March 21, 1939. W. J. POCH 2,151,149

TELEVISION APPARATUS

Filed May 31, 1935 2 Sheets-Sheet 1

Fig. 1.

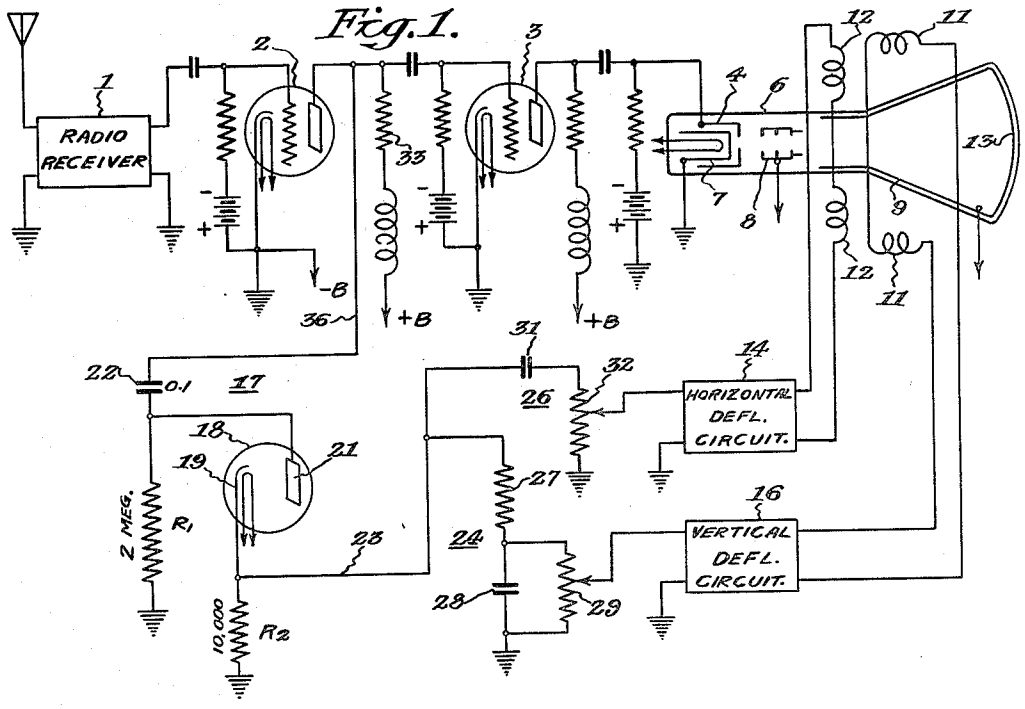
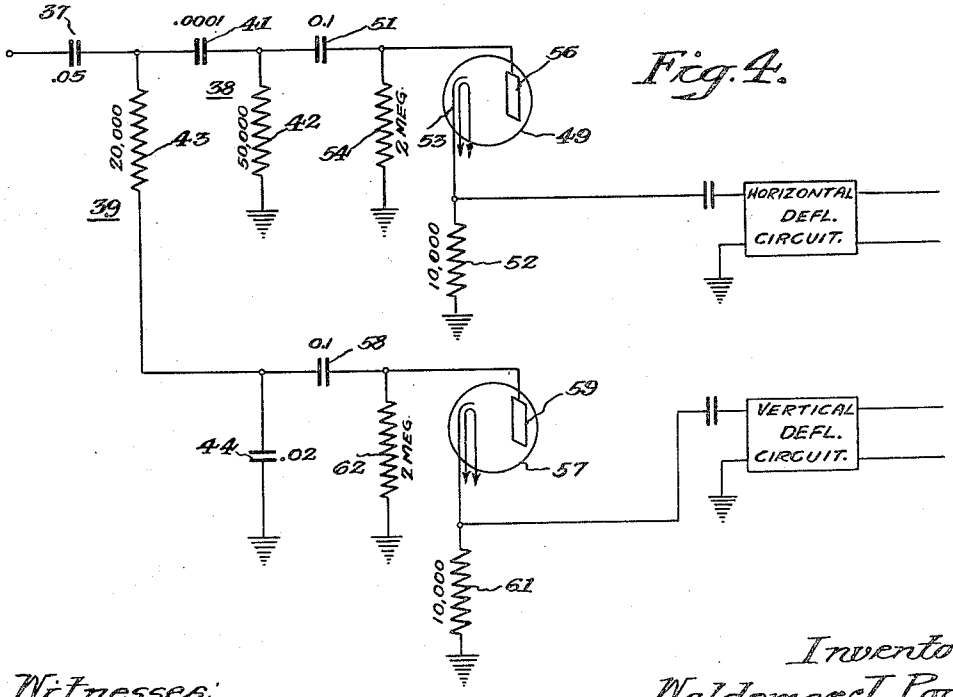


Fig. 4.



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Fig. 2.

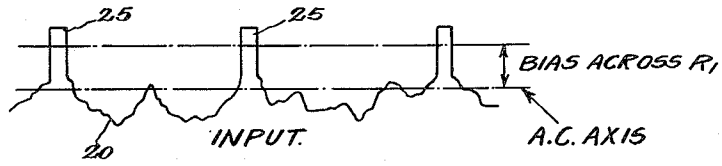


Fig. 3.

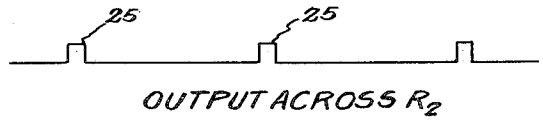


Fig. 5.

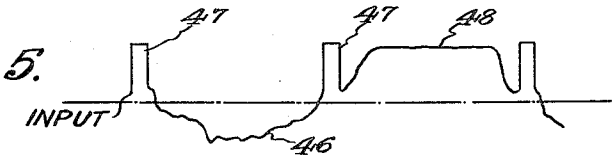


Fig. 6.

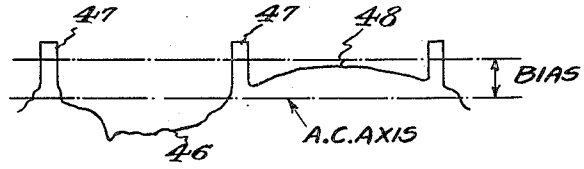


Fig. 7.

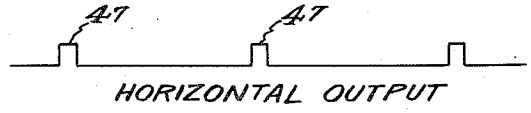


Fig. 8.

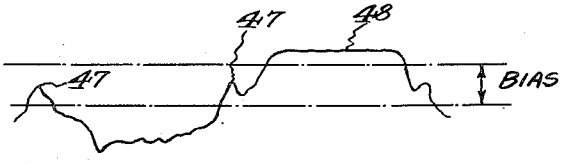
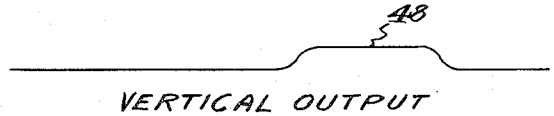


Fig. 9.



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Patented Mar. 21, 1939

2,151,149

UNITED STATES PATENT OFFICE

2,151,149

TELEVISION APPARATUS

Waldemar J. Poch, Collingswood, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application May 31, 1935, Serial No. 24,206

6 Claims. (Cl. 178—7.5)

My invention relates to television apparatus and particularly to means for separating synchronizing signals from picture signals at a television receiver.

In British Patent No. 407,409 there is described a television system in which scanning at the receiver is maintained in synchronism with scanning at the transmitter by transmitting a horizontal synchronizing impulse of short duration at the end of each scanning line and a vertical synchronizing impulse of the same amplitude and longer duration at the end of each picture frame. The synchronizing impulses are of greater amplitude than the picture signals and preferably are in the "black" direction.

An object of my invention is to provide an improved method of and means for separating synchronizing impulses from picture signals in a system of the above-described type.

A further object of my invention is to provide an improved picture signal and synchronizing impulse separating circuit for television receivers which does not reverse the polarity of the synchronizing impulses.

In a preferred embodiment of my invention I impress the combined picture and synchronizing signals upon a vacuum tube of the diode type, the synchronizing signals having a positive polarity when impressed upon the diode and having the same polarity when they appear in its output circuit. In order to prevent any positive polarity picture signals which may be present from appearing in the diode output circuit, a negative bias is applied to the anode of the diode, this bias having a value such that only the positive synchronizing impulses have an amplitude great enough to make the anode positive and thereby produce a flow of current through the diode.

Preferably a biasing means is provided which biases the anode negatively by an amount which varies in accordance with the amplitude of the incoming signals.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawings in which

Figure 1 is a circuit diagram of a television receiver embodying my invention,

Figs. 2 and 3 are curves which are referred to in explaining the operation of the circuit shown in Fig. 1,

Fig. 4 is a circuit diagram of another embodiment of my invention, and

Figs. 5 to 9 are curves which are referred to in explaining the operation of the circuit shown in Fig. 4.

Referring to Fig. 1, there is illustrated a television receiver which is designed to receive picture and synchronizing impulses which have been transmitted by means of a modulated carrier wave in accordance with the teachings of the above-mentioned British patent. The receiving apparatus includes a radio receiver 1 which selects and demodulates the desired carrier wave whereby picture signals and synchronizing impulses of the character described above appear in the output circuit thereof.

The picture signals and synchronizing impulses are amplified in resistance coupled amplifiers 2 and 3 and impressed upon the control grid 4 of a cathode ray tube 6. The cathode ray tube 6 may be of well known construction comprising an evacuated envelope having therein a cathode 7, the control grid 4, a first anode 8, and a second anode 9. Suitable deflecting means, such as deflecting coils 11 and 12, are provided for deflecting the cathode ray both horizontally and vertically to effect scanning of a fluorescent screen 13 at the end of the tube.

The horizontal deflecting coils 12 are supplied with saw-tooth current having a comparatively high frequency from a horizontal deflecting circuit indicated at 14. The vertical deflecting coils 11 are supplied with saw-tooth current having a comparatively low frequency from a vertical deflecting circuit indicated at 16. The deflecting circuits may be any of several well known designs, such circuits generally including a relaxation or blocking oscillator which can be locked in step with synchronizing impulses impressed thereon.

The number of amplifier stages in the radio receiver 1 is so selected that the polarity of the synchronizing impulses impressed upon the control grid 4 of the cathode ray tube is negative whereby the cathode ray is blocked at the end of each scanning line, this being desirable in order to prevent a trace on the fluorescent screen during the return line period.

The scanning of the fluorescent screen 13 by the cathode ray is maintained in synchronism with the scanning at the transmitter by separating the synchronizing impulses from the picture signal and impressing these impulses upon the deflecting circuits 14 and 16. In accordance with my invention the combined picture signals and synchronizing impulses are taken from a point in the circuit, such as the output circuit of the amplifier 2, where the synchronizing impulses are

of positive polarity and are impressed upon a separating circuit 17.

The separating circuit 17 comprises a vacuum tube 18 of the diode type having an indirectly heated cathode 19 and an anode 21. The cathode 19 is connected to ground through an output resistor R_2 while the anode 21 is connected to ground through an input resistor R_1 which, preferably, has a large resistance value compared with that of R_2. Thus the circuit between the cathode 19 and the anode 21 includes two resistor sections or elements connected in series.

The picture signals and the synchronizing impulses are fed to the anode 21 through a condenser 22 whereby they are impressed across the input resistor R_1.

For reasons which will be explained hereinafter, only the synchronizing impulses appear in the output circuit of the separating tube 18, these impulses being fed through a conductor 23 to two filter circuits 24 and 26. The filter circuit 24 includes a resistor 27 of fairly high resistance value connected in series with a condenser 28 having comparatively large capacity whereby only the lower frequency vertical synchronizing impulses appear across the condenser 28. Preferably, the vertical synchronizing impulses are supplied through a potentiometer 29 in shunt to the condenser 28 to the vertical deflecting circuit 16.

The filter circuit 26 consists of a small capacity condenser 31 connected in series with a resistor 32 of fairly low resistance value whereby only the comparatively high frequency horizontal synchronizing impulses pass through the condenser 31 to develop voltage impulses across the resistor 32 which are impressed upon the horizontal deflecting circuit 14.

Referring now to the operation of the picture separating tube 18, the positive synchronizing impulses impressed upon the anode 21 cause a flow of current through the diode whereby the condenser 22 receives a charge. The charging circuit may be traced from the upper end of the plate resistor 33 of the amplifier 2, through the conductor 36, the condenser 22 and diode 18, and through the output resistor R_2 and ground to the cathode of the amplifier 2. Between successive horizontal synchronizing impulses, a portion of the charge on the condenser 22 leaks off through the input resistor but the time constant of the circuit including the condenser 22 and the input resistor R_1 is such that a substantially steady negative bias is applied to the anode 21 so long as there is no charge in the amplitude of the incoming synchronizing impulses.

The action of the circuit will be better understood by referring to Figs. 2 and 3. The curve in Fig. 2 represents a composite signal consisting of picture signals 20 and horizontal synchronizing impulses 25 appearing in the output circuit of the amplifier 2. It will be noted that the greater part of the picture signals have a negative polarity with respect to the alternating current axis and that the synchronizing impulses have a positive polarity. It will also be noted that the amplitude of the synchronizing impulses is greater than the amplitude of any positive polarity picture signal.

It will be apparent that there can be no current flow through the diode 18 until the amplitude of a positive polarity impulse impressed upon the anode 21 is sufficient to overcome the negative bias. Therefore, if the bias is of the magnitude indicated in Fig. 2, only the peaks of the synchronizing impulses will appear in the output resistor R_2 as shown in Fig. 3. If the amplitude of the incoming signals increases, the negative bias increases correspondingly with the result that, even though the amplitude of the picture signals has increased, their amplitude is still insufficient to overcome the bias and only the synchronizing impulses appear across the output resistor R_2.

Instead of first separating the synchronizing signals from the picture signals and then separating the horizontal synchronizing impulses from the vertical synchronizing impulses as described above, the filtering of the horizontal and vertical synchronizing impulses may be done before the picture signals are removed. This method of separation has certain advantages as will be apparent from the following description of the circuit shown in Fig. 4. In practicing the invention illustrated in Fig. 4, the composite signal which appears in the output circuit of the amplifier 2 is impressed through a coupling condenser 37 upon two filter circuits 38 and 39. The filter circuit 38 may consist of a small capacity condenser 41 and a comparatively low impedance resistor 42 connected in series, this filter being similar to the filter 26 shown in Fig. 1. The filter 39 may consist of a resistor 43 connected in series with a condenser 44 of comparatively large capacity.

The signals which are impressed upon the filters 38 and 39 are represented by the curve in Fig. 5 where the picture signals are represented at 46 and the horizontal and vertical synchronizing impulses are represented at 47 and 48, respectively. The signal appearing across the filter resistor 42 is represented in Fig. 6. It will be seen that the amplitude of the vertical synchronizing impulse 48 has been considerably reduced with respect to the amplitude of the horizontal synchronizing impulses 47. The signal appearing across the filter resistor 42 is impressed upon a thermionic diode 49 through a condenser 51. The diode circuit is the same as the one previously described and includes an output resistor 52 connected between the cathode 53 of the diode 49 and ground and an input resistor 54 connected between the anode 56 of the diode 49 and ground.

The flow of diode current produced by the horizontal synchronizing impulses causes a negative bias to be applied to the anode 56 as indicated in Fig. 6 whereby only the peaks of the horizontal synchronizing impulses appear across the output resistor 52. It will be understood that the negative bias is given a value such that the amplitude of the vertical synchronizing impulse 48 is insufficient to overcome the bias. Therefore, the output of the diode includes only horizontal synchronizing impulses as represented by the curve in Fig. 7.

The signal which appears across the condenser 44 of the vertical filter circuit 39 is represented by the curve in Fig. 8. It will be seen that in this circuit the horizontal synchronizing impulses 47 have been so attenuated that their amplitude is considerably less than the amplitude of the vertical synchronizing impulse 48. This signal is impressed upon a second diode 57 through a condenser 58 whereby the anode 59 of the diode 57 is biased negatively by means of the current flow produced by the vertical synchronizing impulses, and only vertical synchronizing impulses appear across the output resistor 61 as indicated by the curve in Fig. 9. The time constant of the circuit including the condenser 58

and the input resistor 62 is great enough to prevent the charge on the condenser 58 from leaking off any substantial amount between vertical synchronizing impulses.

It will be understood that in place of the specific type of rectifier illustrated, other types of rectifiers may be employed. For example, the thermionic diode might be replaced by a rectifier of the copper oxide type or it might be replaced by a rectifier of the gas filled type having a cold cathode.

In the drawings, the values of certain resistors and condensers have been indicated in ohms, megohms, and microfarads. These values are given merely by way of example and may be varied within rather wide limits. The particular values indicated are satisfactory for a system in which the horizontal synchronizing impulses occur at the rate of 10,290 cycles per second and the vertical synchronizing impulses occur at the rate of 60 cycles per second.

From the foregoing description it will be apparent that various modifications may be made in my invention without departing from the scope and spirit thereof and I desire, therefore, that only such limitations shall be imposed thereon as are necessitated by the prior art and set forth in the appended claims.

I claim as my invention:

1. In a television receiver of the type which includes a cathode ray tube having deflecting devices for deflecting the cathode ray and of the type having deflecting circuits coupled to said deflecting devices, an electric discharge tube having a cathode and an anode, two resistor elements connected in series between said cathode and said anode, a condenser, means for impressing received picture and synchronizing signals across one of said resistor elements through said condenser with the synchronizing signals in a direction to produce current flow through said discharge tube and means for coupling the other of said resistor elements to at least one of said deflecting circuits, the time constant of the circuit including said resistor being such that said anode is maintained negative with respect to said cathode between successive synchronizing signals.

2. In a television receiver for separating positive polarity synchronizing impulses from picture signals of less amplitude in the positive direction with respect to an alternating current axis than said impulses, an electric discharge tube having a cathode and an anode, a utilization circuit for said impulses, two resistor sections connected in series between said anode and said cathode, said utilization circuit being coupled across the said resistor section adjacent to said cathode, a condenser, and means for impressing said positive impulses across a portion of said resitive circuit adjacent to said anode through said condenser whereby it receives a charge periodically, the time constant of the circuit including said condenser and said last resistor section being such that a substantially steady voltage appears across said last portion whereby said anode is maintained negative with respect to said cathode by an amount greater than the amplitude of said picture signals in said positive direction.

3. A separating circuit in a television system of the type in which picture signals and synchronizing signals are transmitted and in which at least the greater part of the picture signal voltage is of opposite polarity to the synchronizing signal voltage with respect to a given axis, and of the type in which the receiver includes a cathode-ray having a horizontal deflecting device and a vertical deflecting device, a saw-tooth wave generator coupled to said first device, a saw-tooth wave generator coupled to said second device, said separating circuit comprising an electric discharge tube having a cathode and an anode, two resistor sections connected in series between said cathode and said anode, means for coupling said generators across one of said resistor sections, a condenser, means for impressing said picture signals and said synchronizing signals across the other of said resistor sections through said condenser with said synchronizing signals having a polarity such that they cause current flow through said discharge tube, the time constant of the circuit including said condenser and said other resistor section having a time constant such that said anode is maintained negative between synchronizing signals.

4. A separating circuit in a television system of the type in which a carrier wave is modulated by picture signals and by both horizontal and vertical synchronizing impulses, and in which said impulse modulation is introduced into the carrier in the same direction as the modulation thereof by dark portions of a view being transmitted, and of the type in which the receiver includes a cathode-ray tube having deflecting devices and two saw-tooth wave generators coupled thereto, said separating circuit comprising a vacuum tube having a cathode and an anode, two resistor elements connected in series between said cathode and said anode, means for impressing said signals and impulses upon one of said resistor elements through a condenser with the synchronizing impulses having a polarity such that they cause current flow through said vacuum tube, the time constant of the circuit including said condenser being such that said anode is maintained negative between synchronizing impulses, and means for impressing the synchronizing impulses appearing across the other of said resistor elements upon said generators.

5. In a television receiver adapted to receive a carrier wave modulated by picture signals and by both vertical and horizontal synchronizing impulses, said impulses all having substantially the same amplitude, said amplitude being greater than the peak amplitude of picture signals of the same polarity as said impulses, the method of operation which comprises in one channel decreasing the amplitude of one of said groups of synchronizing impulses with respect to the other group of synchronizing impulses, next separating out said other group of synchronizing impulses substantially to the exclusion of said picture signals, and then utilizing said other group of synchronizing impulses for synchronizing, and further comprising in a second channel separating out said one group of synchronizing impulses substantially to the exclusion of said picture signals, and then utilizing said one group of synchronizing impulses for synchronizing.

6. In a television receiver adapted to receive a carrier wave modulated by picture signals and by both vertical and horizontal synchronizing impulses, said impulses all having substantially the same amplitude, said amplitude being greater than the peak amplitude of picture signals of the same polarity as said impulses, the method which comprises in one channel decreasing the

amplitude of said horizontal impulses with respect to said vertical impulses, next separating out said vertical impulses to the exclusion of said picture signals, and then utilizing said vertical impulses for synchronizing, and further comprising in a second channel decreasing the amplitude of said vertical impulses with respect to said horizontal impulses, next separating out said horizontal impulses to the exclusion of said picture signals, and then utilizing said horizontal impulses for synchronizing.

WALDEMAR J. POCH.