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TELEVISION SCANNING SYSTEM

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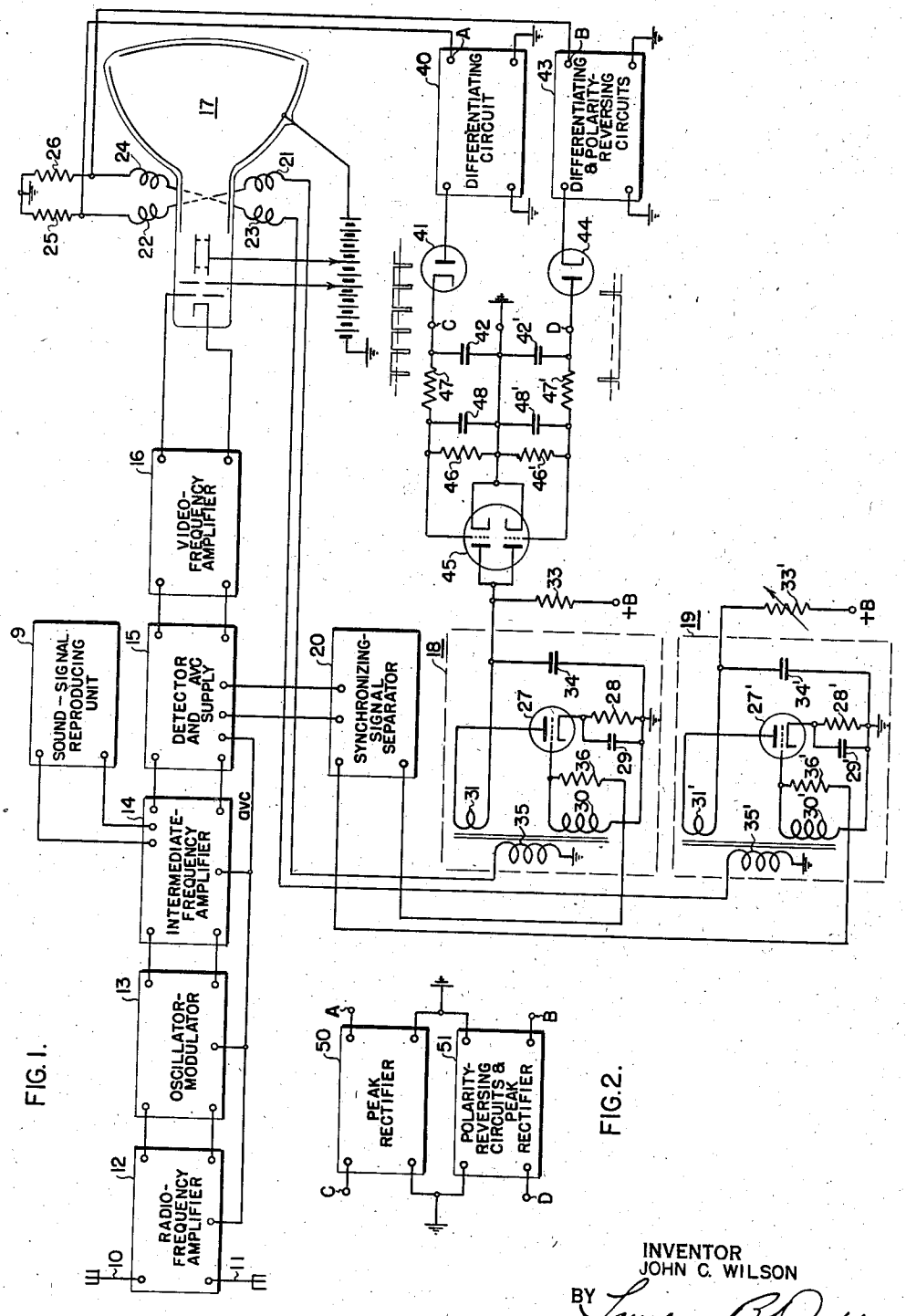


FIG. 1.

FIG. 2.

INVENTOR
JOHN C. WILSON

BY Laurence B. Dodds

ATTORNEY

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TELEVISION SCANNING SYSTEM

John C. Wilson, Bayside, N. Y., assignor to Hazeltine Corporation, a corporation of Delaware

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This invention relates to television scanning systems and, particularly, to television scanning systems of the type provided for a cathode-ray tube and comprising an arrangement for controlling the aspect ratio of the scanning, that is, for controlling the relative amplitudes of the scanning deflections in two scanning directions.

A conventional television scanning system for a cathode-ray tube comprises an arrangement for scanning a target of the tube in one direction at a predetermined or line-scanning frequency and for scanning the target of the tube in a second direction at a different or field-scanning frequency. Some prior art television receiver scanning systems of the type under consideration are intended to be adjusted at the factory to provide a predetermined maximum scanning amplitude in each of the two scanning directions, thereby to provide a picture of a given length and of a given width, that is, of a definite aspect ratio. As used in this specification, the term "aspect ratio" is used in its customary sense to mean the ratio of these two dimensions. However, in receivers of the type just mentioned, the relative maximum amplitudes of the scanning deflections may vary with changes in operating conditions, such as changes in humidity, temperature, unidirectional operating voltages, etc., which affect the scanning generators. However, unless the ratio of the picture dimensions or the aspect ratio is at all times the same, an objectionable picture distortion results. It has, therefore, been found to be desirable to provide controls in the receiver to permit adjustment of each of the picture dimensions and, furthermore, it is generally found to be necessary to adjust both picture dimensions in order to effect a satisfactory operating condition. It is particularly desirable, however, to provide a television scanning system in which only a single control is provided for changing one of the picture dimensions and in which the aspect ratio of the reproduced picture is maintained substantially constant under all operating conditions.

Furthermore, in some cases it is desirable to control the relative incremental amplitudes of the scanning fields of a television receiver over their respective amplitude ranges, thereby to ensure a predetermined constant incremental aspect ratio as well as a predetermined over-all aspect ratio. Moreover, in some cases it is desirable to control the relative amplitudes of the scanning fields in accordance with the relative slopes or rates of change of amplitude of the scanning fields over a scanning cycle or over a predetermined portion of such cycle.

It is an object of the present invention, therefore, to provide an improved television scanning system which is not subject to one or more of the above-mentioned disadvantages of prior art television scanning systems.

It is another object of the invention to provide a television scanning system in which the aspect ratio is maintained substantially constant under all operating conditions.

It is still another object of the invention to provide a television scanning system in which control of the scanning amplitudes in two directions is effected by a single control means.

In accordance with the invention, a television system comprises a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan the target with the beam in one direction at a predetermined frequency and with a first predetermined amplitude, and a second means for developing and using a second scanning signal to scan the target with the beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions. The scanning system also comprises means responsive to the scanning signals and dependent upon an amplitude characteristic of the first signal and upon an amplitude characteristic of the second signal for deriving a control effect, and means responsive to the control effect for controlling the ratio of the scanning amplitudes.

As used in this specification, the term "amplitude" is intended to include either an instantaneous value, the peak value, or the average value of a repeating wave form. Also as used in this specification, the term "amplitude characteristic" is intended to include all characteristics which vary with amplitude and is specifically intended to include the differential or rate of change of an amplitude value which varies with time.

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 drawing and its scope will be pointed out in the appended claims.

Fig. 1 of the drawing is a circuit diagram, partially schematic, of a complete television receiver of the superheterodyne type embodying a scanning system in accordance with the invention,

while Fig. 2 is a schematic diagram illustrating a modification of a portion of the scanning system of Fig. 1.

Referring now more particularly to the drawing, the system illustrated comprises a receiver of the superheterodyne type including an antenna system 10, 11 connected to a radio-frequency amplifier 12 of one or more stages to which are connected, in the order named, a frequency changer or oscillator-modulator 13, an intermediate-frequency amplifier 14 of one or more stages, a detector 15, a video-frequency amplifier 16 of one or more stages, and a cathode-ray image-reproducing device 17. A line-scanning generator 18 and a field-scanning generator 19 are coupled to an output circuit of detector 15 through a synchronizing-signal separator 20, the line-scanning generator 18 being coupled to the line-deflecting windings 21, 22 and the field-scanning generator 19 being coupled to field-deflecting windings 23, 24 of cathode-ray tube 17. An amplification control voltage derived from detector 15 is applied to one or more tubes of stages 12, 13, and 14. A unit 9 for reproducing sound signals accompanying the received television signals is coupled to an output circuit of intermediate-frequency amplifier 14. The stages or units 9–17, inclusive, and 20–24, inclusive, may all be of conventional well known construction so that detailed illustration and description thereof are deemed unnecessary herein.

Referring briefly, however, to the operation of the system described above, television signals intercepted by antenna circuit 10, 11 are selected and amplified in radio-frequency amplifier 12 and applied to the oscillator-modulator 13 wherein they are converted into 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 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 the brilliancy-control electrode of image-reproducing device 17. Modulation components are also supplied from detector 15 to the synchronizing-control elements of generators 18 and 19 through the synchronizing-signal separator 20. The intensity of the scanning ray of the device 17 is thus modulated or controlled in accordance with the video-frequency voltages impressed upon the control electrode in the usual manner. Scanning waves are generated in the line-scanning and field-scanning generators 18, 19, which are controlled by synchronizing voltage pulses supplied from detector 15 through synchronizing-signal separator 20, and applied to the scanning windings 21, 22 and 23, 24, respectively, of the image-reproducing device 17 to produce electric scanning fields, thereby to deflect the scanning ray in two directions normal to each other so as to trace a rectilinear scanning pattern on the screen of tube 17 and thereby reconstruct the transmitted image. An automatic amplification control bias derived from detector 15 and applied to one or more tubes of stages 12, 13, and 14 serves to maintain the amplitude of the signal input to unit 9 and to detector 15 within relatively narrow limits for a wide range of received signal amplitudes. Sound signals accompanying the received television signals are reproduced in unit 9 in a conventional manner.

Referring now more particularly to the portion of the system of Fig. 1 embodying the invention, scanning generator 18, which is a scanning oscillator of the inductance-resistance type, comprises a vacuum tube 27 having an input circuit in which is included a cathode-biasing resistor 28 bypassed by a condenser 29 in order to provide a suitable operating bias for the tube. An inductance 30 is also included in the input circuit of the tube and is inductively coupled to an inductance 31 in the output circuit of the tube, the inductance 31 being connected to a source of suitable operating potential +B through a resistor 33. In order to maintain the unidirectional operating potential applied to the anode of tube 27 substantially constant, a smoothing condenser 34 is connected between the common junction of inductance 31 and resistor 33 and ground. The output scanning current of the oscillator is derived from an inductance 35 which is in series with line-scanning windings 21, 22 and inductively coupled to windings 30, 31. Line-synchronizing signals are applied from synchronizing-signal separator 20 to the grid of tube 27 through an isolating resistor 36.

The circuit of field-scanning generator 19 is generally similar to that of line-scanning generator 18 and circuit elements which are similar have identical reference numerals with the addition of a prime ('). Resistor 33' of field-scanning generator 19 is an adjustable resistor, being provided for the purpose of adjusting the maximum output amplitude of the generator, thereby to adjust the maximum amplitude of the scanning in the field-scanning direction, that is, to adjust one dimension of the picture repreduced on the fluorescent screen of tube 17.

In order to develop a control voltage for automatically controlling the ratio of the output amplitudes of generators 18 and 19 upon any variation of either of them, as, for example, upon adjustment of resistance 33', there is provided in series with line-scanning windings 21, 22 and field-scanning windings 23, 24 resistors 25 and 26, respectively, across which are developed voltages, the wave forms of which correspond with those of the scanning currents applied to the scanning windings and thus with those of the scanning fields. There is also provided an arrangement for deriving a control effect from the voltages developed across resistors 25 and 26 and for utilizing this control effect to control the amplitude of the output of line-scanning generator 18. For this purpose, the voltage across resistor 25 is applied through a differentiating circuit 40 and a diode rectifier 41 to a condenser 42 while the voltage across resistor 26 is applied through a differentiating and polarity-reversing circuit 43 and a diode rectifier 44 to a condenser 42'.

In order to utilize the control effects developed across condenser 42 and condenser 42' to control the amplitude of the output of line-scanning generator 18, there is provided a control tube 45 which is of the double-triode type, having its single anode-cathode circuit effectively coupled across resistor 33 and the source of unidirectional operating potential +B for tube 27 and having one input circuit connected to condenser 42 through a time-constant circuit or filter including a series resistor 47 and a shunt condenser 48 and its other input circuit connected to condenser 42' through a time-constant circuit or filter including a series resistor 47' and a shunt condenser 48'. Grid-leak resistors 46 and 46' are provided for the tube 45.

In considering the operation of the television scanning system of Fig. 1, it will be seen that

the system includes the cathode-ray tube 17 having a target which is to be scanned by the beam of the tube, a first scanning means comprising line-scanning generator 18 for developing and using a first scanning signal to scan the target with the beam in one direction at a predetermined frequency and with a predetermined amplitude, and a second scanning means comprising field-scanning generator 19 for developing and using a second scanning signal to scan the target with the beam in another direction at a different predetermined frequency and with an amplitude relative to the signal amplitude of the first oscillator which may tend to vary, for example, due to an adjustment of resistor 33'.

In considering the effect of an adjustment of resistor 33', it will be seen that generator 19 is of a conventional design effective to provide a scanning current of saw-tooth wave form. Specifically, neglecting for the moment the effect of the synchronizing signals on the generator and assuming that a proper bias is maintained across resistor 28' so that tube 27' is normally conductive, the current through the tube rises in accordance with the exponential law for a circuit comprising resistance, resistor 33' and the internal resistance of tube 27', and inductance, the inductance of transformer winding 31', in series with a source of steady potential. As the current rises, a voltage proportional to its rate of change is induced in the grid winding 30' in such a sense as to increase the potential of the grid of the tube positively. This action regenerates the output current and the current continues to rise in the anode circuit until, according to the exponential law, its rate of rise begins materially to diminish. However, the induced voltage in the grid circuit, which tends to keep the grid positive, is then reduced and the grid potential decreases and this action is highly regenerative. At a predetermined point in the cycle, the tube is operated to cutoff and the anode current then falls extremely rapidly to zero, the grid at the same time being driven strongly negative by the induced voltage due to the fall of anode current. The action during this return stroke or retrace interval is also highly regenerative. When the anode current has ceased and the induced potential collapses, the cycle begins anew. Adjustment of resistor 33' in series with winding 31' has the effect of changing the rate of rise of current therethrough and, therefore, of changing the amplitude of the output of the oscillator. The effect of the synchronizing pulses which are applied negatively to the grid of tube 27' is to initiate the retrace interval of the cycle shortly before it would otherwise take place.

If the function of tube 45 is omitted, it is seen that an adjustment of resistor 33' in the circuit of Fig. 1 has the effect of changing the field-scanning amplitude, while the line-scanning amplitude is not changed and, therefore, has the effect of changing the aspect ratio of the reproduced picture. It is for the purpose of preventing such a change that the control tube 45 and its controlling circuits are provided. Thus, under normal operation of the circuit, the voltage developed across resistor 25 is of saw-tooth wave form and is differentiated in circuit 40 to provide at the output circuit thereof a voltage of the wave form illustrated adjacent terminal C. This voltage is applied during line-trace intervals through the rectifier 41 to condenser 42 and tends to charge the condenser positively, thereby to increase the internal conductance of tube 45. Similarly, the saw-tooth voltage developed across resistor 26 is differentiated and has its polarity reversed in circuit 43 to provide in the output circuit thereof a voltage of the wave form illustrated by the curve adjacent terminal D. This voltage is negative during field-trace intervals and is applied during these intervals through rectifier 44 to condenser 42' and tends to charge condenser 42' negatively, thus to reduce the conductance of tube 45.

The circuit constants are so proportioned that, under normal operating conditions, a suitable control effect is provided for tube 45 so that a given aspect ratio is maintained. If, however, one of the scanning amplitudes tends to vary, for example, if the field-scanning amplitude is increased in response to an adjustment of resistor 33', it is necessary simultaneously to increase the amplitude of the output of line-scanning generator 18 in order to maintain the same aspect ratio. Under the conditions assumed, the increased amplitude of the output of field-scanning generator 19 results in a voltage of greater amplitude across resistor 26, which, in turn, has the effect of producing, through differentiating and polarity-reversing circuit 43 and diode 44, a greater negative potential across condenser 42'. This potential has the effect of decreasing the conductance of tube 45, thereby effectively applying a higher anode voltage to tube 27 and increasing the amplitude of the saw-tooth current output thereof to such a point that a condition of equilibrium is again established in the system, that is, to such a point that the aspect ratio is restored to its normal value.

The charging circuits for condensers 42 and 42', therefore, comprise means responsive to the line-scanning and field scanning signals and dependent jointly upon an amplitude characteristic of the line-scanning signal and upon an amplitude characteristic of the field-scanning signal for developing a control effect which is utilized to control the ratio of the amplitudes of the scanning fields. If the time constants of resistor 47 and condenser 48 and of resistor 47' and condenser 48' are very small or zero, the control of the arrangement just described is very fast-acting and depends jointly upon the instantaneous-amplitude characteristics of the two scanning signals and serves to control the ratio of the instantaneous-amplitude values of the scanning fields which, in turn, determines the incremental aspect ratio of the reproduced picture over the scanning amplitude ranges. However, it will be understood that these time constants can be made to be appreciable and in such case the control of tube 45 is not fast-acting but serves to maintain a constant over-all aspect ratio averaged over an appreciable interval.

In some cases it is sufficient to provide an aspect-ratio control arrangement which is responsive only to the peak amplitudes of the two scanning fields and which serves to control the ratio of the peak amplitudes of these fields. For this purpose the peak rectifiers of Fig. 2 can be connected into the circuit of Fig. 1 by omitting the elements 40 and 43 and tubes 41 and 44 and connecting the terminals of the elements of Fig. 2 to the correspondingly designated terminals of Fig. 1.

In considering the operation of this modification of the invention, it will be seen that each of the peak rectifiers is effective to derive a voltage which is averaged over an appreciable period. These voltages are applied to condensers 42 and 42', respectively, in a manner similar to that de-

scribed above in connection with Fig. 1 and serve to provide a control effect for tube 45 which serves to control the aspect ratio as before. However, in this case, due to the time constant of the circuits of peak rectifiers 50 and 51, the control effect does not vary instantaneously in accordance with the rate of change of the amplitudes of the scanning fields, but varies only in accordance with their relative peak amplitudes averaged over an appreciable period. Therefore, the arrangement of Fig. 2 is effective to control the ratio of these amplitudes averaged over an appreciable period.

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. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon an amplitude characteristic of said first signal and upon an amplitude characteristic of said second signal for deriving a control effect, and means responsive to said control effect for controlling the ratio of said amplitudes.

2. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon an instantaneous-amplitude characteristic of said first signal and upon an instantaneous-amplitude characteristic of said second signal for deriving a control effect, and means responsive to said control effect for controlling the ratio of the instantaneous amplitudes of said first and second signals.

3. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon the instantaneous slope of said first signal and upon the instantaneous slope of said second signal for deriving a control effect, and means responsive to said control effect for controlling the incremental ratio of said first and second signals.

4. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined peak amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with a peak amplitude relative to said first peak amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon the peak amplitude of said first signal and upon the peak amplitude of the scanning wave of said second signal for deriving a control effect, and means responsive to said control effect for controlling the ratio of said peak amplitudes.

5. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon an amplitude characteristic of said first signal averaged over an appreciable period and upon an amplitude characteristic of said second signal averaged over an appreciable period for deriving a control effect, and means responsive to said control effect for controlling the ratio of said amplitudes averaged over an appreciable period.

6. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said beam in another direction at a predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon the average slope of said first signal and upon the average slope of said second signal for deriving a control effect, and means responsive to said control effect for controlling the ratio of the amplitudes of the first and second signals.

7. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a predetermined different frequency and with a predetermined amplitude, manual

means for adjusting one of said amplitudes, whereby the ratio of said amplitudes tends to vary under operating conditions, means responsive to said signals and dependent jointly upon an amplitude characteristic of said first signal and upon an amplitude characteristic of said second signal for deriving a control effect, and means responsive to said control effect for so controlling the ratio of said amplitudes that the aspect ratio of said scanning is maintained substantially constant upon a manual adjustment of said one of said amplitudes.

8. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in a line-scanning direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in a field-scanning direction at a predetermined different frequency and with a predetermined amplitude, manual means for adjusting said field-scanning amplitude, whereby the ratio of said amplitudes tends to vary under operating conditions, means responsive to said signals and dependent jointly upon an amplitude characteristic of said first signal and upon an amplitude characteristic of said second signal for deriving a control effect, and means responsive to said control effect for so controlling the ratio of said amplitudes that the aspect ratio of said scanning is maintained substantially constant upon a manual adjustment of the scanning amplitude in said field-scanning direction.

9. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means including a condenser adapted to be charged in accordance with an amplitude characteristic of said first signal and a condenser adapted to be charged in accordance with an amplitude characteristic of said second signal for deriving control effect, and means responsive to said control effect for controlling the ratio of said amplitudes.

10. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means for deriving a first voltage the wave form of which corresponds to that of said first signal, means for deriving a second voltage the wave form of which corresponds to that of said second signal, two condensers, two differentiating circuits, means for applying one of said derived voltages to one of said condensers through one of said differentiating circuits with a given polarity and for applying the other of said derived voltages to the other of said condensers through the other of said differentiating circuits with opposite polarity to derive a control effect, and means responsive to said control effect for controlling the ratio of said amplitudes.

11. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means for deriving a first voltage the wave form of which corresponds to that of said first signal, means for deriving a second voltage the wave form of which corresponds to that of said second signal, two condensers, means for peak-rectifying each of said derived voltages, means for applying said peak-rectified voltages respectively to said condensers with opposite polarities to derive a control effect, and means responsive to said control effect for controlling the ratio of said amplitudes.

12. A television scanning system comprising, a cathode-ray tube including a target to be scanned by the cathode-ray beam of the tube, a first means for developing and using a first scanning signal to scan said target with said beam in one direction at a predetermined frequency and with a first predetermined amplitude, a second means for developing and using a second scanning signal to scan said target with said beam in another direction at a different predetermined frequency and with an amplitude relative to said first amplitude which may tend to vary under operating conditions, means responsive to said signals and dependent jointly upon an amplitude characteristic of said first signal and upon an amplitude characteristic of said second signal for deriving a control effect, and means responsive to said control effect for varying one of said predetermined amplitudes, thereby to control the ratio of said amplitudes.

JOHN C. WILSON.