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TELEVISION TRANSMITTING SYSTEM

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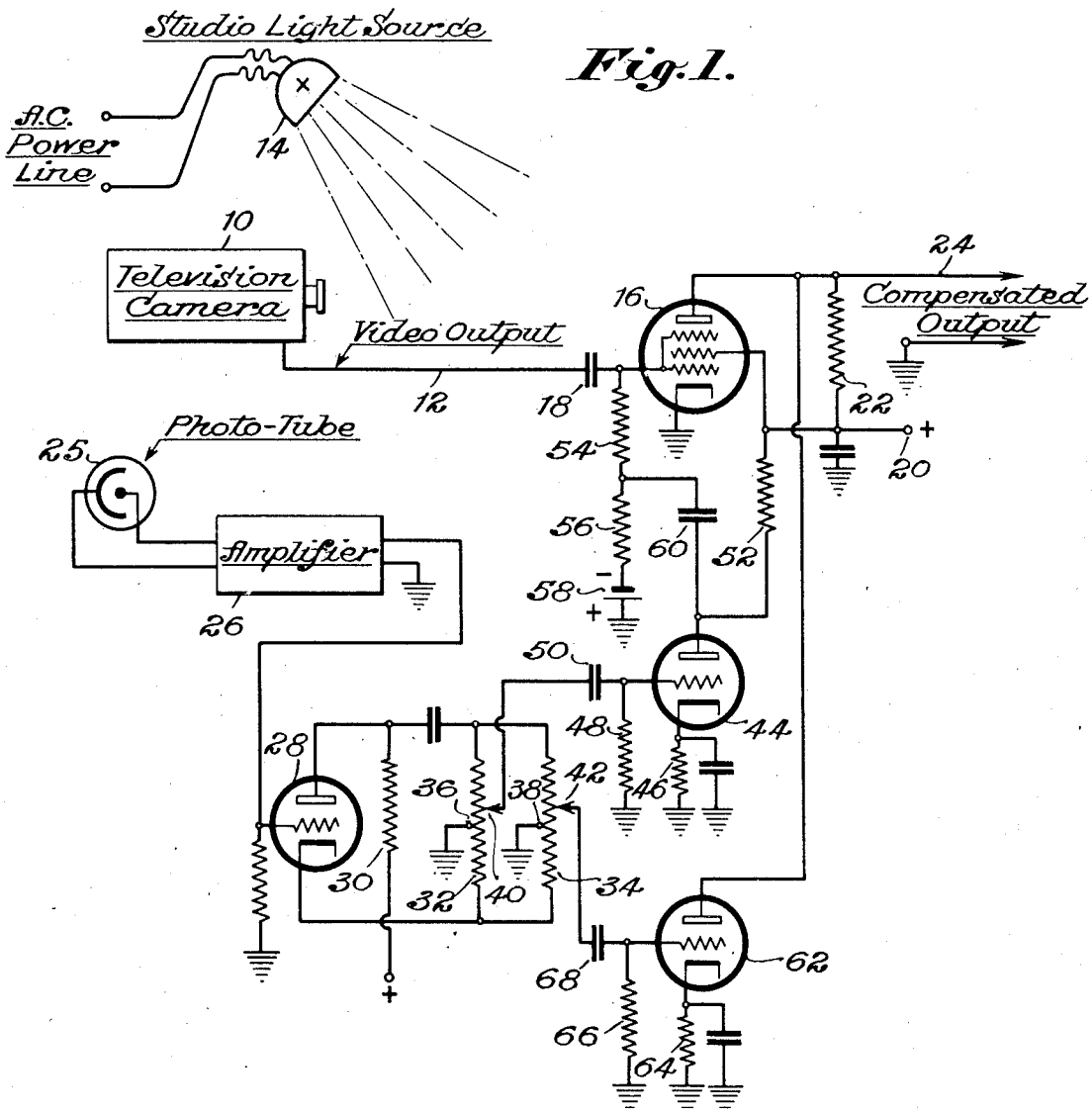
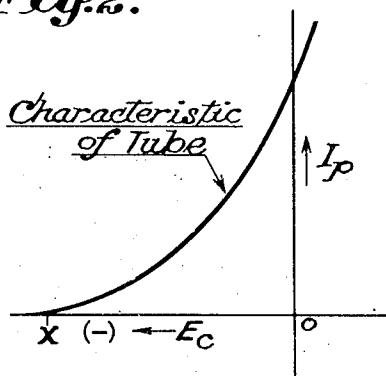


Fig. 2.



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TELEVISION TRANSMITTING SYSTEM

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The present invention relates to a television transmitting system and, more particularly, to systems wherein the television field or frame frequency does not bear a harmonic or a sub-harmonic relationship to the power line frequency.

In present television systems an optical image of the object or scene to be transmitted is projected upon the light responsive electrode and the television camera. An electrical charge image is produced on the electrode as a result of the variations in the light intensity of the optical image and the light responsive electrode or some other electrode bearing a charge image is scanned by a focused cathode ray beam in order to produce a series of picture signals. For the scanning operation the cathode ray beam is deflected in mutually perpendicular directions at different related rates in order that the charge image of the light responsive electrode may be scanned in a systematic manner.

When the television camera is used in an indoor studio, artificial lighting must, of course be used, and inasmuch as most electrical power is now distributed at 60 cycles alternating current, then naturally the sources of studio lighting are energized from the 60 cycle power. In virtually all lighting devices which operate on a 60 cycle power line some fluctuation is present in the light supplied, the fluctuation rate being double the power line frequency. This fluctuation in light intensity is present in incandescent lights, even of relatively high power, and even where the thermal lag is appreciable. If, on the other hand, mercury discharge lamps are used as a source of light, or, if fluorescent sources are used as a source of light, then naturally there will exist a considerable variation in light intensity and the light intensity will fluctuate at the rate of 120 fluctuations per second (for single phase operation).

If the television transmitting tube is operated in such a manner that the scanning rate in fields per second corresponds to, or is a multiple or sub-multiple of the power line frequency, then this variation in light intensity in the studio is not particularly objectionable, since the variation for each successive field or frame remains relatively constant and fixed in position with respect to any particular portion of the picture area. Variation in brilliancy of the illumination source will naturally cause a variation in signal strength, but this variation in signal strength may be removed or compensated for in the dark spot correction circuit which is normally provided in television transmitting sys-

tems. By an adjustment of the dark spot correcting network the variation in picture signal strength may be compensated for and the spurious signals may be effectively removed.

If, however, the deflection rate or scanning rate at which the television camera is operated does not bear a harmonic or sub-harmonic relationship to the frequency of the alternating current power line, then the variations in light intensity in the studio are quite objectionable and, unless removed, appear as light and dark horizontal bands that move vertically across the receiver screen. The rate of progressive or retrogressive movement is naturally a function of the relative frequencies at which the television fields repeat, as compared with the power line current alternations.

One purpose of the present invention, therefore, is the provision of the means and apparatus whereby spurious signals which are introduced into the video signal series may be compensated.

Another purpose of the present invention resides in the provision of means whereby a television camera may be operated asynchronously with respect to the alternating current power line frequency without objectionable spurious effects.

When the television camera is operated asynchronously with respect to the frequency of the alternating current power line, two spurious signals are, in fact, introduced. One effect of the variation in light intensity appears as an amplitude modulation of the video signals at a rate corresponding to twice the power line frequency so that the video or picture signals vary in intensity in accordance with the pulsations in the light emitted from the studio light sources. Another spurious signal which is introduced in the video signal series is the double power line frequency signal component, which naturally must be removed from the video signal series. This spurious signal is also at double the power line frequency and inasmuch as the video signal spectrum extends from substantially zero frequency to frequencies of the order of 4 or 5 megacycles per second or higher, naturally the double power line frequencies, which are introduced by reason of the variable intensity light source, are transmitted along with the actual picture signals.

Another purpose of the present invention, therefore, resides in the provision of means whereby the undesired amplitude modulation of the picture signals may be removed.

Still another purpose of the present invention

resides in the provision of means whereby the spurious double power line frequency signals may be removed from the picture signal series.

A still further purpose of the present invention resides in the provision of a relatively simple circuit together with means whereby compensating voltages may be applied in varying degrees and in selectable polarity in order to properly compensate for the undesired effects which are introduced by reason of the asynchronous operation of the television transmitter.

A further purpose of the present invention resides in the provision of means whereby the gain or amplification factor of one of the amplifying tubes for the picture signal series may be varied at double the power line frequency in order to compensate for the undesired amplitude modulation of the picture signals.

Still other purposes and advantages of the present invention will become more apparent to those skilled in the art from the following specification and claims, particularly when considered in connection with the drawing wherein:

Figure 1 schematically represents one form of the present invention and,

Figure 2 shows a curve representing the operating characteristic of a picture signal amplifying tube.

Referring now to the drawing, and particularly to Figure 1, a television transmitting camera is shown schematically at 10 and the camera necessarily includes a television transmitting tube, together with a lens system for projecting an optical image of the subject matter or scene to be transmitted upon a light responsive electrode in the television transmitter tube. The camera also includes means for scanning an electrical charge image representative of the optical image in order to produce a picture signal series which is applied to the output conductor 12 of the television camera.

A studio lighting source 14 is also shown and the light source is energized from the alternating current power line. The studio lighting source naturally is used to provide the desired illumination in order that a sufficiently intense optical image may be projected upon the light responsive electrode in the television transmitting tube.

A picture signal amplifier tube 16 is provided including at least a cathode, a control electrode, and an anode. This picture signal amplifier tube may have an operating characteristic as indicated in Figure 2 of the drawing and preferably the intensity of the picture signals which are applied to the control electrode of tube 16, by way of condenser 18, is so regulated that the peak to peak picture signal voltage will be small as compared to the total operating range represented at O—X in Figure 2. In order to maintain the anode of tube 16 positive with respect to its cathode, a source of positive potential is applied to the terminal 20 and connected between the terminal 20 and the anode of the tube 16 is a load resistance 22. When the picture signals are applied to the control electrode of tube 16, they will be amplified by the tube and these amplified signals may be derived from the output conductor 24.

In the system as so far described, no compensation for variations in studio light intensity has been made and when the television camera is operated asynchronously with respect to the power line frequency, the spurious signals which would be present in conductor 24 would seri-

ously impair the quality of the reproduced image in many practical cases.

In order to compensate for the undesired signals which are introduced by reason of asynchronous operation of the television camera a photo-tube 25 is provided. This photo-tube or light responsive tube is positioned in the studio and preferably relatively adjacent the television camera in order that the light which is permitted to strike the photo-cathode of the photo-tube is substantially the same as the light which is used in the television transmitting camera. Accordingly, the output from the photo-tube will bear a direct relationship to the fluctuations in light intensity of the studio light source 14. Inasmuch as the fluctuations of the produced light in most cases will not vary sinusoidally or will not correspond to the wave form of the power line frequency, it is desirable to derive correction control potentials from the photocell 25. The variations in potentials which are derived from the photo-tube and which are a result of the variations in the studio lighting are applied to an amplifier 26 for amplification and are, in turn, impressed upon the control electrode of tube 28. The tube 28 includes, in addition to the control electrode, a cathode and an anode, and in order to maintain the anode positive with respect to its cathode a load resistance 30 is connected between the anode and a source of positive potential.

In order that both negative and positive control potentials may be derived from tube 28 and in order that their intensity may be controlled, two potentiometers 32 and 34 are provided. A point 36 along the potentiometer 32 is connected to ground or a point of fixed potential, and a corresponding point 38 on potentiometer 34 is also connected to the same point of fixed potential. Cooperating with potentiometers 32 and 34 are movable contacts 40 and 42 respectively.

A tube 44 is provided which includes a cathode, a control electrode and an anode. The cathode is connected to ground or a point of fixed potential through cathode resistance 46, and the control electrode is also connected to ground through the grid resistance 48. The movable contact 40 of the potentiometer 32 is connected to the control electrode of tube 44 by way of condenser 50 in order that the voltage variations which appear along potentiometer 32 may be applied between the control electrode of tube 44 and its associated cathode. The anode of tube 44 is maintained positive with respect to its cathode by connecting a load resistance 52 between the positive terminal 20 and the anode of the tube. The voltage variations which are derived from the photo-tube 25 will have a frequency of double the power line frequency and will have a wave form corresponding to the change in light intensity in the studio, and substantially these same variations will be present at the anode of tube 44. The intensity of the variations will be determined by the position of the movable contact 40 on the potentiometer 32 and the polarity of the variations will be determined by the position of the movable contact 42 on the potentiometer 34 with respect to the ground point 36.

The control electrode of the video signal amplifier tube 16 is connected to ground through the grid resistors 54 and 56, as well as biased cell or the grid biasing potential 58. The voltage variations which appear at the anode of tube 44 are applied to the junction of grid resistors 54 and 56 by way of coupling condenser 60. Normally

the bias which is applied between the control electrode and the cathode of tube 16 is such as will cause the tube to operate at a predetermined point along the characteristic curve shown in Figure 2 at a point between points O and X. As stated above, the peak to peak video signal voltage should not be excessive and should be small as compared to the total operating range extending from O to X. The voltage variations, which are applied from the anode to tube 44 through coupling condenser 80 and resistance 84 and to the control electrode of tube 16, therefore alter the operation point of the tube 16 along its characteristic curve. When the potential of the control electrode of tube 16 is reduced or altered in a negative direction, it operates in a range nearer the point X, whereas when the potential of the control electrode of tube 16 is altered in a positive direction, then the tube will operate about a point on the characteristic curve nearer the point O. This shifting of the operating range of tube 16 along its characteristic curve naturally alters the gain of the tube so that it is effective to amplify the picture signals in varying amounts in accordance with its range of operation along its characteristic curve. As stated above, picture signals, as derived directly from the television camera are amplitude modulated at double the power line frequency, and, by altering the gain of tube 16 (by varying its bias) this undesired amplitude modulation may be removed. Substantially complete removal of this undesired amplitude modulation is accomplished by properly adjusting the movable contact 40 along the potentiometer 32. Furthermore, inasmuch as the photo-tube 25 responds to fluctuations in light produced by the studio lighting source and since the undesired amplitude modulation of the video signals is also a function of the fluctuations in the studio lighting, substantial complete elimination of the undesired modulation may be accomplished by the above described method and apparatus.

There yet remains a further undesired spurious signal of double the power line frequency which must be removed from the video signal series. This is accomplished by the provision of tube 62 which includes at least a cathode, a control electrode and an anode. The cathode and the control electrode of this tube are connected to ground or a point of fixed potential through cathode and control resistances 64 and 68, respectively, and the control electrode of tube 62 is also connected to the movable contact 42 of the potentiometer 44 by means of condenser 66. There is, therefore, a voltage variation impressed upon the control electrode of tube 62 which is determined in intensity and polarity by the position of the movable contact 42 with respect to the ground point 38. The wave form of these voltage variation corresponds substantially identically to the variation in the light in the studio. The anode of tube 62 is connected directly to the anode of tube 16 in order that a positive potential may be applied to the anode of tube 62 with respect to its associated cathode. Furthermore, by reason of this connection, voltage variations which appear at the anode of tube 62 are also superimposed upon the voltage variation appearing in the anode circuit of tube 16. The load resistance for tube 62 is the resistance 22, which is common to both tubes 62 and 16. By an adjustment of the movable contact 42 along the potentiometer 34 it is possible, therefore, to superimpose voltage variations upon the anode of

tube 16 which are comparable in frequency and in intensity to the undesired voltage variations and which bear a phase relationship such that the undesired voltage variations may be substantially completely eliminated.

From the above described system it is, therefore, possible to operate a television camera asynchronously with respect to the alternating current power line frequently when the light used in the studio is derived from the power line without having undesired and spurious signals present in the picture signals as finally transmitted. Accordingly, the undesired light and dark vertically moving horizontal bands which would otherwise be visible in the receiver are eliminated. It is possible, therefore, to derive from the output conductor 24 a picture signal series which is properly indicative of the scene or optical image televised and which does not include any spurious signals or undesired amplitude modulations as a result of fluctuations in the studio lighting when the television camera is operated asynchronously with respect to the power line frequency.

The system is readily adaptable to any type television camera and may be used to remove the undesired spurious signals, as well as the undesired amplitude modulation of the picture signals. Furthermore, the system is readily adaptable to any type studio lighting, since the photocell 25 responds directly to fluctuations in the light supplied in the studio.

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

What I claim is:

1. A circuit arrangement for use in a television transmitter wherein artificial lighting is employed and wherein the source of artificial light is energized from an alternating current power line having a frequency different from the television field scanning frequency comprising a light responsive element for producing voltage variations in accordance with the fluctuations in the artificial lighting, a television camera for producing a series of video signals, means including an amplifier tube for amplifying the video signals, and means for altering the amplification factor of said video signal amplifying tube in accordance with the voltage variations derived from the light responsive element to compensate for cyclically recurrent changes in the intensity of the produced video signals.

2. A circuit arrangement for use in a television transmitter wherein artificial lighting is employed and wherein the source of artificial light is energized from an alternating current power line having a frequency different from the television field scanning frequency comprising a television camera for producing a series of video signals, means including an amplifier tube for amplifying the video signals, a light responsive tube for producing voltage variations in accordance with the fluctuations in the artificial lighting, means for amplifying the produced voltage variations, and means for altering the amplification factor of said video signal amplifying tube in accordance with the amplified voltage variations to compensate for cyclically recurrent changes in the intensity of the produced video signals.

3. A television transmitting system including

an artificial light source, means for energizing the light source from an alternating current power line having a predetermined frequency, a television camera for producing a video signal series, the field repetition rate at which a scene of action is scanned by the camera being different from the said predetermined frequency of the alternating current power line, means for amplifying the video signal series, a light responsive tube positioned to respond to variations in the artificial light, and means for superimposing the voltage variations derived from the light responsive tube upon the amplified video signal series to thereby eliminate cyclically recurrent transient signals from the video signal series.

4. A television transmitting system including a source of artificial light, means for energizing the light source from an alternating current power line having a predetermined frequency, a television camera for producing a video signal series, the television field repetition rate at which a scene of action is scanned by the camera being different from the said predetermined frequency of the alternating current power line, means for amplifying the video signal series, a light responsive tube positioned to respond to variations in the artificial light for producing voltage variations corresponding to the light variations, means for superimposing the voltage variations derived from the light responsive tube upon the amplified video signal series, and means for controlling the amplitude of the superimposed voltage variations in order that spurious cyclically recurrent signals resulting from fluctuations in the artificial light may be compensated.

5. A television transmitting system including an artificial light source, means for energizing the light source from an alternating current power line having a predetermined frequency, a television camera for producing a television picture signal series, the field repetition rate at which a scene of action is scanned by the camera being different from the said predetermined frequency of the alternating current power line, means for amplifying the picture signal series, a light responsive cell positioned relatively adjacent the camera to respond to variation in the artificial light and for generating voltage variations in accordance with the light variations, means for superimposing the voltage variations derived from the light responsive cell upon the amplified video signal series, and a single means for controlling the amplitude and polarity of the superimposed voltage variations in order that cyclically recurrent spurious signals resulting from fluctuations in the artificial light may be compensated.

6. In a television transmitting system wherein artificial lighting is used, the artificial light sources being energized from an alternating current power line, and wherein the television field repetition rate is different from the frequency of the alternating current power line comprising a light responsive cell positioned to respond to fluctuations in the artificial light source, a television camera for producing a series of picture signals, an amplifier tube for amplifying the series of picture signals, and means for varying the amplification factor of the amplifying tube in accordance with voltage variations derived from said light responsive cell to compensate for cyclically recurrent amplitude modulations of the picture signal series as a result of the asynchronous operation of the television camera as

compared with the frequency of the alternating current power line.

7. In a television transmitting system wherein artificial lighting is used, the artificial light sources being energized from an alternating current power line, and wherein the television field repetition rate is different from the frequency of the alternating current power line comprising a light responsive tube positioned to respond to fluctuations in the artificial light source, a television camera for producing a series of picture signals, an amplifier tube for amplifying the series of picture signals, means for varying the amplification factor of the amplifying tube in accordance with voltage variations derived from said light responsive tube, and means responsive to the voltage variations from said light responsive tube for superimposing said voltage variations in a predetermined polarity and amplitude upon the amplified picture signal series to compensate for spurious signals introduced in the picture signal series as a result of the asynchronous operation of the television camera as compared with the frequency of the alternating current power line.

8. In a television transmitting system wherein artificial lighting is used, the artificial light sources being energized from an alternating current power line, and wherein the television field repetition rate is different from the frequency of the alternating current power line comprising a light responsive tube positioned to respond to fluctuations in the artificial light source for generating voltage variations corresponding to the light fluctuations, a television camera for producing a series of picture signals, an amplifier tube for amplifying the picture signals, means for varying the amplification factor of the amplifying tube in accordance with the generated voltage variations, and means responsive to the generated voltage variations for superimposing said voltage variations in a predetermined polarity and amplitude upon the amplified picture signal series to compensate for cyclically recurrent spurious signals introduced in the picture signal series as a result of the asynchronous operation of the television camera as compared with the frequency of the alternating current power line used to energize the artificial light sources.

9. In a television transmitting system wherein artificial light is used in the studio and wherein the television camera is operated asynchronously with respect to the frequency of the alternating current power line used to energize the artificial light source, including a television camera for producing a series of picture signals, an amplifying tube for increasing the intensity of the series of picture signals, a light responsive cell positioned to respond to fluctuation in the artificial light, and means responsive to the voltage variations derived from the light responsive cell for varying the amplification factor of the amplifying tube in order that cyclically recurrent amplitude modulations of the picture signals by reason of the asynchronous operation of the television camera may be substantially completely eliminated.

10. In a television transmitting system wherein artificial light is used in the studio and wherein the television camera is operated asynchronously with respect to the frequency of the alternating current power line used to energize the artificial light source, including a television camera for producing a series of picture signals, an

amplifying tube for increasing the intensity of the series of picture signals, a light responsive tube positioned to respond to fluctuation in the artificial light, means responsive to the voltage variations derived from the light responsive tube for varying the amplification factor of the amplifying tube, and means for superimposing a predetermined component of the voltage variations derived from the light responsive tube upon the amplified series of picture signals, the predetermined component being adjustable as to intensity and polarity relationship in order that cyclically recurrent spurious signals introduced in the series of picture signals by reason of the asynchronous operation of the television camera may be substantially completely compensated.

11. In a television transmitting system wherein artificial light is used and wherein the television camera is operated asynchronously with respect to the frequency of the alternating current power line used to energize the artificial light source, including a television camera for

5 producing a series of picture signals, an amplifying tube for increasing the intensity of the series of picture signals, a light responsive tube positioned to respond to fluctuation in the artificial light source for generating voltage variations in accordance with the light fluctuations, means responsive to the voltage variations derived from the light responsive tube for varying the amplification factor of the amplifying tube within predetermined adjustable limits, and means for superimposing a predetermined component of the voltage variations derived from the light responsive tube upon the amplified series of picture signals, the predetermined component being adjustable as to intensity and polarity relationship in order that cyclically recurrent spurious signals introduced in the series of picture signals by reason of the asynchronous operation of the television camera may be substantially completely compensated.

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