

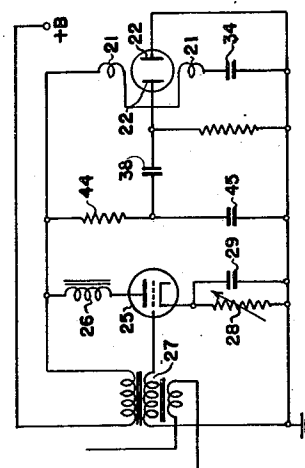
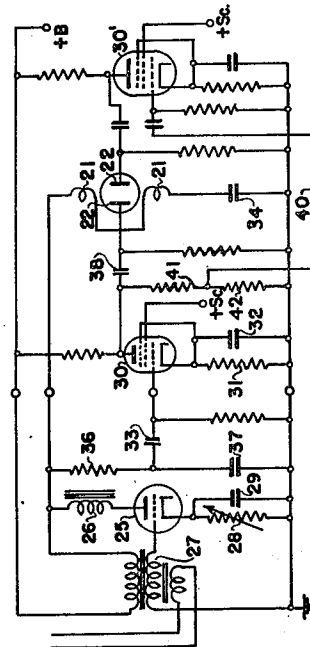
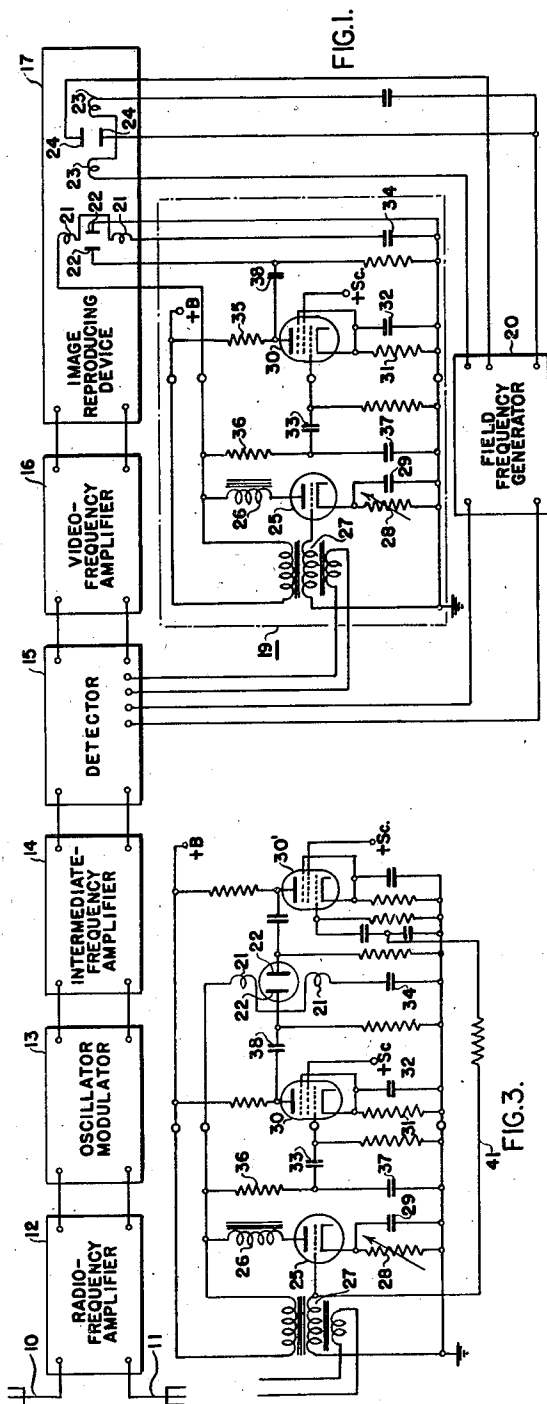
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TELEVISION SCANNING SYSTEM

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TELEVISION SCANNING SYSTEM

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8 Claims. (Cl. 178—7.5)

This invention relates to television scanning systems and more particularly to such systems comprising cumulative deflection of a cathode-ray beam by means of an electromagnetic scanning field and an electrostatic scanning field.

In conventional television receivers, it has been the practice to provide scanning of the cathode-ray beam of the cathode-ray signal-reproducing device in one direction by means of either an electromagnetic scanning field or an electrostatic scanning field. Due to the fact that the lengths of the cathode-ray tubes heretofore in general use are great in comparison with their screen diameters, the cabinets of television receivers in which such tubes are horizontally disposed therein have, of necessity, been quite large. This difficulty has been overcome to some extent by arranging the cathode-ray tube vertically, but this has necessitated the use of a viewing mirror. To avoid these disadvantages, shorter cathode-ray tubes have been produced with a view to reducing both the bulk and the cost of the cabinets required to accommodate them. However, these shorter tubes have the disadvantage of requiring a greater angular deflection of the electron beam for a given size of picture if their screen diameters are to be the same as those of the longer tubes previously employed. To obtain a large angle of deflection solely by means of electrostatic scanning, excessively high potentials are required on the deflecting plates. To obtain a large angular deflection solely by the use of electromagnetic scanning, high values of magnetic scanning flux are necessary and it is difficult to design a deflecting system to develop such high flux values when the time ratio is high. Furthermore, the energy required to provide a given deflection by a field of one given type varies approximately as the square of the deflection. For this reason the energy requirements are considerably reduced if a part of the required deflection is provided by a field of one type and the remainder of the required deflection is provided by a field of the other type.

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 the arrangements of the prior art.

It is a further object of the present invention to provide an improved television scanning system which provides simultaneously electromagnetic and electrostatic scanning fields which are cumulative in their deflecting action on the cathode-ray beam.

In accordance with the invention, a television scanning system for deflecting a cathode-ray beam comprises an oscillation generator, electromagnetic scanning windings, and means including the generator for producing a current of substantially saw-tooth wave form in the electromagnetic scanning windings. There are also provided electrostatic scanning plates and means including the same oscillation generator for supplying thereto, simultaneously with the application of said saw-tooth current to said electromagnetic scanning windings, a scanning voltage of substantially saw-tooth wave form and of periodicity the same as the above-mentioned saw-tooth current. The electromagnetic scanning windings and the electrostatic scanning plates are relatively positioned and excited to provide a cumulative deflection of the cathode-ray beam.

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.

In the accompanying drawing, Fig. 1 is a complete circuit diagram, partly schematic, of a television receiving system including a scanning system in accordance with the present invention, while Figs. 2, 3, and 4 are circuit diagrams of different embodiments of the scanning system of the invention.

Referring now more particularly to Fig. 1 of the drawing, the system there illustrated comprises a receiver of the superheterodyne type including an antenna system 10, 11 connected to a radio-frequency amplifier 12 to which is 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. For developing saw-tooth waves for the scanning elements included in cathode-ray signal-reproducing device 17, there are provided a line-frequency generator 19 and a field-frequency generator 20. The output circuit of detector 15 is coupled to a television scanning system for deflecting a cathode-ray beam and including generators 19 and 20 for maintaining them in synchronism with the scanning system at the transmitter in a conventional manner. The output circuits of line-frequency generator 19 are connected to the scanning elements including electromagnetic scanning winding 21 and electrostatic scanning plates 22 of the cathode-ray signal-reproducing device 17. Similarly, the output circuits of field-

frequency generator 20 are connected to field-frequency electromagnetic scanning winding 23 and field-frequency electrostatic scanning plates 24. Line-frequency electromagnetic scanning winding 21 and line-frequency electrostatic scanning plates 22 are relatively positioned so that they provide a cumulative deflection of the cathode-ray beam in the line-frequency scanning direction. Similarly, field-frequency electromagnetic scanning winding 23 and field-frequency electrostatic scanning plates 24 are positioned for a cumulative deflection of the cathode-ray beam in the field-frequency scanning direction.

Line-frequency scanning generator 19 comprises an oscillation generator including a low-impedance triode vacuum tube 25 and a source of unidirectional operating potential +B therefore, to which the anode of tube 25 is connected through a self-saturating reactor 26 in series with the anode winding of a feed-back coupling transformer 27. The grid winding of feed-back coupling transformer 27 is coupled to the grid of vacuum tube 25 and there is provided an additional winding on the transformer 27 through which synchronizing impulses are applied to vacuum tube 25 from the output circuit of detector 15. The line-frequency electromagnetic scanning winding 21 are included in the anode circuit of vacuum tube 25 by way of saturating reactor 26 and blocking condenser 34. A suitable cathode-biasing resistor 28, bypassed by condenser 29, is provided for vacuum tube 25. There is also included in line-frequency scanning generator 19 a pentode vacuum tube 30 having input electrodes connected by way of a cathode-biasing resistor 31, shunted by by-pass condenser 32, and blocking condenser 33 to the output electrodes of triode 25 through a wave form changing means comprising a series-connected resistor 36 and condenser 37. The anode of pentode 30 is connected by way of a load resistor 35 to the source of unidirectional operating potential +B and is also connected by way of a blocking condenser 38 to one of the pair of line-frequency electrostatic scanning plates 22, the other of the scanning plates 22 being grounded.

The details of the field-frequency scanning generator 20 have not been shown and it will be understood that this generator may be constructed in a manner similar to that described for line-frequency generator 19.

Coming now to an explanation of the operation of the system of Fig. 1, it will be understood that the elements 10-16, inclusive, may all be of conventional well-known construction so that detailed illustrations and description thereof are deemed unnecessary herein. Briefly described, however, signals intercepted by the antenna circuit 10, 11 are selected and amplified in radio-frequency amplifier 12, and supplied to the oscillator-modulator 13 wherein they are converted to intermediate-frequency signals which are, in turn, selectively amplified in the intermediate-frequency amplifier 14 and delivered to the detector 15. The modulation components of the signal are derived by detector 15 and the video-frequency components are supplied to the video-frequency amplifier 16 wherein they are amplified and from which they are supplied to the brilliancy-control element of the signal-reproducing device 17. The intensity of the scanning beam of the image-reproducing device 17 is thereby modulated or controlled in accordance

with the video-frequency voltages impressed on its input circuit.

The saw-tooth scanning waves developed by the line-frequency generator 19 and field-frequency generator 20 and applied to the scanning elements of cathode-ray reproducing device 17 cause the beam to be deflected so as to trace a rectilinear scanning pattern on the target of the reproducing device 17 and thereby reconstruct the transmitted image. The generators 19 and 20 are synchronized with the corresponding scanning apparatus at the transmitter by synchronizing pulses appearing in output circuits of detector 15, it being understood that suitable synchronizing-signal separating circuits of a conventional form are included in the circuit of detector 15.

Referring now more particularly to the part of the system involving the present invention, the triode 25 generates oscillations at the line-scanning frequency of the system due to the feed-back coupling existing between its grid and anode circuits through transformer 27, the frequency of these oscillations being maintained constant by the synchronizing pulses introduced into the input circuit of tube 25 from detector 15. The circuit constants of the relaxation oscillator including tube 25 are so related that a voltage of rectangular wave form is produced at the anode of tube 25 which is effective to develop current of substantially saw-tooth wave form in the line-frequency electromagnetic scanning winding 21, the degree of linearity of this current during the trace interval of the system being increased by saturating reactor 26 in a manner fully described in applicant's British Patent No. 493,142, accepted October 5, 1938. By suitably proportioning the circuit constants of the elements associated with tube 25, the current of saw-tooth wave form through the scanning winding 21 may readily be made to provide about half the required deflection of the cathode-ray beam of image-reproducing device 17 in the line-frequency scanning direction.

Vacuum-tube 30 is provided in order to supply to line-frequency electrostatic scanning plates 22 a scanning voltage of substantially saw-tooth wave form simultaneously with the application of the current of saw-tooth wave form to scanning winding 21. Coupling network 36, 37 serves to derive from the voltage of rectangular wave form at the anode of tube 25 a voltage of saw-tooth wave form and of periodicity the same as the saw-tooth current supplied to windings 21 which voltage appears across condenser 37 and is applied to the input circuit of vacuum tube 30 and which, after amplification thereby, is applied to the deflecting plates 22 of the cathode-ray image-reproducing device 17. The windings 21 and the plates 22 are relatively positioned and energized to provide a cumulative deflection of the cathode-ray beam of reproducing device 17.

Since each of the electromagnetic and electrostatic scanning fields contributed by generator 19 is of a magnitude usually provided in connection with conventional relatively long cathode-ray tubes, sufficient deflection of the scanning beam of a relatively short cathode-ray tube can be obtained without resorting to high current values in the scanning winding or to high potentials on the scanning plates with the attendant higher power requirements.

Fig. 2, in which circuit elements similar to those of Fig. 1, have identical reference numerals, is a circuit diagram of a modified embodiment

of the invention wherein two pentode vacuum tubes 30 and 30' are used, the pentode tubes being coupled in a balanced or push-pull connection to line-frequency electrostatic scanning plates 22. An input voltage of opposite phase is provided for pentode 30' by means of a connection 40 to potential divider 41, 42 across the output terminals of pentode 30.

A further embodiment of the modification shown in Fig. 2 is illustrated in Fig. 3, in which similar circuit elements have identical reference numerals. The circuit of Fig. 3 differs from that of Fig. 2 only in that the input voltage for pentode 30' is derived by means of conductor 41 directly from the input circuit of vacuum tube 25 rather than from the output circuit of vacuum tube 30 as in Fig. 2.

In the above examples, it has been assumed that a substantially linear saw-tooth current is applied to scanning winding 21 and that a substantially linear saw-tooth voltage is applied to electrostatic scanning plates 22. Due to the resistance of the scanning winding 21 and to the resistances of the coupling circuit between tubes 25 and 30, these ideal conditions will not actually obtain and there will result some slight non-linearity during the trace interval in each of the saw-tooth scanning wave forms these nonlinearities being of opposite sense. By properly proportioning the resistance of the scanning winding 21 and the resistance and capacitance of the coupling elements between tubes 25 and 30, the effect of these deviations from linearity during the trace interval can be made substantially to compensate one another. In other words, an effective resultant scanning field which is linear during the trace interval is provided, even though neither the magnetic component nor the electrostatic component is linear during the trace interval.

In Fig. 4 there is shown a modification of the invention in which only a single triode vacuum tube is employed in the oscillator. Circuit elements which are similar to those of corresponding elements of the preceding figures have identical reference numerals. The saw-tooth current for electromagnetic scanning winding 21 is derived from the output of vacuum tube 25 in the manner described in detail above. However, in the modification of Fig. 4 the pentode amplifier is omitted and a voltage of saw-tooth wave form for electrostatic scanning plates 22 is derived directly from the output circuit of vacuum tube 25 by means of an integrating resistor-condenser combination including a resistor 44 and a condenser 45, series-connected across the output circuit of vacuum tube 25. The embodiment of Fig. 4 requires a higher value of current in the scanning winding 21 than do the other embodiments described, but the saving of an amplifier stage effects a saving in manufacturing cost.

While there have been described what are at present considered to be the preferred embodiments of the 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 for deflecting a cathode-ray beam comprising, an oscillation generator, electromagnetic scanning windings, 75

means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, and means including said generator for supplying to said plates simultaneously with said saw-tooth current, a scanning voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the cathode-ray beam.

2. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator including a synchronizing circuit adapted to be excited by input synchronizing pulses, electromagnetic scanning windings, means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, and means including said generator for supplying to said plates simultaneously with said saw-tooth current, a scanning voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

3. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator including a low-impedance triode having inductively coupled input and output circuits, electromagnetic scanning windings, means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, and means including said generator for supplying to said plates simultaneously with said saw-tooth current, a scanning voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current, said coils and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

4. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator for providing an output current of saw-tooth wave form and an output voltage of rectangular wave form, electromagnetic scanning windings, means for supplying said saw-tooth current to said windings, electrostatic scanning plates, and means for deriving from said voltage of rectangular wave form a voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current and for applying it to said plates simultaneously with the application of said current of saw-tooth wave form to said scanning windings, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

5. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator, electromagnetic scanning windings, means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, a vacuum-tube amplifier, and means including said generator and said vacuum-tube amplifier for supplying to said plates, simultaneously with said saw-tooth current, a scanning voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

6. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation

generator, electromagnetic scanning windings, means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, and means including said generator and two vacuum tubes having a balanced output circuit connection for supplying to said plates, simultaneously with said saw-tooth current, a balanced scanning voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

7. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator, electromagnetic scanning windings, means including said generator for producing a current in said windings of substantially saw-tooth wave form, having relatively long trace intervals, and being subject to slight deviations from linearity during said trace intervals, electrostatic scanning plates, and means including said generator for supplying to said plates, simultaneously with said saw-tooth current, a voltage of substantially saw-tooth wave form and of periodicity the same as said saw-tooth current,

said voltage having relatively long trace intervals and being subject to slight deviations from linearity during said trace intervals of opposite sense to that of said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam, and the circuit constants of said generator being so proportioned that the effect of said deviations from linearity during said trace intervals substantially compensates one another.

8. A television scanning system for deflecting a cathode-ray beam comprising, an oscillation generator including a single vacuum tube, electromagnetic scanning windings, means including said generator for producing a current of substantially saw-tooth wave form in said windings, electrostatic scanning plates, and wave form changing means coupled to said generator for supplying to said plates, simultaneously with said saw-tooth current, a scanning voltage of substantially saw-tooth form and of periodicity the same as said saw-tooth current, said windings and said plates being relatively positioned to provide a cumulative deflection of the scanned cathode-ray beam.

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