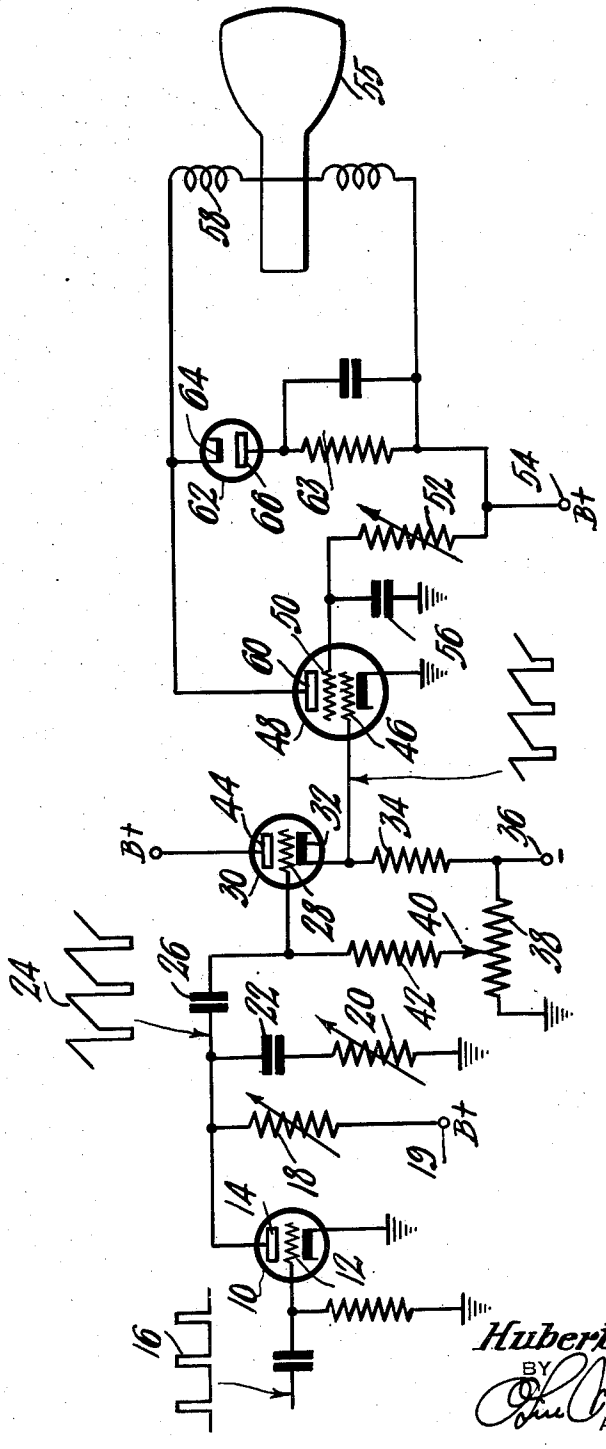
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TELEVISION RECEIVER HORIZONTAL DEFLECTION

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TELEVISION RECEIVER HORIZONTAL DEFLECTION

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This invention relates to circuits including magnetic deflecting members for controlling the position and rate of deflection of the beams in cathode ray tubes.

While the present invention is broadly concerned with apparatus used in television transmitting and receiving equipment employing cathode ray tubes as image scanning or reproducing devices, the invention does find application to apparatus of the oscillographic type used in observing recurrent transient phenomena. More particularly, application of the present invention to modern television receiving apparatus results in advantages which will be apparent as the specification proceeds.

In television receivers employing electromagnetic deflection of the kinescope electron beam, it is the normal practice to employ transformers which suitably transform the low impedance of the deflection yoke windings to a value of impedance into which the horizontal and vertical output tubes may properly operate. Such transformers are usually quite bulky and heavy, and the cost of transformers having designs adequate to handle the frequencies involved in horizontal deflection circuits is normally quite high. In systems using a 15,750 horizontal deflection frequency, an output transformer must handle not only the 15 kc. fundamental, but also harmonic contents up to at least the tenth harmonic of the fundamental, which truly presents serious demands upon transformer performance. Accordingly, a system which would provide sufficient deflection for horizontal scanning without the use of an output transformer would be extremely desirable both from the standpoint of cost as well as efficiency since transformers of necessity add considerable loss to the overall deflection circuit. Another disadvantage which obtains through the use of a horizontal output transformer having no specific primary damping and conventional secondary or yoke damping is that of Barkhausen oscillation which is a parasitic phenomena occurring within the output tube due to the negative excursions of the output tube's anode which exceeds the negative potential of the vacuum tube cathode. Barkhausen oscillation is well known to the art and is particularly undesirable since it often occurs at a frequency which interferes with television reception through pickup by the picture IF or actual RF interference due to beating with the local oscillator to produce interferring radio frequency signals.

The present invention discloses a system whereby, through the low impedance driving of the

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deflection signal output tube, it is not only possible to eliminate the use of the conventional deflection signal output transformer and thus avoid those system losses therein included, but such elimination permits the conventional deflection yoke damping to reduce the amplitude of the output tube's plate negative excursions to an extent that eliminates Barkhausen oscillation.

It is a purpose of this invention to provide a circuit permitting the realization of increased beam deflection efficiency in cathode ray tubes employing electromagnetic deflection.

It is further an object of this invention to provide an improved deflection circuit for kinescopes used in television receivers whereby the tendency for Barkhausen oscillations in the output tube of the deflection system is eliminated.

It is another object of this invention to provide an improved means for applying deflection energy to an electromagnetic deflection circuit, wherein greater peak-to-peak deflection of the electron beam is permitted for a given dissipation of energy within the deflection system.

The invention will be understood from the following description taken in connection with the accompanying drawing in which is shown an embodiment of my invention.

Referring now to the drawing, a vacuum tube 10 having a grid 12 and plate electrode 14 is supplied with a series of synchronizing pulses 16. The discharge tube 10 is connected in a conventional manner to produce a sawtooth waveform of voltage across its plate resistor 18 according to well known principles of sawtooth discharge tube operation described for example. A variable peaking resistor 20 is placed in series with charging condenser 22 in order to provide a peaking control for the generated sawtooth wave shown at 24. The sawtooth signal 24 is in turn coupled through condenser 26 to grid 28 of vacuum tube 30. Cathode 32 of electron tube 30 is connected through cathode resistor 34 to a negative source of voltage 36. A potentiometer 38 is connected across negative voltage supply terminal 36 and ground, and by means of variable tap 40 thereon a variable bias voltage is made available through resistor 42 shown connected to grid 28. The plate 44 of vacuum tube 30 is connected to a source of positive potential as in typical cathode follower arrangements. The signal appearing across the cathode follower resistor 34 is then applied to grid 46 of output tube 48, while screen grid 50 of vacuum tube 48 is supplied with a positive potential through variable resistor 52 which is connected to a source of positive potential 54.

A suitable by-pass condenser 56 is connected from the screen grid 50 to ground in order to stabilize the voltage appearing thereon. A deflection yoke winding 58 is connected in series with plate 60 and positive potential supply 54, thereby permitting the plate current of the vacuum tube 48 to energize the deflection yoke and cause deflection of the electron beam in cathode ray tube 55. Damping tube 62 having a cathode 64 and an anode 66 is connected across the yoke winding 58 to act as a reaction damping device operating in a conventional manner.

Operation of the deflection circuit is substantially as follows:

A synchronized high impedance source of deflection signal is provided by vacuum tube 10, which is connected as a conventional sawtooth discharge tube. Sawtooth condenser 22 is permitted to charge linearily through variable resistor 18 from voltage source 19. Upon the arrival of a synchronizing pulse 16, which is of sufficient amplitude to drive the tube 10 into heavy conduction, the condenser 22 is discharged through the resulting low plate impedance of the discharge tube. The rate of charge and the amplitude of the produced sawtooth is controllable by means of variable resistor 18, normally referred to as a size control. Peaking for the sawtooth deflection signal is accomplished by variable resistor 20 placed in series with charging condenser 22 and ground. The peaked sawtooth deflection signal appearing across the condenser 22 and ground is coupled through capacitor 26 to grid 28 of vacuum tube 30, which is connected as a conventional cathode follower type of amplifier. This amplifier when properly adjusted develops a voltage across the cathode impedance 34 which is an exact replica of the waveform contour applied to the control grid 28, the function of the amplifier stage being to reduce the effective impedance of the source of sawtooth deflection signal applied for driving the output tube 48. It will be noticed that since the cathode follower resistor 34 is connected to a source of minus potential 36, that a negative bias will be placed on the grid 46 of vacuum tube 48. This bias will be equal to the magnitude of the negative potential supply 36 minus the D. C. voltage drop occurring in resistor 34 due to plate current of vacuum tube 30. Since the plate current of vacuum tube 30 is controllable by adjusting potentiometer 38 which controls the bias on control grid 28, this potentiometer also serves to establish the grid operating condition of vacuum tube 48.

An important feature of the present embodiment resides in the driving of vacuum tube 48 from a low impedance source so that its control grid 46 may be driven well into positive grid conducting regions without distortion of the waveform as would necessarily occur were such operation attempted from a high impedance source such as presented by connection to the sawtooth condenser 22. This permits the elimination of the usual output transformer for driving the deflection yoke, in that the deflection yoke 58 may be included directly in the plate circuit of the tetrode vacuum tube 48, which, due to the permissible increased drive of its control grid, is able to supply the necessary peak current in the deflection yoke for deflection of the electron beam in cathode ray tube 55. Although the impedance of a practical deflection yoke cannot be made sufficiently high to permit optimum normal operation of presently available output tubes, the reduction of maximum deflection output power under these conditions of reduced yoke impedance is compensated by the increase in peak plate currents made possible by the provision of a low direct coupled impedance. Avoiding the use of an output transformer not only reduces the losses attributable to the transformer itself, but also appreciably reduces the output tube screen dissipation necessary to achieve high peak plate currents and therefore increases the overall efficiency of the deflection system.

In accordance with well known practice, damping tube 62 in conjunction with its storage network 63 acts as a reaction scanning damping device which can be adjusted to provide up to 50 percent of the scanning phase of the deflection cycle. The energy to accomplish this is obtained from the energy stored up in the magnetic yoke at the end of the retrace phase of the deflection cycle. This action is well known to the art and materially reduces the necessary conduction time of vacuum tube 48 in supplying energy to the deflection system. Accordingly, it is desirable that potentiometer 38 be adjusted to provide a negative bias for vacuum tube 48 which is sufficiently negative to allow plate current conduction in vacuum tube 48 for only slightly more than one-half of the deflection cycle. When the adjustment is properly made, that portion of the deflection cycle not supplied by the reaction damping circuit, will be supplied for slightly more than one-half the deflection cycle by the plate current of output tube 48.

It is important to note that the practice of applicant's invention reduces the possibility of Barkhausen oscillations which occur in a vacuum tube under conditions when the plate element is negative with respect to its cathode. Since damping tube 62 has its cathode 64 connected to the plate 60 of vacuum tube 48, and plate 66 of damping tube 60 is in turn connected through the damping RC network 63 to plate supply source 54, it is evident that when plate 60 swings sufficiently in a negative direction, diode 62 will conduct and damp the voltage swing to the extent that the plate cannot swing negative with respect to ground, thus preventing Barkhausen oscillation. This deflection system can be adjusted to operate satisfactorily with a very minimum of negative peaking applied to the deflection signal generated by discharge tube 10. Since the requirement of negative peaking is to insure plate current cut-off of vacuum tube 48 during the retrace phase of the deflection cycle, the magnitude of the negative peaking required is proportional to the maximum positive voltage appearing on the plate 60 of the vacuum tube. Since the high impedance of a transformer primary is eliminated by direct connection to the lower impedance deflection yoke, the maximum voltage swing appearing on plate 60 is necessarily lower, therefore requiring less negative excursion of the control grid 46 to effect cut-off of the tube.

From the above it is seen that a system suitable for controlled electron beam deflection in such devices as monoscopes, iconoscopes, kinescopes and the like as may be incorporated in television receivers or other electronic equipment, and in so doing provision has been made for the elimination of the usually included deflection system output transformer. As a result of this, it is found possible to orient the usually present damping tube so as to eliminate Barkhausen oscillations, which are extremely undesirable in modern systems.

What is claimed is:

1. In a deflection system for a cathode ray tube having a deflectable beam of electrons therein, a primary source of deflection signal, a first and second vacuum tube, each having a cathode, an anode, and a control grid, a circuit communicating the deflection signal derived from said primary source to said first vacuum tube control grid, an impedance connected in the cathode circuit of said first vacuum tube to provide a secondary source of deflection signal, an electromagnetic deflection yoke having a winding, said yoke being adapted to cause cathode ray beam deflection upon excitation of said deflection winding, a circuit connecting said yoke winding between said second tube anode and a source of energy for said second tube anode, a third vacuum tube having a cathode and an anode, a connection between said third tube cathode and said second tube anode, a connection between said third tube anode with said source of energy for said second tube anode, and a circuit connecting said second tube control grid to said secondary source of deflection signal so that variations of said yoke winding current will have greater peak-to-peak values attendant with more faithful conformation to the contour of said primary deflection signal waveform than would obtain if said second tube control grid were driven by said primary source.

2. In a cathode ray deflection system employing electromagnetic deflection, an electron tube having at least a plate, a cathode, and a control grid, a magnetic deflection yoke having an electromagnetic winding, a circuit for connecting the said deflection yoke winding in series with said electron tube plate and an energizing source of potential, a high impedance source of deflection signal, a cathode follower circuit for converting said high impedance source of deflection signal to a low impedance source of deflection signal, means for connecting the low impedance source of deflection signal to the control grid of said electron tube such that the driving impedance imposed across the grid is sufficiently low to permit driving of said grid well into grid conducting operation, whereby improved and more efficient operation of said deflection system results by merit of the low impedance source of excitation so provided.

3. In a cathode ray deflection system employing electromagnetic deflection, a vacuum tube having at least a plate, a cathode, and a control grid, a magnetic deflection yoke having an electromagnetic winding, means for connecting said deflection yoke winding in said electron tube plate circuit, a source of deflection signal, a second vacuum tube connected in a cathode follower circuit connected for converting said source of deflection signal to a lower impedance source of deflection signal, means connecting the lower impedance source of deflection signal to the control grid of said electron tube such that the driving impedance imposed across the grid is sufficiently low to permit driving of said grid well into grid conducting operation, a third electronic vacuum tube having at least a cathode and a plate connected across said deflection yoke so as to provide damping storage release action, whereby the operation and efficiency of the said deflection system is improved by said merit of the low impedance of said driving source for the first electronic vacuum tube.

4. In a cathode ray deflecting system employing electromagnetic deflection, a high impedance source of deflection signal, means converting said high impedance source of deflection signal to low impedance source of deflection signal such that said low impedance provides a driving source of voltage for sufficient excitation of a first electronic discharge tube having at least a cathode, a plate, and a control grid, an electromagnetic deflection yoke having a winding connected in series with the plate circuit of said first electronic discharge tube, a second electronic discharge tube having at least a cathode and an anode connected in damping relationship to said electromagnetic deflection yoke, whereby the low impedance of the driving source of deflection voltage for said first electronic discharge tube is such as to permit operation of said first electronic discharge tube into an extended region of control grid current whereby the improved operation of the deflection system is permitted by merit of the permissible operation of said first electron discharge tube in the grid conducting region due to the low impedance of the source of deflection voltage.

5. In a deflection system for a cathode ray tube having a deflectable beam of electrons therein, a primary source of deflection signal, a first and second vacuum tube, each having a cathode, an anode, and a control grid, a circuit communicating the deflection signal derived from said primary source to said first vacuum tube control grid, an impedance connected in the cathode circuit of said first vacuum tube to provide a secondary source of deflection signal, an electromagnetic deflection yoke having a winding, said yoke being adapted to cause cathode ray beam deflection upon excitation of said deflection winding, a circuit connecting said yoke winding between said second tube anode and a source of energy for said second tube anode, and a circuit connecting said second tube control grid to said secondary source of deflection signal so that variations of said yoke winding current will have greater peak-to-peak values attendant with more faithful conformation to the contour of said primary deflection signal waveform than would obtain if said second tube control grid were driven by said primary source.

6. In a cathode ray deflection system employing electromagnetic deflection, a vacuum tube having at least a plate, a cathode, and a control grid, a magnetic deflection yoke having an electromagnetic winding, means for connecting said deflection yoke winding in said electron tube plate circuit, a high impedance source of deflection signal, means converting said high impedance source of deflection signal to a low impedance source of deflection signal, means connecting the low impedance source of deflection signal to the control grid of said electron tube such that the driving impedance imposed across the grid is sufficiently low to permit driving of said grid well into grid conducting operation, a second electronic vacuum tube having at least a cathode and a plate connected across said deflection yoke so as to provide damping storage release action, whereby the operation and efficiency of the said deflection system is improved by said merit of the low impedance of said driving source for the first electronic vacuum tube.

7. In a deflection system for a cathode ray tube having a deflectable beam of electrons therein, the combination of, a primary source of deflection signal, a first and second vacuum tube each having at least a cathode, an anode and control electrode, a circuit communicating the deflection

signal derived from said primary source to said first vacuum tube control electrode, an impedance connected in the cathode circuit of said first vacuum tube to provide a secondary source of deflection signal, an electromagnetic deflection yoke having a winding, said yoke being adapted to cause cathode ray tube beam deflection upon excitation of said winding, means for coupling said yoke winding to the anode-cathode circuit of said second tube to receive deflection excitation therefrom, and a circuit for coupling said second tube control grid to said secondary source of deflection signal so that variations of said yoke winding current will have greater peak-to-peak values attendant with more faithful conformation to the contour of said primary signal waveform than would obtain if said second tube control electrode were driven by said primary source.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,074,496	Vance	Mar. 23, 1937
2,182,608	Andrieu	Dec. 5, 1939
2,439,321	Starr	Apr. 6, 1948