

Aug. 9, 1949.

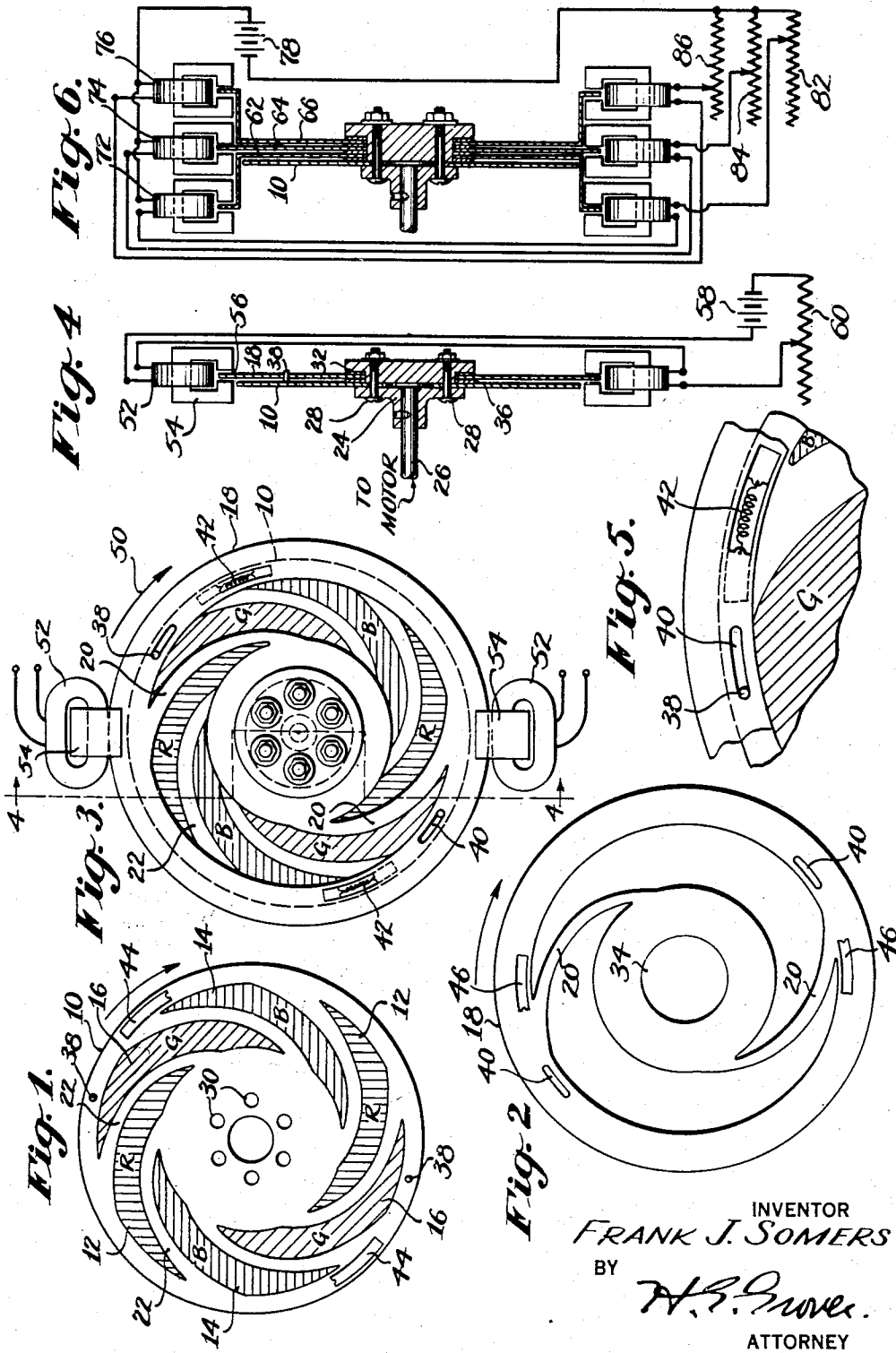
F. J. SOMERS
VARIABLE COLOR FILTER ASSEMBLY FOR
TELEVISION TRANSMITTING SYSTEMS

2,478,598

Filed Sept. 15, 1945

2 Sheets-Sheet 1

T2661



INVENTOR
FRANK J. SOMERS
BY
H. S. Groves.
ATTORNEY

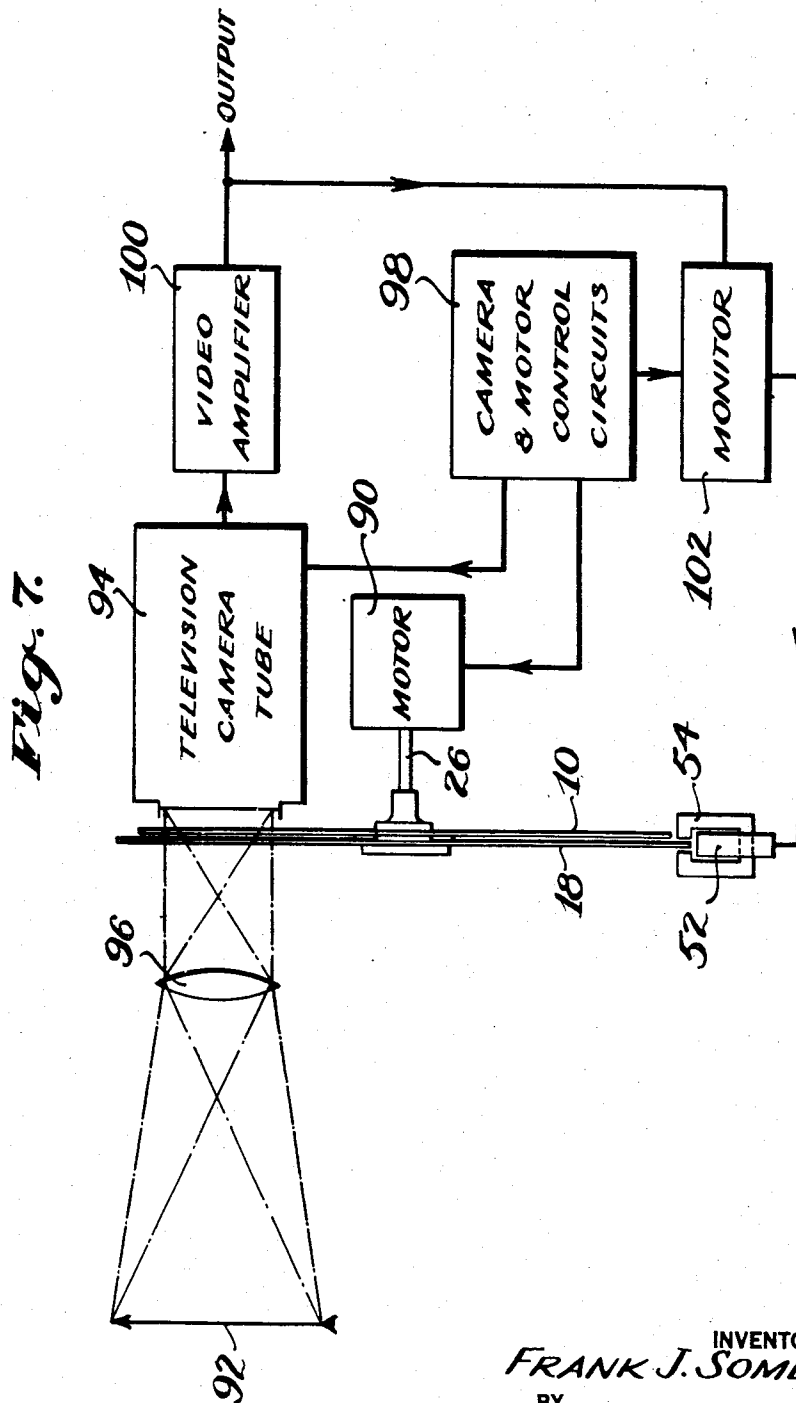
Aug. 9, 1949.

F. J. SOMERS
VARIABLE COLOR FILTER ASSEMBLY FOR
TELEVISION TRANSMITTING SYSTEMS

2,478,598

Filed Sept. 15, 1945

2 Sheets-Sheet 2



INVENTOR
FRANK J. SOMERS.
BY
H. S. GANER.
ATTORNEY

Patented Aug. 9, 1949

2,478,598

UNITED STATES PATENT OFFICE

2,478,598

VARIABLE COLOR FILTER ASSEMBLY FOR
TELEVISION TRANSMITTING SYSTEMSFrank J. Somers, Jackson Heights, N. Y., assignor
to Radio Corporation of America, a corpora-
tion of Delaware

Application September 15, 1945, Serial No. 616,618

16 Claims. (Cl. 88—111)

1

This invention relates to an improvement in color television systems and more particularly to an improvement in the manner in which a desired combination of color tones is obtained in the image produced at a television receiver.

In color television systems of the presently proposed tricolor variety it is current practice to utilize three component colors, namely red, blue and green, and video signals representative of these three component colors are transmitted in a sequential manner. The production of the video signals representative individually of the three component colors is generally accomplished through the use of a plurality of filter segments or filter elements which are sequentially interposed in the optical light path or the image forming light beam path of the television camera or image pick-up tube, in synchronism and in phase with the scanning operation. This sequential change of filters is generally exercised at a rate corresponding to the vertical or field deflection rate of the scanning cathode ray beam in the television camera or image pick-up tube. In tricolor operations (which will herein be referred to by way of example to illustrate the principle of this invention) light from an object area is permitted to pass through the three filters in sequence and this light is then directed upon the light responsive electrode of the television camera tube where an electrostatic or charge image is produced in proportion to the intensity of the light of the particular color and in accordance with the sensitivity of the tube for that color.

As is well known to those skilled in the art, the light transmitting efficiency of the various filter elements is not uniform or identical and, furthermore, the spectral response of the television camera tube is not linear throughout the entire visible spectral. Accordingly, the produced television video or image signals representing the three component colors do not bear the proper relative intensities with respect to each other with the result that if these signals, as produced, are transmitted and utilized at a receiver to produce television images, a properly toned image would not be produced insofar as color balance is concerned. By reason of this, various circuit arrangements have been proposed and used by means of which the signal strengths of the video signals representing the various component colors may be altered in intensity relatively to each other so that the signals representative of an image of one color are amplified by a greater or lesser extent than are the signals representative of an image of another color. When the dif-

2

ferent degrees of amplification to which the image signals are subjected are properly chosen, a desired color balance may be obtained at the television receiver.

5 According to the present invention, it is desired to provide a television transmitter in which the video signals representing the various component colors are produced initially in approximately the proper relative intensities so that the video signals may thereafter be amplified by a similar and uniform amount. In order to accomplish this purpose and in accordance with the present invention, the color filter disc or other type of color separation unit is constructed in such a manner that the effective areas of the various filter elements may be charged relative to each other so that the video signals as produced will bear the proper proportionate intensities.

20 In my U. S. Patent No. 2,429,849, issued on October 28, 1947 entitled "Television systems," there is shown and described a system in which a color filter drum or disc is employed where the effective areas of the filter element are so chosen in size and so spaced that the signals produced by the television camera or pick-up tube have approximately the proper relative signal strengths. When the subject matter to be televised originates in a studio where the illumination is fixed and constant and where the light transmitting efficiency of the filters and the spectral response of the television camera tube remain constant, it is possible to so proportion the effective sizes of the filter elements that a desired color balance is obtained. Where a television camera is employed for outside pick-up, however, the lighting conditions change materially from day to day and even during the day with the result that it may become necessary to alter the relative sizes of the filter elements to suit the particular circumstances or to accommodate the spectral response of a particular camera tube for different color temperature illumination conditions, for instance. In the present invention, provision is made whereby the effective areas of the filter elements may be altered at will by an operator even while the television camera is in action. The fact that the relative size of the filter may be altered during operation of the television camera also permits deliberate shifting of color balance or tone to accentuate a particular desired color effect, even though this might be an actual color distortion under some conditions.

Accordingly, it is one purpose of the present invention to provide, in a color television trans-

3

mitter, a filter disc in which the relative sizes of the filter elements may be regulated and altered.

Another purpose of the present invention resides in the provision of a color filter disc or assembly to be used in a color television system whereby the effective size of one or another of the filter elements may be varied at will without in any way affecting the effective size of the other filter elements.

Still another purpose of the present invention resides in the provision of a filter disc or assembly to be used in a color television transmitter by means of which it is possible to alter or change the relative effective areas of the filter elements even during operation of the television camera.

Various other purposes and advantages of the present invention will become more apparent to those skilled in the art from the following detailed description particularly when considered in connection with the drawings, wherein:

Figure 1 shows a color television filter disc;

Figure 2 shows a shutter or mask that may be used to reduce the effective size of the filter elements of a particular color;

Figure 3 shows the color filter disc of Figure 1 with the mask or shutter of Figure 2 superimposed thereon together with means for shifting the relative position of the filter disc and shutter;

Figure 4 shows a sectional view taken along lines 4—4 of Figure 3;

Figure 5 is a detailed enlargement of a portion of Figure 3;

Figure 6 shows a modification wherein three shutter elements are used, as in the assumed tri-color operation of the system; and

Figure 7 is a schematic representation of a portion of a television transmitter incorporating the present invention.

Referring now to the drawings and more particularly to Figure 1, there is shown a color television filter disc 10 having red, blue and green component color filter elements 12, 14 and 16 respectively. These filter elements are separated by spirally shaped spokes or opaque portions for supporting the filters and for casting a shadow on the light responsive electrode of the television camera tube during operation. The color filter disc is rotated by means of a motor 90 (see Figure 7) and the speed of rotation is synchronized with the field (or vertical) deflection rate of the cathode ray beam of the television camera tube. The phase relationship of the disc with respect to the vertical deflection of the cathode ray beam are preferably such that the scanning operation takes place in the shadow of the spokes of the filter disc.

Figure 2 shows a shutter disc 18 having a diameter somewhat larger than the diameter of the filter disc 10. This shutter disc includes an outer portion and an inner portion, the two portions being joined by diametrically opposite spiral spokes 20. The configuration of the spokes 20 corresponds to the configuration of the spokes 22 of the color filter disc 10.

The color filter disc 10 and the shutter disc 18 are maintained in proper position relative to each other by the construction shown in Figure 4. This construction includes a hub 24 which is provided with a central opening by means of which the hub may be attached to a motor shaft 26. This hub is provided with a plurality of holes near its periphery to accommodate bolts 28 for maintaining the parts in proper relative position. The holes in the hub 24 are located so as to match

4

the holes 30 in the color filter disc 10. The support also includes an end plate 32 having a turned down or reduced diameter portion on its inner side. The bolts 28 extend through the hub 24, the color filter disc 10 and the end plate 32 in order to permanently fix the filter disc 10 with respect to the hub and the motor shaft. The shutter disc 18 is provided with an inner central hole 34 having a diameter slightly larger than the diameter of the turned down portion of the end plate 32 so that the shutter disc may rotate freely on the end plate. The shutter disc 18 is maintained spaced by a small amount from the filter disc 10 by means of washer or spacer 36. Both the spacer and the shutter disc 18 are free to rotate with respect to the end plate 32 but are maintained in position with respect to the filter disc 10 by reason of the enlarged outer portion of the end plate.

In order to limit the motion of the shutter disc 18 with respect to the filter disc 10, a pin 38 is attached near the periphery of the color filter disc, with the axis of the pin parallel to the axis of the disc. Preferably two diametrically positioned pins are provided. These two pins cooperate with slots 40 that are provided near the periphery of the shutter disc 18, and the lengths of the slots determine the extent of the relative motion of the shutter disc with respect to the filter disc. In order that the shutter disc will be normally held in a particular position with the spoke 20 of the shutter disc exactly coinciding with the spoke 22 between the red and green filter elements of the filter disc 10, a tension spring 42 is provided. One end of spring 42 is attached to the color filter disc whereas the opposite end of the spring 42 is attached to the shutter disc. If necessary, additional space may be provided for the spring by providing cut out portions 44 in the filter disc and 46 in the shutter disc. These cut out portions will accommodate the tension spring 42 if the space between the two discs is insufficient. Normally, therefore, the tension spring 42 maintains the shutter disc in its maximum clockwise rotation direction with respect to the filter disc but permits a certain amount of relative motion of the shutter disc in a counter-clockwise direction, the amount being determined by the length of the slots 40 in the shutter disc.

When the color disc is in operation, the motor 90 rotates the shaft 26 which, in turn, rotates the entire assembly including the color filter disc 10 and the shutter disc 18. These elements are both rotated at the same rotational speed. Due to the action of the tension spring 42 the relative position of the filter disc and the shutter disc is maintained fixed. When in a normal position the diametrically opposite spokes 20 of the shutter disc exactly coincide with the spokes 22 between the red and green filter elements.

As explained in the specification of my above referred to patent, the response of a television camera tube of the iconoscope variety, for instance, is generally considerably more for wave lengths corresponding to red than for either blue or green. Accordingly, in order to reduce the intensity of the video signals corresponding to the red component color the effective size or area of the red filter element may be reduced. If the size of the filter element is reduced by a predetermined amount substantially desirable color balance may be obtained for a particular set of conditions. Should the conditions or the lighting be altered, a new effective area for the red

2,478,598

5

filter may be required in order to produce the desired color balance.

Since it is more desirable to reduce the size of the red filter element in as much as the video signals representing the red component color are exceptionally large as compared with signals representing the other colors, the spoke of the shutter disc was chosen to lie over the spoke between the red and green filter elements. The direction of rotation of the entire assembly is represented as being clockwise by the arrow 50 while the shutter disc may be rotated relative to the filter disc in a counter-clockwise direction by a predetermined small amount (slots 40) thereby stressing the tension spring 42. If, during rotation of the entire assembly in a clockwise direction, a drag is applied to the shutter disc, springs 42 will be stressed and a counter-clockwise motion of the shutter disc will result with respect to the filter disc. In order to accomplish this drag, a pair of coils 52 and a magnetic structure 54 are provided as shown in Figures 3 and 4. When the coil 52 is energized, a magnetic field is set up in the magnetic circuit and a strong magnetic field is produced across the air gap 56 of the magnetic circuit. The periphery of the shutter disc is positioned to rotate within this air gap so that an induction drag is produced on the shutter disc due to eddy currents induced in the shutter disc. Preferably the shutter disc should be made of aluminum or some other non-magnetic material. Aluminum or some similar material is preferable both from the standpoint of magnetic properties and weight.

The coils 52 are preferably energized in series and derive current from a source of potential 58. Included in the circuit is an adjustable resistance 60. By adjusting the value of the resistance 60, the amount of current that is permitted to flow through the coils may be altered, and, accordingly, the amount of drag may be adjusted. A plurality of coils is used in order to balance the drag on the shutter disc, although only a single coil is necessary. When a large amount of current is permitted to flow in the coils, considerable drag is produced which results in a considerable shifting of the shutter disc with respect to the filter disc which results in an occultation of a portion of the red filter element. The largest amount of the red filter element that can be effectively removed is determined by the width of the shutter spoke 20 and by properly choosing the widths of the spokes in both the filter and shutter discs, the necessary maximum amount of reduction of the video signals corresponding to the red component color may be brought about. Any intermediate reduction in the effective size of the red filter element is also possible by properly regulating the amount of current that is permitted to flow through the coils 52 of the magnetic 54.

By means of the foregoing, it is, therefore, possible to operate a color television transmitter in which all of the color filter segments or elements have the same effective areas and it is also possible to reduce the effective areas of the color filters of a particular color even while the television transmitter is in operation by adjusting the amount of current that is permitted to flow through the stationary electromagnets associated with the shutter disc.

There are some instances when an adjustment in the size of two or even all three of the filter elements would be desirable and under such conditions a structure such as shown in Figure 6 may

6

be employed. In this case, a color filter disc 10 is employed which is similar in construction to the filter disc shown in Figure 1. Associated with this filter disc are three shutter discs 62, 64 and 66 each of which is substantially identical to the shutter disc shown in Figure 2. The three shutter discs 62, 64 and 66 are all positioned adjacent the color filter disc 10 and slots may be provided for limiting the extent of their motion relative to the filter disc. Furthermore, springs (not shown for reasons of simplicity) are also preferably provided to maintain them normally in a predetermined position. These springs, associated with the color filter disc and each of the shutter discs, would be similar to the springs 42 shown in Figures 3 and 5.

The central one of the shutter disc 64 is flat, and, for producing a drag on disc 64, electromagnet 74 is provided. Discs 62 and 66 have their peripheral edges offset in order to accommodate their associated magnetic structures and cooperating with the peripheries of these discs are electromagnets 72, and 76 respectively. All of the magnets 72, 74 and 76 may be energized from a common source of current 78 and the amount of current that is permitted to flow through the three electromagnets may be determined by the three separate adjustable resistances 82, 84 and 86.

Naturally, each of the shutter discs 62, 64 and 66 include diametrically arranged spokes and the spokes of each disc are normally in coincidence with the spokes between a predetermined and different pair of filter elements so that each of the three shutter discs individually determine the effective area of a particular color filter element.

By means of the construction shown in Figure 6 and described above, it is, therefore, possible to provide a color filter disc for use in a television camera in which the effective area of all of the filter elements used may be controlled and may be individually varied even while the filter disc is in operation. By separately adjusting the amount of drag on the three shutter devices, it is possible to change the relative intensities of the video signals produced by the television camera tube in order to produce a desired color balance or in order to produce an abnormal color balance for aesthetic or other production reasons.

The relationship of the filter disc and shutter disc to the immediately associated elements of a television transmitter is shown in Figure 7. In this figure, the object to be televised is represented by the arrow 92 while the television camera tube is represented at 94. In order to focus an optical image of the object area upon the light responsive electrode surface of the camera tube 94, a lens system 96 is provided. For simplicity only single lens element is represented in the drawing, however, in actual practice, more complex and highly corrective lens systems would naturally be used. Interposed in the optical axis are the color filter disc 10 and the shutter disc or discs 18 so as to totally encompass the light beam. The color separation assembly, including the filter disc and the shutter disc are rotated at the desired rate of speed by means of the motor 90 and the speed and phase relationship of this motor with respect to the rate of deflection of the cathode ray beam in the camera tube is controlled by means of the control circuits represented at 98.

The television camera tube supplies video signals representative sequentially of the various component colors of the object area and these

video signals are supplied to a video amplifier 100. An amplified video signal output is then derived from the video amplifier 100 and with this video signal are combined blanking impulses, synchronizing impulses and shading control voltage variations (where necessary) as well as any other required modification of the signal series.

Some energy from the video amplifier is also supplied to a monitor 102 which includes an image producing tube, the operation of which may be controlled from the control circuits 98. The electromagnet 54 including the winding 52 is shown associated with the shutter disc 18 and the amount of the current that is permitted to flow through the winding 52 is under the control of an appropriate element located preferably at or near the monitor tube.

The attendant who is monitoring the television program views the image produced on the tube at the monitor and, accordingly, regulates the effective area of the various color filter elements used in order to produce the desired tone or color balance in the reproduced image. By so doing, a properly balanced color television image may be assured at a television receiver.

As a matter of simplicity, only a single electromagnet is shown in Figure 7 and it is to be understood that two or more such electromagnets may be used in actual practice. Furthermore, only a single shutter disc 18 is represented in Figure 7 although two or more such shutter discs may be employed when arranged in a manner similar to that shown in Figure 6 of the drawing.

The above described apparatus for producing a desired color balance may also be used where the subject matter is derived from a color motion picture film. Under such circumstances the average speed of motion of the film (in frames per second) is maintained proper and is preferably harmonically related to the television frame speed and properly phased with respect thereto in a manner well known to those skilled in the art.

I claim:

1. A rotatable filter disc for use in connection with a sequential color television transmitter comprising a plurality of differently colored filter elements arranged in a predetermined sequence and separated by opaque areas, a shutter disc, means for positioning the shutter disc adjacent the filter disc with their axes of rotation coincident, said shutter disc being adapted to be shifted a predetermined angular amount with respect to the filter disc, said shutter disc having an opaque portion substantially corresponding in size to the opaque portion between two predetermined adjacent color filter elements, means for normally maintaining the opaque portion of the shutter disc in alignment with the opaque portion between the two predetermined color filter elements, means for simultaneously rotating both the filter disc and the shutter disc, and electromagnetic means associated with the shutter disc to shift the angular position of the shutter disc with respect to the filter disc while both discs are rotating thereby to occult a portion of a filter element of a predetermined color.

2. A rotatable color filter disc for use in connection with a sequential color television transmitter comprising a disc having alternate opaque and color filter portions, successive filter elements being of different predetermined colors, a shutter disc having an opaque portion substantially corresponding in size to the size of at least one of the opaque portions between the filter elements,

means to position both the filter disc and the shutter disc on a common axis of rotation, said shutter disc being angularly shiftable with respect to the filter disc, means to normally maintain the shutter disc in such a position with respect to the filter disc that the opaque portion of the filter disc and an opaque portion of the shutter disc coincide, means to simultaneously rotate both the filter disc and the shutter disc, and means to apply a drag force to the shutter disc to cause it to shift in angular position with respect to the filter disc by a predetermined adjustable amount to thereby cause the opaque portion of the shutter disc to coincide with a predetermined portion of a filter element of a predetermined color thereby to effectively reduce the size of that filter element.

3. A rotatable color filter disc for use with a sequential color television transmitter comprising a filter disc having a series of substantially spirally arranged color filter elements of successively different colors, opaque portions or spokes of substantially spiral configuration immediately adjacent color filter elements, a shutter disc having a substantially spiral opaque portion of a configuration substantially corresponding to the configuration of the opaque portions between filter elements in the filter disc, means to position the filter disc and the shutter disc relatively adjacent each other and on a common axis of rotation, said shutter disc being freely shiftable by a predetermined angular amount with respect to the filter disc, means to normally urge the shutter disc in a predetermined position with respect to the filter disc, means to rotate both the filter disc and the shutter disc, and means cooperating with the shutter disc to cause the shutter disc to be shifted angularly by predetermined adjustable amounts with respect to the filter disc to thereby alter the effective area of one of the filter elements of the filter disc.

4. A rotatable color filter disc for use with a sequential color television transmitter comprising a filter disc having a series of substantially spirally arranged color filter elements of successively different colors, opaque portions of substantially spiral configuration immediately adjacent color filter elements, a shutter disc of slightly larger diameter than the filter disc having a substantially spiral opaque portion of a configuration corresponding substantially to the configuration of the opaque portions between filter elements in the filter disc, means to position the filter disc and the shutter disc relatively adjacent each other and on a common axis of rotation, said shutter disc being freely shiftable by a predetermined angular amount with respect to the filter disc, spring means to normally urge the shutter disc in a predetermined position with respect to the filter disc, means to simultaneously rotate both the filter disc and the shutter disc at a predetermined angular velocity, and electromagnetic means cooperating with the periphery of the shutter disc to cause the shutter disc to be shifted angularly by predetermined adjustable amounts with respect to the filter disc while both discs are rotating to thereby alter the effective area of one of the filter elements of a predetermined color of the filter disc.

5. Apparatus as defined in claim 4 wherein the effect of the electromagnetic means may be adjusted by means for regulating the current permitted to flow therethrough thereby to alter the degree of angular displacement of the shutter disc with respect to the color filter disc.

2,478,598

9

6. Apparatus as defined in claim 4 wherein means are provided for adjusting the effect of the electromagnetic means by regulating the effective strength of the magnetic field produced thereby so as to alter the degree of angular displacement of the shutter disc with respect to the color filter disc.

7. A rotatable color filter disc for use in connection with a color television transmitter comprising a plurality of different color filter elements separated from each other by opaque portions, a shutter disc having an opaque portion substantially corresponding in configuration and size to at least one of the opaque portions between the color filter elements, means to position the filter disc and the shutter disc relatively adjacent each other and superimposed with respect to each other, said shutter disc being capable of angular rotation with respect to the filter disc by an amount not exceeding the separation of the filter elements, means to normally urge the shutter disc in a predetermined direction with respect to the filter disc, means to simultaneously rotate both the filter disc and the shutter disc, a stationary electromagnet positioned to cooperate with the shutter disc, and means to regulate the degree of magnetic drag on the shutter disc whereby the angular position of the shutter disc with respect to the filter disc may be adjusted.

8. A color filter disc for use in connection with a color television transmitter comprising a plurality of sequentially arranged color filter elements separated from each other by opaque portions, a shutter disc of slightly larger diameter having an opaque portion corresponding substantially in configuration and size to at least one of the opaque portions between the color filter elements, means to position the filter disc and the shutter disc relatively adjacent each other and co-axial with respect to each other, said shutter disc being capable of angular rotation with respect to the filter disc by an amount not exceeding the separation of the filter elements, spring means to normally urge the shutter disc in a predetermined rotational direction with respect to the filter disc, means to simultaneously rotate both the filter disc and the shutter disc in said predetermined direction, a stationary electromagnet positioned to cooperate with the peripheral portion of the shutter disc, and means to adjust the amount of current that is permitted to flow through the electromagnet thereby to produce a predetermined adjustable drag on the shutter disc whereby the angular position of the shutter disc with respect to the filter disc may be adjusted within the said predetermined limits.

9. A color filter disc for use in connection with a tricolor television transmitter comprising a filter disc having red, blue and green filter elements arranged in sequence and separated from each other by opaque areas, three shutter discs each of which is provided with an opaque portion corresponding substantially in size and configuration to certain of the opaque portions between the color filter elements, means to position the filter disc and the shutter discs so that their axes of rotation are coincident, said shutter discs being each individually capable of a predetermined angular movement with respect to the filter disc, the amount of angular movement being less than the separation of the successive color filter elements, means to normally urge the three shutter discs so that they individually oc-

10

cupy a predetermined angular position with respect to the red, blue and green filters respectively, means to simultaneously rotate the filter disc and the three shutter discs as a unit at a predetermined angular velocity, and means to individually apply a predetermined adjustable drag to the three shutter discs whereby their angular positions may be individually adjusted with respect to their three associated color filter elements.

10. A color filter disc for use in connection with a tricolor television transmitter comprising a filter disc having red, blue and green filter elements arranged in sequence and separated from each other by opaque areas, a shutter disc provided with an opaque portion substantially corresponding in size and configuration to the opaque portions between the color filter elements, means to position the filter disc and the shutter disc so that their axes of rotation are coincident, said shutter disc being capable of a predetermined limited angular movement with respect to the filter disc, means to normally urge the shutter disc so that it occupies a predetermined angular position with respect to a filter element of a predetermined color, means to rotate the filter disc and the shutter disc as a unit at a predetermined angular velocity, and means to apply a predetermined adjustable drag to the shutter disc whereby its angular position may be adjusted with respect to the associated predetermined color filter elements.

11. A color filter disc for use in connection with a tricolor television transmitter comprising red, blue and green substantially spirally shaped color filter elements, each filter element being separated from its adjacent filter elements by a substantially spirally shaped opaque area, three shutter discs each having a substantially spirally shaped opaque substantially corresponding in configuration to the opaque portion between adjacent color filter elements, means to position the shutter discs in a superimposed manner and in proximity to the filter disc with their axes of rotation in coincidence, said shutter discs being each independently capable of a predetermined amount of angular rotation with response to the filter disc, spring means to normally maintain each of the shutter discs in a predetermined individual position with respect to the red, blue and green filter elements, means to rotate the filter disc and the three shutter discs as a unit at a predetermined angular velocity and in a predetermined direction, an electromagnet individually associated with each shutter disc, and means to individually regulate the current supplied to the electromagnets thereby to individually produce predetermined amounts of drag on each of the shutter discs to individually control the amount of angular shift of the discs with respect to their associated color filter elements in a direction opposite to said predetermined rotational direction.

12. A color filter disc for use in connection with a sequential tricolor additive television transmitter comprising red, blue and green substantially spirally shaped color filter elements, each filter element being separated from its adjacent filter elements by a substantially spirally shaped opaque area, a shutter disc having a substantially spirally shaped opaque portion substantially corresponding in configuration to the opaque portion between adjacent color filter elements, means to position the shutter disc in a superimposed manner and in proximity to the filter disc with their axes of rotation in coincidence, said shutter disc being capable of a pre-

11

determined amount of angular displacement with response to the filter disc, spring means to normally maintain the shutter disc in a predetermined position with respect to a filter element of a predetermined color, means to rotate the filter disc and the shutter disc as a unit at a substantially constant angular velocity and in a predetermined direction, an electromagnet associated with the shutter disc, and means to regulate the current supplied to the electromagnet thereby to produce predetermined amounts of drag on the shutter disc to control the amount of angular displacement of the disc with respect to the associated color filter element in a direction opposite to said predetermined rotational direction.

13. A color filter disc for use in connection with a color television transmitter comprising a filter disc having a plurality of consecutively arranged color filters of different successive colors, means to rotate the color filter disc, a shutter element optically associated with said filter disc and rotatable therewith, said shutter element having an opaque portion associated with a filter element of a predetermined color on said filter disc, and electromagnetic means associated with said shutter element to shift the position of the shutter with respect to the color filter disc by predetermined adjustable amounts during rotation of the filter disc whereby the effective area of said filter element of a predetermined color may be altered.

14. A color filter disc for use in connection with a color television transmitter comprising a filter disc having a plurality of consecutively arranged color filters of different successive colors, said filter elements being separated by opaque areas of a predetermined size, means to rotate the color filter disc in a predetermined direction, a shutter element associated with said filter disc and rotatable therewith, said shutter element having an opaque portion associated with a filter element of a predetermined color on said filter disc and having a size similar to the size of the opaque areas between the filter elements, stationary electromagnetic means associated with the shutter element, and means to alter the effect of the electromagnetic means to shift the position of the shutter with respect to the color filter disc by predetermined adjustable amounts during rotation of the filter disc and shutter whereby the effective area of the predetermined color filter may be altered.

15. A color filter disc for use in connection

12

with a sequential color television transmitter comprising a filter disc having sequentially arranged red, blue and green filter elements, said filter elements being spaced by opaque portions, means to rotate the filter disc at a predetermined angular velocity, a shutter element optically associated with a colored filter element of a particular color, electromagnetic means associated with the shutter element, and means to alter the effect of the electromagnetic means thereby to shift the position of the shutter with respect to the associated color filter element by a predetermined adjustable amount during rotation of the color filter disc whereby the effective area of said particular color filter element may be altered.

16. A color separation filter unit arranged in combination with an optical system for directing the light of an image upon a light responsive image receiving element comprising a disc element having a series of spaced component color filter elements of sequentially different colors arranged in a selected order, means to rotate the filter disc relative to the optical system to reveal light to the image receiving element in successively changing colors, a masking disc having opaque areas corresponding substantially to the spacing between said color filter elements, means for rotating the masking disc simultaneously with the filter disc and cophasally therewith, and electromagnetic means associated with the masking disc to shift the position of the masking disc and the filter disc relative to each other during rotation of both the masking and filter discs so that the opaque areas of the masking disc are caused to overlap an adjustable portion of a filter element of at least one color.

FRANK J. SOMERS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,154,607	Brasseur	Sept. 28, 1915
1,374,965	Tate	Apr. 19, 1921
1,741,385	Thomas	Dec. 31, 1929
1,860,967	Tate	May 31, 1932

FOREIGN PATENTS

Number	Country	Date
412,498	France	Feb. 10, 1910
2,786	Great Britain	Feb. 3, 1913
358,875	Great Britain	Oct. 12, 1931