Aug. 12, 1941. R. L. FREEMAN ET AL 2,251,929

TELEVISION CONTROL SYSTEM

Filed Dec. 8, 1939 2 Sheets-Sheet 1

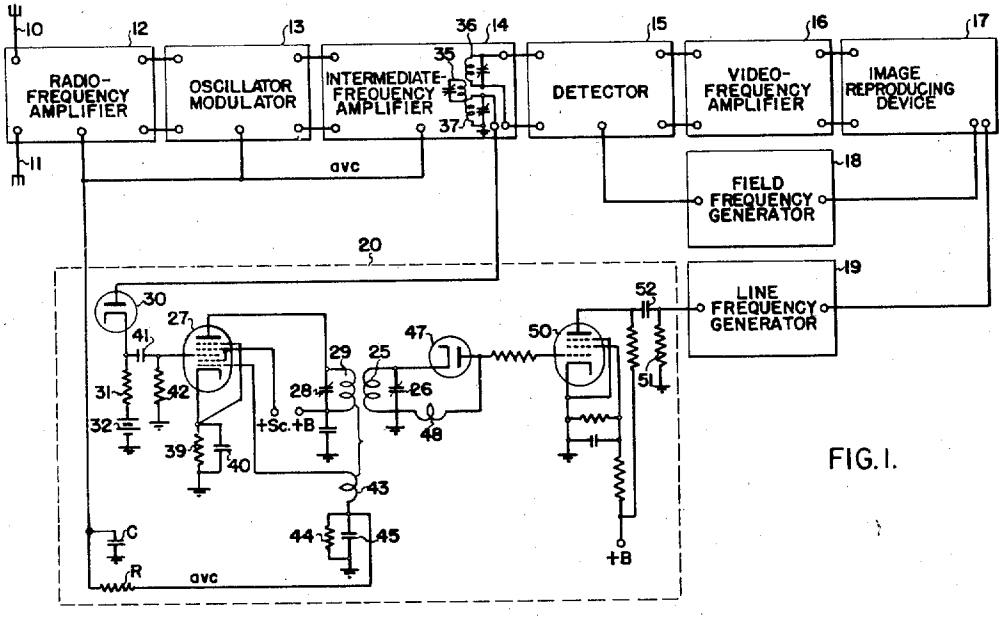


FIG. I.

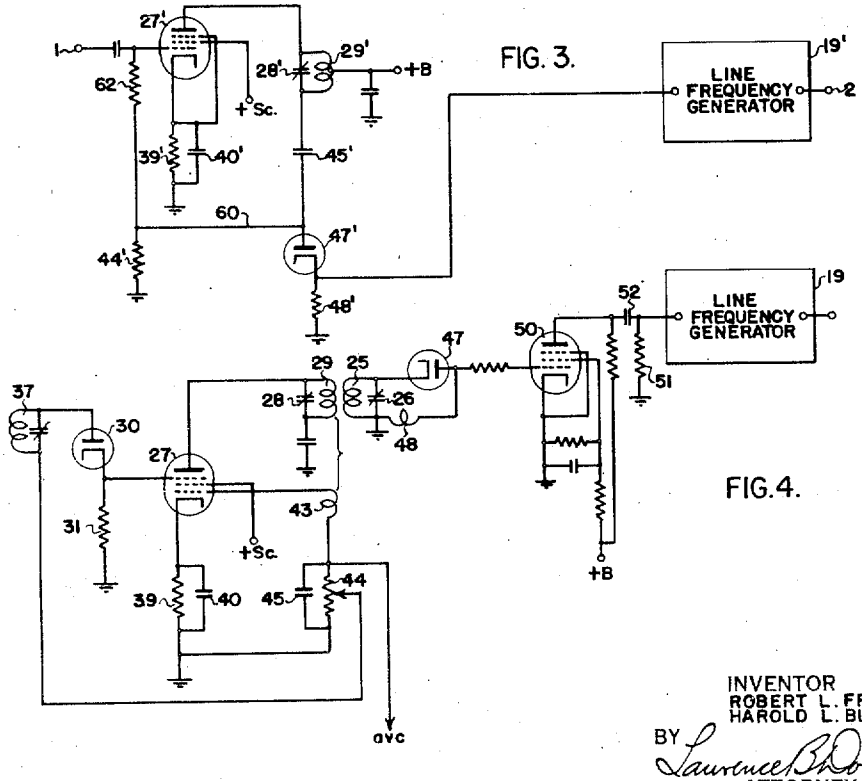


FIG. 3.

FIG. 4.

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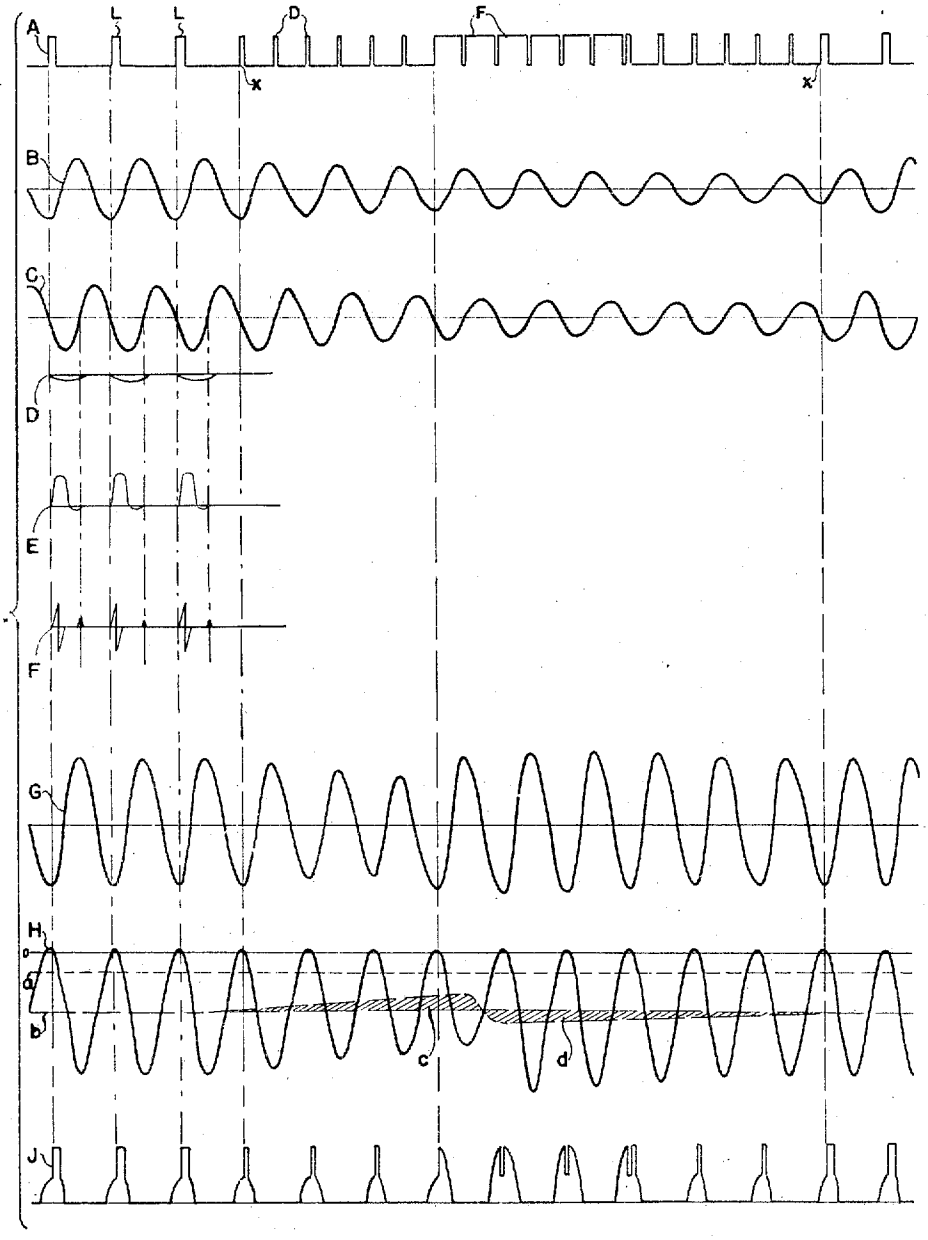


FIG.2.

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UNITED STATES PATENT OFFICE

2,251,929

TELEVISION CONTROL SYSTEM

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Application December 8, 1939, Serial No. 308,152

21 Claims. (Cl. 178—7.5)

This invention relates generally to control systems for television receivers for deriving, from a synchronizing signal including line-frequency components subject to periodic interruptions, a control effect for controlling an operating characteristic of the receiver. The invention is of particular utility in providing an automatic amplification control or in providing a stable and continuous line-frequency synchronizing signal, or both.

In conventional television broadcasting systems there are transmitted composite synchronizing signals including line-frequency synchronizing pulses and field-frequency synchronizing pulses which are utilized at the receiver to initiate successive line-scanning and field-scanning cycles, respectively. The timing of each line-scanning cycle at the receiver is generally in response to a control effect derived from the energy of a single line-synchronizing pulse or derived from the energy of a very few line-synchronizing pulses. Inasmuch as noise components in a television signal have many of the characteristics of synchronizing pulses, it is difficult to design a receiver which is capable of distinguishing between a single desired synchronizing pulse and an undesired noise pulse. It is, therefore, very desirable to provide a line-synchronizing system for a television receiver, the timing effect of which does not depend solely upon a single line-synchronizing pulse but which is instead dependent upon the occurrence of an appreciable number of preceding line-synchronizing pulses. Specifically, it is desirable to provide a line-frequency timing effect which is dependent upon the averaging of a series of several successive line-synchronizing pulses rather than on the occurrence of a single pulse, so that the failure to receive one or more pulses of the series will not interrupt the scanning of the receiver at the line frequency.

Certain prior art systems have been proposed for deriving a timing effect for a television receiver which is responsive to the line-synchronizing pulses and which is not dependent solely upon a single pulse. Inasmuch as the standard synchronizing signal which has been generally adopted comprises line-synchronizing pulses which are effectively periodically interrupted for a considerable interval by line-doubling and field-synchronizing pulses, such prior art systems have had the undesirable characteristic that the derived timing effect is adversely affected by such interruptions of the line-synchronizing pulses. Irregular interruptions may also occur due to faulty reception of the desired line-synchronizing pulses. It is, therefore, particularly desirable to provide a synchronizing control system for a television receiver which is not subject to these disadvantages.

Furthermore, it has been the practice in television systems to derive an automatic amplification control effect for the receiver from the received line-synchronizing pulses. In most such amplification control systems, it has been necessary to provide a time constant in the amplification control circuit sufficiently large that the system does not respond at the frequency of the field-synchronizing pulses. While such an automatic amplification control system may be generally satisfactory, it is subject to the disadvantage that the gain of the receiver is reduced for a relatively long interval after an increase in amplitude of received signals of short duration, which increase may be caused, for instance, by noise pulses of short duration, thus effectively paralyzing the receiver for an interval. It is very desirable, therefore, to provide an improved automatic amplification control system for television receivers responsive to the received line-synchronizing pulses which comprises a fast-acting gain control circuit substantially unaffected by synchronizing components other than the received line-synchronizing pulses, the frequency of which primarily determines the time constant of the automatic amplification control circuit.

It is an object of the present invention, therefore, to provide an improved control system for a television receiver which derives a control effect for the receiver from a received synchronizing signal.

It is another object of the invention to provide an improved line-frequency synchronizing system for a television receiver, the operation of which is substantially immune to irregular noise pulses.

It is still another object of the invention to provide an improved fast-acting automatic amplification control for a television receiver responsive to a received synchronizing signal.

It is another object of the invention to provide a control system for a television receiver which is responsive to received line-synchronizing signals, but which is substantially unresponsive to interruption of the received line-synchronizing pulses for an appreciable period.

In accordance with the invention, there is provided, in a television receiver adapted to be synchronized by synchronizing signals including line-frequency components such as line-synchro-

nizing pulses, subject to periodic interruptions, a control system comprising a low-decrement tuned circuit resonant at such frequency that it can be excited by line-frequency synchronizing components of the received signal. Means are provided for exciting the tuned circuit with the line-frequency components of the received signal to develop continuous free oscillations in the tuned circuit which tend substantially to decrease in amplitude during the interruptions of the received line-frequency components, as by line-doubling pulses and field-synchronizing pulses. There are provided also means coupled to the tuned circuit for substantially reducing such amplitude decrease during the interruptions and means also coupled to the tuned circuit for deriving a control effect from the oscillations. The derived control effect is utilized to control an operating characteristic of the receiver, for example, to synchronize the line-scanning generator or to develop an automatic amplification control bias, or both.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the accompanying drawings, Fig. 1 is a circuit diagram, partly schematic, of a complete television receiver of the superheterodyne type including a control system embodying the present invention; Fig. 2 comprises a series of curves utilized to explain certain of the operating characteristics of the receiver of Fig. 1; while Figs. 3 and 4 are partial circuit diagrams of modifications of the invention.

Referring now more particularly to the drawings, the system illustrated in Fig. 1 comprises a television receiver of the superheterodyne type including an antenna system 10, 11 connected to a radio-frequency amplifier 12, to which are connected in cascade, in the order named, an oscillator-modulator 13, an intermediate-frequency amplifier 14, a detector 15, a video-frequency amplifier 16, and an image-reproducing device 17, which may be of the cathode-ray tube type. The receiver includes a field-frequency generator 18 coupled to the detector 15 and connected to field-scanning elements of image-reproducing device 17 in a conventional manner. There is also provided a suitable line-scanning generator 19 coupled to the intermediate-frequency amplifier 14, by means of a control system 20, constructed in accordance with the invention and described more fully hereinafter, and having an output circuit connected to line-scanning elements of image-reproducing device 17. The stages or units 10–19, inclusive, may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are deemed unnecessary herein.

Referring briefly, however, to the operation of the system described above, television signals intercepted by the antenna circuit 10, 11 are selected and amplified in radio-frequency amplifier 12 and supplied to oscillator-modulator 13, wherein they are converted to intermediate-frequency signals which, in turn, are selectively amplified in the intermediate-frequency amplifier 14 and delivered to the detector 15. The modulation components of the received signal are derived by the detector 15 and are supplied to the video-frequency amplifier 16, wherein they are amplified and from which they are supplied in the usual manner to a brilliancy-control electrode of the image-reproducing device 17 and to the synchronizing control element of the field-scanning generator 18. A suitable synchronizing signal is derived from line-scanning generator 19 from the intermediate-frequency amplifier 14 by means of the unit 20 constructed in accordance with the invention and operating in a manner to be hereinafter fully described. The intensity of the electron beam of image-reproducing unit 17 is thus modulated or controlled in the usual manner in accordance with the video-frequency signal components applied to the control electrode thereof. Saw-tooth current or voltage scanning waves are generated in the line-frequency and field-frequency generators 19 and 18, respectively, and are applied to the scanning elements of image-reproducing unit 17 to produce electric scanning fields, thereby to deflect the cathode ray in two directions normal to each other so as to trace a rectilinear scanning pattern on the screen of the cathode-ray tube and thereby reconstruct the transmitted picture.

Referring now more particularly to the portion of the system of Fig. 1 embodying the present invention, for the purpose of deriving a control effect for the television receiver, the control system 20 includes a tuned circuit 28, 29 adapted to be excited, through a vacuum-tube amplifier 27 of the virtual cathode type, with the line-synchronizing pulses of the received signal to develop continuous free oscillations therein which tend substantially to decrease in amplitude during the interruptions of the line-synchronizing pulses. Tuned circuit 28, 29 is preferably resonant at the fundamental frequency of the line-synchronizing pulses, although it may be resonant at some other related frequency such that it is adapted to be excited by the line-synchronizing pulses, for instance, it may be resonant at a harmonic of the fundamental of the line-synchronizing pulses.

In order to supply the line-synchronizing pulses of the received signal to the input circuit of tube 27, there is provided a coupling circuit between the input circuit of tube 27 and the intermediate-frequency channel of the receiver including a diode 30 coupled to the intermediate-frequency channel of the receiver in series with a resistor 31 and a suitable source of amplitude-delay bias 32. There are shown in intermediate-frequency amplifier 14 three coupled tuned circuits 35, 36, and 37, and it will be understood that tuned circuits 35, 36 are included as selective circuits directly in the intermediate-frequency signal-translating channel of the receiver and that circuit 35 may, for instance, comprise the load impedance of a conventional vacuum-tube amplifier in intermediate-frequency amplifier 14. A self-bias is provided for the input circuit of tube 27 by means of a cathode-resistor 39 by-passed for signal components by a condenser 40, while a suitable coupling condenser 41 and grid-leak 42 are coupled to the grid of the tube. There is provided a feed-back circuit from the output circuit of tube 27 to an input circuit thereof including an inductance 43 inductively coupled to inductance 29 and connected in series with a resistor 44 shunted by a condenser 45. The voltage developed across resistor 44 is applied by way of a conductor designated as "A. V. C." to the control electrodes of one or more of the tubes in radio-frequency amplifier 12, oscillator-modulator 13, and intermediate-frequency amplifier

14 to control the amplification of the receiver in a conventional manner.

In order to derive a suitable line-synchronizing signal from the oscillations developed in tuned circuit 28, 29, there is provided a tuned circuit 25, 26 inductively coupled to tuned circuit 28, 29 and a diode 47 coupled across tuned circuit 25, 26 in series with inductance 48. Tuned circuit 25, 26 is provided primarily to obtain a proper phase relationship of the input to diode 47. There is provided a vacuum-tube repeater 50 having its input electrodes coupled across inductance 48 and having in its output circuit a suitable differentiating circuit including a resistor 51 and coupling condenser 52 in series, the voltage across resistor 51 being applied to line-scanning generator 19 for synchronization.

Reference is made to Fig. 2 for an explanation of the operation of the control system 20 of Fig. 1 incorporating the present invention. It will be assumed that the received synchronizing signal is of the conventional standard composite form, a portion of which occurring during the field-retrace interval is illustrated in curve A of Fig. 2, including line-synchronizing pulses L, line-doubling pulses D, and field-synchronizing pulses F. Diode 30 acts as an amplitude-delayed detector due to the bias provided by battery 32 which is selected to have such value that the diode 30 is effective to detect only the synchronizing components of the intermediate-frequency signal of the receiver, the amplitude of the intermediate-frequency signal input to diode 30 being maintained within a relatively narrow range for a wide range of received signal amplitudes by the automatic amplification control to be described presently.

The detected composite synchronizing signal, as represented by curve A, is applied by way of coupling condenser 41 to an input circuit of tube 27. Tuned circuit 28, 29 which preferably has a low decrement, is thus excited through tube 27 by means of the line-synchronizing pulses of the wave form of curve A to develop continuous free oscillations in tuned circuit 28, 29 which tend substantially to decrease in amplitude during the effective interruptions of the line-synchronizing pulses by the field-synchronizing and line-doubling pulses, as illustrated by the wave form of curve B of Fig. 2 during the interval x—x. The amplitude of these oscillations decreases during the line-doubling and field-synchronizing pulses due to the fact that there is substantially no component of excitation during this interval at the resonant frequency of tuned circuit 28, 29. Tuned circuit 25, 26 derives from circuit 28, 29, to which it is coupled, oscillations having a suitable phase relationship with the line-synchronizing pulses L, as illustrated in curve C of Fig. 2, the oscillations developed across tuned circuit 25, 26 being substantially in quadrature with those developed across tuned circuit 28, 29. Preferably the phase of the oscillations of curve C is so adjusted by adjustment of the circuit constants that the axis intercepts of the oscillations occur coincidentally with the leading edges of the line-synchronizing pulses, as indicated.

Diode 47 is effective to pass current during only the negative half-cycles of the wave of curve C and, due to the impedance of inductance 48, the diode current is substantially of the wave form shown by curve D of Fig. 2. The voltage across inductance 48 is applied to the control electrode of repeater tube 50 so that a voltage of the wave form of curve E is thus developed in the output circuit of the tube 50, the inductance 48 thus effectively constituting a differentiating means in the circuit. The output voltage of tube 50 is again differentiated by means of the circuit 51, 52 to provide an input voltage to line-scanning generator 19 of substantially the form illustrated by curve F of Fig. 2. It is seen that the voltage input to line-scanning generator 19 comprises sharp impulses coincident in time with the leading edges of line-synchronizing pulses L, these impulses being utilized to synchronize line-frequency generator 19. Also, it is seen that the sharp impulses of the wave of curve F are coincident in time with the axis intercepts of the wave of curve C.

The feed-back circuit associated with amplifier tube 27 and including inductance 43 is provided in order substantially to reduce the amplitude decrease of the oscillations developed in tuned circuit 28, 29 during the interval when the line-synchronizing pulses are effectively interrupted. The voltage developed across tuned circuit 28, 29, taking into consideration the action of the feed-back arrangement to be described, is represented by the wave form of curve G of Fig. 2. The average amplitude of the oscillations developed in tuned circuit 28, 29 is maintained constant during the interval when there is no excitation at the line frequency of the system, by means of the nonlinear feed-back arrangement including inductance 43. Reference is made to curve H of Fig. 2 for an explanation of the operation of this feed-back circuit. A current of the wave form of curve G appearing in tuned circuit 28, 29 induces in the winding 43 a voltage of similar wave form but of reversed polarity which is applied to the inner input electrode of tube 27 where the feed-back voltage is stabilized upon the positive peaks of the oscillation by means of the rectifying action of the input electrode of which the resistor 44 and condenser 45 comprise the load circuit. The system is so proportioned that tube 27 is biased considerably beyond its cut-off point except during the positive peaks of the applied feed-back voltage, whereby the action of the feed-back circuit is nonlinear; that is, the tube becomes conductive during only the portion of the wave of curve H above the line a, which represents the cutoff point of the tube, which portions occur only at periodic intervals and at the frequency of the line-synchronizing components. Under these conditions, the effective inputs to the first and second control electrodes of the vacuum tube 27 during its conductive intervals are effectively the portion of wave form H above the line a and the composite synchronizing signal represented by curve A, respectively. These signal inputs are effective to develop an anode current in tube 27 of substantially the wave form illustrated by curve J of Fig. 2. Since the amplitude of the oscillations developed in tuned circuit 28, 29 varies with the energy of the output current of tube 27, that is, with the area of the pulses of the wave of curve J, the feed-back circuit of the invention is effective to vary the amplitude of the oscillations of tuned circuit 28, 29 substantially as illustrated in curve G. Preferably, the circuit is so proportioned that the average amplitude of the generated oscillations during the interval x—x when the line-synchronizing pulses are effectively interrupted by the field-synchronizing and line-doubling pulses is maintained substantially equal to the amplitude of the oscillations generated during periods of continuous excitation by the line-synchronizing pulses. Under these conditions, no component of field fre-

quency is present in the envelope of the generated oscillations represented by curve G. Preferably, the regeneration provided is safely short of that required to develop sustained oscillations in tuned circuit 28, 29 in the absence of synchronizing signals.

Inasmuch as the amplitude of the oscillations developed in tuned circuit 28, 29 varies in accordance with the amplitude of the composite synchronizing signal applied to tube 27 from the intermediate-frequency channel of the receiver and since the amplitude of the synchronizing signal is a measure of the unmodulated amplitude of the television carrier wave, the unidirectional voltage developed across resistor 44 by grid rectification has a corresponding variation, as illustrated by the distance between the zero line and the dotted-line axis *b* of curve H of Fig. 2, and this voltage is used for automatic amplification control of the receiver. The circuit constants are so adjusted that the area of portion *c* of the curve *b* above its average value and the area of portion *d* of the curve *b* below its average value are equal so that there is no component of field-scanning frequency in the developed bias voltage and it is only necessary to provide filtering for the A. V. C. control system at the higher harmonics of the field-scanning frequency and at the line-scanning frequency of the system. The system of the invention, therefore, permits the use of a much faster A. V. C. circuit than arrangements of the prior art, that is, embodies a filter R, C with a much lower time constant, for example, 0.01 second, so that the A. V. C. system is not paralyzed by noise-signal components of short duration, as is frequently the case in conventional automatic amplification control systems for television receivers, due to the fact that such conventional automatic amplification control systems must have a time constant which is sufficiently large to provide filtering at the fundamental of the field-scanning frequency of the system.

While applicants do not intend to be limited to any particular circuit values for the arrangement of Fig. 1, the following circuit constants have been found to be particularly suitable:

Tube 27	Type 6L7
Tube 47	Type 6H6
Tube 50	Type 6SJ7
Inductance 29	16 millihenries
Inductance 25	40 millihenries
Inductance 43	80 millihenries
Inductance 48	1 millihenry
Capacitance 28	0.009 microfarad
Capacitance 26	0.003 microfarad
Resistance 44	1 megohm
Condenser 45	0.001 microfarad
Tuned circuit 28, 29	Preferably has a "Q" between 50 and 500

In Fig. 3 there is represented a control system, per se, including a modified form of the present invention in which circuit elements which are similar to those of Fig. 1 have identical reference numerals with the addition of a prime. It will be understood that the circuit of Fig. 3 is adapted to be connected into the circuit of a television receiver in substantially the same manner as the control system of Fig. 1, that is, the intermediate-frequency signal of the receiver is applied to terminal 1 and there is derived at terminal 2 a scanning current or voltage for image-reproducing device 17. The circuit of Fig. 3 comprises a vacuum tube 27' which detects the synchronizing components of the received signal and through which tuned circuit 28', 29' is excited by synchronizing-signal components of line-scanning frequency to develop therein continuous free oscillations which tend substantially to decrease in amplitude during the interruptions of the line-synchronizing pulses. A portion of the oscillation voltage developed across tuned circuit 28', 29' is rectified by diode 47' to develop line-synchronizing pulses across a load resistor 44'. In order to provide a feed-back voltage for tube 27' which is effective substantially to reduce the amplitude decrease of the oscillations generated in tuned circuit 28', 29' during interruptions of the excitation of the tuned circuit at the frequency of the line-synchronizing pulses, there is provided a feed-back circuit including conductor 60 and series-connected resistors 44', 62 coupled between the input electrodes of tube 27' and ground.

The operation of the circuit of Fig. 3 is generally similar to that of Fig. 1 insofar as synchronization of line-frequency generator 19' is concerned, but no automatic amplification control bias is developed. That is, continuous free oscillations which tend substantially to decrease in amplitude during interruptions of the line-frequency excitation are developed in tuned circuit 28', 29'. The feed-back circuit including conductor 60 comprises a nonlinear arrangement for feeding back the rectified oscillation voltage across resistor 48' to the input circuit of tube 27' for substantially reducing the amplitude decrease during the interruption of the line-synchronizing pulses. The rectifier 47' is effective to pass only the portions of the generated oscillations of a given polarity and the derived synchronizing signal across resistor 48' corresponds in time to the peaks of the generated oscillations.

In Fig. 4 there is shown a further embodiment of the invention which is generally similar to that of Fig. 1 and similar circuit elements have identical reference numerals. The circuit of Fig. 4 differs from that of Fig. 1 primarily in the fact that the constant amplitude-delay bias for detector 30 provided by battery 32 has been replaced by a delay bias, which varies in accordance with the amplitude of the received signal, derived from an adjustable tap on resistor 44. The tap on resistor 44 may be adjusted so that a delay bias is provided for rectifier 30 which is effective to provide accurate clipping of the synchronizing signals at the black level of the received composite television signal. Since the amplitude of the synchronizing-signal input to tuned circuit 37 varies in accordance with the unmodulated amplitude of received signals, a clipping action varying with the amplitude of the intermediate-frequency signal input to circuit 37 is required to ensure that the signal input to tube 27 includes only the synchronizing-signal components, whereby the automatic amplification control bias is completely independent of video-frequency modulation components. The operation of the circuit of Fig. 4 is otherwise identical with that of Fig. 1.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all

such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at such frequency that it can be excited by said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

2. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

3. In a television receiver adapted to be synchronized by a received composite synchronizing signal including line-frequency components effectively subject to periodic interruptions by field-frequency components, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said composite signal to develop continuous free oscillations therein at the line frequency which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

4. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations in said tuned circuit which tend substantially to decrease in amplitude during said interruptions, feed-back means between said output and input circuits for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

5. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said tube with said line-frequency components to develop continuous free oscillations in said tuned circuit which tend substantially to decrease in amplitude during said interruptions, feed-back means coupled between said output and input circuits to provide regeneration for said vacuum tube of a value insufficient to produce sustained oscillations in said tuned circuit in the absence of said line-frequency components, said feed-back means being effective substantially to reduce said amplitude decrease during said interruptions, means coupled to said tuned circuit for developing a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

6. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations in said tuned circuit which tend substantially to decrease in amplitude during said interruptions, a feed-back means between said output and input circuits and having a nonlinear input-output characteristic for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

7. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, feed-back means between said output and input circuits effective to deliver energy to said input circuit only at periodic intervals and at the frequency of said line-frequency components for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

8. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising a low-decrement tuned circuit

resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, feed-back means between said input and output circuits effective to deliver energy to said input circuit only at periodic intervals and at the frequency of said line-frequency components for substantially reducing said amplitude decrease during said interruptions, said vacuum tube being biased beyond its cut-off point except during said periodic intervals, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

9. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including input and output circuits, means for exciting said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations in said tuned circuit which tends substantially to decrease in amplitude during said interruptions, feed-back means between said output and input circuits effective to feed energy to said input circuit during only the peaks of said oscillations for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

10. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, a vacuum tube including two input electrodes and an output circuit, means for applying said received synchronizing signal to one of said input electrodes to excite said tuned circuit through said vacuum tube with said line-frequency components to develop continuous free oscillations in said tuned circuit which tend substantially to decrease in amplitude during said interruptions, feed-back means between said output circuit and the other of said input electrodes effective to feed energy to said other of said input electrodes during only the peaks of said oscillations for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect from said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

11. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein varying in amplitude in accordance with the amplitude of said line-frequency components and which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect varying in accordance with the amplitude of said oscillations, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

12. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein varying in amplitude in accordance with the amplitude of said line-frequency components and which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect varying in accordance with the amplitude of said oscillations, and means responsive to said control effect for controlling the gain of said receiver inversely in accordance with the amplitude of said control effect.

13. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein varying in amplitude in accordance with the amplitude of said line-frequency components and which tend substantially to decrease during said interruptions, means coupled to said tuned circuit for maintaining said oscillations at an average amplitude during said interruptions equal to the amplitude of said oscillations during periods of continuous excitation, means coupled to said tuned circuit for deriving a control effect varying in accordance with the amplitude of said oscillations, and means responsive to said control effect for controlling the gain of said receiver inversely in accordance with the amplitude of said control effect.

14. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions by line-doubling and field-synchronizing components, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein varying in amplitude in accordance with the amplitude of said line-frequency components and which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for deriving energy from said field-synchronizing pulses to increase the amplitude of said oscillations with respect to their amplitude during periods of continuous excitation by said line-synchronizing pulses to compensate for their decrease in amplitude dur-

ing said line-doubling synchronizing pulses, means coupled to said tuned circuit for deriving a control effect varying in accordance with the amplitude of said oscillations, and means responsive to said control effect for controlling the gain of said receiver inversely in accordance with the amplitude of said control effect.

15. In a modulated-carrier wave-signal television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, an amplitude-delayed detector coupled to a carrier-frequency channel of said receiver for deriving from the translated carrier-frequency signal said synchronizing signal including said line-frequency components, means coupled to said detector for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations in said tuned circuit which vary in accordance with the amplitude of said line-frequency components and which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving a control effect varying in accordance with the amplitude of said oscillations, means for utilizing a portion of said control effect as an amplitude-delay bias for said detector, and means for utilizing said control effect for controlling an operating characteristic of said receiver.

16. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, and means coupled to said tuned circuit and responsive to a frequency characteristic of said oscillations for synchronizing the line-scanning operation of said receiver.

17. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving auxiliary oscillations therefrom having axis intercepts bearing a predetermined phase-relation to said line-synchronizing pulses, and means responsive to said axis intercepts for synchronizing the line-scanning operation of said receiver.

18. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving auxiliary oscillations, and means for rectifying said auxiliary oscillations and utilizing the resulting rectified signal to synchronize the line-scanning operation of said receiver.

19. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving auxiliary oscillations, means for rectifying said auxiliary oscillations, and means for differentiating the rectified resultant to provide a synchronizing signal for the line-scanning operation of said receiver.

20. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising, a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, means coupled to said tuned circuit for deriving auxiliary oscillations, means for rectifying said auxiliary oscillations, and means for successively differentiating said rectified oscillations for synchronizing the line-scanning operation of said receiver.

21. In a television receiver adapted to be synchronized by a received synchronizing signal including line-frequency components effectively subject to periodic interruptions, a control system comprising a low-decrement tuned circuit resonant at the fundamental frequency of said line-frequency components, means for exciting said tuned circuit with said line-frequency components to develop continuous free oscillations therein which tend substantially to decrease in amplitude during said interruptions, means coupled to said tuned circuit for substantially reducing said amplitude decrease during said interruptions, an inductance, a diode coupled to said tuned circuit through said inductance, a line-scanning generator, and means for utilizing the voltage across said inductance to synchronize said line-scanning generator.

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