

Oct. 20, 1942.

R. D. KELL

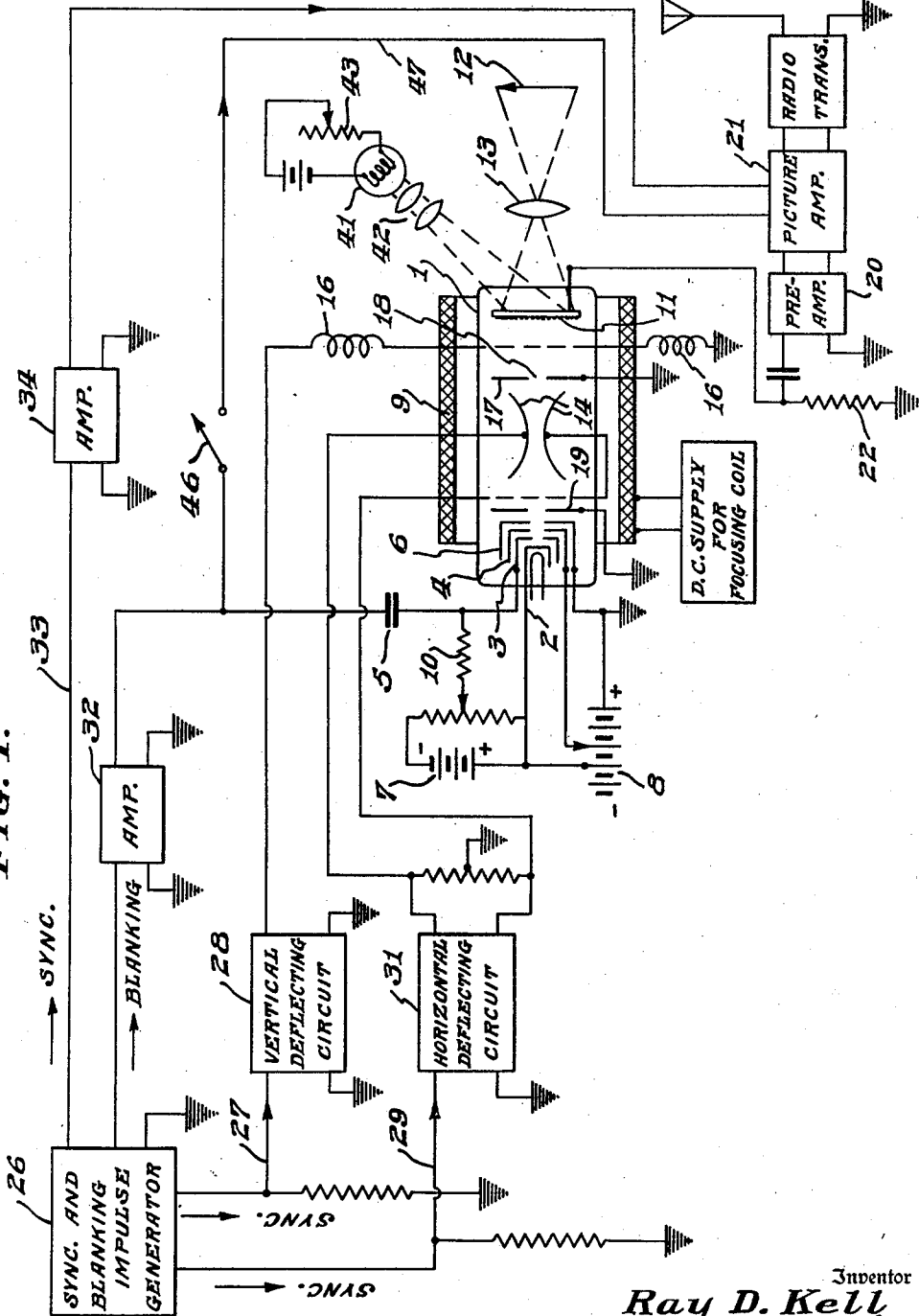
2,299,328

TELEVISION APPARATUS

Filed Aug. 31, 1939

3 Sheets-Sheet 1

FIG. 1.



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FIG. 2.



FIG. 3.

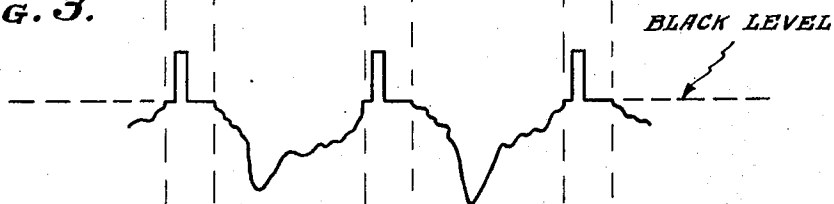


FIG. 4.

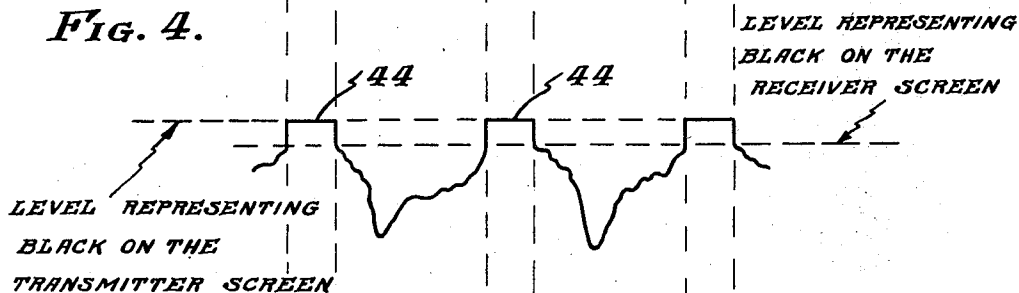
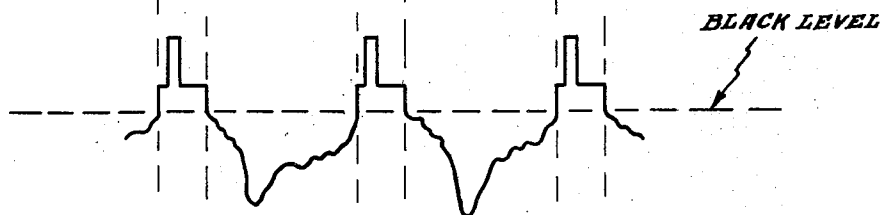


FIG. 5.



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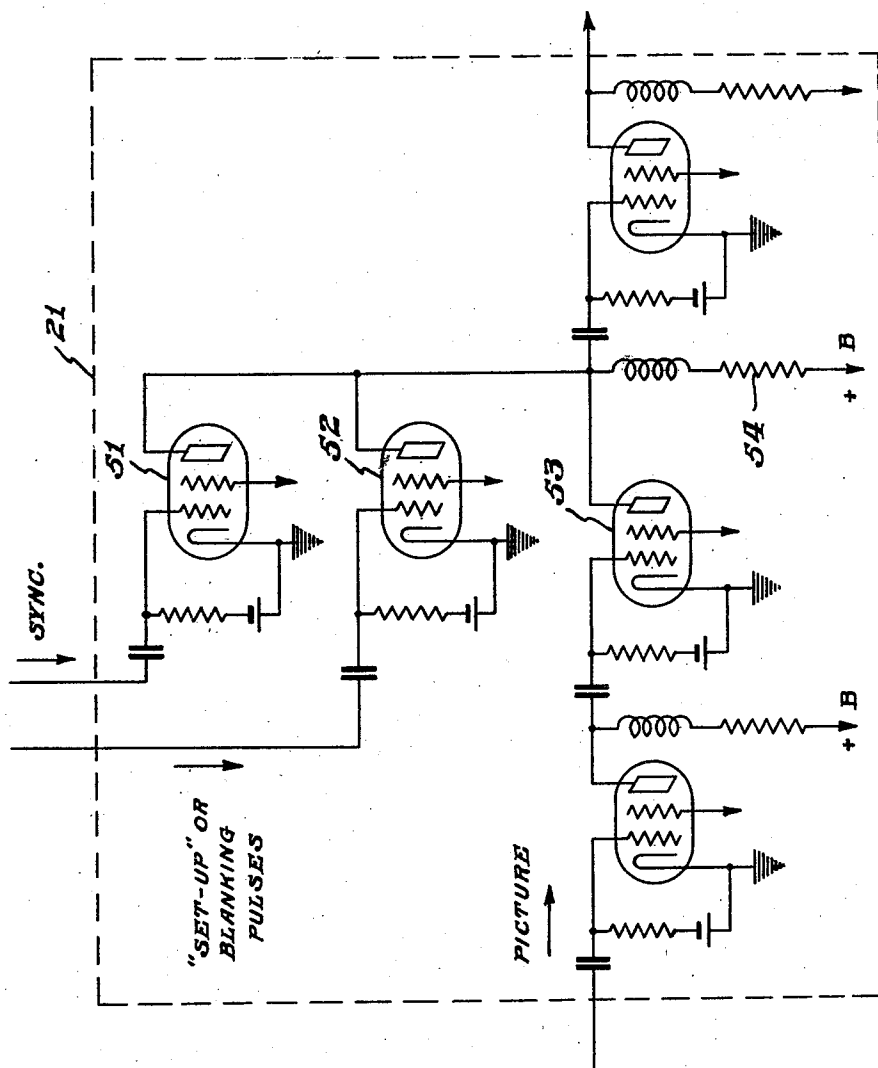


FIG. 6.

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UNITED STATES PATENT OFFICE

2,299,328

TELEVISION APPARATUS

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Application August 31, 1939, Serial No. 292,790

6 Claims. (Cl. 178-7.2)

My invention relates to the transmission of television pictures and has for its object to provide an improved method of and means for so transmitting pictures that the received pictures may be reproduced with the proper background or over-all average illumination. Such reproduction requires either that the transmitted picture contain the direct current component of the picture signal or that it contain direct current "intelligence" in lieu of the direct current component itself.

As explained in Bedford British Patent No. 448,065 and in Holmes U. S. patent application Serial No. 658,894, filed February 28, 1933, entitled "Television systems" and assigned to the Radio Corporation of America, if periodically recurring impulses in a video signal are caused to go to a fixed level such as "black" in the picture, these impulses may be utilized at the television receiver to reinsert the original direct current component of the picture being transmitted with the result that the background of the reproduced picture is the same as that of the original picture or scene.

In accordance with a preferred embodiment of my invention, the transmitted video signal is made to go to "black" periodically in a system utilizing a cathode ray pick-up tube of the type wherein the electrons of the electron beam approach zero velocity at the point of impact with a mosaic screen by applying to the control electrode of this tube periodically recurring blanking pulses which block or cut off the cathode ray periodically. As will be explained more fully hereinafter, this is possible because it is a characteristic of a tube of this type that, when its mosaic or screen is dark, none of the electrons of the cathode ray reach the screen.

The invention will be better understood from the following description taken in connection with the accompanying drawings in which

Figure 1 is a diagram of a television transmitter embodying the invention,

Figures 2, 3, 4 and 5 are curves which are referred to in explaining the invention, and

Figure 6 is a circuit diagram of an amplifier included in the transmitter of Fig. 1.

Referring to Fig. 1, the cathode ray picture transmitting or pickup tube is shown at 1. This tube, which is of the above-mentioned type, is described specifically in Patent No. 2,213,175, issued Aug. 27, 1940, in the names of Hariey A. Iams and Albert Rose, and assigned to the Radio Corporation of America. It is also described as to the principle of operation in Patent No. 2,213,174,

issued Aug. 27, 1940, in the name of Albert Rose, and assigned to the Radio Corporation of America.

The pickup tube 1 comprises a highly evacuated envelope having therein an electron gun which consists of an indirectly heated cathode 2, a control electrode 3, and accelerating electrodes 4 and 6. Suitable biasing and accelerating voltages are provided by the batteries 7 and 8, negative bias being applied to the control electrode 3 through a grid leak resistor 10.

By means of a focusing coil 9, the electron beam leaving the electron gun is focused to a small spot on a mosaic screen 11. The screen 11 is of the well known type commonly employed in iconoscopes with the exception that it is made translucent whereby the image of an object 12 to be transmitted may be projected on the photoelectric elements of the screen from the back side by means of a suitable optical system indicated at 13.

The electron beam is caused to scan the screen 11 by means of deflecting plates 14 and deflecting coils 16, the plates 14 preferably being curved as described in the above-mentioned Iams and Rose patent for the purpose of eliminating distortion in scanning.

An electrode 17 having a slot 18 therein is provided for electrostatic shielding purposes. A centrally apertured electron collecting electrode 19 is provided to which the electrons of the beam not reaching the mosaic screen 11 are directed and collected.

As explained in the above-mentioned Rose patent, the electrons of the electron beam are directed upon the mosaic screen 11 with a very low velocity, that is, a velocity approaching zero velocity at the point of impact therewith. The importance of this feature is that the electrons of the beam approach the mosaic of the point of impact with a velocity such that the ratio of secondary electrons to primary electrons is less than unity.

In operation, elemental areas of the mosaic electronic acquire electrostatic potentials proportional to the intensity of light incident thereon. Particles of the mosaic which are more highly illuminated acquire the most positive electrostatic charge with respect to the unilluminated particles. The positive charges representing an electrostatic image of a picture to be transmitted are neutralized by the scanning beam electrons. When the electrons of the scanning beam are directed toward those particles of the target which are negative with respect to the cathode they

cannot reach those particles because of their low velocity. These electrons, since they are prevented from impinging on the target are returned to an electron collecting electrode adjacent the electron gun. The scanning means which cause the electron beam to scan over the mosaic electrode or target are so chosen as to prevent those electrons of the beam which do not reach the target from returning to the electron gun but rather causes them to be re-directed along paths other than those followed by those electrons in traversing the distance between the electron gun and the target.

A tube of this type has a linear characteristic between light input and signal output. It is so adjusted that when the mosaic screen 11 is dark all of the electrons of the electron beam are repelled and returned to the collector electrode 19. Any light on the screen 11 causes some of the electrons of the beam to reach the screen for neutralizing the positive charges which the light has caused the photoelectric capacity element to assume. This neutralizing current is the picture current. Preferably, it is taken off the back or signal plate of the screen 11 and supplied to a pre-amplifier 20 and to a picture amplifier 21 through an output resistor 22.

From the foregoing, it will be evident that if a negative voltage is applied to the control electrode 3 with sufficient amplitude to block the electron beam, the signal output of the tube 1 will be exactly the same as when the screen 11 is dark. In accordance with my invention, therefore, I block the electron beam at a rate equal to the horizontal scanning frequency whereby the output signal of the tube 1 periodically goes to "black." Thus, the video signal appearing across the output resistor 22 is as shown in Fig. 2.

Referring now more specifically to the circuit associated with the pick-up tube, there is provided a suitable synchronizing signal and blanking impulse generator indicated at 26. This generator preferably supplies synchronizing and blanking signals similar to those described in the above-mentioned Bedford British patent. It may comprise rotatable discs having apertures therein corresponding to the impulses desired as described in the said British patent, or it may comprise vacuum tube oscillators and shaping circuits, as described in Smith Patent No. 2,132,655.

Synchronizing or driving impulses occurring at the vertical deflecting frequency are supplied over a conductor 27 to a suitable vertical deflecting circuit 28 which forces the desired saw-tooth current through the deflecting coils 16.

Likewise, synchronizing impulses occurring at the horizontal deflecting frequency are supplied over a conductor 29 to a suitable horizontal deflecting circuit 31 which impresses a saw-tooth deflecting voltage across the deflecting plates 14.

In accordance with my invention, the video output of the pick-up tube 1 is caused periodically to go to "black" by applying blanking impulses from the generator 26 to the control electrode 3 over a suitable circuit which may include an amplifier 32. In the particular circuit shown they are applied to the electrode 3 through a coupling condenser 5. As previously stated, these impulses drive the electrode 3 so far negative with respect to the cathode 2 that the electron beam is cut off or blocked.

The resulting periodically recurring "black" levels in the video output of the tube 1 may have the synchronizing impulses set on top thereof for transmission to the receiver just as described in

the above-identified Bedford British patent and as illustrated in Fig. 3. This may be done by supplying both horizontal and vertical synchronizing impulses to a suitable amplifier stage in the picture amplifier 21 in such a way that the synchronizing impulses and the video output of the tube 1 add. One way of doing this is shown in Fig. 6 and will be described in detail hereinafter. In the drawing, these synchronizing impulses are shown supplied to the amplifier 21 through a conductor 33 and amplifier 34. It is assumed that both vertical and horizontal blanking impulses are applied to the control electrode 3.

The above-described system produces at the output terminals of the amplifier 21 a video signal which is substantially the same as the video signal comprising "pedestals" having "super-sync" impulses set thereon which is described in the above-identified Bedford British patent. The result is that at any place in the system (at either transmitter or receiver) where the D. C. component has been lost, it may be reinserted since the distance from the A. C. axis of the signal to the "black" level is a measure of the D. C. component.

Although the signal shown in Fig. 3 may be transmitted to the receiver with fairly satisfactory results, it is preferred to have the synchronizing pulses "set up" a certain amount above the black level of the picture being transmitted. The reason for this is that the "pedestal" is utilized at the receiver to block the cathode ray of the cathode ray receiver tube during the return line period. If the pedestal goes only to the black level instead of slightly beyond it, the adjustment at the receiver may be somewhat critical.

The desired "set-up" of the synchronizing pulses may be obtained, for example, by uniformly illuminating the mosaic screen 11 a small amount in any suitable manner as by means of a lamp 41 and a lens system 42. Means is provided whereby the amount of this illumination and, therefore, the amount of "set-up" may be adjusted, such means in the apparatus illustrated being a filament rheostat 43.

Fig. 4 represents the signal appearing across the output resistor 22 when the "set-up" illumination is employed. It will be apparent that the "set-up" has been obtained as a result of the additional illumination showing the entire picture signal toward "white" in the picture. The raised pedestals 44 result since during the intervals of these pedestals the electron beam is blocked and the same condition exists as though the screen 11 were actually dark.

It will be understood that in practice the synchronizing pulses are added to the pedestals 44 to produce the final signal shown in Fig. 5.

Instead of employing the additional illumination for producing a signal with pedestal "set-up" such as shown in Fig. 5, the blanking impulses from the amplifier 32 may be fed through a switch 46 and conductor 47 to a point in the amplifier 21 where they are added to the picture signal having the character shown in Fig. 2. When the synchronizing pulses are also added, a signal like that of Fig. 5 results.

In Fig. 6, there is shown, by way of example, one satisfactory circuit for the picture amplifier 21 of Fig. 1. The circuit itself is conventional and includes three amplifier tubes 51, 52 and 53 which have a common plate resistor 54 whereby the signals supplied to the three tubes are added

together. The circuit is shown with the usual peaking coils for holding up the amplifier gain at the higher frequencies.

I claim as my invention:

1. In a television system having a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing an electron beam and directing it against said mosaic, the electrons in said beam approaching zero velocity at the point of impact on said mosaic and having substantially zero velocity in the region of said mosaic when it is dark, the method of causing the output signal of said tube to go periodically to an amplitude level in the direction of black at least as great as that representative of black in the picture being transmitted which comprises producing periodically recurring electrical pulses and so applying said pulses to said tube as to periodically block said beam.

2. In a television system having a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing an electron beam and directing it against said mosaic, the electrons in said beam approaching zero velocity at the point of impact on said mosaic and having substantially zero velocity in the region of said mosaic when it is dark, the method of causing the output signal of said tube to go periodically to a certain amplitude level greater than that representative of black in the picture being transmitted which comprises uniformly illuminating said mosaic a fixed amount during picture transmission and periodically blocking said beam.

3. In a picture transmitting system, a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing an electron beam and directing it against said mosaic, the electrons in said beam approaching zero velocity at the point of impact on said mosaic and having substantially zero velocity in the region of said mosaic when it is dark, means for producing periodically recurring impulses, means for applying said impulses to said tube and for blocking said electron beam periodically therewith whereby the output of said tube periodically goes to the black level of picture signal, means for producing periodically recurring synchronizing impulses which occur during the time said beam is blocked, and means for so adding said synchronizing impulses and the output of said tube that the synchronizing impulses extend beyond said black level in the direction of black.

4. In a picture transmitting system, a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing an electron beam and directing it against said mosaic, the electrons in said beam approaching zero velocity at the point of impact on said mosaic and having sub-

stantially zero velocity in the region of said mosaic when it is dark, means for periodically deflecting said electron beam comparatively slowly across said mosaic during a picture-signal-producing deflecting period and for periodically returning said beam comparatively rapidly during a return-line period, means for blocking said electron beam during said return-line periods whereby the output signal of the pick-up tube goes to a level representative of black in the picture during each of said return line periods, means for producing synchronizing impulses which occur periodically and simultaneously with said return-line periods, and means for adding said output signal and said synchronizing impulses in such polarity relation that the synchronizing impulses in the resulting signal have a greater amplitude than the amplitude or level representing black in the picture.

5. In a picture transmitting system, a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing a low velocity electron beam and directing it against said mosaic, the electrons in said beam approaching zero velocity at the point of impact on said mosaic and having substantially zero velocity in the region of said mosaic when it is dark, means for producing periodically recurring impulses, means for applying said impulses to said tube and for blocking said electron beam periodically thereby whereby the output of said tube periodically goes to the level representing black on the mosaic, and means for so adding said output with blanking pulses and synchronizing pulses that during the intervals said beam is blocked the signal extends to a certain level beyond the said black level in the direction of black and has set thereon the synchronizing pulses which extend beyond said certain level in the direction of black.

6. In a picture transmitting system, a cathode ray pick-up tube of the type having a mosaic of electron emissive capacity elements and having means for producing an electron beam and directing it against said mosaic, the electrons in said beam approaching said mosaic at the point of impact with a velocity such that the ratio of secondary electrons to primary electrons is less than unity, means for producing periodically recurring impulses, means for applying said impulses to said tube and for blocking said electron beam periodically therewith whereby the output of said tube periodically goes to the black level of picture signal, means for producing periodically recurring synchronizing impulses which occur during the time said beam is blocked, and means for so adding said synchronizing impulses and the output of said tube that the synchronizing impulses extend beyond said black level in the direction of black.

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