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CATHODE RAY TUBE SYSTEM

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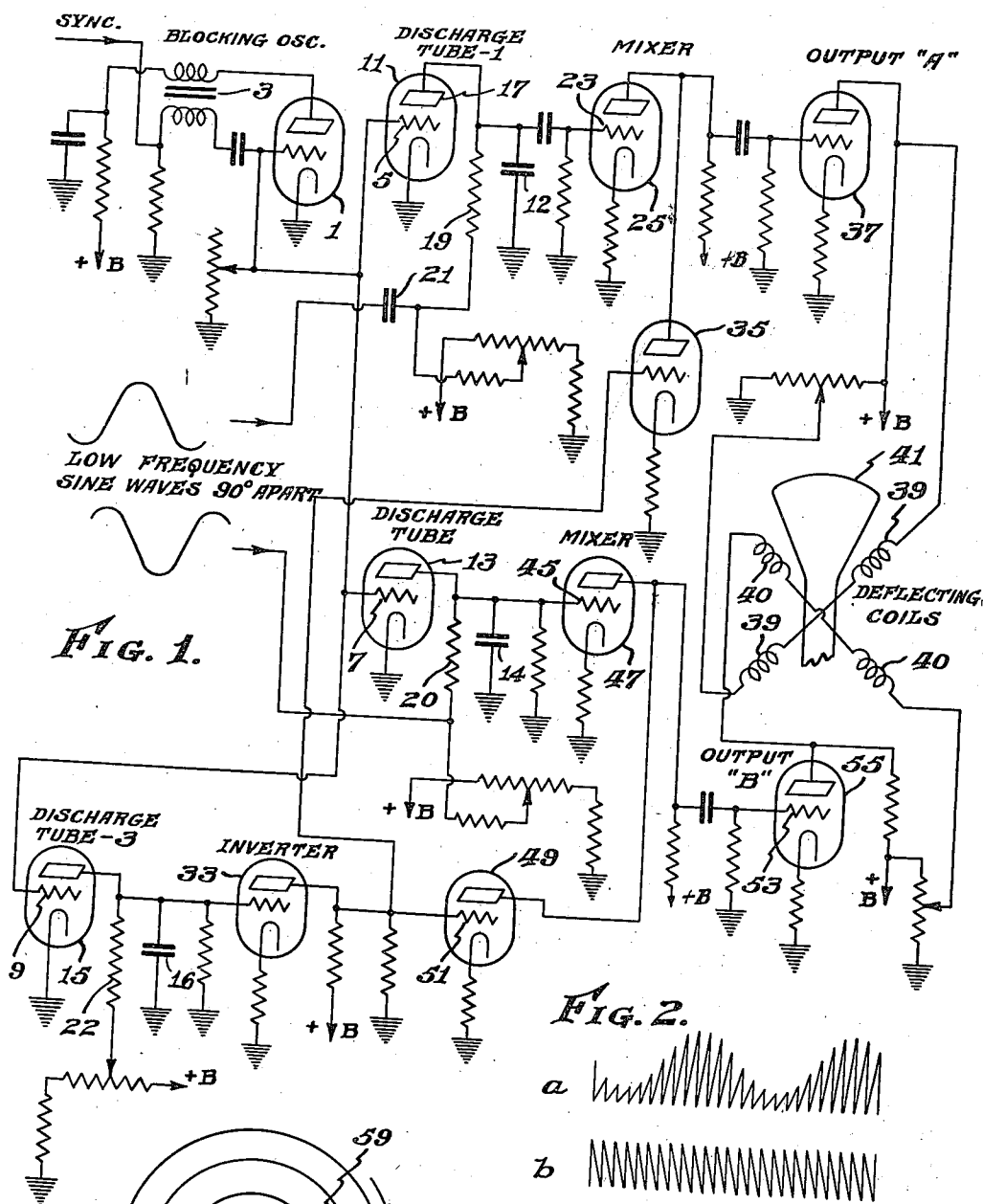


FIG. 1.

FIG. 2.

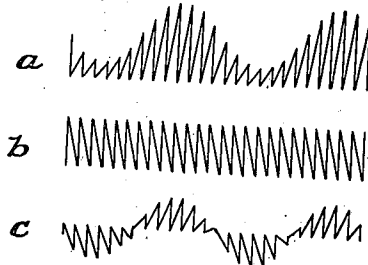


FIG. 3.

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CATHODE RAY TUBE SYSTEM

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7 Claims. (Cl. 250—27)

This invention relates to indicating systems and, more particularly, to cathode ray beam deflection signal generators.

In cathode ray tube systems, it is sometimes desirable to rotate the plane of deflection of the cathode ray beam around the axis of the tube.

This has been heretofore accomplished by mechanically rotating the deflection coils of the beam tube about the axis of the tube. This has been generally unsatisfactory, because it is necessary to provide bulky and complicated equipment to mechanically rotate the deflection coils about the tube and, if it is desired to rotate the plane of deflection at a high rate, the mechanical method becomes very impractical.

According to this invention, the plane of deflection of a cathode ray beam in a beam tube is rotated about the axis of the tube by impressing upon each of the beam deflecting means a saw-tooth wave signal whose amplitude varies sinusoidally and wherein the sinusoidal variation on each of the beam deflecting means differs in phase by 90 degrees.

The primary object of this invention is to provide an improved method and means for deflecting a cathode ray beam.

Another object of this invention is to provide an electronic method and means for rotating the plane of deflection of a cathode ray beam about the axis of the cathode ray tube.

Still another object of this invention is to provide an improved method and means for rotating the plane of deflection of the cathode ray beam about the axis of the tube at a high rate of speed.

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

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

Figure 2 is an illustration showing graphically the operation of the form of this invention shown in Figure 1.

Figure 3 is an illustration showing the resulting deflection obtained by the use of this invention.

Figure 1 shows a circuit diagram in which a synchronizing signal is applied to a blocking oscillator including a tube 1 and a coupling transformer 3 which produces in its output circuit a train of pulses whose frequency is equal to the frequency of the incoming synchronizing pulses. Any pulse generator may be used in the practice of this invention and the one shown in

this particular form of the invention is such as described in the Tolson et al., Patent 2,101,520, issued December 7, 1937, wherein a complete description as to the elements and the operation of such an oscillator is given.

The pulse signal is applied simultaneously to the control electrodes 5, 7 and 9 of tubes 11, 13 and 15, respectively. Condensers 12, 14 and 16 in the output circuits of tubes 11, 13 and 15, respectively, store the energy of the pulse signal and allow it to leak off through resistors 19, 20 and 22, respectively, such as to result in a train of saw-tooth waves whose frequency is equal to the incoming synchronizing pulses. A further explanation of the operation of such a saw-tooth wave generator may also be found in the above-identified Tolson et al., Patent 2,101,520.

Although a synchronizing pulse control is shown, the type of oscillator shown does not necessarily require such control. The anode 17 of the tube 11 is supplied with its anode potential through a resistor 19 to which there is also applied a comparatively low frequency sinusoidal wave through coupling condenser 21. This causes the signal voltage applied to the control electrode 23 of tube 25 to take the shape of a saw-tooth wave signal whose amplitude varies sinusoidally. This variation is shown graphically by curve a in Figure 2.

The output signal from the tube 15 is passed through an amplifying tube 33, such as to invert the saw-tooth wave signal. The inverted saw-tooth wave voltage is applied to the output circuit of tube 25 through an amplifying tube 35.

It will be seen that the saw-tooth wave voltage applied to the output circuit of tube 25, through the channel including the tubes 15, 33 and 35 is inverted to the saw-tooth voltage which is applied to the channel including tubes 11 and 25. This signal voltage is represented by curve b in Figure 2. By properly adjusting the gain in each of the channels, such that the maximum amplitude of the nonmodulated saw-tooth wave signal is equal to the average peak amplitude of the saw-tooth wave signal whose amplitude is varying sinusoidally, a curve will result such as that shown by curve c in Figure 2. It will be noticed that curve c results from adding curve a to b. This signal is amplified in tube 37 and applied to one set of deflecting coils 39 of the cathode ray tube 41.

The deflection signal energy applied to the deflecting coils 40 is obtained in a similar manner but the sinusoidal variation is displaced in phase

by 90 degrees. A sinusoidal wave having the same frequency as the previously mentioned low frequency sinusoidal wave but displaced in phase therefrom by 90 degrees is applied to the anode resistor 20 in the anode circuit of tube 13, causing the output voltage of the tube 13 to also take the form of a saw-tooth wave signal whose amplitude varies sinusoidally, but the phase relation between the two sinusoidal variations differs by 90 degrees. The resulting signal voltage from the tube 13 is applied to the control electrode 45 of the tube 47, whose output circuit is connected in parallel with the output circuit of tube 49. Tube 49 has impressed on its control electrode 51 a saw-tooth wave voltage from the saw-tooth wave channel including the tubes 15 and 33.

It will be seen that the saw-tooth wave voltage in the output circuit of tube 49 is inverted with respect to the saw-tooth wave signal in the output circuit of tube 47, resulting from the channel including tube 13. By adding the two signals on the output of tube 47 and 49, a curve such as shown by curve c in Figure 2 results. This combination signal is applied to the control electrode 53 of tube 55 whose output circuit supplies the current through the set of deflecting coils 40 of the cathode ray tube 41.

It will thus be seen that each set of deflecting coils 39 and 40 of the cathode ray tube 41 has impressed thereon saw-tooth wave signals whose amplitude varies sinusoidally and wherein the sinusoidal variation of the amplitude or the saw-tooth signal in one of the sets of coils 39 varies in phase from a similar signal in the set of deflecting coils 40 by 90 degrees. It follows that the difference in phase of the two deflecting signal voltages will cause the plane of the deflection of the cathode ray beam to be rotated about the axis of the tube at a rate equal to the frequency of the low frequency sine waves applied to their respective deflection signal generator channels.

Figure 2 shows a graphical illustration of the operation of this invention. Curve a represents the signal upon the control electrode 23 of the tube 25, by reason of combining the saw-tooth wave signal from the blocking oscillator with the low frequency sinusoidal wave. It will be seen that, by adding to this resulting figure shown by curve a in Figure 2, the inverted saw-tooth wave represented by curve b, as is done in the output circuit of tubes 25 and 35, a curve such as illustrated by curve c in Figure 2 will result. By applying a signal whose amplitude varies as shown by curve c to one set of deflecting coils, and by applying to the other set of deflecting coils a signal having the same amplitude curve but displaced in phase by 90 degrees from the signal applied to the first set of deflecting coils, a rotating plane of deflection of the cathode ray beam will result.

Figure 3 shows an application of the rotating plane of deflection of a cathode ray beam. The deflection of the cathode ray beam is illustrated by the line 59 which starts from the center point d of the tube and stops at an outside point e, point e being on the circle whose radius is determined by circuit constants. It will be noticed that the arrow indicates a rotation of the path of deflection 59 about the center point d, so that the following saw-tooth wave pulse will cause deflection of the cathode ray beam from d to position e'. The frequency of the deflection along the line de and de' with respect to the rotational rate of the plane of deflection will depend upon the relative frequencies between

the incoming synchronizing impulses driving the blocking oscillator including tube 1, as compared with the frequency of the low frequency sine waves applied to the deflection beam signal generator channels.

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 of this invention as set forth in the appended claims.

I claim as my invention:

1. In an indicating system of the type employing a cathode ray beam tube having two sets of beam deflecting means, a beam deflection signal generator comprising in combination a signal channel connected to one of said deflecting means and a second signal channel connected to the other of said deflecting means, and means for applying to each of said channels a saw-tooth wave signal whose amplitude varies sinusoidally and wherein the sinusoidal variation of the signal in one of the said channels is displaced in phase from the sinusoidal variation of the signal in the other of the said channels by 90 degrees.
2. The method of rotating the plane of deflection in an indicating system of the type wherein there is employed a cathode ray tube comprising the steps of sinusoidally varying the amplitude of a saw-tooth wave signal and controlling the deflection of the cathode ray beam of said tube in one direction therewith and varying the amplitude of a similar saw-tooth wave signal sinusoidally at the same frequency but displaced in phase by 90 degrees from the other of said sinusoidal variations and deflecting the cathode ray beam in a direction perpendicular to the direction of the first deflection with the latter of the varying saw-tooth wave signals.
3. In an indicating system of the type employing a cathode ray beam tube having two sets of beam deflecting means, a beam deflection signal generator comprising in combination a signal channel connected to one of said deflection means and a second signal channel connected to the other of said deflecting means, means for applying to each of said channels a saw-tooth wave signal, means for applying to each of said channels sine wave energy whose frequency is low with respect to the frequency of said saw-tooth wave and such that the phase of the sine wave applied to one of said channels is displaced in phase by 90 degrees from the sine wave energy applied to the other of the said channels, and means for applying to each of said channels a saw-tooth wave voltage whose frequency is equal to the said applied saw-tooth wave signal, at a point in each of said channels where the saw-tooth wave signal therein is 180 degrees out of phase with the subsequently applied saw-tooth wave voltage.
4. The method of rotating a plane of deflection in an indicating system of the type wherein there is employed a cathode ray tube, comprising the steps of producing a saw-tooth wave signal and sinusoidally varying its amplitude, applying to the resulting signal a saw-tooth wave voltage having a frequency equal to the saw-tooth wave signal frequency but displaced therefrom in phase by 180 degrees, controlling the deflection of the cathode ray of the cathode ray tube in one direction therewith, and sinusoidally varying the amplitude of a saw-tooth wave signal whose frequency is equal to the first of said saw-tooth wave

signals at the same frequency of the sinusoidal variation of the first-mentioned saw-tooth wave signal but displaced in phase therefrom by 90 degrees and controlling the deflection of the cathode ray beam in a direction perpendicular to the direction of the first deflection with the latter of the varying saw-tooth wave signals.

5. In an indicating system of the type employing a cathode ray beam tube having two sets of beam deflecting means, a beam deflection signal generator comprising in combination a signal channel connected to one of said deflecting means and a second signal channel connected to the other of said deflecting means, means for applying to each of said channels a saw-tooth wave signal whose amplitude varies sinusoidally and wherein the sinusoidal variation of the signal in one of the said channels varies in phase from the sinusoidal variation of the signal in the other of the said channels by 90 degrees, and means for applying to each of said channels a saw-tooth wave voltage whose frequency is equal to the said applied saw-tooth wave signal at a point in each of said channels where the saw-tooth wave signal therein is 180 degrees out of phase with the subsequently applied saw-tooth voltage.

6. In an indicating system of the type employing a cathode ray beam tube having two sets of beam deflecting means, a beam deflection signal generator comprising in combination a signal channel connected to one of said deflecting means and a second signal channel connected to the other of said deflecting means, means for apply-

ing to each of said channels a saw-tooth wave signal whose amplitude varies sinusoidally from relatively low amplitude to a predetermined level and wherein the sinusoidal variation of the signal in one of said channels varies in phase from the sinusoidal variation of the signal in the other of the said channels by 90 degrees, and means for applying to each of said channels a saw-tooth wave signal whose frequency is equal to the other of said applied saw-tooth wave signal at a point in each of said channels where the saw-tooth wave signal therein is 180 degrees out of phase with the subsequently applied saw-tooth wave signal and wherein the amplitude of the subsequently applied saw-tooth wave signal is substantially the average peak amplitude of the saw-tooth wave signal therein.

7. In an indicating system, a cathode ray tube having a plurality of deflecting means which are angularly displaced with respect to each other about the longitudinal axis of said tube, a plurality of signal channels each of which is connected to a separate one of said deflecting means, and means for applying to each of said channels a saw-tooth wave signal whose amplitude varies sinusoidally and wherein the sinusoidal variation of the signal in any one of said channels is displaced in phase from the sinusoidal variation of the signal in any other one of said channels by an amount which causes rotation of the plane of deflection of said cathode ray.

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