

March 25, 1941.

W. J. POCH

2,236,066

TELEVISION APPARATUS

Filed May 31, 1935

2 Sheets-Sheet 1

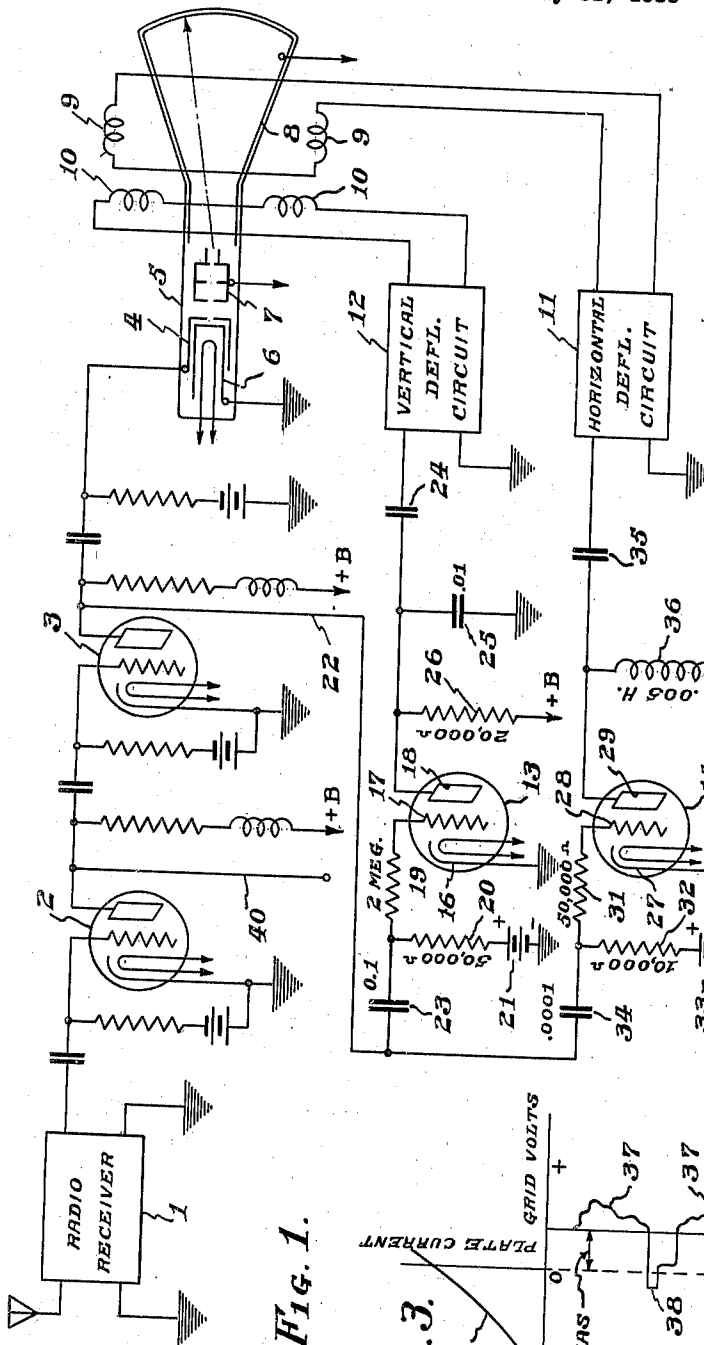


Fig. 1.

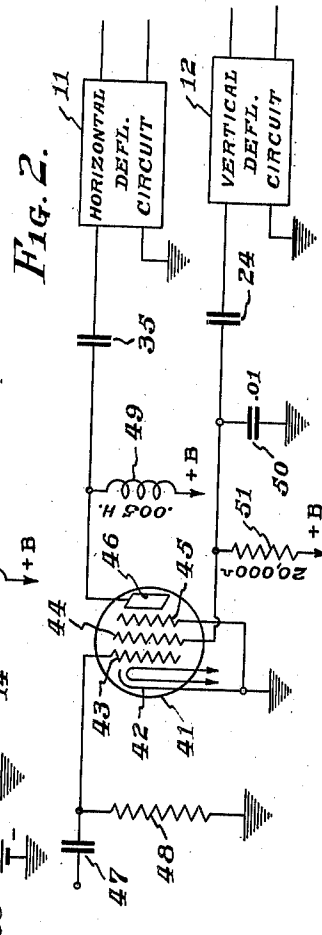


Fig. 2.

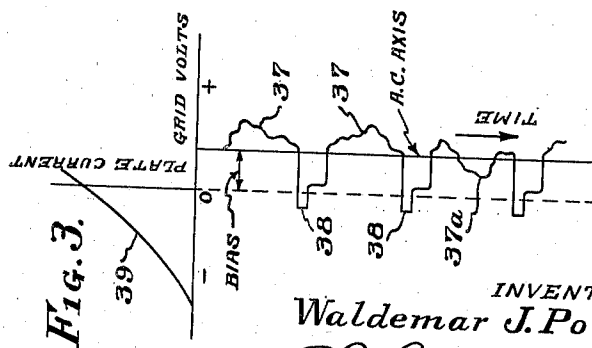


Fig. 3.

Witness:

F. M. Harris

INVENTOR

Waldemar J. Poch

BY *DR Goldborough*

ATTORNEY

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W. J. POCH

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2 Sheets-Sheet 2

Fig. 4.

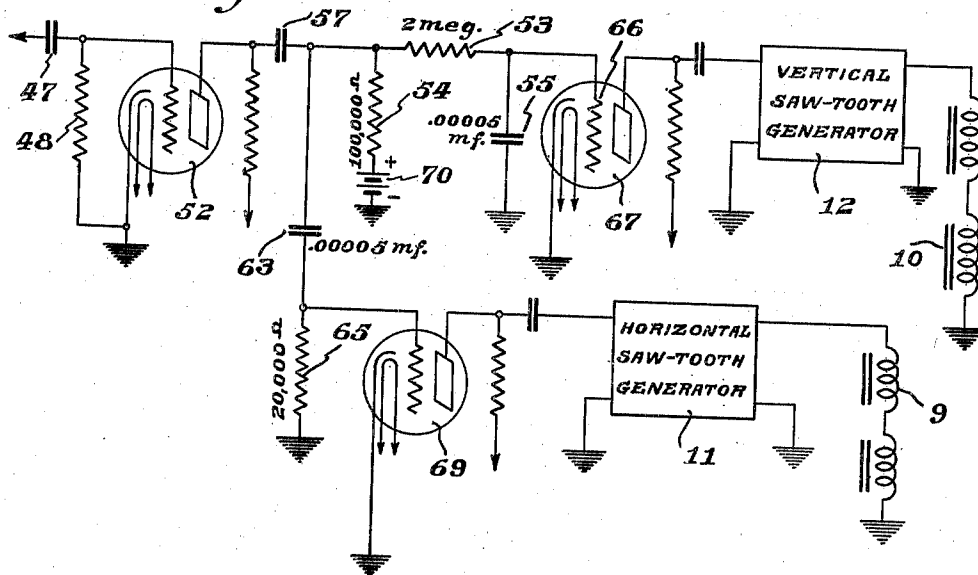


Fig. 5.

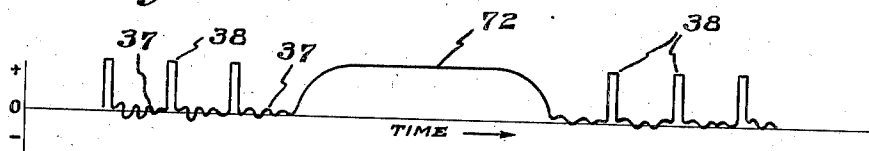
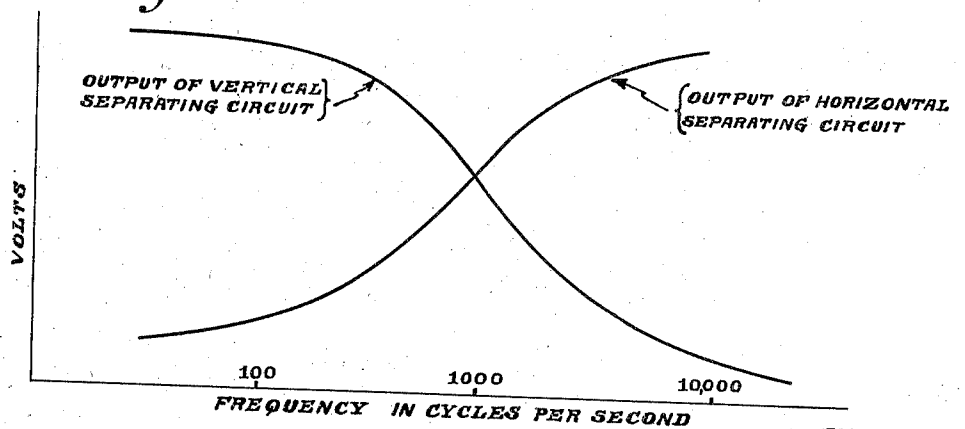


Fig. 6.



INVENTOR
Waldemar J. Poch

BY *J. R. Goldstowich*
ATTORNEY

UNITED STATES PATENT OFFICE

2,236,066

TELEVISION APPARATUS

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

Application May 31, 1935, Serial No. 24,207

4 Claims. (Cl. 178-7.5)

My invention relates to television apparatus, and particularly to a method of and means for obtaining proper synchronization between scanning at the transmitter and scanning at the 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 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.

In a television receiver for the reception of composite signals of the above-described character, the horizontal and vertical deflecting circuits which produce the deflecting currents or voltages for scanning at the receiver, and which are controlled by the synchronizing impulses, usually each include an oscillator such as a relaxation oscillator or an oscillator of the dynatron or blocking oscillator type. Such deflecting circuits are described in the article by Holmes, Carlson and Tolson which was published in the Proceedings of the Institute of Radio Engineers for November, 1934, pages 1266 to 1285. It has been found that the strong voltage impulses produced by the oscillator in one deflecting circuit tend to get into the other deflecting circuit and adversely affect the scanning.

Accordingly, it is an object of my invention to provide an improved television receiver of the above-mentioned type in which one deflecting circuit does not produce a disturbance in the other deflecting circuit.

It is a further object of my invention to provide an improved method of and means for separating picture signals from synchronizing signals in a television receiver.

In one embodiment of my invention, I obtain the desired isolation of horizontal and vertical deflecting circuits by employing a vacuum tube in each deflecting circuit channel for separating picture signals from synchronizing impulses. Instead of employing two separating tubes, a single screen grid tube may be utilized, the plate circuit being coupled to one deflecting circuit and the screen grid circuit being coupled to the other deflecting circuit whereby at least one deflecting circuit is substantially isolated from the other.

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;

Fig. 2 is a circuit diagram of a picture signal and synchronizing impulse separating circuit which may be substituted for a portion of the circuit shown in Fig. 1;

Fig. 3 is a group of 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 and 6 are curves which are referred to in explaining the invention.

Referring to Figure 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 a signal channel including resistance coupled amplifiers 2 and 3 and are impressed upon the control grid 4 of a cathode ray tube 5. The cathode ray tube 5 may be of well known construction comprising an evacuated envelope having therein a cathode 6, the control grid 4, a first anode 7, and a second anode 8. Suitable deflecting means, such as deflecting coils 9 and 10 are provided for deflecting the cathode ray both horizontally and vertically to effect scanning of a fluorescent screen at the end of the tube 5.

The horizontal deflecting coils 9 are supplied with saw-tooth current having a comparatively high frequency from a horizontal deflecting circuit indicated at 11. The vertical deflecting coils 10 are supplied with saw-tooth current having a comparatively low frequency from a vertical deflecting circuit indicated at 12. The deflecting circuits 11 and 12 may be any of the designs described in the above-mentioned article, such as a circuit including a 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 con-

trol grid 4 of the cathode ray tube 5 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 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 11 and 12. In accordance with my invention, the composite signal comprising picture signals and synchronizing impulses is impressed upon two separating tubes 13 and 14, the tube 13 supplying synchronizing impulses to the vertical deflecting circuit 12 and the tube 14 supplying synchronizing impulses to the horizontal deflecting circuit 11.

In the particular receiver illustrated, the separating circuit is of the general type described and claimed in Patent 2,178,766, issued Nov. 7, 1939, in the name of William A. Tolson and assigned to the same assignee as this application. While a particular type of separating circuit is illustrated which is for separating synchronizing impulses having a negative polarity, other types of separating circuits may be employed, such as those which are designed for separating synchronizing impulses having a positive polarity.

The separating tube 13 which supplies the vertical deflecting circuit may be a vacuum tube of the three element type, having a cathode 16, a control grid 17 and a plate 18. The input circuit of the tube 13 includes a resistor 19 next to the grid 17 and a resistor 20 across which the picture and synchronizing signals are impressed. Preferably, a biasing battery 21 or other biasing means is provided for the purpose of applying a positive bias to the grid 17 in order to obtain better separation of picture and synchronizing signals as will be explained later.

The composite signal, which includes the negative polarity synchronizing impulses, is supplied from the output of the amplifier 3 through a conductor 22 and a condenser 23 to the input circuit of the separating tube 13. For reasons which will appear later, only the synchronizing impulses appear in the output circuit of the separating tube 13 and these impulses are supplied through the coupling condenser 24 to the vertical deflecting circuit 12.

In order to separate the vertical synchronizing impulses from the horizontal synchronizing impulses, the plate impedance of the separating tube 13 is made low for the comparatively high frequency horizontal impulses. This low plate impedance is obtained by connecting a comparatively high capacity condenser 25 across the plate resistor 26. The capacity of the condenser 25 is sufficient to make the plate circuit of the tube 13 present a very low impedance to the higher frequency synchronizing impulses whereby substantially all of these impulses are eliminated and only the vertical synchronizing impulses are impressed upon the deflecting circuit 12.

The picture separating circuit for supplying synchronizing impulses to the horizontal deflecting circuit 11 may be of the same type as the separating circuit described above. In the circuit which is illustrated, it comprises the vacuum tube 14 which has a cathode 27, a control grid 28 and a plate 29. The input circuit of the tube includes a resistor 31 next to the grid 28, a resistor 32 across which the composite signal is

impressed, and a biasing battery 33 for applying a positive bias to the grid.

The composite signal is supplied to the input circuit through a condenser 34. Just as in the case of the other separating circuit, only the synchronizing impulses appear in the plate circuit of the tube 14 and these impulses are supplied through a coupling condenser 35 to the horizontal deflecting circuit 11. Only the high frequency horizontal synchronizing impulses are supplied to this circuit, however, the plate circuit of the tube 14 having a low impedance to the vertical synchronizing impulses. This low plate impedance is obtained by supplying positive voltage to the plate 29 through an inductance coil 36 which presents a high impedance to the high frequency horizontal synchronizing impulses, and a comparatively low impedance to the lower frequency synchronizing impulses. Also, the coupling condenser 35 may be given a small capacity whereby it presents a high impedance to the vertical synchronizing impulses.

From the foregoing description it will be seen that the two deflecting circuits 11 and 12 are isolated from each other by means of the picture separating tubes 13 and 14 whereby impulses produced by an oscillator in one deflecting circuit cannot be fed back into the other deflecting circuit.

In addition to the filtering action obtained in the plate circuits of the separating tubes 13 and 14 for separating vertical and horizontal synchronizing impulses, an additional filtering action can be obtained in the input circuits of these separating tubes by giving the condenser 23 a comparatively large capacity and the resistor 19 a comparatively large resistance and by giving the condenser 34 a comparatively small capacity and the resistor 31 a comparatively small resistance.

The action of the separating tubes 13 and 14 in separating synchronizing impulses from picture signals, especially when they have a positive bias on the grid, will be understood by referring to Fig. 3. In this figure, the picture signals are indicated at 37 and the horizontal synchronizing impulses at 38. The grid voltage-plate current characteristic of a picture separating tube is indicated at 39. As explained in the above-mentioned Tolson patent, only negative impulses which are impressed upon the input circuit of the separating tube will appear in the plate circuit since the grid-cathode impedance of the tube becomes very low when positive impulses are impressed upon the grid. When the grid is negative, however, the grid-cathode impedance is high and the negative impulses appear in the plate circuit.

By referring to the curve representing picture signals in Fig. 3, it will be seen that the picture signals sometimes have a negative polarity as at 37a. It is in order to prevent such negative polarity picture signals from being passed by the separating tube that a positive bias is applied to the control grid. The effect of such a bias is apparent from an inspection of Fig. 3, it being evident from this figure that the positive bias has shifted the A. C. axis of the composite signal to the right sufficiently to prevent the negative polarity picture signal at 37a from driving the control grid negative.

In the embodiment of my invention shown in Fig. 2, a single tube 41 of the screen grid type is employed in place of the two separating tubes 13 and 14 shown in Fig. 1. The particular tube

illustrated is a vacuum tube having a cathode 42, a control grid 43, a screen grid 44, a suppressor grid 45 and an anode 46. While the separation of picture signals and synchronizing impulses may be obtained by employing an input circuit of the type shown in Fig. 1, it may be preferable to employ a different circuit of the type which separate positive polarity synchronizing impulses from the picture signals. In the circuit shown in the drawings, the input circuit of the tube 41 includes a grid condenser 47 and a grid leak resistor 48, the grid condenser 47 to be connected to a conductor 40 in the output circuit of the amplifier 2 shown in Fig. 1. The positive polarity synchronizing impulses cause a periodic flow of grid current which causes a negative bias to be applied to the control grid 43. This bias is sufficient to bias the tube beyond cut-off whereby only the positive polarity synchronizing impulses are passed by the tube. So long as the amplitude of the synchronizing impulses does not change, the negative bias applied to the control grid 43 is substantially constant since the circuit including the grid condenser 47 and the grid resistor 48 has a time constant great enough to hold over the condenser charge between horizontal synchronizing impulses.

In this embodiment of my invention, I take advantage of the fact that the synchronizing impulses appear in both the plate circuit and the screen grid circuit. The plate circuit is designed to have a low impedance to vertical synchronizing impulses by applying the voltage to the plate 46 through an inductance coil 49 whereby the horizontal synchronizing impulses are applied to the horizontal deflecting circuit 11 substantially to the exclusion of the vertical synchronizing impulses.

The screen grid circuit is designed to have a low impedance to the horizontal synchronizing impulses whereby only the vertical synchronizing impulses are impressed upon the vertical deflecting circuit 12. This low plate impedance is obtained, as in the circuit shown in Fig. 1, by connecting a comparatively large capacity condenser 50 between the screen grid 44 and ground.

It will be apparent that impulses produced by an oscillator in the horizontal deflecting circuit 11 cannot get back into the vertical deflecting circuit 12. This is of particular importance in television systems employing interlaced scanning, since horizontal synchronizing impulses appearing in the vertical deflecting circuit may destroy the interlacing. It is of less importance that the impulses produced by an oscillator in the vertical deflecting circuit 12 be prevented from getting into the horizontal deflecting circuit 11, although this is desirable. However, the circuit shown in Fig. 2 may be of particular value in television receivers which must be manufactured at low cost.

Referring to the embodiment of my invention shown in Fig. 4, the picture signals and synchronizing impulses are separated from each other by means of any suitable separating circuit such as a circuit including a separating tube 52 which is biased beyond cut-off by means of grid leak biasing, as described in connection with Fig. 2. The vertical synchronizing impulses and the horizontal synchronizing impulses are separated from each other by means of filters, the vertical synchronizing impulses being supplied to the vertical deflecting circuit or saw-tooth current generator 12 through a vacuum tube 67, and the horizontal synchronizing impulses being supplied

to the horizontal deflecting circuit or saw-tooth current generator 11 through a vacuum tube 69. Like parts in Figs. 1, 2 and 4 are indicated by the same reference numerals.

The vacuum tube 67, which may be of the three-element type, has in its input circuit a resistor 53 of high resistance next to the grid and a resistor 54 having comparatively low resistance across which the synchronizing impulses are impressed. These impulses are supplied from the tube 52 through a coupling condenser 57. The input circuit also preferably includes a biasing battery 70 or other biasing means for applying a positive biasing potential to the control grid. A filter condenser 55 is connected across the input electrodes of the vacuum tube 67, this condenser, in conjunction with the resistor 53, serving to substantially eliminate the horizontal synchronizing impulses whereby only the vertical synchronizing impulses are impressed upon the vertical deflecting circuit 12.

It will be apparent from a comparison of Figs. 1 and 4 that the input circuit of the vacuum tube 67, in addition to serving as a filter, will function to eliminate any positive polarity picture signals which may have passed through the separating tube 52. In other words, only negative polarity signals in the output of tube 52 are passed by the tube 67 for the reasons given in describing the action of the separating tubes shown in Fig. 1.

The input circuit of the vacuum tube 69 includes a grid resistor 65 connected between the grid and the cathode, the tube preferably being operated with the grid at zero bias. The grid of the tube 69 is coupled to the output circuit of the separating tube 52 through a condenser 63 having such small capacity that it presents a high impedance to the lower frequency vertical synchronizing impulses. Therefore, because of the filter action of the condenser 63 and the grid resistor 65 only the horizontal synchronizing impulses appear in the output circuit of the tube 69 and are impressed upon the horizontal deflecting circuit 11.

It will be seen that the vacuum tubes 67 and 69 isolate the two deflecting circuits from each other. Thus, voltage impulses produced by an oscillator in one deflecting circuit cannot be fed back into the other deflecting circuit to have a detrimental effect upon the scanning.

The character of the filter action obtained by the circuits shown in Fig. 4 will be better understood by referring to Figs. 5 and 6. Fig. 5 represents the composite signal previously referred to which consists of the picture signal 37, horizontal synchronizing impulses 38 and vertical synchronizing impulses 72. It may be noted that this composite signal is the same as the one represented in Fig. 3, except that in Fig. 3 each horizontal synchronizing impulse 38 is shown placed on top of a "pedestal" in accordance with the latest practice.

It will be seen by referring to the curves in Fig. 6 that the characteristic of the filter circuit preceding the vacuum tube 67 is that it passes the comparatively low frequency components of the synchronizing impulses and excludes the higher frequency components, while the characteristic of the filter circuit preceding the vacuum tube 69 is that it passes these higher frequency components which are excluded by the first filter circuit and excludes the lower frequency components. Thus the filter circuits shown in Fig. 4 substantially isolate the vertical synchronizing impulses and the horizontal synchronizing im-

pulses, since impulses having the general character shown in Fig. 5 are characterized by the fact that most of the energy in the vertical synchronizing impulses appears in a frequency band below a certain frequency (in general, the horizontal synchronizing frequency), while most of the energy in the horizontal synchronizing impulses appears in a frequency band above this frequency.

In the drawings, the values of certain elements have been indicated in ohms, megohms, microfarads, and henries. The values which are given are satisfactory for a television system employing interlaced scanning in which the horizontal synchronizing impulses occur at the rate of 10,290 per second and the vertical synchronizing impulses occur at the rate of 60 per second. It should be understood, however, that these values are given merely by way of example and that they may be varied within rather wide limits.

I claim as my invention:

1. In a television receiver of the type including a cathode ray tube having deflecting means for deflecting the cathode ray vertically and deflecting means for deflecting the cathode ray horizontally, a vertical deflecting circuit coupled to said first means, a horizontal deflecting circuit coupled to said second means, a signal channel for the reception of a composite signal comprising picture signals and vertical and horizontal synchronizing signals, said horizontal impulses occurring at a higher frequency than said vertical impulses, an electric discharge tube having a cathode, a control grid and an anode, said electric discharge tube having an output circuit including said anode, means including said electric discharge tube for reducing the amplitude of said picture signals relative to said impulses, means for impressing said composite signal upon said grid whereby said impulses of greater relative amplitude than said picture signals appear in said output circuit, means for coupling said output circuit to said vertical deflecting circuit, a second electric discharge tube having a cathode, a control grid and an anode, said second tube having an output circuit including said second anode, means including said second tube for reducing the amplitude of said picture signals relative to said impulses, means for impressing said composite signal upon the grid of said second

tube whereby said synchronizing impulses of relatively greater amplitude than said picture signals appear in said second output circuit, and means for coupling said second output circuit to said horizontal deflecting circuit.

2. The invention according to claim 1 characterized in that the anode to cathode circuit of the first electric discharge tube has a substantially lower impedance to said horizontal synchronizing impulses than to said vertical synchronizing impulses, and further characterized in that the anode to cathode circuit of the second electric discharge has a substantially lower impedance to said vertical synchronizing impulses than to said horizontal synchronizing impulses.

3. In a television receiver, a signal channel for the reception of a composite signal comprising picture signals, horizontal synchronizing impulses, and vertical synchronizing impulses, a cathode ray tube, horizontal and vertical deflecting circuits for said tube, means including a vacuum tube having a grid circuit and a plate circuit for reducing the amplitude of said picture signals relative to said synchronizing impulses, said grid circuit being coupled to said signal channel and said plate circuit being coupled to said horizontal deflecting circuit, said plate circuit having a substantially lower impedance to said vertical synchronizing impulses than to said horizontal synchronizing impulses, and means including a second vacuum tube having a grid circuit and a plate circuit for reducing the amplitude of said picture signals relative to said synchronizing impulses, said second grid circuit being coupled to said signal channel and said second plate circuit being coupled to said vertical deflecting circuit, said second plate circuit having a substantially lower impedance to said horizontal synchronizing impulses than to said vertical synchronizing impulses.

4. The invention according to claim 3 characterized in that the grid circuit of said first vacuum tube includes means for attenuating said vertical synchronizing impulses more than said horizontal synchronizing impulses and further characterized in that the grid circuit of said second vacuum tube includes means for attenuating said horizontal synchronizing impulses more than said vertical synchronizing impulses.

WALDEMAR J. POCH.