, 30G and 30B is rotated by the motor 28, the signals available at the output of the amplifier 24 will be switched sequentially to the slip rings 34, 36 and 38. The phase of the commutator, with respect to the color filter disc and the vertical scanning of the mosaic electrode is such that the brush 32 will begin to traverse the commutator segment 30R at the beginning of the vertical scanning cycle for the red component of the color television image. Inasmuch as the commutator segment 30R occupies approximately 120°, the brush 32 will move the segment 30R at the conclusion of the scanning of the red component, and the brush 32 will then contact the segment 30G at the beginning of the vertical deflection scanning cycle for the green component of the television image. Similarly, the brush 32 will be in contact with the commutator segment 30B during the scanning cycle for the blue component of the television image.

By means of this commutating device, only picture signals representative of the red component will be applied to the slip ring 34, and similarly, picture signals representative of the green and blue components will be applied to the slip rings 36 and 38 respectively. By means of this switching arrangement it is, therefore, possible to derive from the brushes 40, 42 and 44, color television signals representative respectively of the three color components red, green and blue.

The delineation of the signals derived from these brushes corresponds to a band width of approximately sixteen megacycles.

It has been found that different colors have different delineatory or picture defining capabilities. For example, the color yellow is almost lacking in delineatory capabilities and, as a result, the transmission of picture signals of the yellow portions of a television image with high fidelity would be nearly useless, since yellow has very low delineatory capabilities.

It has been found, by experimentation, that the delineatory capabilities of the various primary colors increases in the following order: yellow, orange, red, green and blue. The last named color, namely blue, has the maximum delineatory capabilities and, as a result, if high fidelity color television images are to be transmitted, the best color detail can be usefully produced by the transmission of the higher frequency signals produced during the scanning of the blue component of the television picture.

As a result of these findings, picture signals are transmitted in varying degrees of delineation and in accordance with the delineatory capabilities of the particular colors used in the color television transmitting system. For example, in the above assumed television system, where the three colors red, green and blue are employed, picture signals ranging from 0 to 5.33 megacycles are transmitted for the red component of the television picture.

Since the color green is next of value in delineatory capabilities, then signals of the order of from 0 to 10.66 megacycles are in effect transmitted, representative of the green component of the television picture.

Similarly, inasmuch as the color blue has the greatest delineatory capabilities, picture signals ranging from 0 to 16 megacycles are in effect transmitted for the blue component of the television picture.

When these transmitted signals are then combined in the sequential color television transmitting system, a high fidelity color television picture will be produced with an economically limited frequency band and having good resolution in both the horizontal and the vertical directions.

Referring again to Figure 2, and on the above assumption that of the three colors used, red has the least delineatory capabilities, the picture signals that are derived from the brush 40 which correspond to the red component of the television picture are applied directly to a television picture signal modulator and transmitter 46. The modulator is also supplied with a radio frequency oscillation that is to be used as the carrier from a radio frequency carrier oscillator 48.

The band width of the circuits included in the modulator and transmitter 46 is such that only picture signals of the order of 5.33 megacycles are transmitted, and all picture signals exceeding this frequency are attenuated or suppressed. Accordingly, even though the picture signals representative of the red component, as derived from the brush 40, may range from 0 to 16 megacycles, only those frequencies ranging from 0 to 5.33 megacycles are permitted to pass through the modulator and are effective toward amplitude or frequency modulation of the radio frequency carrier.

Since it is desirable that a band width not exceeding 5.33 megacycles be required for the transmission of color television picture signals, it is impossible directly to modulate the radio frequency carrier to picture signals exceeding 5.33 megacycles without exceeding the desired band width.

In order to overcome this situation, and in order to permit the transmission of picture signals having modulation frequencies exceeding 5.33 megacycles, the picture signals corresponding to the green component of the television picture, as derived from the brush 42, are supplied to a second commutating device including com-

mutating segments 50GL and 50GM by means of a commutator brush or contact 52. The commutator contacts 50GL and 50GM are rotated by means of the motor 28 through a speed reduction device 54 having preferably a speed reduction ratio of 2 to 1. The rotational speed of the commutator including the segments 50GL and 50GM is, therefore, one-half the speed of rotation of the commutator including the segments 30R, 30G and 30B. The commutating segment 50GL is connected directly to a slip ring 56, while the commutating segment 50GM is connected directly to the slip ring 58. Two brush contacts 60 and 62 are associated with the slip rings 56 and 58.

The phase of the commutator segments 50GL and 50GM is so arranged that the brush contact 52 contacts the segment 50GL at the beginning of the red component scanning cycle, and inasmuch as the speed of rotation of the segments 50GL and 50GM is one-half the speed of rotation of the commutating segments 30R, 30G and 30B, the brush 52 will continue in contact with the segment 50GL through one complete revolution of the commutator directly associated with the amplifier. Similarly, during the next complete revolution of the commutating segments 30R, 30G and 30B the brush 52 will be in contact with the commutating segment 50GM. Even though the brush is in contact with segment 50GL or segment 50GM during a complete revolution of the commutating segments 30R, 30G and 30B, picture signals will only be supplied to the brush 52 during approximately one-third of these time intervals. This naturally is by reason of the action of the first commutator, since the brush 32 contacts the segment 30G during only one-third of its revolution, and picture signals corresponding to the green component of the television picture are supplied from the brush 42 to the brush 52. Accordingly, picture signals corresponding to the green component are applied alternately to the slip rings 56 and 58. The picture signals which are applied to the slip ring 56 during the time the brush 52 is in contact with the segment 50GL are then supplied directly to the modulator and transmitter 46 by means of the brush 60.

During the next interval that green picture signals are generated, these picture signals, as available at the brush 62, are supplied to a band-pass filter circuit 64. This band-pass filter is arranged to pass only frequencies between 5.33 megacycles and 10.66 megacycles. All picture signal frequencies below 5.33 megacycles and all picture signals above 10.66 megacycles are substantially completely suppressed.

The output from the band-pass filter 64 therefore includes only picture signals ranging between the frequency limits of 5.33 megacycles and 10.66 megacycles. These picture signals are supplied to a heterodyne frequency reducer 66 which includes also a heterodyne oscillator operating at 10.66 megacycles. When the picture signals ranging from 5.33 megacycles to 10.66 megacycles are heterodyned with the fixed oscillation frequency of 10.66 megacycles, beat frequency oscillations of from 5.33 megacycles down to zero are produced, and these in turn are supplied to the modulator and transmitter 46.

From the above, it will therefore be seen that picture signals representative of the green component of the television picture will, in effect, be transmitted through a delineation band (corresponding to video signal frequencies) of from 0

to 10.66 megacycles, although the actual transmission band width will only extend from 0 to 5.33 megacycles.

Similarly, picture signals representative of the blue component of the television picture are supplied to a brush contact 68 which is associated with commutating segments 70BL, 70BM and 70BH. These three commutating segments are connected directly to slip rings 72, 74 and 76 respectively. The slip rings have associated therewith corresponding brushes 78, 80 and 82.

Inasmuch as the color blue has the maximum delineatory capabilities, it is desired that picture signals of the maximum frequency band width be transmitted corresponding to the blue component of the television picture. When picture signals of the blue component are transmitted at a high delineatory level, the result at the receiver is that of the production of a high fidelity color television image. According to the present invention, the entire spectrum of the picture signals produced for the blue component is transmitted, and since a maximum band width of 5.33 megacycles is to be employed, a heterodyning system, similar to the heterodyne system described above in connection with the green picture signals, is used.

The commutating segments 70BL, 70BM and 70BH are also rotated by means of the motor 28 through a speed reduction device 84. The speed reduction device preferably has a reduction ratio of 3 to 1, so that the red commutating device will have a speed one-third the speed of rotation of the first described commutating device including segments 30R, 30G and 30B. The phase of operation of the commutating segments 70BL, 70BM and 70BH is such that the brush 68 contacts segment 70BL, for example, at the conclusion of a red scanning cycle and at the beginning of the succeeding green color cycle. Inasmuch as the speed of rotation of these segments is one-third the speed of rotation of the commutating device including the segments 30R, 30G and 30B, the contact 68 will remain in contact with the segment 70BL during one complete revolution of the color filter disc and one complete revolution of the first described commutating device.

Similarly, the brush 68 will remain in contact with the segment 70BM during the next succeeding green, blue and red scanning cycles, and likewise, the brush will remain in contact with the segment 70BH during the next succeeding green, blue and red scanning cycles.

This phase relationship of the commutating segments 70BL, 70BM and 70BH is so chosen in order to assure that the contact 68 will not be in the vicinity of the insulating segment between the commutating segments during the time that blue picture signals are applied to the brush contact 68.

Since three commutating segments are associated with the picture signals representative of the blue component, these picture signals, representative of the blue component, will be sequentially available from the brushes 78, 80 and 82. In order to transmit the picture signals ranging from 0 to 5.33 megacycles, representative of the blue component, the picture signals available from the brush 78 are applied directly to the modulator and transmitter 46 which, as above described, permits transmission of frequencies of the order of 5.33 megacycles.

During the next complete color cycle, the picture signals representative of the blue compo-

nent, as derived from the brush 80, are supplied to the band-pass filter 64 which, as above described in connection with the green component, permits transmission of signals ranging from 5.33 to 10.66 megacycles. The output from this band-pass filter is then supplied to the heterodyne frequency reducer 66, and the resultant heterodyne signals, which range from 5.33 megacycles to 0, and which actually represent frequencies from 5.33 to 10.66 megacycles of the blue component, are then applied to the modulator and transmitter 46.

During the next succeeding production of picture signals, representative of the blue component, picture signals from the brush 82 are supplied to a high-pass filter 88 which is so designed as to attenuate frequencies below 10.66 megacycles, but permit signals from 10.66 to 16 megacycles to be passed therethrough. As a result, the signals available at the output of the high-pass filter 88 therefore range from 10.66 megacycles to 16 megacycles and correspond to the blue component of the television picture. These frequencies are then directed to a heterodyne frequency reducer 90 which also includes a 16 megacycle oscillator, so that when the applied frequency band is heterodyned against the 16 megacycle oscillator, picture signals ranging from 5.33 to 0 megacycles result. These picture signals actually correspond, as stated above, to the picture signals ranging from 10.66 to 16 megacycles of the blue component of the television picture. The output from the heterodyne frequency reducer 90 is then applied to the modulator and transmitter 46 for transmission thereby. If desired, filter 88 may be a band-pass filter, transmitting substantially only frequencies between 10.66 and 16 megacycles.

The sequence of operation of the above described system is shown graphically in Figure 1. In this figure, the transmitted delineation level is indicated for each of the three colors red, green and blue. Each tricolor frame, which includes three complete frame scanning cycles of $\frac{1}{120}$ of a second each, is represented by the groups of three horizontal rectangles. These correspond to one revolution of the color filter disc 26, or one complete tricolor television frame occupying a total time of $\frac{1}{40}$ of a second.

In this specification, the use of the word "delineation" means the picture detail transmitted by the produced picture signals. Therefore, in Figure 1 and in the above description, the delineation level is an index of the degree of picture detail transmitted. Accordingly, low, medium and high delineation levels represent the transmission of low, medium and high picture detail. In the transmission of television pictures, as is well known by those skilled in the art, small details and high fidelity pictures require the transmission of high frequency picture signals.

It will be noted from Figure 1 that picture signals representative of the red component are always transmitted at a delineation level of 0 to 5.33 megacycles. The figure also indicates that picture signals representative of the green component are transmitted throughout the range of from 0 to 10.66 megacycles, the transmission not being simultaneous but being instead broken into two groups, one of which has a low delineation level of from 0 to 5.33 megacycles, and the other has a medium delineation level of from 5.33 to 10.66 megacycles.

As will be observed from the second and third

vertical columns of rectangles in Figure 1, the picture signals representative of the green component are transmitted alternately at low and medium delineation levels. Similarly, the last three columns of rectangles represent the transmitted delineation levels of the picture signals representative of the blue component, so that during the first tricolor frame the picture signals, representative of the blue component, will be transmitted at a low delineation level, and this same transmission level is again repeated in the fourth tricolor frame.

The picture signals representative of the blue component are transmitted at medium delineation during the second and fifth tricolor frames, whereas picture signals representative of the blue component are transmitted at the highest delineation level during the third and sixth tricolor frames.

By reason of the particular sequence of transmission of the color components and their various delineation levels, it requires six complete tricolor frames for one complete cycle. This complete cycle is represented by the bracket at the end of the figure, and occupies a time interval of $\frac{3}{20}$ of a second. After the tricolor frame six has been scanned, the entire cycle then is repeated.

It will therefore be observed from Figure 1 that picture signals ranging from 0 to 16 megacycles are transmitted representative of the blue component, these picture signals being broken into three groups which are transmitted during successive tricolor frames.

The principles involved in the present invention for the transmission of television picture signals are similar to the principles underlying the operation of the television transmitting system described in the applicant's Patent No. 2,236,502, issued April 1, 1941. The present invention, however, is a continuation of these principles, and an adaptation of the same to the transmission of color television images. Furthermore, in the present invention, television picture signals of different delineation levels are transmitted in accordance with the particular color scanned. This selection or choice of delineation level is not a random choice, but is made in accordance with the delineatory capabilities of the various colors.

In the present invention, no corresponding television receiver circuit has been shown, in view of the fact that the construction of a receiver capable of receiving the transmitted picture signals would be fully within the abilities of one skilled in the art. This is particularly true in view of the applicant's above referred to patent, wherein receiver circuits are shown employing fixed oscillators for heterodyning the medium and high delineation level signals in order that they may be re-established at the proper frequency levels.

From the above description it will now be appreciated that high fidelity color television pictures may be transmitted having a resolution corresponding to the transmission of frequencies of the order of 16 megacycles, although a band width only of the order of 5.33 megacycles is employed for such transmission. Furthermore, it will be appreciated that good color reproduction will result in view of the fact that the transmitted delineation level is chosen in accordance with the delineatory capabilities of the particular colors employed in the color transmission system.

It is to be understood that although mechanical commutating devices are shown and described for switching the produced picture signals, various other switching and commutating arrange-

ments could be used. Preferably, in an actual transmitting system, electronic switching devices would be employed. Examples of such electronic switching arrangements are to be found in Roys and Mayer Patent No. 2,089,430, issued August 10, 1937, and in the patent to Strobel, No. 1,757,345, issued May 6, 1930.

Furthermore, it is to be appreciated that different television pickup tubes may be employed, and that differently constructed filter discs could as well be used in the present invention. Furthermore, although heterodyne oscillators of 10.66 and 10 megacycles are used in the heterodyne reducers 66 and 90 respectively, it is also possible to use other fixed oscillators since, for example, an oscillator supplying 5.33 megacycles could be used in the frequency reducer 66 and an oscillator operating at 10.66 megacycles could be used in the heterodyne frequency reducer 90.

Various alterations and modifications may be made in the present invention without departing from the spirit and scope thereof, and it is desirable that any and all such alterations and modifications be considered within the purview of the present invention except as limited by the hereinafter appended claims.

Having now described my invention, what I claim is:

1. A composite delineatory multicolor television system comprising means for sequentially scanning a field of view in a predetermined cyclically recurring color series to produce video signals representing each of the selected colors and each occupying substantially a like frequency spectrum, means to suppress the video signals representative of at least one of the selected colors in a portion of the normal frequency spectrum thereof, means to retain substantially all of the video signals representative of at least one other of the selected colors, heterodyning means to shift unsuppressed frequency bands of the selected colors each to a frequency spectrum substantially coinciding with the lowest of the video frequencies retained after video signal band suppression, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an integral multiple of the number of the component colors of the multicolor system so that the said resulting signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

2. A composite delineatory multicolor television system comprising a camera means for sequentially scanning light images representing predetermined fields of view to produce output video signals, a color separation element for causing the images scanned to appear in a predetermined cyclically recurring color series so that the produced video signals are representative of the selected colors and each series occupies substantially a like maximum frequency spectrum, filter means to suppress the video signals representative of at least one of the selected colors in a portion of the normal frequency spectrum thereof, signal separation means to retain substantially all of the video signals representative of at least one other of the selected colors, heterodyning means to shift the frequency band occupied by the unsuppressed video frequency ranges of the predetermined selected colors each to a frequency spectrum substantially coinciding with

the lowest of those frequencies represented by the video signals which are retained, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an integral multiple of the number of component colors of the multicolor system so that the resulting signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

3. A composite delineatory multicolor television system comprising a camera means for sequentially scanning a light image representing a field of view to produce output video signals, a color separation element for causing the image scanned to appear in a predetermined cyclically recurring color series so that the produced video signals are representative of the selected colors and each series occupies substantially a like maximum frequency spectrum, filter means to suppress the video signals representative of at least one of the selected colors in a portion of the normal frequency spectrum thereof, signal separation means to retain substantially all of the video signals representative of at least one other of the selected colors, distributor means for transferring the produced video signal series to the signal separation means, heretodyning means to shift the frequency band occupied by the unsuppressed video frequency ranges of the predetermined selected colors each to a frequency spectrum substantially coinciding with the lowest frequency range which embodies the video signals which are retained, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an integral multiple of the number of component colors of the multicolor system so that the resulting signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

4. A composite delineatory multicolor television system comprising a camera means for sequentially scanning a light image representing a field of view to produce output video signals, a color separation element having filter areas of predetermined component colors for causing the image scanned to appear in a predetermined cyclically recurring color series so that the produced video signals are sequentially representative of the selected component colors and each series occupies substantially a like maximum frequency spectrum, filter means to suppress the video signals representative of at least one of the selected component colors in a major portion of the normal frequency spectrum thereof which includes the frequency range from at least an intermediate frequency to the highest frequency developed, signal separation means to retain substantially all of the video signals representative of at least one other of the selected component colors, heterodyning means to shift the frequency band occupied by the unsuppressed video frequency ranges of the predetermined selected colors each to a frequency spectrum substantially coinciding with the lowest frequency range which embodies the video signals which are retained, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an integral multiple

of the number of component colors of the multicolor system so that the resulting signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

5. A composite delineatory tricolor television system comprising camera means for scanning a field of view to produce output video signals, a color separation filter having color areas of predetermined component colors, and means for moving the color separation element relative to the camera for causing the scanned image to appear in a predetermined cyclically recurring color series so that the produced video signal series is sequentially representative of the selected component colors and so that each series of video signals normally occupies substantially a like frequency spectrum, filter means to suppress a major portion of the normal frequency spectrum of the video signals representing a first of the component colors, said suppressed frequency portion including the frequencies of both the intermediate and the higher frequency range, filter means to suppress a minor portion of the normal frequency spectrum of the video signal representing a second of the component colors, said suppressed frequency portion including only the higher frequency range, signal separation means to retain substantially all of the video signals representative of the third of the selected component colors, distributor means to supply the said signals to the said filter and separation means, heterodyning means to shift the frequency bands occupied by the unsuppressed video frequency ranges of the intermediate and higher frequency portions of the spectrum of the second and third component color video signal series to frequency ranges coinciding with those occupied by the video signals of the first of the component colors of which the major portion of the normal frequency spectrum is suppressed, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the cyclic analysis and in a delineatory cyclic series representing the frequency shifted spectra of a number greater than and an integral multiple of the component colors of the tricolor system so that the said video signals when energizing the transmission channel constitute an interwoven series of color cyclic and delineatory cyclic successions.

6. The method of transmitting composite delineatory multicolor television signals which comprises sequentially scanning a field of view in a predetermined cyclically recurring series of component colors to produce video signals representing each of the selected component colors with each of the video series normally occupying substantially a like maximum frequency spectrum, suppressing the video signals representative of at least one of the selected colors in a portion of the normally developed frequency spectrum, retaining substantially all of the video signal frequency range of the video series representative of at least one other of the selected colors, shifting by heterodyning unsuppressed frequency bands of the selected colors each to a frequency spectrum coinciding substantially with that occupied by the lowest frequency range of the video signals of the certain frequencies representing any of the component colors, and then energizing a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an

integral multiple of the number of component colors of the multi-color system so that the resulting signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

7. The method of transmitting composite delineatory multicolor television signals which comprises sequentially scanning a field of view in a predetermined cyclically recurring series of component colors to produce video signals representing each of the selected component colors with each of the video series normally occupying substantially a like maximum frequency spectrum, suppressing the video signals representative of at least one of the selected colors in a major portion of the normally developed frequency spectrum which includes the highest developed frequencies, retaining substantially all of the video signal frequency range of the video series representative of at least one other of the selected colors, dividing the frequency band of the unsuppressed component color series into a number of sections each corresponding in spectral width to a multiple of the unsuppressed spectral range of the suppressed component color series, shifting by heterodyning unsuppressed frequency bands of the selected colors each to a frequency spectrum coinciding substantially with that occupied by the lowest frequency range of video signals of any of the component color video signal series, and then energizing a transmission channel by all of the signals in a color cyclic series corresponding to the color cyclic analysis and in a delineatory cyclic series representing frequency shifted spectra of a number greater than and an integral multiple of the number of component colors of the multicolor system so that the said signals constitute an interwoven series of color cyclic and delineatory cyclic successions.

8. A method of transmitting composite delineatory tricolor television signal indications comprising scanning a field of view to produce output video signals, introducing color filtering areas

of predetermined component colors in the optical path, moving the component colors relative to the scanning field for causing the scanned image to appear in a predetermined cyclically recurring color series so that the produced video signal series is sequentially representative of the selected component colors and so that each series of video signals normally occupies substantially a like frequency spectrum, filtering the produced signal series to suppress a major portion of the normal frequency spectrum of the video signals representing a first of the component colors, the suppressed frequency portion including the frequencies of both the intermediate and the higher frequency range, filtering the produced signal series to suppress a minor portion of the normal frequency spectrum of the video signal representing a second of the component colors, the suppressed frequency portion including only the higher frequency range, separating the produced signal series to retain substantially all of the video signals representative of the third of the selected component colors, heterodyning the various signal series to shift the frequency bands occupied by the unsuppressed video frequency ranges of the intermediate and higher frequency portions of the spectrum occupied by the second and third component color video signal series to frequency ranges coinciding with those occupied by the video signals of the first of the component colors of which the major portion of the normal frequency spectrum is suppressed, and means to energize a transmission channel by all of the signals in a color cyclic series corresponding to the cyclic analysis and in a delineatory cyclic series representing the frequency shifted spectra of a number greater than and an integral multiple of the component colors of the tricolor system so that the said video signals when energizing the transmission channel constitute an interwoven series of color cyclic and delineatory cyclic successions.

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