YOKE DRIVING CIRCUIT WHICH REDUCES TRANSIENTS

Filed Jan. 2, 1964

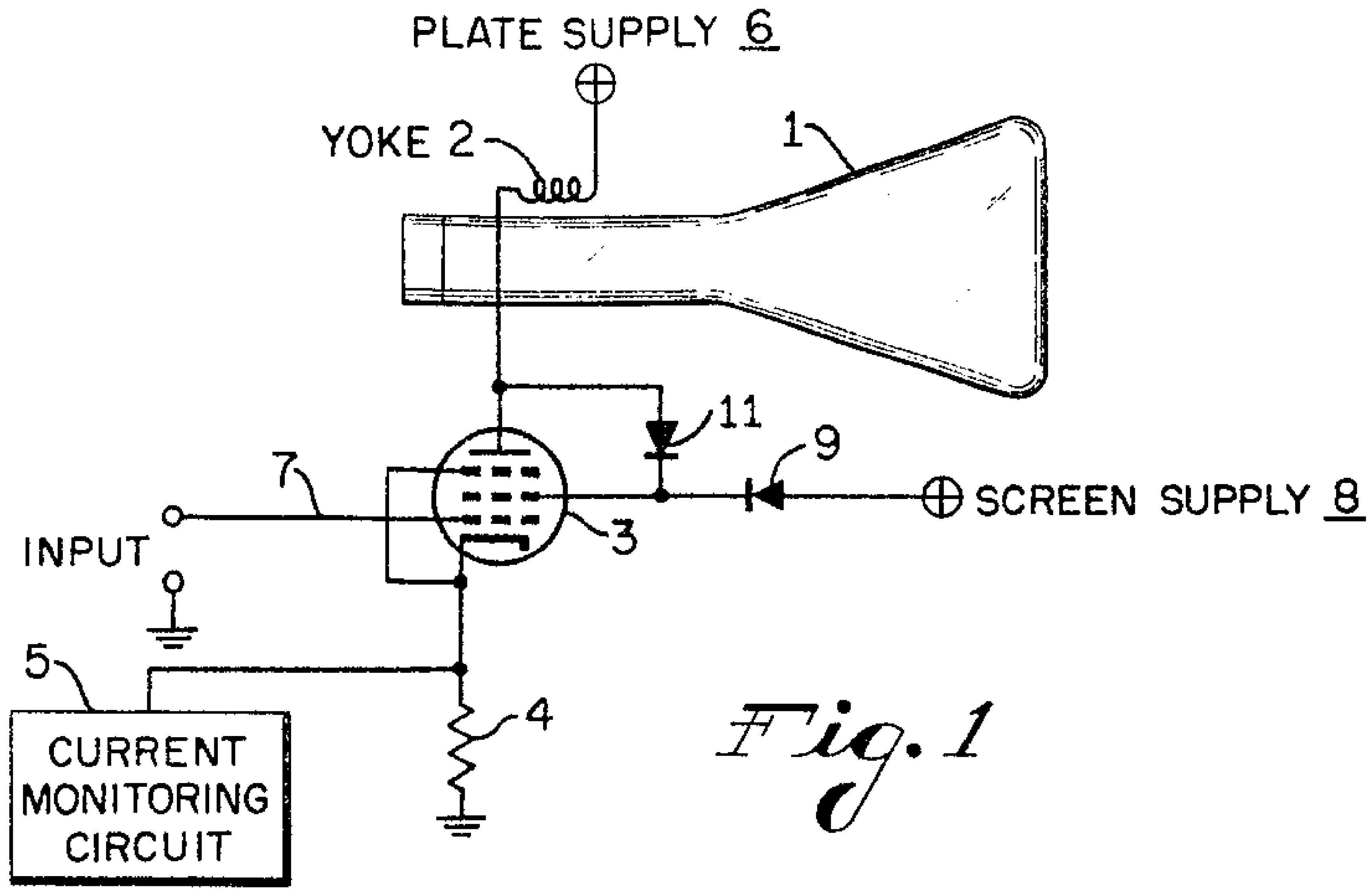

Fig. 1

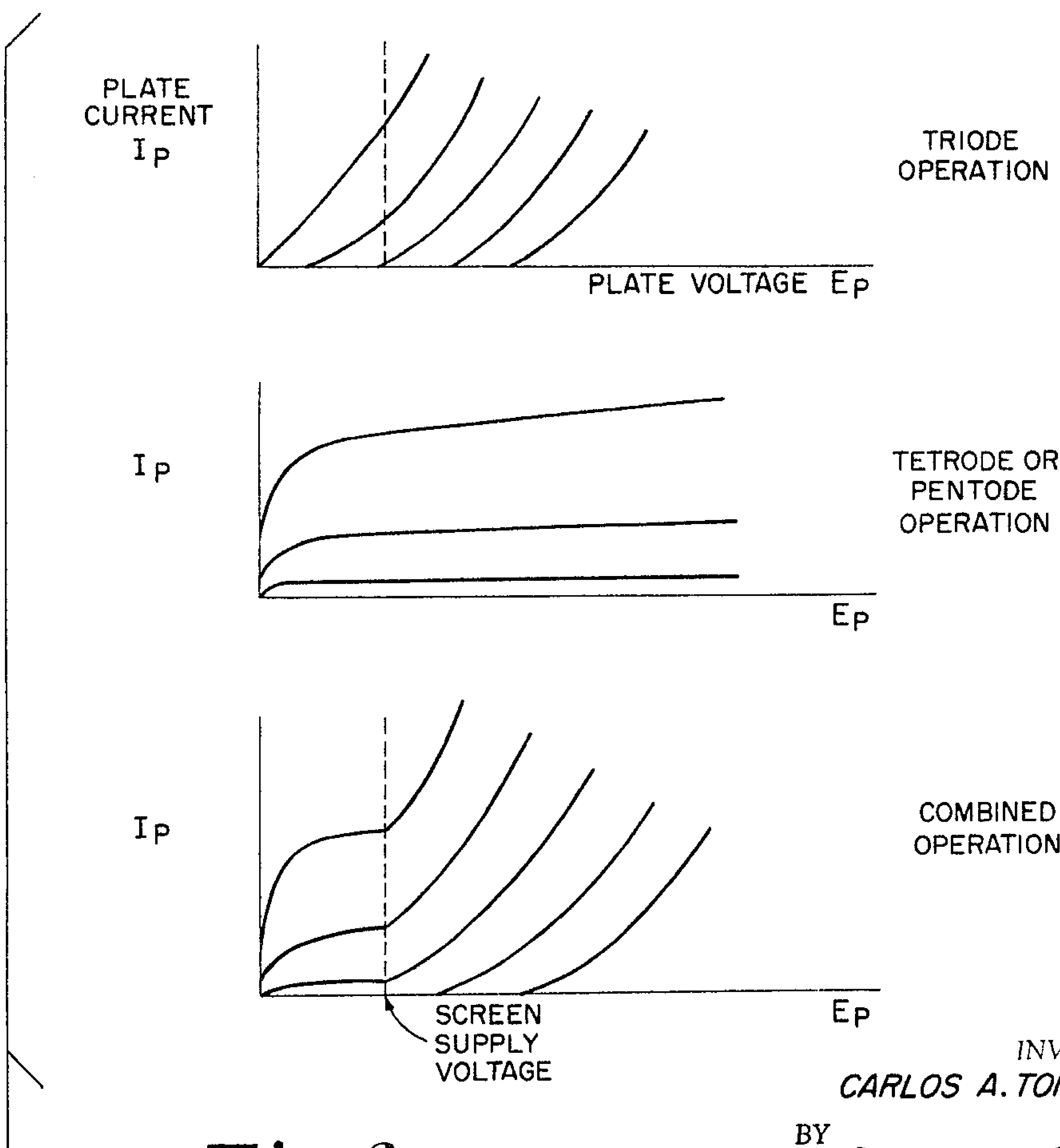

Fig. 2

INVENTOR.
CARLOS A. TOMASZEWSKI

BY Robert L. Nathans

ATTORNEY

United States Patent Office

3,273,009

Patented Sept. 13, 1966

3,273,009

YOKE DRIVING CIRCUIT WHICH REDUCES TRANSIENTS

Carlos A. Tomaszewski, Canoga Park, Calif., assignor, by mesne assignments, to Stromberg-Carlson Corporation, Rochester, N.Y., a corporation of Delaware

Filed Jan. 2, 1964, Ser. No. 335,194
5 Claims. (Cl. 315—27)

The present invention relates to cathode-ray tube electromagnetic yoke driving circuitry.

Readout equipment for data processors may utilize shaped beam cathode-ray tubes. These tubes include a beam-forming matrix which shapes the beam to form indicia prior to its striking the face of the tube at a particular point which is controlled by passing different D.C. currents through X and Y direction electromagnetic yokes. Such readout equipment is disclosed in U.S. Patent 2,924,742, assigned to the same assignee as the present invention.

In order to facilitate rapid information readout, it is important that the beam be shifted from one position to another in the shortest possible time. However, abrupt current changes within the electromagnetic yokes cause random oscillations, or transients, to be generated within the yokes. As a result, the settling time of the beam upon being shifted from one position to another is considerably greater than it would be in the absence of these transients. In prior art yoke driving circuits, a triode was connected in series with a current monitoring resistance connected to the cathode of the triode and an electromagnetic yoke coupled to the anode of the triode. Sharp increases in plate current which were necessary to rapidly shift the beam also caused large *Ldi/dt* voltage drops across the yoke which, in turn, sharply reduced the positive voltage at the plate of the triode. As a result of this drop in plate voltage, plate current flow and hence current flow through the yoke was sharply reduced temporarily which aggravated the production of transients and increased the settling time of the beam. The fact that the plate current of a tetrode or pentode is relatively independent of plate voltage suggested the use of such a tube in place of a triode. However, the screen current would pass through the aforementioned current monitoring resistance and an error would be produced in the current monitoring circuit, since this circuit is only supposed to measure the current which passes through the yoke. This monitoring circuit may be used to compensate for parameter changes which could result in beam positioning errors in the absence of the monitoring circuit, or for other purposes that have nothing to do with the invention.

In accordance with the present invention, triode operation of a tetrode or pentode is obtained by electrically coupling the screen grid to the plate during steady state operation by forward biasing a first diode connected between the plate and the screen grid. When the current through the tube is sharply increased and a sharp drop in plate voltage is manifested due to the *Ldi/dt* drop across the yoke winding during the transient period, the first diode becomes back biased to electrically decouple the screen grid from the plate and a second diode connected between the screen grid and a screen supply is now forward biased so that the tube operates as a tetrode or pentode until the transient condition is terminated. As a result, the plate current is held to a relatively high level during the transient period and no error due to screen current is generated during steady state operation when such an error is undesirable.

Accordingly, it is an object of the present invention to provide current control circuitry employing a single tetrode or pentode which combines characteristics of both triodes and tetrodes, or pentodes.

It is a further object of the present invention to provide new and improved electromagnetic yoke driving circuitry which sharply reduces the effects of transients set up within an electromagnetic beam-positioning yoke.

Further objects and advantages of the invention will become apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which:

FIG. 1 discloses a preferred embodiment of the invention; and

FIG. 2 discloses current-voltage curves which will be useful in the understanding of the operation of the embodiment of the invention disclosed in FIG. 1.

FIG. 1 schematically discloses a cathode-ray tube **1** having an electromagnetic yoke **2** associated therewith. A pentode **3** is shown having its cathode grounded through resistance **4** and having its anode connected to plate supply **6** through yoke **2**. Input circuit **7** is coupled to the control grid so that various changes in the voltage impressed upon the control grid may be utilized to control the current through yoke **2** which, in turn, controls the beam position within cathode-ray tube **1**. The screen grid of pentode **3** is coupled to screen supply **8** through diode **9** and is also coupled to the plate via diode **11**. The suppressor grid is directly connected to the cathode in the conventional manner.

Let it be assumed that the current through yoke **2** is to be sharply increased to shift the beam within cathode-ray tube **1**. Since the resistance of yoke **2** is relatively small, the voltage on the plate of tube **3** will be almost as positive as the plate supply voltage and, accordingly, diode **11** will be forward biased so that the screen grid is electrically coupled to the plate. On the other hand, diode **9** will be back biased since the screen voltage is considerably less than the plate voltage. Some electrons will flow through the screen grid, diode **11** and yoke **2**, together with the electrons which are gathered up by the plate. Accordingly, the IR drop across current monitoring resistor **4** will accurately reflect the yoke current. Now let it be assumed that the voltage impressed upon the control grid is made more positive so as to sharply increase the plate current. This tends to cause the plate voltage to become sharply reduced which, in turn, would sharply reduce the plate current. In other words, the abrupt reduction in plate voltage would cause a correspondingly abrupt drop in plate current during the transient period, if tube **3** were operating as a triode. Diodes **9** and **11**, however, are arranged so that when the plate voltage is reduced below the screen supply voltage, tube **3** will operate as a pentode which means that the plate current would not be substantially reduced during the transient condition and therefore the transient will die out much faster. Under these circumstances, the reduction of the plate voltage below the screen supply voltage causes diode **11** to become back biased to decouple the screen grid from the plate. In addition, diode **9** becomes forward biased and the screen supply voltage is applied to the screen grid so that tube **3** operates as a pentode as long as the plate voltage of tube **3** is somewhat below the screen supply voltage. As the current through yoke **2** approaches the higher steady state level, the *Ldi/dt* drop will decrease and the plate of tube **3** will again become more positive than the screen voltage so as to forward bias diode **11** and back bias diode **9**, and, accordingly, triode operation is resumed. The fact that a component of the current flowing through the monitoring resistance **4** is entering the screen supply through diode **9** during the transient or pentode operation period is of no importance. This is because the aforementioned error introduced by this component into current monitoring circuits has no effect during the transient period. After steady state conditions are re-established, diode **9** becomes back biased, as mentioned hereinabove, triode operation is again manifested, and the voltage produced across the current monitoring resistance **4** will accurately reflect the current through yoke **2**.

While there has been shown and described a specific embodiment of the invention, other modifications will readily occur to those skilled in the art. It is not, therefore, desired that this invention be limited to the specific arrangement shown and described, and it is intended in the appended claims to cover all modifications within the spirit and scope of the invention.

What is claimed is:

1. In a cathode-ray tube yoke driving circuit, a current control element having an input electrode, an output electrode, a control electrode and a screen electrode; a first D.C. voltage source having a first and second terminal, a cathode-ray tube having a beam-positioning electromagnetic yoke winding associated therewith, said yoke winding having a first and second terminal, means for coupling the input electrode of said current control element to the second terminal of said first D.C. voltage source, means for coupling the output electrode of said current control element to the first terminal of said electromagnetic yoke, means for coupling the output terminal of said electromagnetic yoke to the first terminal of said first D.C. voltage source, a second D.C. voltage source for producing a screen voltage lower than the voltage produced by said first voltage source, an input circuit coupled to said control electrode for abruptly changing the current flowing through said electromagnetic yoke winding and said current control element to alter the position of the beam within said cathode-ray tube, means for effectively coupling said screen electrode and said output electrode together when the voltage at the output electrode is greater than a predetermined voltage somewhat lower than the voltage produced by said second D.C. voltage source and for effectively decoupling said output electrode and said screen electrode as long as the voltage at the output electrode remains below said predetermined voltage, and means for effectively coupling said second D.C. voltage source to said screen electrode only during that period when the voltage at the output electrode remains below said predetermined voltage.

2. In combination, a current control element having an input electrode, an output electrode, a control electrode and a screen electrode; a first D.C. voltage source, a reactance circuit, means for coupling said first D.C. voltage source, said reactance circuit, said input electrode and said output electrode in series to cause D.C. current to flow through said reactance circuit; a second D.C. voltage source, an input circuit coupled to said control electrode for abruptly changing the current flowing through said reactance circuit and said current control element, means for effectively coupling said screen electrode and said output electrode together when the voltage at the output electrode is greater than a predetermined voltage somewhat lower than the voltage produced by said second D.C. voltage source and for effectively decoupling said output electrode and said screen electrode as long as the voltage at the output electrode remains below said predetermined voltage, and means for effectively coupling said second D.C. voltage source to said screen electrode only during that period when the voltage at the output electrode remains below said predetermined voltage.

3. In a current control element having an input electrode, an output electrode, a control electrode and a screen electrode; a first D.C. voltage source having a first and second terminal, a reactance circuit, means for coupling the first terminal of said first D.C. voltage source to said output electrode through said reactance circuit, means for coupling the second output terminal of said first D.C. voltage source to said input electrode, a second D.C. voltage source, an input circuit coupled to said control electrode for abruptly changing the current flowing through said reactance circuit and said current control element, means for effectively coupling said screen electrode and said output electrode together when the voltage at the output electrode is greater than a predetermined voltage somewhat lower than the voltage produced by said second D.C. voltage source and for effectively decoupling said output electrode and said screen electrode as long as the voltage at the output electrode remains below said predetermined voltage, and means for effectively coupling said second D.C. voltage source to said screen electrode only during that period when the voltage at the output electrode remains below said predetermined voltage.

4. In combination, a multi-element electron tube having at least an anode, a cathode, a control grid and a screen grid; a cathode-ray tube having a beam-positioning electromagnetic yoke winding associated therewith, a power supply having a first terminal for supplying B+ to the anode of said electron tube, a second terminal for applying a positive D.C. screen potential to the screen electrode of said electron tube and a third ground reference potential terminal, means for coupling the cathode of said electron tube to the third terminal of said power supply, means for coupling said yoke winding between the first terminal of said power supply and said anode, an input circuit coupled to the control grid of said electron tube for abruptly increasing the current flowing through said tube thereby to reduce the potential at the plate of said electron tube below the potential at the second terminal of said power supply, means for effectively coupling said screen grid to said plate and for decoupling said screen grid from the second terminal of said power supply as long as the potential at said anode is higher than a predetermined voltage somewhat lower than the potential at the second output terminal of said power supply and for effectively decoupling the screen grid from said plate and for causing the second terminal of said power supply to be effectively coupled to said screen grid as long as the voltage at said anode remains below said predetermined voltage.

5. In combination, a multi-element electron tube having at least an anode, a cathode, a control grid and a screen grid; a reactance circuit, a power supply having a first terminal for supplying B+ to the anode of said electron tube, a second terminal for applying a positive D.C. screen potential to the screen electrode of said electron tube and a third ground reference potential terminal, means for coupling the cathode of said electron tube to said third terminal of said power supply, means for coupling said reactance circuit between the first terminal of said power supply and said anode, an input circuit coupled to the control grid of said electron tube for abruptly increasing the current flowing through said tube thereby to reduce the potential at the plate of said electron tube below the potential at the second terminal of said power supply, means for effectively coupling said screen grid to said plate and for decoupling said screen grid from the second terminal of said power supply as long as the potential at said anode is higher than a predetermined voltage somewhat lower than the potential at the second output terminal of said power supply and for effectively decoupling the screen grid from said plate and for causing the second terminal of said power supply to be effectively coupled to said screen grid as long as the voltage at said anode remains below said predetermined voltage.

No references cited.

DAVID G. REDINBAUGH, *Primary Examiner.*

T. A. GALLAGHER, *Assistant Examiner.*