March 16, 1943. J. H. ROE 2,313,971

TELEVISION SYSTEM

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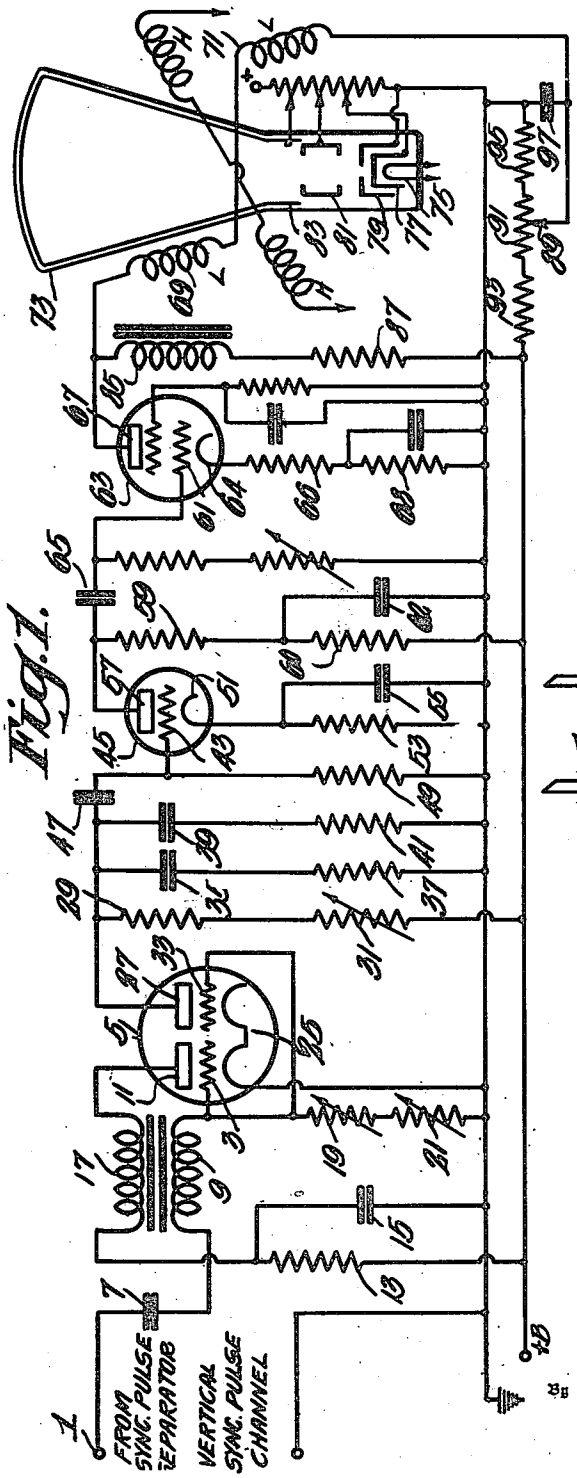


Fig. 1.

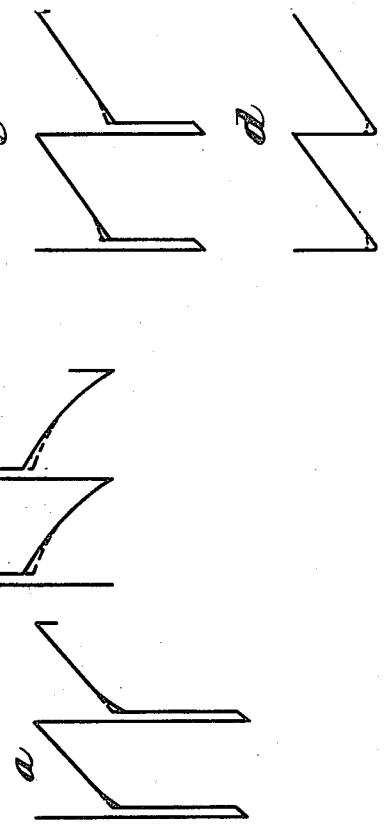


Fig. 2.

Inventor
John H. Roe
Attorney

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TELEVISION SYSTEM

John H. Roe, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

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1 Claim. (Cl. 250—27)

This invention relates to television systems and more particularly to cathode ray tube electron beam deflection circuits.

In television systems employing cathode ray tubes in the transmitter and receiver, it is necessary to provide a voltage having a saw-tooth wave shape for deflecting the electron beam of the picture tube in synchronism with the electron beam in the transmitter tube. A synchronizing pulse is generally transmitted simultaneously with the picture which in turn drives an oscillator at the receiving station that generates a voltage having a sawtooth wave and a frequency in synchronism with the transmitted deflection pulse signals. Heretofore it has been the general practice to amplify the saw-tooth wave generated by the oscillator and apply this amplified signal to the deflection means of the picture tube with such a polarity that the signal current through the deflection yoke of the picture tube increased slowly during a greater portion of a complete saw-tooth cycle and decreased to its minimum value almost instantaneously.

According to this invention, the amplified saw-tooth wave deflection signal is applied to the deflecting means of the picture tube with such a polarity that the signal current through the deflection yoke of the picture tube decreases slowly during a greater portion of a complete saw-tooth cycle and increases to its maximum value almost instantaneously. This permits the addition of one stage of amplification which provides an additional coupling circuit to allow the addition of wave shaping circuits. This makes it possible to obtain practically flawless linearity in the rate of scanning.

A pentode amplifier output tube is used without danger of sparking over because the maximum peak voltage across the deflection coil is limited to the plate supply voltage; that is, the voltage pulse caused by the discharge of the stored up energy in the deflection coil of the picture tube is in a negative direction.

The principal object of this invention is to provide a deflection circuit for a picture tube which gives a very nearly linear scanning rate.

Another object of this invention is to provide an improved deflection circuit wherein wave shaping circuits may be employed.

Still another object of this invention is to provide an improved system wherein the electron beam deflection current flowing through the deflection coils of a picture tube decreases progressively over a greater portion of the saw-tooth wave cycle as the picture is scanned from the top to the bottom.

Other and incidental objects of the invention will be apparent to those skilled in the art from consideration of the following specification in connection with the accompanying drawing in which

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

Figure 2 contains a number of graphical representations illustrating the operation of this invention.

Referring to Fig. 1, the vertical deflection pulses are received from the synchronizing pulse separator in a television receiver at terminal 1. The synchronizing pulse separator may be of the type shown and described in Tolson Patent No. 2,207,839, granted July 16, 1940. These pulses are applied to the control electrode 3 of the saw-tooth wave generator discharge device 5 through coupling condenser 7 and transformer winding 9. The first anode 11 of the blocking oscillator tube 5 is provided with a positive potential through resistor 13, and by-pass condenser 15 and transformer winding 17 which is inductively coupled to the previously mentioned transformer winding 9. The free vibration period or fundamental frequency of the saw-tooth wave generator is manually controlled by resistances 19 and 21. The control electrode 3 is connected to the second control electrode 23 which governs the current flow from the cathode 25 to the anode 27 which receives its potential through resistance 29 and manually adjustable resistance 31 which is employed to control the amplitude of the output of the saw-tooth wave generator. A detailed description of the operation of this type of oscillator is given in the patent to Tolson and Duncan No. 2,101,520, granted December 7, 1937.

The deflection signal is then subjected to a first shaping circuit comprising a condenser 35 in series with the resistance 37. This shaping circuit is followed by a second shaping circuit of the similar type having condenser 39 in series with resistance 41. It has been found that it is not possible to combine these two shaping circuits because each circuit individually reacts upon the other so that the combined effect will provide the desired wave shape. This combined effect will be more readily understood when one considers that the anode resistors 29 and 31 are also included as part of the shaping circuit.

The signal is then applied to the control electrode 43 of the amplifier tube 45 through coupling condenser 47. A grid leak 49 is provided for

the amplifying tube 45 and the control electrode bias is supplied in the circuit of the cathode 51 through resistor 53 and by-pass condenser 55. The anode 57 of this amplifier tube 55 is supplied with its potential through resistances 59 and 60. Resistance 60 is of high value compared with resistance 59 and is shunted by condenser 62 which provides another shaping circuit increasing the flexibility of the amplifier. The signal is then fed to the control electrode 61 of the output tube 63 through coupling condenser 65. The control electrode bias for tube 63 is supplied from cathode 64 through resistances 66 and 68.

The signal from the anode 67 of the output tube 63 is fed to the vertical deflection coils 69 and 71 of the picture tube 73 which has the usual cathode heater 75, cathode 77, control electrode 79, first anode 81, and second anode 83. Anode 67 is supplied with its potential through inductance 85 and resistance 87. The circuit through the deflecting coils 69 and 71 is returned to a variable tap 89 on resistor 91 which is part of a set of resistors 93 and 95 which are connected across a positive potential source to provide a variable potential filtered through condenser 97 to locate the image in the center of the screen of the picture tube 73.

The impedances of the deflecting coil 69 and 71 are principally resistive and, for the purpose of illustration, L equals four henrys and resistance equals 450 ohms. If a deflecting yoke having a relatively high L/R ratio is used, the peak voltage across the deflecting yoke coil 69 and 71 would exceed the plate supply voltage and the anode 67 of tube 63 would become negative with respect to cathode 64 of tube 63.

In Fig. 2, the broken line in each of the curves shows the results obtained when only one shaping circuit of the type comprising condenser 35 and resistance 37 is used in the anode circuit of the blocking oscillator tube 5.

The broken line shown by curve *a* represents the voltage output wave of the blocking oscillator. It should be noticed here that the sloping portion of the curve is substantially a straight line. The application of this signal voltage to the control electrode 43 of the amplifying tube 45 results in an output voltage from the anode 57 having a shape as indicated by the solid line in curve *b*, whose sloping portion takes on a decided curve because of non-linearity of coupling circuits and tube characteristics. This signal is then applied to the control electrode 61 of the output tube 63 which produces in its output circuit at anode 67 the voltage curve as indicated by the solid line of the curve *c*, whose sloping portion is not a straight line, and consequently the resulting current through the vertical deflecting coils 69 and 71, shown by the solid line of curve *d* also shows a curve in the sloping portion of the saw-tooth wave.

It will be noticed, from a study of curve *d*, that, without employing the second wave shaping circuit as taught by this invention, the current increases non-uniformly over the greater portion of the complete saw-tooth wave cycle, thus resulting in a non-uniform scanning or a bunching of scanning lines at one edge of the image.

The invention thus involves a combination of wave shaping circuits comprising a series capacitor 35, resistor 37 and series capacitor 39, resistor 41 inserted in the output circuit of the blocking oscillator, and resistances 59, 60 and condenser 62 in the anode circuit of tube 45 for modifying the wave shapes as represented by the solid lines in each of curves, *a*, *b*, *c*, and *d* at the same points as given above for the voltage curves without the combination of wave shaping circuits. The combination of the two wave shaping circuits in the output circuit of the blocking oscillator tube curve the sloping portion of the saw-tooth voltage wave output of the blocking oscillator as represented by the solid line of curve *a*.

This formation of the sloping portion of the curve provides a corresponding change in the curve of the voltage output from tube 45 when another shaping circuit comprising resistances 59, 60 and capacity 62 is included as represented by the solid line in curve *b*. It will be noticed, however, that in curve *b* the application of the wave shaping circuits reduces the curve of the voltage so that the output of the tube 63 provides a voltage curve which is substantially straight over the sloping portion of the saw-tooth wave cycle as shown by the solid line in curve *c*.

It follows that the current through the deflection coil will decrease gradually at a uniform rate over the sloping portion of the saw-tooth cycle when the wave shaping circuits previously described are inserted in the circuit. This results in a uniform separation of scanning lines which, of course, ultimately results in an image of better detail.

While one system for carrying this invention into effect has been indicated and described, it will be apparent to one skilled in the art that this invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope thereof as set forth in the appended claim.

I claim as my invention:

In a television system, an electric discharge device having an anode and a cathode, an output circuit including an anode resistor for said discharge device, a direct-current voltage source connected between said cathode and said anode resistor to apply a positive voltage to said anode, at least two wave shaping circuits connected in parallel with each other and each comprising a resistor and a condenser only, said condenser and said resistor of each of said wave shaping circuits being connected in series with each other, said parallel combination of wave shaping circuits being connected between said anode and said cathode whereby said condensers receive a charge through said anode resistor, means for holding said discharge tube normally non-conducting from anode to cathode, and means for producing and so applying recurring voltage pulses to said discharge tube that said condensers discharge through said tube during the occurrence of each voltage pulse.

JOHN H. ROE.