March 30, 1943. D. E. FOSTER 2,315,369

TELEVISION SYSTEM

Filed Sept. 28, 1940

FIG. 1.

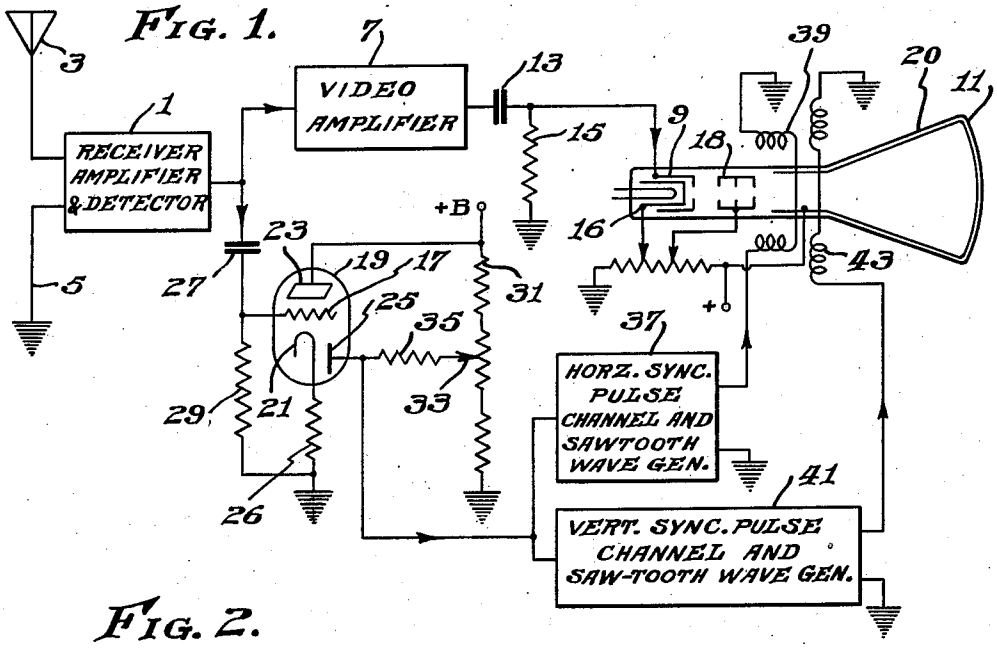


FIG. 2.

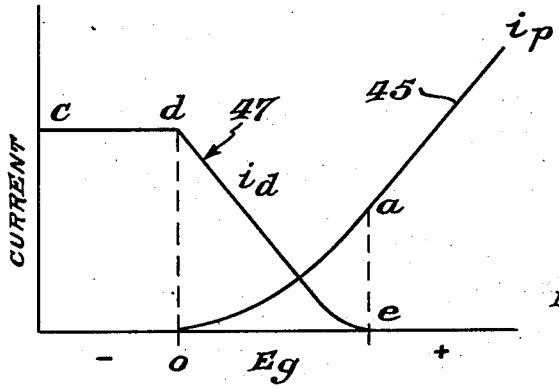


FIG. 3.

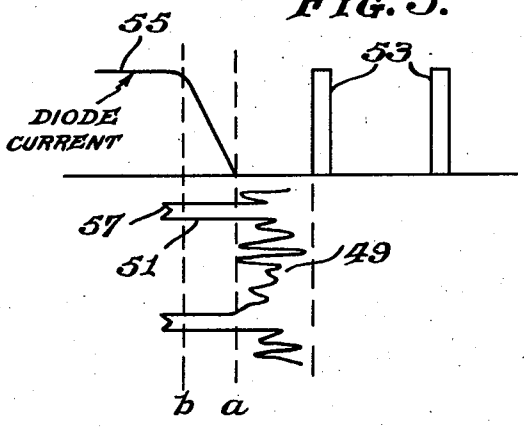
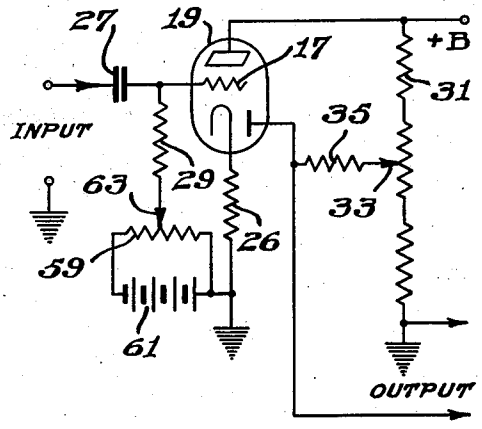


FIG. 4.



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2,315,369

TELEVISION SYSTEM

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4 Claims. (Cl. 178—7.5)

This invention relates to television and more particularly to a method and means for separating the synchronizing pulse signal from a composite television signal.

In television systems wherein the synchronizing pulses both horizontal and vertical are of greater amplitude than the picture (video) signal and transmitted concomitantly therewith, it is necessary to separate the synchronizing pulses from the picture signal. This is generally accomplished by passing the composite signal through a separator tube adjusted so that only the synchronizing pulses which are of high amplitude are clipped from the composite signal. The vertical synchronizing pulses are then separated from the horizontal synchronizing pulses and each of the signals is then transmitted to their corresponding saw-tooth wave generators to produce the necessary deflection currents in the picture reproducing equipment. The synchronizing pulses are preferably in the "black" picture direction and of greater amplitude in that direction than the blackest of the picture signals. A composite signal such as one including both picture signal and synchronizing pulses is illustrated in "Electronics" for July 1938 on pages 28 and 29.

A number of systems have been proposed for clipping the synchronizing pulses from a composite signal by applying the composite signal to a discharge device having cathode and anode and a control electrode whereby the negative bias impressed upon the control electrode is of sufficient magnitude to allow the discharge device to pass only the synchronizing pulses.

It has also been proposed to provide a discharge device having a cathode and an anode and biased such that only the greater amplitude signals are passed therethrough.

According to this invention a discharge device having cathode, a control electrode and an anode together with an auxiliary diode anode adjacent the cathode is provided so that not only are the synchronizing pulses clipped from the composite video signal but the circuit may be adjusted to clip a predetermined portion in the range of amplitude occupied by the synchronizing pulses. The cathode of the discharge device is operated as a cathode follower and the triode portion of the discharge device controls the potential of the cathode. The diode anode will draw current from the cathode only when the cathode is at a negative potential with respect to the diode anode. Therefore, the triode portion of the separator tube is adjusted so that the cathode will be negative with respect to the diode anode only as a result of the synchronizing pulses.

Accordingly the principal object of this invention is to provide a simplified synchronizing pulse separator circuit.

Another object of this invention is to provide a separating circuit adapted to clip a portion of the amplitude of the synchronizing pulses from a composite television signal.

Other and incidental objects and advantages will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawing in which

Figure 1 is a block diagram of a television receiving system including a circuit showing one form of this invention,

Figures 2 and 3 are graphical illustrations showing the operation of this invention, and

Figure 4 is a circuit diagram showing another form of this invention.

Referring now in more detail to Fig. 1, a receiver and amplifier such, for example, as the type shown and described in Carlson Reissue Patent 20,700, patented April 19, 1938, is shown by block 1 having an antenna 3 and a ground 5. Signals from the receiver 1 are transmitted through one channel to video amplifier 7 and thence to the control electrode 9 of the picture tube 11 through coupling condenser 13. The accumulated charge on the control electrode 9 is allowed to leak to ground through resistor 15. The picture tube 11 contains an electron gun including a cathode 16, the control electrode 9, a first anode 18 and a second anode 20.

A portion of the composite television signal from the receiver and amplifier 1 is fed to the control electrode 17 of the discharge device 19 which has a cathode 21, an anode 23 and a diode-anode 25 adjacent the cathode 21. A cathode resistor 26 is provided in the circuit of the cathode 21.

A coupling condenser 27 and a grid leak resistor 29 are provided to maintain the control electrode 17 at a proper bias potential with respect to ground. The anode 23 is supplied with its positive potential from a voltage source B+ across which is connected potentiometer 31 whose variable tap 33 is connected to the diode-anode 25 through resistance 35.

The signal from the diode-anode 25 is then transmitted through a horizontal synchronizing pulse channel and saw-tooth wave generator represented by block 37 and thence to the horizontal deflecting coils 39 of the picture tube 11. The

signal from the diode-anode 25 is also transmitted to the vertical synchronizing pulse channel and saw-tooth wave generator represented by block 41 and thence to the vertical deflecting coils 43 of the picture tube 11.

The operation of the separating circuit will now be explained. When a composite video signal from the receiver and amplifier 1 is impressed upon the control electrode 17 of the triode section of the discharge device 19, the potential of the cathode 21 will tend to follow the potential of the control electrode 17 because, as the voltage impressed upon the control electrode 17 goes more positive, there is more current flowing from the cathode 21 to the anode 23, and, therefore, a greater drop in voltage results across the resistor 26 causing the cathode 21 to change its potential in the positive direction. Conversely, when the control electrode 17 is made more negative, the conductance of the tube 19 is decreased so that very little current flows from cathode 21 to anode 23; thus a smaller voltage drop exists across resistor 26 due to the reduced current so that the cathode 21 is less positive with respect to ground when the control electrode 17 is at a more negative potential.

It will be seen that if the potential on the diode-anode 25 is adjusted properly the signals passing through the discharge device 19 from the cathode 21 to the cathode-anode 25 will be cut off beyond an amplitude where the potential of the cathode 21 exceeds in a positive direction the potential on the diode-anode 25. In actual operation, the potential on the diode-anode 25 will be adjusted so that it is equal to the potential of the cathode 21 when the potential on the control electrode 17 is at an amplitude greater than the blackest of the picture signals. Thus it will be seen that only the synchronizing pulses which, as before mentioned, are in the "black" picture direction and of greater amplitude in that direction than the blackest picture signals, will be passed from the cathode 21 to the diode-anode 25 and thence to the synchronizing signal channels.

The circuit will also operate to stop passing signals whose amplitudes are above a predetermined level in a negative direction. For example, if the signal on the control electrode 17 reaches a sufficient magnitude in a negative direction, the current flowing from the cathode 21 to the anode 23 will be cut off at the cut-off point of the tube 19. It is true that at this point there will be a current flowing from the cathode 21 to the anode 25 because the cathode 21 will be at substantially ground potential with respect to the diode-anode 25, but as the control electrode 17 goes farther negative than the cut-off point there is no change in potential difference between the cathode 21 and the diode-anode 25 so that there will be no change in current flowing to the diode-anode 25 irrespective of change in the potential of the control electrode 17 beyond this cut-off point of discharge device 19.

The operation of this separating circuit will be more fully understood by a reference to the graph illustrated in Fig. 2.

The voltage of the control electrode 17 is represented as the abscissa marked E_g. Curve 45 represents the plate current i_p of the triode, and curve 47, the diode current i_d. The magnitude is shown on the current axis of ordinates. It will be seen that as the potential on control electrode 17 increases in the positive direction the triode plate current increases and likewise the cathode potential. When control electrode 17 is more negative than the cut off value shown by point *o* of curve 45, no plate current is drawn and the diode is positive with respect to the cathode, so that a constant magnitude of diode current flows as shown from *c* to *d* on curve 47. As electrode 17 becomes more positive (less negative) in accordance with the composite video and synchronizing signal impressed thereon, the cathode 21 increases in potential (becomes more positive) and the diode current decreases as shown from *d* to *e* of the curve 47. At some point, *a*, on curve 45 potential of cathode 21 becomes equal to that of diode plate 25 and the diode current becomes zero. For any value of E_g more positive than that of line *a*—*e* of Figure 2, cathode 21 is positive with respect to diode plate 25 and no diode current flows. The potential at which cathode 21 equals potential of diode plate 25 is controllable by slider 33 on voltage divider 31.

Fig. 3 is another graphical illustration of the operation of this invention in which the composite signal 49 being fed to the control electrode 17 results in a clipping of the synchronizing pulses 51 to form a diode current represented by curve 53. The diode current curve is illustrated by 55. Positive potential on the diode 25 is adjusted such that the potential of the diode-anode 25 will equal that potential on the cathode 21 when the incoming signal has an amplitude of *a*. The circuit constants of the tube 19 are so adjusted that the cut-off value of the tube is of such a value that the potential on the control electrode 17 is represented by *b*.

It will be seen that the push-pull clipping effect of the discharge device 19 will result in a clipping off of the top of the synchronizing pulses 51 so that any interference or other disturbance such as indicated by 57 will be eliminated so that the top of the clipped synchronizing pulses will be flat such as indicated by curves 53.

Fig. 4 illustrates another form of this invention in which a potentiometer 59 is connected across a potential source 61 to furnish through variable tap 63 a bias potential for the control electrode 17 of the discharge device 19. This provides a means of adjusting the bias potential on the control electrode 17 such that the range of potentials at which the clipping circuit operates may be easily adjusted. By adjusting the potentiometer tap 33 and the potentiometer tap 63 both limitations of the amplitude of the signal passed by the separating tube 19 may be readily adjusted.

While several systems for carrying this invention into effect have been indicated and described, it will be apparent to one skilled in the art that this invention is by no means to be limited by the particular organization shown and described but that many modifications thereof will be made without departing from the scope of this invention as set forth in the appended claims.

I claim as my invention:

1. In a television system of the type wherein synchronizing pulses are combined with picture signals, the combination of a discharge device having a cathode, an anode, and a control electrode, means for impressing said combined synchronizing pulses and picture signals on said control electrode and adapted to cause said cathode to change its potential in accordance with said synchronizing pulses and said picture signals, means responsive to changes in potential of said cathode caused by said synchronizing pulses, and means connected to said control elec-

trode to block said discharge device within the range of said synchronizing pulses.

2. In a television system of the type wherein synchronizing pulses are combined with picture signals, the combination of a discharge device having a cathode, an anode, and a control electrode, means for impressing said combined synchronizing pulses and picture signals on said control electrode and adapted to cause said cathode to change its potential in accordance with said synchronizing pulses and said picture signals, means responsive to a predetermined portion of changes in potential of said cathode, and means for blocking the current flow between said cathode and anode within the amplitude range of said synchronizing pulses.

3. In a television system of the type wherein synchronizing pulses are combined with picture signals, the combination of a discharge device having a cathode, an anode, a diode anode adjacent said cathode, and a control electrode, means for impressing said combined synchronizing pulses and picture signals on said control electrode and adapted to cause said cathode to change its potential in accordance with said synchronizing pulses and said picture signals, means adapted to supply a positive potential to said diode anode to cause it to be responsive to changes in the potential of said cathode caused by said synchronizing pulses, and means for applying a bias to said control electrode to limit the response of said cathode to a portion of said synchronizing pulses.

4. In a television system of the type wherein synchronizing pulses are combined with picture signals, the combination of a discharge device having a cathode, an anode, and a control electrode, means for impressing said combined synchronizing pulses and picture signals on said control electrode, a biasing potential applied to said control electrode to block the flow of current between said cathode and said anode during the greater portion of said synchronizing pulses, an impedance connected to said cathode adapted to cause said cathode to change its potential in accordance with said synchronizing pulses and said picture signals, and means responsive to changes in the potential of said cathode caused by said synchronizing pulses.

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