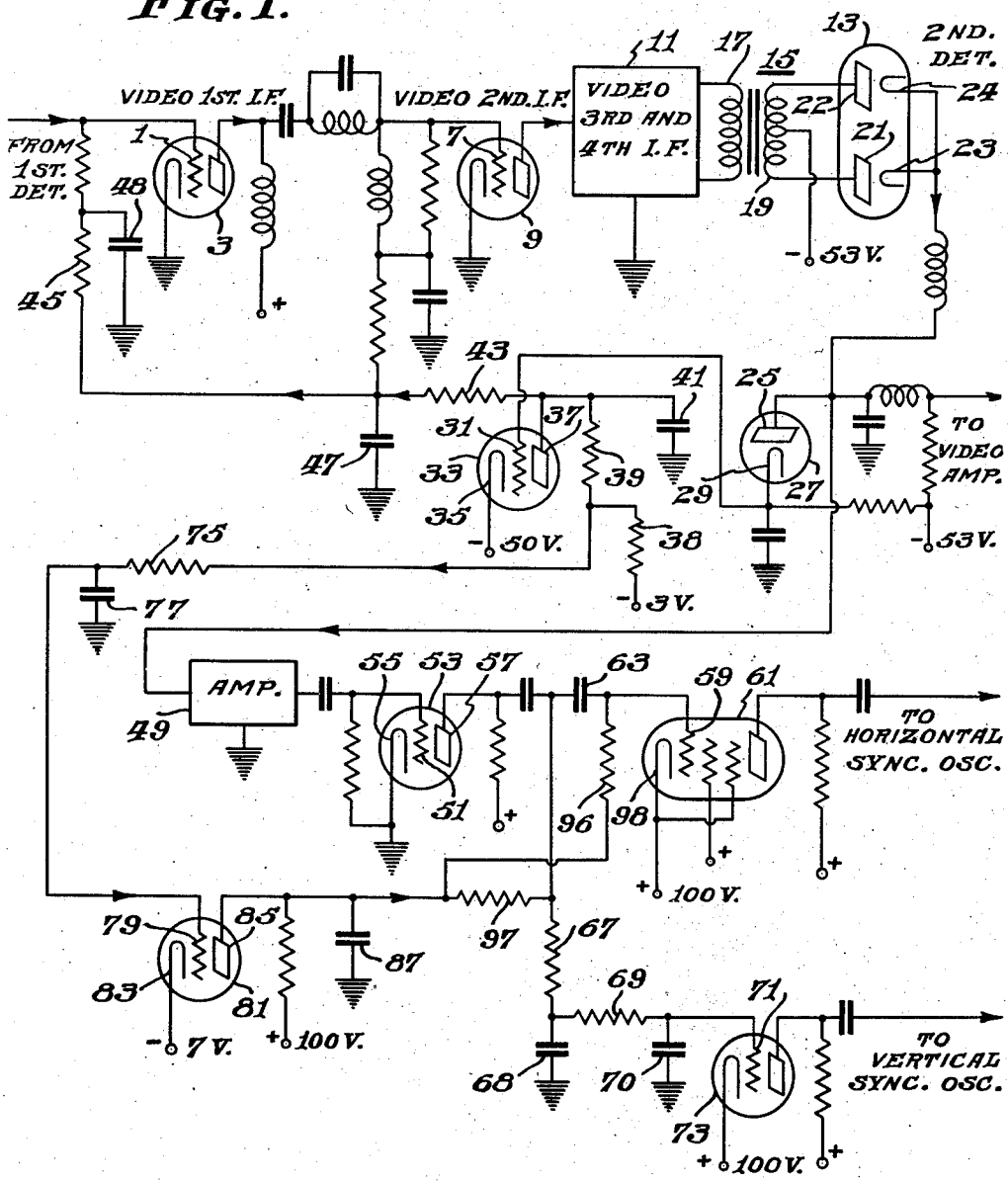
March 16, 1943. A. V. BEDFORD 2,313,915

SYNCHRONIZING CIRCUIT FOR TELEVISION RECEIVERS

Filed July 31, 1940 3 Sheets-Sheet 1

FIG. 1.



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SYNCHRONIZING CIRCUIT FOR TELEVISION RECEIVERS

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FIG. 2.

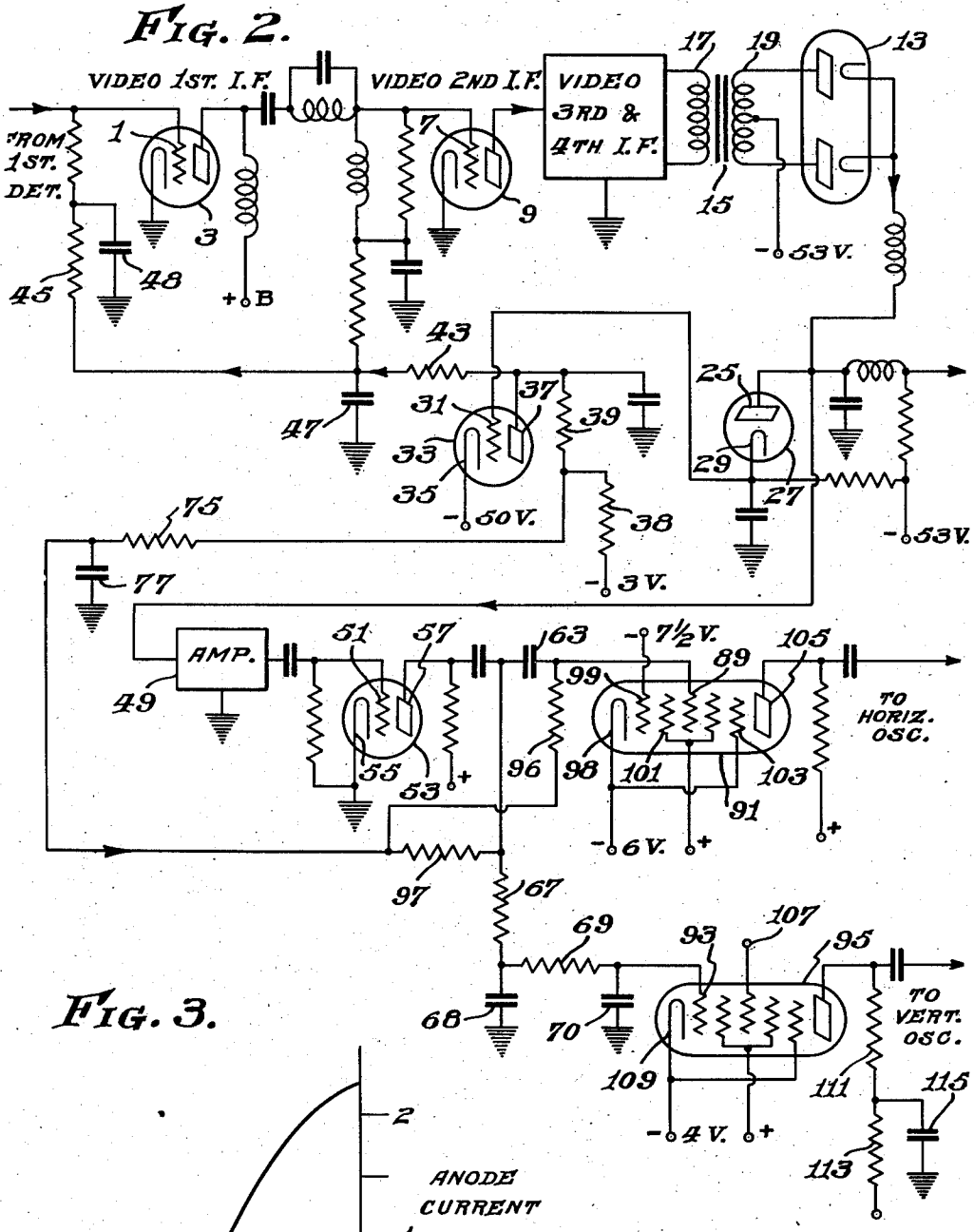
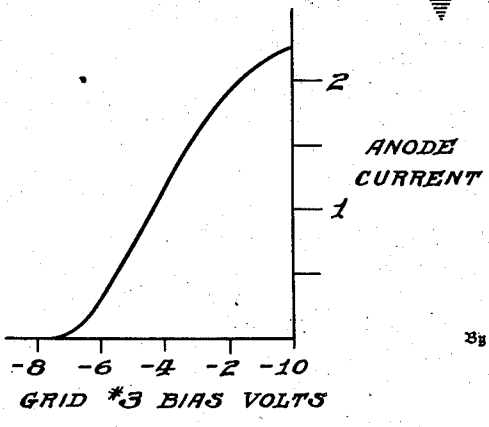


FIG. 3.



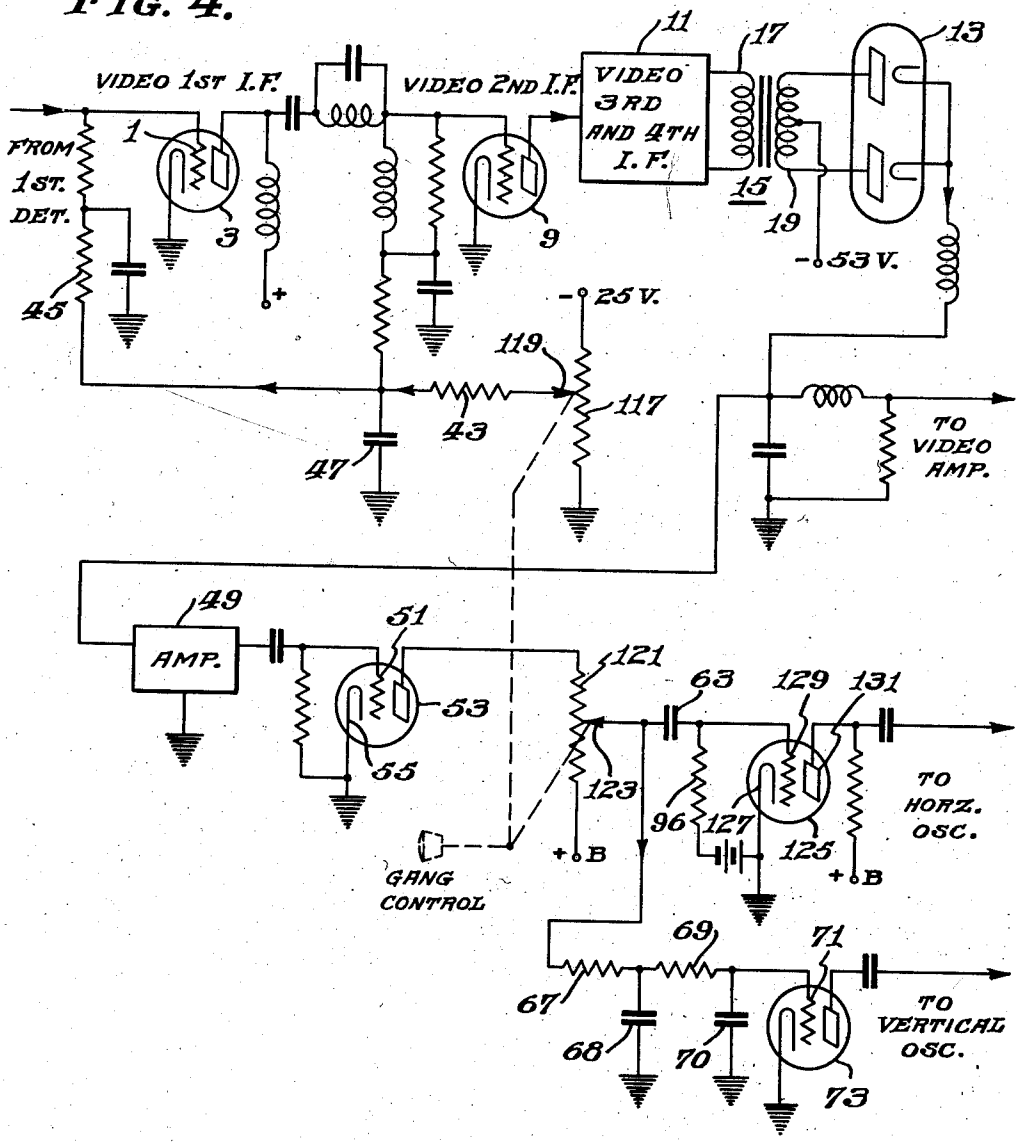
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SYNCHRONIZING CIRCUIT FOR TELEVISION RECEIVERS

Filed July 31, 1940 3 Sheets-Sheet 3

FIG. 4.



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UNITED STATES PATENT OFFICE

2,313,915

SYNCHRONIZING CIRCUIT FOR TELEVISION RECEIVERS

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Application July 31, 1940, Serial No. 348,878

4 Claims. (Cl. 178—7.5)

This invention relates to television circuits, and more particularly to synchronizing circuits for television receivers.

In receiving television signals which include pulses for maintaining the operating action of the receiver in synchronism with the transmitter, the disturbances of static and man-made interference sometimes cause the receiver to fall out of synchronism with the transmitter. This trouble is experienced when the strength of the incoming signals drop to a level at which the effect of the interference on the receiving apparatus is enough to disturb the frequency of the cathode ray deflection oscillator.

It has been discovered that by reducing the level of the synchronizing pulses applied to the deflection oscillators when receiving television signals of low strength, the oscillator will not be greatly disturbed by the interference. The principal reason for this improvement is probably because the reduced amplitude of the combined synchronizing pulses and interference allows a more critical adjustment of the free-running frequency control of the oscillators which, under these conditions, are more likely to maintain the desired frequency. This is particularly true when the oscillator controlling the receiver synchronizing generator is especially stable or contains frequency control properties such as those shown and described in my copending application Serial No. 348,877, filed concurrently herewith.

When receiving strong signals, a high amplitude of synchronizing signal should be applied to the oscillator since the percentage of interference is lower and, under these conditions, the adjustments of the oscillators are not critical.

According to this invention, an optimum level of synchronizing pulses is maintained over a large range of incoming signal strength by automatically controlling the gain of the synchronizing signal channels so that, under conditions of low incoming signal strength, the gain of the synchronizing signal channel is lower than under conditions of higher incoming signal strength.

With the foregoing in mind, the principal object of this invention is to provide a synchronizing circuit with improved stability for television receivers.

Another object of this invention is to provide an automatic control of the gain in the synchronizing signal channels.

Still another object of this invention is to provide a method and means for decreasing the amplitude of the synchronizing signals under conditions of low signal strength and increasing their amplitude under conditions of high signal strength.

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

Figure 1 is a circuit diagram showing one form of this invention,

Figure 2 is a circuit diagram showing another form of this invention,

Figure 3 is a graphical illustration of the operation of the invention as shown in Fig. 2, and

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

Referring to Fig. 1, a portion of a television receiver, for example, one such as described by E. W. Engstrom and R. S. Holmes in Electronics Magazine for April 1939, page 23, is shown having an intermediate frequency picture signal input from a first detector impressed on the control electrode 1 of a tube 3 which is in the first stage of the intermediate frequency amplifier. The signals are then impressed on control electrode 7 and further amplified in tube 9, which is part of a second intermediate frequency stage and further amplified by the third and fourth stages of the intermediate frequency amplifier represented in block 11.

The last stage of video signal intermediate frequency amplification is followed by a second detector 13 whose coupling from the preceding amplifier stage is accomplished through transformer 15 having primary 17 and secondary 19.

A push-pull detector circuit is shown and the detector anodes 21 and 22 are connected to coupling transformer winding 19, whose center tap is returned to negative voltage, and for the purpose of illustration, minus 53 volts. The rectified signal voltage taken from the second detector 13 through the cathodes 23 and 24 is supplied to the video amplifier providing modulation for the picture tube.

This rectified signal voltage is also applied to an anode 25 and a diode 27 operating as an automatic gain control rectifier for obtaining a control voltage in accordance with the height of the synchronizing peaks in the video signal. The rectifier cathode 29 is connected to the control electrode 31 of an automatic gain control amplifier tube 33. The cathode 35 of tube 33 is also maintained at a negative potential, for example, 50 volts, in order that the control electrode 31 will be negative with respect to its associated cathode 35.

The anode 37 is supplied with a potential more

positive than its cathode 35 through resistances 38, 39 and bypass condenser 41. For purposes of illustration, this potential may be —3 volts. The signals taken from the anode 37 are filtered through resistances 43 and 45 and condensers 47 and 48 and, in turn, are impressed on control electrodes 1 and 7 of tube 3 and 9 of the first and second stages, respectively, of the video signal intermediate frequency amplifier.

This automatic gain control circuit tends to maintain the second detector input at a substantially uniform level. Any of the well-known automatic gain control circuits may be substituted without departing from the spirit of this invention.

The output of the second detector 13 is also fed to an amplifier shown as block 49 which, in turn, impresses a video signal on the control electrode 51 of the synchronizing signal separating tube 53 which has a cathode 55 and a anode 57. The function of this tube 53 is to clip the synchronizing pulses from the composite video signal.

The synchronizing signal is made up of two trains of pulses, one train controlling the horizontal deflection oscillator and the other controlling the vertical deflection oscillator. The horizontal synchronizing pulses are impressed upon the control electrode 59 of the horizontal synchronizing pulse amplifier tube 61 through series condenser 63. The vertical synchronizing pulses are integrated in the filter circuit comprising resistances 67 and 69 and condensers 68 and 70. This integrated pulse signal is then passed to the control electrode 71 of the vertical synchronizing pulse amplifier tube 73. The signals from the amplifying tubes 61 and 73 are then passed on to the horizontal synchronizing oscillator circuit and to the vertical synchronizing oscillator circuit, respectively.

A portion of the automatic gain control amplifier output voltage from anode 37 of tube 33 is also fed through the filter comprising resistance 75 and condenser 77 to the control electrode 79 of a synchronizing pulse automatic volume control signal amplifier tube 81. The cathode 83 of tube 81 is maintained at a negative potential and, for the purpose of illustration, minus 7 volts. The output signal of tube 81, through its anode 85, is filtered by condenser 87 and impressed upon the control electrodes 59 and 71 of the tubes 61 and 73, respectively, causing a control of the amplification factor of tubes 61 and 73 in accordance with the D. C. potential resulting from the intermediate frequency automatic gain control amplifier tube 33.

It will be noted, however, that, because of the signal inverting action of tube 81, the directional control of this voltage has the opposite effect on the synchronizing pulse amplifier tubes 61 and 73 as it has on the tubes 3 and 9 of the intermediate frequency amplifier; so that, when a signal of relatively high amplitude is impressed upon the intermediate frequency amplifier, the effect of the automatic gain control on the synchronizing pulse amplifier tubes is to cause them to provide more gain and thus a higher pulse signal output to their respective synchronizing oscillators. Conversely, when the signal input level from the first detector of the television receiver is at a relatively low value, the input to the second detector 13 is substantially the same because of the automatic gain control action of the amplifier tube 33 on the intermediate frequency amplifier, but the gain of the synchronizing pulse amplifier tubes is decreased accordingly.

In Fig. 2, similar reference characters designate corresponding parts throughout. In this modification, the horizontal synchronizing pulse component of the output from the synchronizing pulse separating tube 53 is fed to a grid 89 of the horizontal synchronizing pulse amplifier tube 91. The vertical synchronizing pulse component of the output of the synchronizing separating tube 53 is fed to a grid 93 of the vertical synchronizing pulse amplifier tube 95. A portion of the voltage from the automatic gain control amplifier tube 33 is impressed upon the input circuits of tubes 91 and 95 through resistances 96 and 97 such that the gain of each of the tubes 91 and 95 is changed in accordance with the strength of the incoming signal such that it increases upon an increase in incoming signal strength and, conversely, decreases upon a decrease in incoming signal strength.

It will be noted that an auxiliary tube for inverting the control signal is not necessary because the amplification factor of tubes 91 and 95 is such that, upon an increase in negative control electrode potential, the amplification factor of the tubes is increased.

It therefore follows that an automatic volume control potential changing in the same direction as that which is required for a control of the intermediate frequency amplifier may be used.

The amplification control property of the control electrode bias in tubes 91 and 95 may be further explained with reference to the curve shown in Fig. 3. It will be noticed that the anode current decreases more rapidly as the grid No. 3 bias potential increases in a negative direction to a value of approximately minus 5 volts. Therefore, an increase in negative bias, resulting from an increased automatic volume control negative voltage caused by an incoming signal of high amplitude, will cause greater amplification in the synchronizing pulse amplifier stages.

Tubes 91 and 95 may be of the type more commonly known as the 6L7, provided with a cathode, an anode, and four intermediate grids. The cathode 98 of tube 91 is maintained at a negative potential, and for the purpose of illustration, negative 6 volts, the first grid 99 is connected to a negative voltage source, for purposes of illustration minus 7½ volts, the screen grid 101 is connected to a positive voltage source, and the suppressor grid 103 is connected directly to its cathode 98.

The grid 99 operates to limit the number of electrons flowing from the cathode 98 to the anode 105, causing cathode 98 to operate as a cathode would operate in its saturated condition so that, regardless of the attraction caused by a high amplitude signal on grid 89, the number of electrons allowed to pass through grid 99 and flow to the anode 105 is limited. The screen grid 101 isolates the grid 89 from the grid 99 so that any fluctuation in the potential on grid 89 will not prevent the gradual limiting action of grid 99. It can thus be seen that, by operating tube 91 such that its grid 89 varies between zero volts and minus 5 volts the amplification factor may be controlled over a large range.

The same type tube 95 is used to amplify the vertical synchronizing pulses but is hooked up in a slightly different manner. The incoming signal and control voltage is fed to the first grid 93, while grid 107 is kept at a fixed potential, for example, zero volts. The cathode 109 of this tube is maintained at a negative potential and, for

the purposes of illustration, minus 4 volts. The response characteristic of tube 95 is similar to that described for tube 91. However, in the case of tube 95, the curvature in the response characteristic, or the decrease in amplification factor as the control potential bias goes in a positive direction upon decreased signal strength, is caused by the increased drop in anode supply potential through resistances 111 and 113 at increased anode current.

Referring now to Fig. 4, wherein similar reference characters designate corresponding parts throughout, a manual level control is used in place of the automatic level control. A potentiometer 117 is provided with a variable tap 119, which is connected to resistance 43 supplying a negative bias to manually control the amplification factor of tubes 3 and 9. This control potential is applied to control electrodes 1 and 7 of tubes 3 and 9 in the intermediate frequency video signal amplifier. The potentiometer 117 is mechanically coupled to a potentiometer 121 whose variable tap 123 provides an adjustable means to control the level of synchronizing pulses from the separating tube 53 to pass to the pulse amplifier 125 and 73.

The potentiometer 117 is connected from ground to a negative voltage, and, for the purposes of illustration, minus 25 volts, and the potentiometer 121 is shown connected in the anode voltage supply circuit of tube 53. Tube 125 is of conventional design and, for the purpose of this illustration, is shown as a discharge device having a cathode 127, a control electrode 129 and an anode 131.

When receiving signals of high amplitude, the video signal intermediate frequency amplifier manual gain control 117 will be adjusted such as to reduce the gain of the amplifier in order to provide a desired level of signal input to the second detector. The gang control causes a simultaneous change in the potentiometer 121 which is connected to increase the gain of the synchronizing signal amplifier. This results in a greater amplification of the separated synchronizing pulses under conditions of high amplitude incoming signal and a corresponding decrease in amplification of the separated synchronizing pulses under conditions of low amplitude incoming signals.

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 limited to the particular organization shown and described but that many modifications may be made without departing from the scope of this invention as set forth in the appended claims.

Having now described my invention, I claim:

1. In a television system including a synchronizing signal channel, the combination of means for applying signals to said channel and means for increasing the gain of said signals in said channel with an increase in applied signal strength and decreasing the gain of said signals in said channel with a decrease in applied signal strength.

2. In a television system including a synchronizing pulse channel, means for applying synchronizing pulses to said channel and means for increasing the gain in said channel with an increase in applied pulse strength and decreasing the gain in said channel with a decrease in applied pulse strength.

3. A system in accordance with claim 1 and wherein said means for controlling the gain of said signals in the synchronizing signal channel also maintains substantially constant the level of said signals applied to said synchronizing signal channel.

4. A system in accordance with claim 2 and wherein said means for applying synchronizing pulses to the synchronizing pulse channel includes an amplifier, and wherein said means for controlling the gain in the pulse channel also controls the gain in said amplifier.

ALDA V. BEDFORD.