

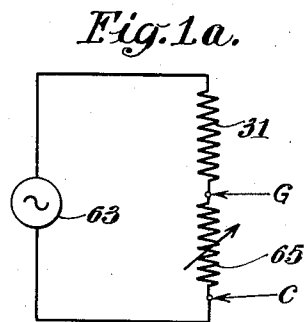
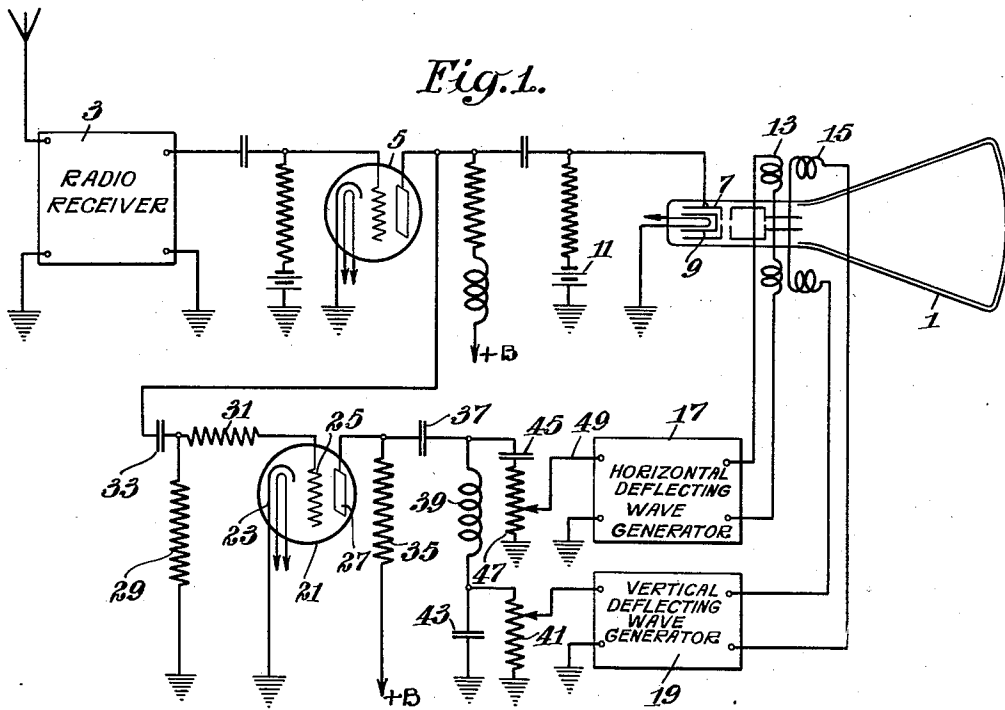
Nov. 7, 1939.

W. A. TOLSON

2,178,766

TELEVISION APPARATUS

Original Filed March 28, 1934 2 Sheets-Sheet 1



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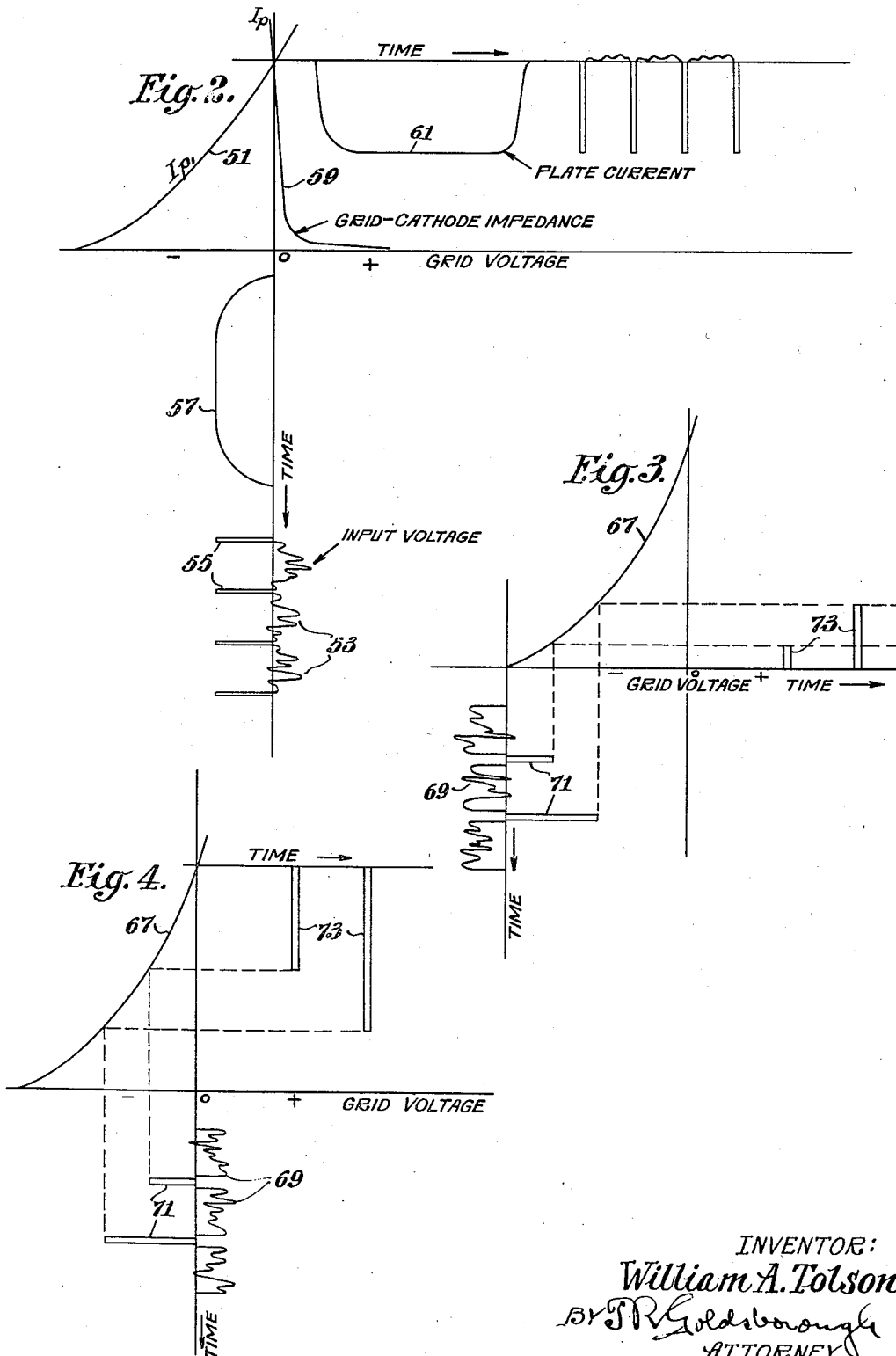
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UNITED STATES PATENT OFFICE

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TELEVISION APPARATUS

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13 Claims. (Cl. 178-7.5)

My invention relates to television systems and particularly to apparatus for synchronizing the transmitters and receivers thereof.

In television receivers utilizing a cathode-ray tube it is the present practice to obtain the necessary horizontal and vertical deflections of the cathode-ray by means of oscillators or generators which produce saw-tooth waves. The receiver is synchronized with the transmitter by means of synchronizing impulses transmitted from the transmitter and impressed upon the saw-tooth oscillators.

In certain television transmitting systems both picture signals and synchronizing impulses are transmitted on the same carrier, the horizontal synchronizing impulses being transmitted at the end of each horizontal scanning line and the vertical synchronizing or framing impulses being transmitted at the end of each picture frame. In systems of this type, precautions must be taken at the receiver to prevent the picture signals from interfering with the synchronizing impulses in their control over the saw-tooth wave oscillators. This may be accomplished by producing, at the transmitter, synchronizing impulses which have a considerably larger amplitude than the amplitude of the picture signals, and, at the receiver, by utilizing the difference in amplitude to prevent the picture signals from having an undesired effect upon the synchronization of the system.

In certain other television systems, the picture signals and synchronizing impulses are separated at the receiver by utilizing a polarity difference between the said signals and impulses. This polarity difference may be obtained, for example, by introducing the synchronizing impulse modulation into the carrier in the same direction as the modulation thereof by the dark portions of a view being transmitted. When this carrier wave is demodulated at the receiver and after amplification in alternating current amplifier having the proper number of stages, the picture signals and synchronizing impulses appear as an alternating current in which all or most of the picture signal component appears on the negative side of the zero axis while the synchronizing impulse component appears on the opposite side of the zero axis. In these systems, the picture signal and synchronizing impulse separation is obtained, before the synchronizing impulses are impressed upon the saw-tooth wave generators, by means of an electric discharge tube biased slightly beyond the cut-off point whereby positive synchronizing impulses will pro-

duce a synchronizing impulse in the output of the tube while negative picture signals will be eliminated.

A system utilizing a tube biased beyond cut-off has been found fairly satisfactory although it has several objectionable features. One of these is that, since the tube operates over a portion of its grid voltage-plate current curve which has a small slope, the amplification is rather low. This defect is accentuated by the fact that in order to allow interchangeability of tubes, it is necessary to increase the bias considerably beyond the optimum value. Another disadvantage is that any difference in the amplitude of the synchronizing signals will be increased by passing the signals through the separating tube.

It will also be apparent that since the synchronizing impulses must have a positive polarity at the time they are impressed upon the separating tube, it is sometimes necessary to add a stage of amplification solely for the purpose of obtaining the correct polarity or phase of synchronizing impulse.

It is, accordingly, an object of my invention to provide an improved means and method for separating picture and synchronizing signals from each other.

It is a further object of my invention to provide means for separating picture and synchronizing signals at a point in the circuit where the synchronizing signals are negative.

It is a still further object of my invention to provide means for minimizing variations in the amplitude of synchronizing 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 partial circuit diagram of a television receiver constructed in accordance with one embodiment of my invention, and

Figs. 1a, 2, 3, and 4 are diagrams which will be referred to in explaining the operation of the circuit shown in Fig. 1.

Referring to Fig. 1, a television receiving system is illustrated in which a cathode-ray receiver tube 1 of the type disclosed in the above-mentioned applications is supplied with picture and synchronizing signals from a radio channel. A radio receiver 3 demodulates the modulated incoming carrier wave to impress picture and synchronizing signals upon the input circuit of any suitable amplifier 5, the output of which is impressed across the control grid 7 and cathode 9 of the cathode-ray tube 1. The control grid 7

may be maintained at a suitable negative bias by means of a biasing battery 11.

It will be noted that both picture signals and synchronizing signals are impressed upon the control grid 7 of the cathode-ray tube, there being no objection to this as the synchronizing impulses are utilized in blocking the tube during the return of the cathode-ray at the end of each scanning line and at the end of each picture frame.

The cathode-ray tube 1 is provided with the customary deflecting devices for producing horizontal and vertical deflection of the cathode-ray beam, these devices being shown in the drawing as horizontal and vertical deflecting coils 13 and 15, respectively. A saw-tooth wave oscillator or generator 17 is provided for supplying a comparatively high frequency deflecting current to the horizontal deflecting coils 13 while another saw-tooth oscillator or generator 19 is provided for supplying a comparatively low frequency deflecting current to the vertical deflecting coils 15.

In order to maintain the deflection of the cathode-ray in synchronism with the transmitter apparatus, the incoming synchronizing impulses are impressed upon the saw-tooth wave oscillators 17 and 19 through a circuit which includes an electric discharge tube 21. The tube 21 may be of the indirectly heated cathode type comprising a cathode 23, a control grid 25 and an anode 27. In accordance with my invention the input circuit of the tube 21 is so designed that if picture and synchronization signals of opposite polarity are impressed thereon, with the synchronizing signals having a negative polarity, only the synchronizing signals or impulses will appear in the output circuit of the tube.

In order to accomplish this separation of picture and synchronizing signals, the input circuit of the tube 21 is provided with an input resistor 29 which is connected at one end through ground to the cathode 23 and which is connected at the other end through a resistor 31 of comparatively high resistance value to the control grid 25. The resistance of resistors 29 and 31 may be given values varying within wide limits. It may be noted, however, that in one receiver embodying my invention excellent results were obtained by giving the resistor 29 a value of 500,000 ohms and the resistor 31 a value of 2 megohms.

The grid end of the input resistor 29 is connected through a coupling condenser 33 to the output circuit of the amplifier 5 whereby both picture and synchronizing signals are impressed upon the separating tube 21.

The anode 27 is maintained at the proper positive potential by means of a connection through a resistor or other impedance unit 35 to a voltage supply (not shown).

As will be explained hereinafter, only the synchronizing impulses appear in the output circuit of the separating tube 21, these impulses consisting of the comparatively high frequency horizontal synchronizing impulses and the lower frequency vertical synchronizing impulses. In order to separate the horizontal and vertical synchronizing impulses, two filter circuits are connected to the output circuit of the separating tube 21 through a coupling condenser 37.

The filter circuit for selecting the vertical synchronizing impulses may consist of an inductance coil 39 connected in series with a resistor 41 whereby only the lower frequency impulses can pass through this circuit. The input circuit of the vertical saw-tooth oscillator 19 is connected

across resistor 41 whereby vertical synchronizing impulses are supplied to that oscillator for holding it in synchronism. In order to provide more effective filtering out of the horizontal synchronizing impulses, the resistor 41 is preferably shunted by a condenser 43.

The filter circuit for selecting the horizontal synchronizing impulses may consist of a condenser 45 connected in series with a resistor 47. This selecting circuit is connected across the output circuit of the selecting tube 21 and in parallel with the above-described vertical impulse filter circuit. The horizontal synchronizing impulses are taken off the resistor 47 and supplied to the horizontal oscillator through a conductor 49.

The operation of the circuit will now be described in connection with Figs. 1a and 2. Referring to Fig. 2, the grid voltage plate-current curve for the selecting tube 21 is indicated at 51. The picture signals 53 and the synchronizing impulses 55 and 57 are shown drawn along a vertical time axis. It will be noted from an inspection of Fig. 2 and from an inspection of the circuit in Fig. 1 that the tube 21 is operated at substantially zero bias. It will also be apparent from Fig. 2 that the picture signals 53 are positive when they appear across the input resistor 29 while the vertical synchronizing impulses 57 and the horizontal synchronizing impulses 55 have a negative polarity when impressed across this resistor.

The grid-cathode impedance curve of the tube 21 is indicated at 59. It will be apparent that any picture signal appearing in the input circuit of the selecting tube 21 causes the grid-cathode impedance of the tube to drop to a low value.

On the other hand, it will be apparent that the synchronizing impulses, since they have a negative polarity, cause the grid-cathode impedance of the tube 21 to increase to a high value. The result is a flow of current in the output circuit of the tube 21 having the character shown by the plate current curve 61.

The reason for this result will be readily understood by referring to Fig. 1a, where the input resistor 29 is represented as a signal generator 63 and the grid-cathode impedance of the tube is represented as a variable resistor 65. It will be seen that the resistor 31 and the grid-cathode impedance 65 form a potentiometer shunted across the source 63 of signal current. If the grid-cathode impedance of the tube is high compared with the impedance of resistor 31, a comparatively large percentage of the signal voltage will be impressed across the control grid and cathode of the tube whereby the signal will be efficiently amplified and appear in the output circuit of the tube 21. If, however, the grid-cathode impedance of the tube is low compared with the impedance of resistor 31, a small percentage of the signal will appear across the control grid and the cathode and there will be no substantial change in the plate current of the tube. Therefore, referring again to Fig. 2, the picture signals 53 cause substantially no change in the plate current of the tube while the negative synchronizing impulses 55 and 57 cause a large reduction in the plate current. The reduction in plate current by a synchronizing impulse results in a reduced IR drop in the plate resistor 35 whereby the plate voltage increases momentarily to a comparatively high value to apply a synchronizing impulse to one of the saw-tooth wave oscillators, 75

It will be evident that, in general, the presence of a small amount of picture signal on the negative side of the zero axis, as shown in Fig. 2, will not be detrimental since any negative picture voltage will have a small amplitude compared with the amplitude of a synchronizing impulse. In some cases, however, it may be found desirable to operate the separating tube 21 with a very small positive bias on the grid for the purpose of preventing any negative picture signal from increasing the grid-cathode impedance of tube 21 to a substantial value. Such a bias will be only slightly greater than zero bias because a positive biasing voltage will be opposed by a voltage drop in resistors 29 and 31 due to a flow of grid current.

It may be noted that the transfer of the positive picture signals to the input circuit of the cathode-ray tube 1 is not interfered with by the action of the separating tube 21, this fact being a result of the high impedance of the resistor 31. In other words, even though the positive picture signals cause the grid-cathode impedance of tube 21 to assume a low value, this does not produce a low impedance shunt across the output circuit of amplifier 5 because resistor 31 is in series with the said grid-cathode impedance.

As previously mentioned, one of the objections to the use of a tube biased beyond the cut-off point for the purpose of separating the picture and synchronizing signals is that such a separating tube accentuates any difference in the amplitude of synchronizing signals. This action is illustrated in Fig. 3 where the control grid-plate current curve of a separating tube is indicated at 67. The picture signals 69 and synchronizing impulses 71 are shown along a vertical time axis. Since the tube is biased beyond the cut-off point and the picture signals are negative, only the synchronizing impulses will appear in the output circuit of the separating tube as indicated by the plate current impulses 73. The second synchronizing impulse 71 has been shown as having an amplitude twice that of the first synchronizing impulse. Referring to the resulting plate current impulses, it will be seen that the second impulse 73 has an amplitude which is more than twice that of the first impulse 73. In other words, the separating tube has increased the amplitude difference of the synchronizing impulses.

Referring now to Fig. 4, where parts similar to those in Fig. 3 have like reference numerals, the action of a separating circuit designed in accordance with my invention is illustrated. It will be seen that although the second synchronizing impulse 71 has twice the amplitude of the first impulse 71, just as in the case shown in Fig. 3, the second resulting plate current impulse 73 is less than twice the amplitude of the first impulse 73. This tendency to smooth out differences in amplitude of synchronizing impulses is of value in systems where the incoming synchronizing impulses are varying considerably in amplitude, since a more positive synchronizing action is obtained when synchronizing impulses of constant amplitude are applied to the saw-tooth wave oscillators.

A still further advantage of my invention resides in the fact that the grid-cathode capacity of the separating tube 21 is not shunted directly across the output circuit of the amplifier 5, the resistor 31 being in series therewith to prevent

undesirable attenuation of the higher picture frequencies.

Various modifications may be made in my invention without departing from the spirit and scope thereof, and I desire therefore that only such limitations shall be placed thereon as are necessitated by the prior art and are set forth in the appended claims.

I claim as my invention:

1. In a television system, means for separating picture signals from synchronizing signals, said means comprising an electric discharge tube having a cathode and a control electrode, an input impedance unit upon which said picture and synchronizing signals may be impressed, one end of said impedance unit being connected to said cathode, and a second impedance unit connected between the other end of said first impedance unit and said control electrode.

2. Apparatus according to claim 1 characterized in that the control electrode of said tube is maintained at approximately a zero bias.

3. Apparatus according to claim 1 characterized in that second impedance unit has a larger impedance value than said first impedance unit.

4. Apparatus according to claim 1 characterized in that said impedance units are resistors.

5. In a television system of the type in which picture and synchronizing signals of opposite polarity are transmitted, an oscillator, and means for impressing said synchronizing signals only upon said oscillator, said means including an electric discharge tube having a cathode and a control electrode and having two resistor sections connected between said cathode and said control electrode, said picture and synchronizing signals being impressed upon the resistor section adjacent said cathode.

6. In a television receiver, a receiver tube of the cathode-ray type having a deflecting device, an oscillator connected to said deflecting device, and an electric discharge tube having an output circuit connected to said oscillator and an input circuit connected to receive picture and synchronizing signals of opposite polarity, said tube being operated at approximately zero bias whereby positive picture signals are transferred through said tube with low efficiency as compared with the transfer of negative synchronizing impulses.

7. In a television system of the type in which picture signals and synchronizing signals are transmitted and in which the synchronizing signals and at least part of the picture signals are of opposite polarity with respect to a given axis, a receiver including a saw-tooth wave generator, an electric discharge tube having an input circuit and an output circuit, means for connecting said output circuit to said generator, means for impressing said picture signals and said synchronizing signals through a condenser upon said input circuit with the synchronizing signals having a negative polarity, and means for rendering said tube effective to transfer said negative polarity signals and substantially ineffective to transfer the positive polarity picture signals.

8. In a television system of the type in which a carrier wave is modulated by picture signals and by synchronizing impulses, and in which said impulse modulation is introduced into said carrier with an amplitude greater than a limiting value for said picture signals, a receiver including a saw-tooth wave generator and also including an electric discharge tube having an

input circuit and an output circuit, means for impressing said signals and impulses upon said input circuit through a condenser with the said signals having a positive polarity with respect to said limiting value and the synchronizing impulses having a negative polarity with respect to said limiting value, means for connecting said output circuit to said generator, and means for rendering said electric discharge tube effective to transfer said negative synchronizing impulses and substantially ineffective to transfer said positive picture signals.

9. In a television system of the type in which a carrier wave is modulated by picture signals and by 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, a receiver including a saw-tooth wave generator and also including an electric discharge tube having an input circuit and an output circuit, means for impressing said signals and impulses upon said input circuit through a condenser with at least part of the said signals having a positive polarity with respect to a certain axis and the synchronizing impulses having a negative polarity with respect to said axis and having a greater amplitude than said signals, means for connecting said output circuit to said generator, and means for rendering said electric discharge tube effective to transfer said negative synchronizing impulses and substantially ineffective to transfer said positive picture signals.

10. In a television system of the type in which picture signals and synchronizing signals are transmitted and in which at least part of the picture signal voltage is of opposite polarity to the synchronizing signal voltage with respect to a given axis, a receiver comprising a cathode-ray tube 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, an electric discharge tube having input electrodes and an output circuit, means for coupling said output circuit to said generators, means for impressing said picture signals and said synchronizing signals upon said input electrodes through a condenser with said synchronizing signals having a negative polarity, and means for rendering said tube effective to transfer said negative polarity signals and substan-

tially ineffective to transfer said positive polarity picture signals.

11. 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, a receiver including a cathode-ray tube having deflecting devices and two saw-tooth wave generators coupled thereto, a vacuum tube having input electrodes and an output circuit, means for impressing said signals and impulses upon said input electrodes with at least part of the said signals having a positive polarity with respect to a certain axis and the synchronizing impulses having a negative polarity with respect to said axis, means for rendering said vacuum tube effective to transfer said negative synchronizing impulses and substantially ineffective to transfer said positive picture signals, and means for impressing the horizontal synchronizing impulses appearing in said output circuit upon one of said generators and for impressing the vertical synchronizing impulses appearing in said output circuit upon the other of said generators.

12. The invention set forth in claim 11 characterized in that the input circuit of said vacuum tube includes an input resistor unit upon which the picture signals and the synchronizing impulses may be impressed, one end of said unit being connected to the cathode input electrode, and further characterized in that a second resistor unit is connected between the other end of said first resistor unit and the control grid input electrode.

13. In a television system, means for separating picture signals from horizontal and vertical synchronizing impulses and means for separating the horizontal synchronizing impulses from said vertical synchronizing impulses, said first means preceding said second means and comprising a vacuum tube having a cathode and a control electrode, an input resistor upon which said picture signals and synchronizing impulses are impressed, one end of said resistor being connected to said cathode, and a second resistor connected between the other end of said first resistor and said control electrode.

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