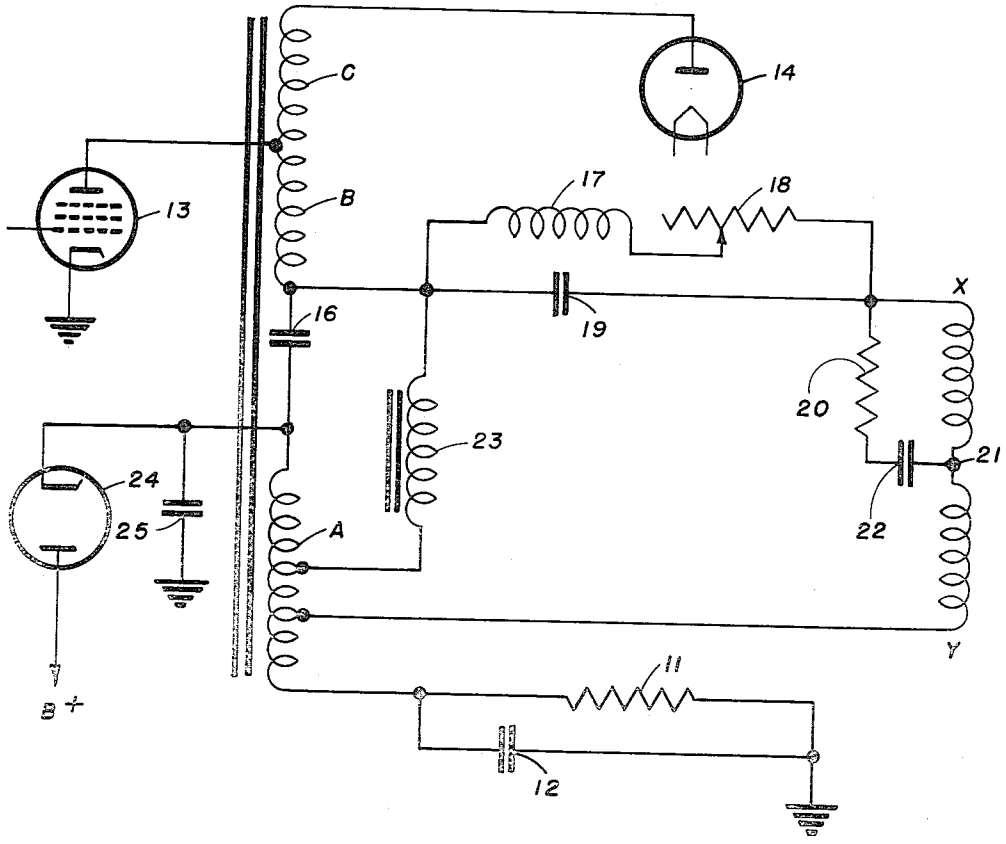
July 19, 1955 A. D. BAYLOR 2,713,652

CONTROLLED BEAM CENTERING DEFLECTION CIRCUIT

Filed Feb. 25, 1954




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United States Patent Office 2,713,652
Patented July 19, 1955



2,713,652

# CONTROLLED BEAM CENTERING DEFLECTION CIRCUIT

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Application February 25, 1954, Serial No. 412,574

6 Claims. (Cl. 315—27)

The present invention relates generally to television systems wherein the electron scanning beam of the cathode-ray tube is electromagnetically deflected cyclicly to effect reproduction of an image, and more specifically, to an electromagnetic deflection circuit and beam centering control circuit.

Television receiver circuits which utilize electromagnetic deflection generally include, at least in the horizontal deflection circuit, a deflection transformer driven or controlled by a driver tube acting in conjunction with a damper tube to provide what is known as "reaction" type scanning. Thus, the damper tube and driver tube are connected in such a manner that a portion of the energy stored in the circuit inductance during the retrace period of the cathode-ray beam is recovered across a circuit, sometimes known as the "B boost" circuit. The energy stored in the "B boost" circuit, or at least a portion thereof, is then returned as useful deflection energy during the trace period. In these circuits the current supplied through the damper diode is combined with current flowing through the driver tube in such fashion as to cause a linear algebraic summation current to flow through the deflection yoke windings to bring about substantially uniform deflection of the cathode-ray beam at the scanning frequency.

Centering of the electron beam in the average cathode-ray tube requires the application of a controlled electromagnetic field, primarily because the average cathode-ray tube gun structure is not properly centered. However, accurate mechanical gun structure alignment does not solve the beam centering problem completely, because of the de-centering effect of the ever-present earth's magnetic field and stray fields set up by adjacent receiver circuitry.

The majority of the prior art beam centering circuits provide D.-C. current from a power source external to the deflection circuit having taps from which a given amount of current may be taken. Some circuits have been developed which eliminate the need for a separate power source by depending upon a rather complicated bridge circuit capable of providing D.-C. current flow through the deflection coils in either direction, and thus capable of shifting the electron beam in either direction.

From experience gained in using these prior art circuits, it has been realized that it is unnecessary to provide D.-C. centering currents capable of flowing in more than one direction. In the majority of cases, beam center error caused by either stray fields or the earth's magnetic field can be compensated for by shifting the beam to the right, as seen by the viewer. Further, it has been found that this prior art deflection circuitry invariably depends upon a D.-C. current flow through the deflection transformer, which tends to saturate the core and require a transformer larger than necessary to carry the normal A.-C. currents alone.

Thus, it would be desirable to provide a deflection circuit which eliminates the need for a separate D.-C. power source for beam centering purposes and which is



so arranged as to eliminate, or at least minimize saturation effects caused by beam centering current flow through the transformer windings.

Therefore, it is an object of this invention to provide a highly efficient magnetic deflection circuit utilizing a single D.-C. power source.

It is a further object of this invention to provide a magnetic deflection circuit capable of shifting the undeflected cathode-ray beam centering position in one direction to compensate for beam centering error, using a minimum of components and taking advantage of the existing D.-C. power source required by the driver tube.

It is also an object of this invention to provide cathode-ray beam centering control in an autotransformer type of deflection circuit with a minimum of core saturation.

In addition, it is another object of this invention to provide a reaction scanning type of deflection circuit which recaptures a portion of the energy stored in the circuit inductances during retrace periods for providing deflection energy during trace periods, and which utilizes a single D.-C. power source for supplying deflection power and centering current.

Briefly, the invention comprises an autotransformer type deflection circuit arranged to provide A.-C. deflection currents through the deflection coils for deflecting a cathode-ray beam cyclicly across the image screen of a cathode-ray tube. The circuit is also arranged to provide a D.-C. current path through the deflection yoke coils in one direction to furnish a centering field suitable for adjusting the normal undeflected position of the cathode-ray beam from a position left of the geometrical center of the image screen, as seen by the viewer, to the geometrical center of the horizontal axis. These two functions are accomplished in an autotransformer type magnetic deflection circuit by dividing the primary coil of the autotransformer into two portions, as far as D.-C. current is concerned, and using a coupling capacitor of sufficient capacitance to allow these two coil portions to operate as a single coil for A.-C. current flow. In addition, the D-.C. current paths are arranged to provide substantially equal and opposite ampere turns, thus avoiding saturation of the transformer core.

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims, in connection with the accompanying drawing, in which the single figure is a circuit diagram of the preferred embodiment of the invention.

In the drawing, I have shown a preferred embodiment of the invention as applied to the horizontal deflection circuit of a television receiver. The circuit comprises an autotransformer having two windings, A and B, coupled between the anode of driver tube 13 and the B boost network comprising resistance 11 and capacitor 12. Driver tube 13 includes a control grid circuit which, in turn, may be driven by a saw-tooth shaped control potential from a source not shown. High voltage coil C, which is connected between the anode of high voltage rectifier tube 14 and the junction of coil B and the anode of tube 13, comprises a conventional high voltage winding placed on the same core as windings A and B.

Coils A and B are A.-C. coupled by capacitor 16. The lower tap of coil B is connected through a linearity and centering control network comprising inductance 17, resistance 18 and capacitance 19 to deflection yoke coils 21. A capacitance 22 may be shunted across one of the deflection coils in conventional manner to improve linearity.

Width coil or inductance 23 is coupled between the lower tap of coil B and a tap provided on coil A. As will be hereinafter explained in detail, the critical selec-

tion of the width coil tap on coil A is of primary importance.

A damper diode 24 which may comprise a plurality of diode elements connected in parallel in any circuit requiring a heavy damper current is coupled between a source of B+ potential and the junction of autotransformer coil A and coupling capacitor 16. Capacitor 25, which is coupled between ground and the cathode of damper diode 24, has a capacitance value tuned to the inductance portion of the circuits connected in parallel therewith so as to modify the deflection system retrace period and to improve linearity by eliminating ringing voltages.

The term "ground" as used herein can be considered in its broadest sense as an equi-potential plane. In other words, the term "ground" indicates that all elements connected thereto are to be considered as electrically joined.

Operation of the circuit described can be considered from either an instantaneous current viewpoint or from the viewpoint generally used by those skilled in the art, i. e., by considering separately the A.-C. and the D.-C. current components of the instantaneous current flow.

Taking this last-mentioned approach, let it be assumed that the retrace period has just ended, during which time both the driver tube and the damper diode were cut off, leaving the deflection coil inductance to oscillate freely with its connected and inherent capacitance. Current at this instant is flowing into deflection coil terminal X through the deflection coil, and out at terminal Y. Damper tube 24 is driven into maximum conduction by the strong negative bias on its cathode, allowing current to flow around the path from the B+ power supply through damper diode 24, coupling capitor 16, capacitor 19, deflection yoke 21, B boost load resistance 11 and capacitor 12 to ground, or the negative terminal of the B+ supply source.

The term "ground" can be considered as any equi-potential plane common to the negative terminal of the B+ supply, not shown, the cathode of driver tube 13 and the lower terminal of capacitor 25.

The portion of the damper-supplied current which flows through the deflection coils decreases linearly with respect to time, thereby supplying the first portion of the sweep current cycle. Driver tube 13 is then driven into conduction by a positive signal excursion on its control grid before damper tube current flow decreases to zero. The deflection coil current during the second and remaining portion of the sweep current cycle comprises the algebraic sum of the damper tube current flow through the deflection coils and the deflection coil current contributed by driver tube conduction. When the current flowing through driver tube 13 is equal to the deflection coil current supplied by damper diode 24, A.-C. current flow through the deflection coils ceases, allowing the beam to assume a deflection position solely under control of the field set up by D.-C. current flow through the deflection coils.

Continuing the cycle, driver tube 13 starts to conduct more current than is supplied by damper diode 24, reversing the current flow through the deflection coils. This current is supplied by the charge on B boost capacitor 12.

Driver tube 13 and damper tube 24 conduct throughout the remaining portion of the cycle until driver tube 13 is cut off at the start of retrace. When driver tube 13 is cut off, the circuit comprising the inductance of deflection coil 21 and its inherent and connected capacitances is shock excited into oscillation. Deflection yoke current flow charges up these capacitances during the first quarter of the oscillating cycle, and during the second quarter of the cycle the capacitances discharge through the deflection coil inductance, providing current flow into deflection coil terminal X and out of coil terminal Y, to complete the cycle.

When considering operation of the circuit in the drawing from a D.-C. current viewpoint, it must be remembered that this term relates to average current flow over the complete cycle. Thus, the D.-C. current flow through driver tube 13 comprises the average A.-C. current through driver tube 13, and even though driver tube 13 is cut off during a portion of each cycle, it is still possible to consider the instantaneous currents as being made up of an A.-C. component and an average or continuously flowing D.-C. component. For this reason, consideration of the D.-C. cycle need not involve a consideration of the intermittent nature of conduction through damper tube 24 and driver tube 13.



Since there is only one source of power, i. e., the B+ potential source, all of the D.-C. current flowing through driver tube 13 must be derived from current flow through damper tube 24.

This D.-C. current flows from the source B+ through diode 24 down through coil A of the autotransformer into terminal Y and out of terminal X of the deflection coil 21 through resistor 18, conductor 17, coil B of the autotransformer and the anode-cathode path of driver tube 13. D.-C. current can also flow from the tap on coil A through inductance 23, through coil B and the anode-cathode path of driver tube 13 and back to ground or the negative terminal of the B+ source. Thus, it can be seen that inductance 23 which normally acts as a width control, as far as A.-C. current flow is concerned, also acts to shunt D.-C. current around the deflection yoke portion of the circuit. The amount of this shunting current is controlled by adjustment of the movable tap on potentiometer 18. As the resistance of potentiometer 18 is increased, less D.-C. current flows through the deflection yoke. Conversely, as this resistance is decreased, more D.-C. current flows through the deflection coil.

As is well-known to those skilled in the art, D.-C. current through the deflection yoke coils causes a change in the beam center position, since it provides a field through which the beam must pass in addition to the ever-changing A.-C. deflection field. As can be seen, my circuit provides such a beam-centering field in one direction. Thus, adjustment of resistor 18, though changing the amount of D.-C. current flowing in the deflection coil, and thus the field strength, can only move the center position of the beam to the right of the position resulting when no deflection field is present.

It has been found that it is unnecessary to provide a centering control which moves the beam to the left, since the major beam-centering error is caused by the earth's magnetic field and other effects which invariably force the beam to center itself to the left of its correct center position. Thus, my circuit develops a centering field which opposes these forces to provide all of the centering control which is necessary in production type television receivers.

As has been stated, inductance 23 acts as a D.-C. shunt path across deflection coils 21, and thus the tap on autotransformer coil A to which this inductance is connected, involves a critical selection. The critical nature of this connection is best understood by considering D.-C. current flow through both coils A and B. As readily will be seen, D.-C. current flow through coil B always flows in one direction, i. e., from the lower end of the coil out through the tap to which the anode of tube 13 is connected. It will also be understood that D.-C. current flows into coil A at the tap or coil end connected to the cathode of damper diode 24, capacitor 16, and out through the taps connected to width coil 23, deflection yoke coil 21 and load resistor 11. Thus, the effect of the ampere turns of coil B, as far as D.-C. current flow is concerned, always opposes the ampere turns of coil A. It follows that if the ampere turns of coil A can be made to equal the ampere turns of coil B, the saturation effect of this D.-C. current flow on the core of the autotransformer can be neutralized. Neutralization in this manner is most readily caused by careful selection of the tap on coil A to which inductor 23 is connected. Thus,

the ampere turns of coil A may be increased by lowering the position of the tap to which width inductor 23 is coupled, and may be decreased by raising the tap to which width inductor 23 is coupled.

Optimum operating conditions result when the ampere turns of both coils A and B are equal and opposite, as far as D.-C. current is concerned, and when the inductance of width inductance 23 is selected to provide the necessary width control action across the resulting taps, as far as A.-C. action is concerned.

It is to be understood that the physical structure, diagrammatically shown in the drawing, may comprise an autotransformer having superimposed windings. In other words, winding A may comprise the first layer adjacent the core surface and winding B a second coil wound over winding A. In like manner, winding C, which is the high voltage winding, may be wound over winding B. Regardless of the winding practice followed, the drawing shows in diagrammatic form the desired electrical structure, and the coil portions coupled by capacitor 16 are to be considered electrically adjacent.

While I do not desire to be limited to any specific circuit parameters, such parameters being in accordance with individual circuit requirements, the following circuit values have been found entirely satisfactory in one successful embodiment of the invention, in accordance with Fig. 1:

Resistors:

| | |
|---|---|
| 18 | 400 ohms. |
| 20 | 1000 ohms. |

Capacitances:

| | |
|---|---|
| 12 | 13.3 mf. |
| 16 | .5 mf. |
| 19 | .1 mf. |
| 22 | 120 mmf. |
| 25 | 100 mmf. |

Coils:

| | |
|---|---|
| Winding A | 555 turns. |
| Winding B | 305 turns. |
| Winding C | 1700 turns. |
| Width Coil | 1500 turns (approximately 30 ohm resistance). |

Tubes:

| | |
|---|---|
| 13 | 6CD6. |
| 14 | 1B3. |
| 24 | Two 6AX4 in parallel. |

While there has been shown and described what is at present considered a preferred embodiment of the present invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the appended claims.

Having thus described my invention, I claim:

1. In a television receiver system of the reaction scanning type, the combination comprising an autotransformer having a first coil portion and a separate second coil portion, both coil portions being wound on a common core, blocking capacitance means coupling the adjacent coil ends of said coil portions so as to form an A.-C. path therebetween, rectifier means having an anode D.-C. coupled to the positive terminal of a direct current source and a cathode D.-C. coupled to a tap on said second coil portion, deflection coils D.-C. coupled between a tap on said first coil portion and a tap spaced below the rectifier cathode tap on said second coil portion, a width inductance D.-C. coupled between a tap on said first coil portion and a tap on said second coil portion, a B boost circuit comprising a resistance capacitance parallel circuit connected between a tap on said second coil portion and the negative terminal of said direct current source, and a driver tube having an anode coupled to a tap on said first coil portion and a cathode coupled to the negative terminal of said direct current source, said coil taps being adjusted to provide D.-C. current ampere turns in the first coil portion substantially equal to the D.-C. current ampere turns in the second coil portion.



2. In a television receiver system of the reaction scanning type, the combination comprising an autotransformer having a first coil portion and a separate second coil portion, both coil portions being wound on a common core, blocking capacitance means coupling the adjacent coil portions so as to form an A.-C. path therebetween, rectifier means having an anode D.-C. coupled to the positive terminal of a direct current source and a cathode D.-C. coupled to a tap on said second coil portion, deflection coils D.-C. coupled between a tap on said first coil portion and a tap spaced below the rectifier cathode tap on said second coil portion, said deflection coil D.-C. coupling including a variable resistance, a width inductance D.-C. coupled between a tap on said second coil portion and a tap on said first coil portion, a B boost circuit comprising a resistance capacitance parallel circuit connected between a tap on said second coil portion and the negative terminal of said direct current source, and a driver tube having an anode coupled to a tap on said first coil portion and a cathode coupled to the negative terminal of said direct current source, said coil taps being adjusted to provide D.-C. current ampere turns in the first coil portion substantially equal to the D.-C. current ampere turns in the second coil portion.

3. In a television receiver system of the reaction scanning type, the combination comprising an autotransformer having a first coil portion and a separate second coil portion, both coil portions being wound on a common core, blocking capacitance means coupling the adjacent coil portions so as to form an A.-C. path therebetween, rectifier means having an anode D.-C. coupled to the positive terminal of a direct current source and a cathode D.-C. coupled to a tap on said second coil portion, deflection coils D.-C. coupled through an A.-C. bypassed variable resistance between a tap on said first coil portion and a tap spaced below the rectifier cathode tap on said second coil portion, a width inductance D.-C. coupled between a tap on said second coil portion and a tap on said first coil portion, a B boost circuit comprising a resistance capacitance parallel circuit connected between a tap on said second coil portion and the negative terminal of said direct current source, and a driver tube having an anode coupled to a tap on said first coil portion and a cathode coupled to the negative terminal of said direct current source, said coil taps being adjusted to provide D.-C. current ampere turns in the first coil portion substantially equal to the D.-C. current ampere turns in the second coil portion.

4. In a television receiver of the magnetic scanning type, a combination comprising an autotransformer having at least two coil portions wound on a common core, a blocking capacitor coupling electrically adjacent coil portions to form an A.-C. path therebetween, a driver tube coupled between one of said coil portions and a source of reference potential, a damper diode and a potential supply series coupled between said source of reference potential and the second of said autotransformer coil portions, a capacitance load coupled between said second coil portion and said source of reference potential, deflection coils D.-C. coupled through an A.-C. bypassed resistance between said coil portions, a width inductance D.-C. coupled between said coil portions to form a partial D.-C. shunt path around said deflection coils, the deflection coil, driver tube and width inductance taps on said one coil portion and the capacitance load, deflection coil and width inductance taps on said second coil portion being selected to provide substantially the same number of D.-C. ampere turns in both autotransformer coil portions.

5. In a television receiver system of the reaction scanning type, the combination comprising an autotransformer having a first coil portion and a separate second coil portion, both coil portions being wound on a common core,

blocking capacitance means coupling the adjacent coil portions so as to form an A.-C. path therebetween, rectifier means having an anode D.-C. coupled to the positive terminal of a direct current source and a cathode D.-C. coupled to a tap on said second coil portion, deflection coils D.-C. coupled between a tap on said first coil portion and a tap spaced below the rectifier cathode tap on said second coil portion, a width inductance D.-C. coupled between a tap on said second coil portion and a tap on said first coil portion, a B boost circuit comprising a resistance capacitance parallel circuit connected between a tap on said second coil portion and the negative terminal of said direct current source, and a driver tube having an anode coupled to a tap on said first coil portion and a cathode coupled to the negative terminal of said potential source.

6. In a television receiver of the magnetic scanning type, a combination comprising an autotransformer having at least two coil portions wound on a common core, a blocking capacitor coupling electrically adjacent coil portions to form an A.-C. path therebetween, a driver tube having an anode-cathode circuit coupled between one of said coil portions and a source of reference potential, a rectifier and a potential supply series coupled between said source of reference potential and the second of said autotransformer coil portions, a capacitance load coupled between said second coil portion and said source of reference potential, deflection coils D.-C. coupled through a variable resistance between said coil portions, a width inductance D.-C. coupled between said coil portions to form a partial D.-C. shunt path around said deflection coils.



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