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[54] **HORIZONTAL CONVERGENCE CIRCUIT**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **315/13 C**
[51] **Int. Cl.** **H01j 29/50**
[50] **Field of Search** ..... 315/13 C

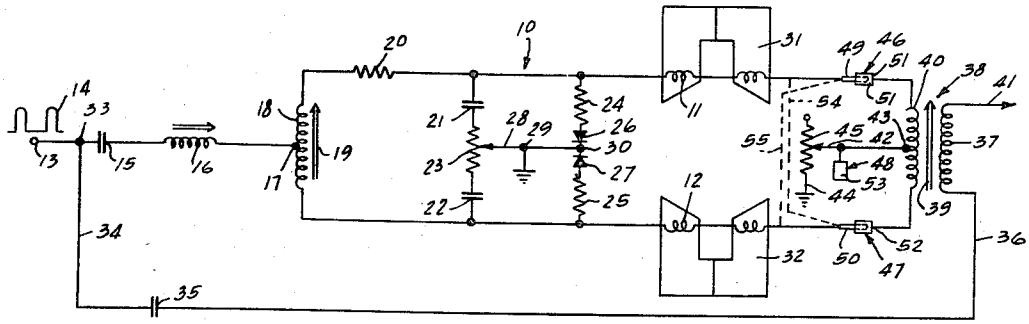
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ABSTRACT: A horizontal convergence circuit having a pair of convergence coils coupled in series with the secondary of a transformer. Means are provided to apply a voltage pulse waveform at the horizontal repetition rate to the transformer and thereby develop a sawtooth current in the respective convergence coils. Means are also provided to apply a sawtooth voltage across the coil which when integrated in the coil develops parabolic currents. The combination of the parabolic currents and sawtooth currents provides the necessary magnetic field to converge the associated electron beams in a cathode ray tube. The secondary winding of the transformer which is used to supply the pulse voltage to the convergence coils has readily releasably connectors for coupling opposite leads of the secondary winding to the respective convergence coils. Pins are provided on the leads of the coils and these pins are received within the connectors. By reversing the points of coupling of the pins in the respective connectors, the direction of sawtooth current in the two convergence coils can be reversed. In this way, convergence is made possible in circumstances where the normal sawtooth amplitude adjustment devices could not accomplish convergence. The secondary winding of the transformer has a center tap which is coupled through a potentiometer to circuit ground. The center tap also has a connector which may receive either one of the pins associated with the leads of the respective convergence coils. In this way, the sawtooth level in either one of the coils may be substantially reduced to zero without affecting the level of sawtooth current in the other coil. As in the case of reversing the direction of current, this greatly extends the range of adjustment for the sawtooth current.



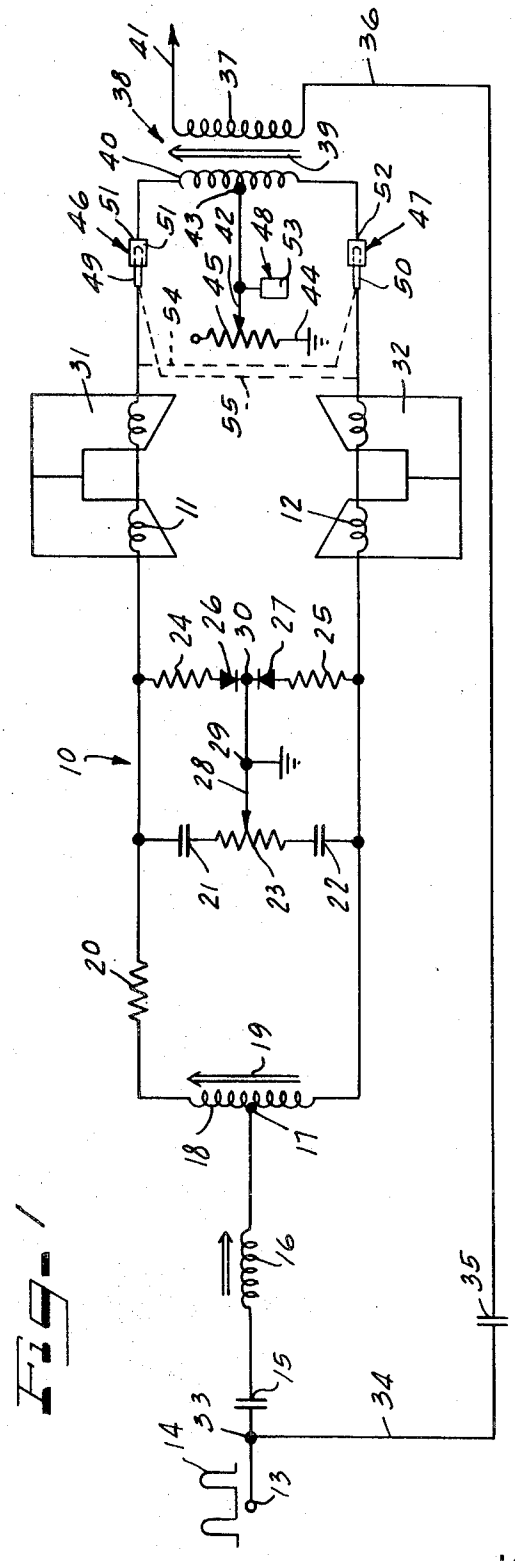


Fig. 1

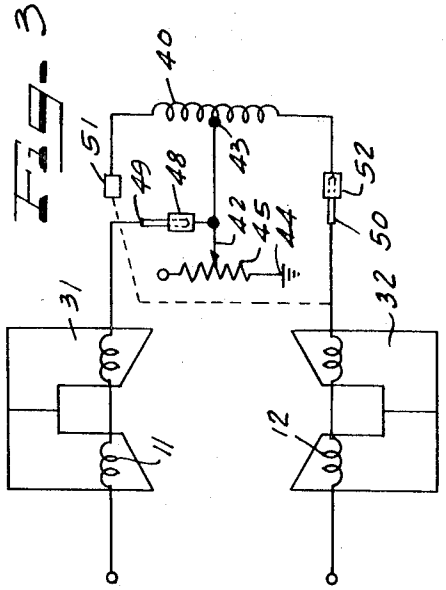


Fig. 3

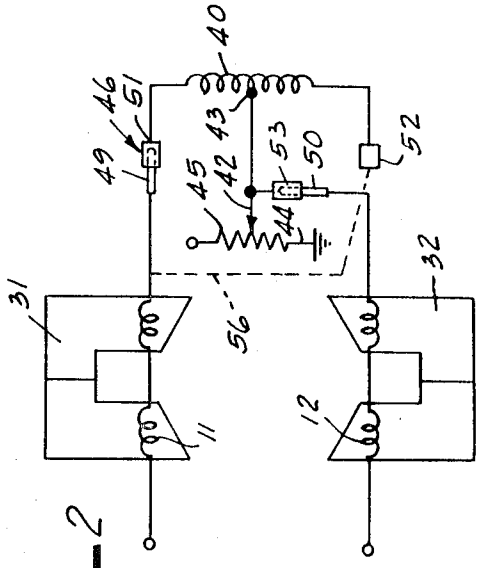


Fig. 2

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HORIZONTAL CONVERGENCE CIRCUIT

BACKGROUND OF THE INVENTION

It has been found that a generally parabolic current is preferable for developing the required magnetic field in a convergence coil to converge a plurality of beams in a cathode ray tube. It has also been found, however, that improved convergence results by adding a sawtooth current to the parabolic waveform thereby to provide a tilted parabola. The amount of tilt required depends on the geometric configurations of the tube and of the various windings mounted on the tube.

Prior art circuits have provided means for adjusting the level of the sawtooth current within the convergence coils in order to accomplish the desired amount of tilt. These prior circuits provide both a master amplitude control which increases and decreases the level of sawtooth in a pair of coils and a differential control which increases the level in one coil while simultaneously decreasing the level of sawtooth in the other coil.

However, it has been found that in a number of production tubes, these normal controls are inadequate to produce the desired convergence.

Accordingly, the present invention has been accomplished to greatly increase the range of the normal sawtooth current adjustment controls.

Field of the Invention

The field of art to which this invention pertains is convergence circuits for color television receivers and in particular to convergence circuits for adjusting the sawtooth current in a pair of series connected convergence coils to control the convergance of a pair of electron beams.

SUMMARY OF THE INVENTION

It is an important feature of the present invention to provide an improved convergence circuit for a color television receiver.

It is another feature of the present invention to provide extended range for the adjustment controls which regulate the sawtooth current in convergence coils of a color television receiver.

It is an important object of the present invention to provide a convergence circuit for a color television receiver which has means for readily reversing the direction of the sawtooth current in a pair of series connected convergence coils.

It is an object of the present invention to provide a convergence circuit having a pair of convergence coils coupled in series with the secondary winding of a transformer wherein the transformer is the source of sawtooth current for the coils and wherein the leads of the transformer are readily releasably coupled to the leads of the convergence coils and are interchangeable.

It is another object of the present invention to provide a convergence circuit as described above wherein the transformer which supplies pulse voltages to the coils has readily releaseable means for being coupled to either one of the leads of the convergence coils.

It is a further object of the present invention to provide circuit means in a color television convergence circuit for substantially reducing the sawtooth current in one of a pair of series connected convergence coils without substantially affecting the sawtooth current in the other coil and in addition to provide selectable means for reversing the direction of the sawtooth current in the other coil.

These and other objects, features and advantages of the invention will be readily apparent from the following description of a certain preferred embodiment thereof, taken in conjunction with the accompanying drawing, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic of a convergence circuit according to the present invention showing a pair of convergence coils coupled in series with a transformer which supplies pulse voltages to the coil and showing the readily releasable pin connectors on the leads of the coils and on the leads of the transformer, and in addition showing a pin connector on the center tap of the transformer secondary winding.

FIG. 2 is a portion of the schematic of FIG. 1 showing the pin lead of one of the convergence coils coupled to the pin connector at the center tap of the transformer secondary winding.

FIG. 3 is a schematic similar to FIG. 2 showing the pin lead of the other convergence coil coupled to the center tap pin connector thereby eliminating the sawtooth correction for that coil.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The horizontal convergence circuit of the present invention utilizes a pair of convergence coils coupled in series with the secondary winding of a transformer. The transformer has a pulse voltage applied thereto from the horizontal output transformer at 15.75 kHz.

The pulse waveform developed across the secondary of the transformer is integrated in the convergence coils to develop a sawtooth current. This sawtooth current is utilized as one of the two convergence waveforms.

The main convergence waveform is a parabolic current and is developed from the horizontal output transformer as well.

The voltage pulse information is coupled from the horizontal output transformer to a variable inductor which is also coupled in series relationship with the two convergence coils. The pulse waveform is integrated in an integrating circuit to develop a sawtooth voltage. The sawtooth voltage is then applied across the convergence coils and is again integrated to develop a parabolic current in the coils. The combination of the parabolic and sawtooth currents then provides the required convergence information for the tube.

The circuit of the present invention provides means for adjusting the amplitudes of the parabolic and sawtooth currents, and also provides means for adjusting the relative magnitude of these waveforms in their respective coils. In other words, means are provided to adjust the overall amplitude in both coils simultaneously, or to increase the amplitude in one coil and, at the same time, decrease the amplitude in the other coil. These controls may be referred to as master amplitude and differential amplitude controls respectively.

Since each picture tube is different in the particulars of the geometric configuration and the manner in which the respective coils are mounted on the tube, the master amplitude and differential amplitude controls must be adjustable in order to accommodate the specific differences in each production item.

However, it has been found that in normal production runs, the variations between tubes may be greater than the amount of available adjustment in a typical convergence circuit. In other words, the master amplitude and differential amplitude controls may be insufficient to accommodate all picture tube situations. The result is that convergence cannot be achieved in certain tubes by adjusting the normal controls.

The present invention provides a means to greatly extend the range of the normal convergence controls and to provide a means for accomplishing convergence in tubes where this was not possible with prior circuits.

The present invention provides readily releaseable couplings between the transformer and the series connected convergence coils. These couplings take the form of pin connectors and pin leads on the convergence coils. By providing these readily releaseable couplings, the direction of the sawtooth current through the coils can be reversed simply by interchanging the points of connection of the convergence coils

with the secondary of the transformer. For instance, the pin lead for the green convergence coil can be inserted in the pin connector normally associated with the red convergence coil and vice versa.

In addition, the present invention provides a pin connector at the center tap of the transformer. The center tap is normally coupled through a variable impedance to circuit ground. By providing the pin connection at the center tap, either of the convergence coil leads can be coupled to the center tap to reduce the sawtooth current in that respective coil to substantially zero. To provide convergance, it may be necessary to eliminate the sawtooth correction in one of the convergence coils without interfering with that correction in the other coil.

Also, by the present invention any of the above mentioned combination of circumstances can be utilized. For instance, one of the convergence pins can be coupled to the center tap, while the other convergence pin can be interchanged. As will be explained, a total of six possible combinations of orientations and magnitudes for the sawtooth current can be obtained by the pin connections to the convergence coils of the present invention.

Referring to the drawings in greater detail, a horizontal convergence circuit according to the present invention is indicated generally by the reference numeral 10. The circuit includes a pair of convergence coil 11 and 12. The coil 11 may be associated with the electron beam for exposing the green phosphor dots, while the coil 12 may be associated with the beam for exposing the red phosphor dots on the cathode ray tube.

As explained, the coils 11 and 12 are supplied with parabolic and sawtooth current waveforms to accomplish the desired convergence function. The energy supplied for these two waveforms is derived from the horizontal output transformer and is applied to a circuit point 13 in the form of pulse information as indicated at 14. The pulse information as a repetition rate of 15.75 kHz.

The voltage pulse waveform is coupled from the circuit point 13 through a coupling capacitor 15 and a variable inductor 16 to a center tap 17 on a further variable inductor 18. The inductor 18 has an adjustable core 19 for varying the impedance between the upper and lower portions of the coil 18.

The inductor 18 integrates the pulse waveform to develop a sawtooth current which is then applied through a resistor 20 to an integrating circuit including first and second capacitors 21 and 22 and a resistor 23. A substantially sawtooth voltage is applied across the branch which includes the elements 21, 22 and 23. This sawtooth voltage is then applied to the convergence coils 11 and 12. The sawtooth voltage is integrated in the coils 11 and 12 to develop a parabolic current.

A further branch is coupled in parallel with the integrating branch 21, 22 and 23. The further branch includes a pair of resistors 24 and 25 and a pair of diodes 26 and 27. The resistor 23 has a variable contact 28 which is grounded as at 29 and which is coupled to the anodes at 30 between the two diodes 26 and 27. The diodes 26 and 27 are used to fix the base of the parabola to a DC reference level to assure proper convergence.

The parabolic current applied to the convergence coils 11 and 12 then produces a magnetic field in the U-shaped cores 31 and 32 in a well understood manner.

To develop the sawtooth current required in the convergence coils 11 and 12, the pulse voltage 14 is coupled from a circuit point 33 through a line 34, a capacitor 35 and a further line 36 to a primary winding 37 of a transformer 38.

The pulse voltage is then coupled by means of a movable core 39 to a secondary winding 40 of the transformer. The output of the primary winding 37 in then coupled by way of a line 41 to the blue convergence circuit.

The pulse voltage as developed across the secondary winding 40 of the transformer 38 is integrated in the convergence coils 31 and 32 to develop the required sawtooth current.

The overall magnitude of this sawtooth current may be adjusted by varying a potentiometer 42 which is coupled from a center tap 43 on the winding 40 to circuit ground at 44 through a resistor 45.

The differential amplitude of the sawtooth current through the convergence coils 11 and 12 may be varied by adjusting the movable contact 28 on the resistor 23. This will increase the sawtooth current through one coil and simultaneously decrease the sawtooth current through the other coil. In a similar manner, the variable inductor 16 acts as a master amplitude control for the parabolic current in the coils 11 and 12, while the variable inductor 19 acts as a differential control for the parabolic current.

Due to differences in the physical characteristics of production picture tubes and the various windings which are mounted to the tube, the adjustment controls 42 and 28 may be inadequate to produce the required tilt in the parabolic current in order to accomplish convergence. In other words, the variations from tube to tube in the production line may exceed the normal range of the convergence adjustment controls for the sawtooth waveform.

It has been found that the range of these controls can be significantly extended by the present invention which utilizes three pin connectors 46, 47 and 48. The pin connectors 46, 47 and 48 include pins 49 and 50 which are coupled to the respective leads of the convergence coils 11 and 12 and connectors 51, 52 and 53 which are adapted to receive the pine 49 and 50.

Any one of the connectors 51, 52 and 53 may receive either one of the pins 49 and 50. This provides a total of six combinations for coupling the pulse voltage to the convergence coils.

For instance, in the position shown in FIG. 1, the sawtooth current will exist in one direction through the convergence coils 11 and 12. If the pins 49 and 50 are interchanged as shown by the dotted lines 54 and 55, the current through the coils 11 and 12 will be reversed.

FIGS. 2 and 3 are substantially identical to FIG. 1 and accordingly reference numerals have been carried to FIGS 2 and 3 from FIG. 1.

FIG. 2 shows two additional combinations of the available possible couplings for the transformer winding 40 to the convergence coils 11 and 12. In FIG. 2, the pin 50 is shown coupled to the connector 53. This arrangement, effectively reduces the sawtooth current in the coil 12 to zero without substantially altering the sawtooth current in the convergence coil 11. In the alternative, the pin 50 may be coupled to the connector 53, but the pin 49 can be coupled to the connector 52 to reverse the direction of sawtooth current in the winding 11.

FIG. 3 shows two additional combinations of the pin connections provided by the present invention. In FIG. 3 the pin 49 is shown received within the connector 48, thereby reducing the sawtooth current in the coil 11 to substantially zero. In the alternative, the pin 50 which is shown received within the connector 52 may be received within the connector 51 thereby reversing the sawtooth current in he convergence coil 12.

Accordingly, six combinations of pin and connector arrangements can be achieved by the present invention to significantly alter the nature of the sawtooth current within the convergence windings 11 and 12 thereby extending the range of the normal control adjustments 28 and 42.

I claim as my invention:

1. A horizontal convergence circuit comprising:
first and second convergence coils for converging a number of electron beams in a cathode ray tube, means for supplying selected amplitudes of parabolic and sawtooth current to said convergence coils, and means for selectably reversing the direction of sawtooth current in one of said convergence coils.

2. A horizontal convergence circuit in accordance with claim 1 wherein means are provided for selectably reversing the direction of current in both of said convergence coils.

3. A horizontal convergence circuit comprising:
a transformer,
first and second convergence coils,

means for coupling substantial pulse voltage to said transformer,

readily interchangeable connector means for coupling and uncoupling said convergence coils in series with said transformer to allow the polarity of said pulse voltage to be reversed upon interchanging the points of connection of said convergence coils with said transformer.

4. A horizontal convergence circuit in accordance with claim 3 wherein said transformer has a center tap, an impedance coupling said center tap to circuit ground, and the point of coupling of said impedance to said center tap being provided with coupling means which are interchangeable with said connector means for said convergence coils.

5. A horizontal convergence circuit in accordance with claim 4 wherein said impedance comprises a resistance and wherein said resistance has a movable contact to provide a master tilt control for said convergence coils.

6. A horizontal convergence circuit in accordance with claim 3 wherein said readily interchangeable connector means comprise pins and associated pin connectors, said pin connectors being provided on opposite ends of the secondary winding of said transformer, and said one of said pins being provided on a lead of each of said convergence coils.

7. A horizontal convergence circuit in accordance with claim 6 wherein an additional one of said pin connectors is coupled to the center tap of said secondary winding and wherein a variable impedance is coupled from said center tap to circuit ground to provide a master tilt control for said convergence coils, said additional pin connector being suitably formed and positioned to receive another one of said pins from said convergence coils thereon.