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COLOR TELEVISION SYSTEM

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Fig. 1

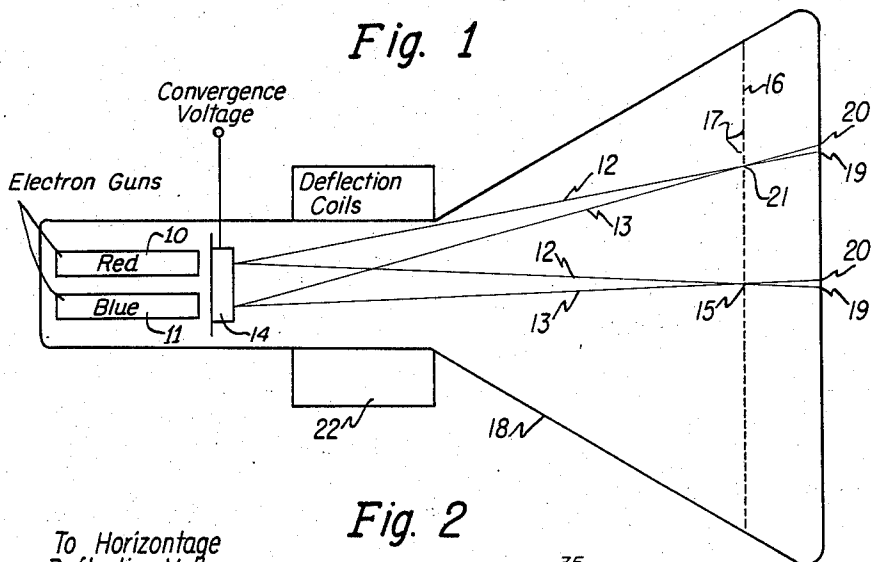
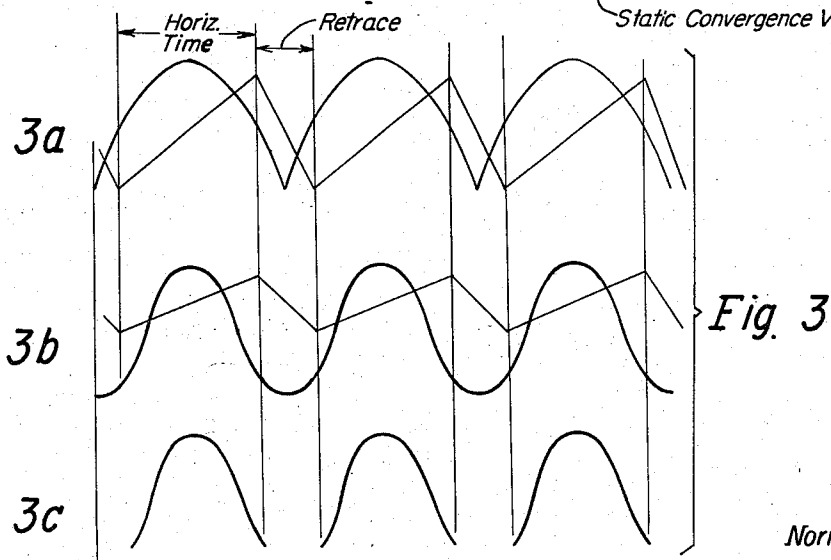
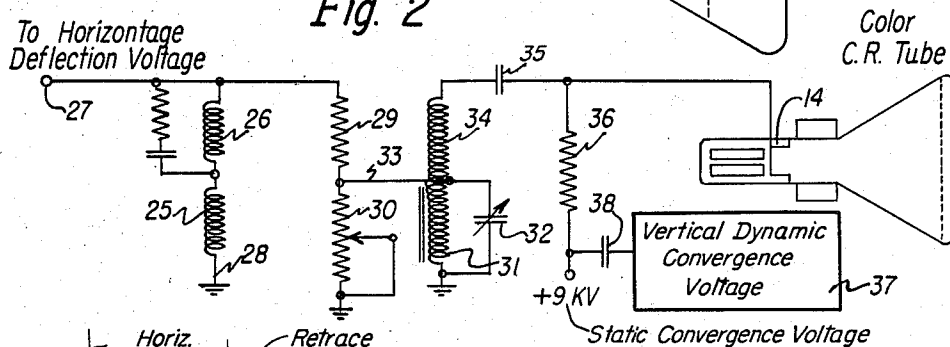


Fig. 2



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COLOR TELEVISION SYSTEM

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The present invention relates to color television receivers and more particularly to a system for converging the beams of a cathode ray tube of the type having a plurality of separately controlled electron beams containing different color information.

For providing color television, cathode ray tubes have been developed wherein a plurality of beams are used to produce different colors. In such tubes, it is necessary to converge the beams which originate at different positions so that the pictures of different colors are in proper registry. One such tube is a direct view cathode ray picture tube having a multi-color phosphor surface comprising a plurality of separate and distinct phosphor dots, each dot emitting light of a selected one of two or more different primary colors. The different color phosphor dots are closely intermixed in symmetrical groups, each group being positioned behind an opening of a shadow mask, the shadow mask being positioned between the electron beam source and the phosphor surface. The shadow mask has a very large number of openings in order to provide sufficient picture detail. Each different color phosphor dot of the phosphor groups behind the mask is arranged to be scanned by a separate electron beam which is individually modulated with the color information for the particular color of phosphor dots.

The separate individually modulated electron beams in such a tube may originate from different electron guns within the tube neck, with all of the beams being simultaneously deflected by common horizontal and vertical deflection systems to thereby scan the shadow mask. All of the separate electron beams, originated at different symmetrical positions within the neck of the tube, are also passed through a voltage responsive convergence lens to cause the beams to converge and cross at a point within the opening of the shadow mask wherefrom they continue toward the respective color phosphor dot of the phosphor dot group behind the mask opening. It is apparent that the focal length for the convergence lens means must vary in accordance with the deflected position of the electron beams if the beams are to be accurately converged and crossed within the openings of the shadow mask as the electron beams are deflected to scan the shadow mask. It has been found that the convergence lens voltage should be dynamically varied in accordance with the horizontal and vertical deflection voltage variations. A substantially parabolic waveform for the dynamically varying convergence voltage, varying in synchronism with the horizontal deflection voltage, is satisfactory to produce the desired synchronized variation of convergence lens focal length.

It is a principal object of the present invention to provide a simplified circuit for converging swept beams in a dynamically varying manner in proper synchronism with the swept position thereof.

Another object of the invention is to provide a simple circuit for use with a color picture tube of the type including a plurality of beams originating from spaced sources producing a dynamically varying convergence

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voltage with an approximately parabolic waveform during the active time interval during which the plurality of electron beams are horizontally scanned from one side of the screen to the other side in the direction to produce a horizontal line of a color television picture.

A feature of the invention is the provision of a resonant circuit tuned to the frequency of the horizontal deflection voltage and coupled to the deflection circuit in such manner as to convert a small portion of the horizontal deflection energy to a dynamically varying convergence voltage. The voltage of sinusoidal waveform developed in the resonant circuit may be phased to provide an approximate parabolic waveform during the time interval in which the horizontal deflection voltage is deflecting the electron beams to produce a horizontal line of a color television picture. The convergence voltage developed by the circuit of the invention may be readily mixed with a convergence voltage responsive to vertical deflection signals in order to produce complete dynamic convergence control.

Another feature of the invention is the provision of an inductance element in a resonant circuit for coupling to the horizontal deflection system in a manner to produce a dynamically varying convergence voltage, the inductance element being so designed as to provide a voltage step-up for the convergence voltage thus produced.

Yet another feature of the invention is the manner of coupling a resonant circuit to the horizontal deflection coils of a television receiver through a network of parallel connected high resistance elements in a manner to produce a dynamic convergence voltage without appreciably loading the horizontal deflection system.

Further objects, features, and the attending advantages of the invention will be apparent with reference to the following specification and drawings in which:

Fig. 1 is a diagrammatic view of one form of direct view color television picture tube for which the dynamic convergence voltage circuit of the invention may be used;

Fig. 2 is a schematic diagram of the circuit of the invention; and

Fig. 3 shows a family of curves representing various voltage waveform aspects of the invention.

In practicing the invention a voltage for converging the beams of a multi-gun color television tube, dynamically varying with the horizontal sweep, is produced by use of a resonant circuit. The resonant circuit is coupled to the horizontal deflection system through a network of high resistance elements connected in parallel with the horizontal deflection coils in a manner to minimize loading thereof. The resonant circuit includes an inductance and a capacitance and is tuned to the approximate frequency of the horizontal deflection voltage, i.e. 15,750 cycles per second. The inductance element may be an iron core coil having a winding effective to produce a voltage step-up ratio. In such manner a small amount of horizontal deflection energy is transformed into a sinusoidally varying voltage, the phase of which may be adjusted by the tuning of the resonant circuit, so that an effectively parabolic waveform is provided during the time that the electron beams are horizontally scanned to produce a horizontal line. The dynamic convergence voltage in the resonant circuit may be connected, together with a static convergence voltage and a vertically synchronized dynamic convergence voltage, to the convergence lens element of the picture tube to thereby obtain complete control of the focal length of the convergence lens for all deflected positions of the electron beam.

Referring to the drawings for a more detailed description of the invention, Fig. 1 diagrammatically shows one embodiment of a color television tube with which the circuit of the invention may be used. In order to simplify the drawing, only two electron guns 10 and 11 for pro-

ducing electron beams containing color information for blue and red respectively have been shown. It should be understood, however, that in at least one practical form of such television tube, three electron guns, symmetrically positioned within the tube neck, are employed to produce three differently modulated electron beams containing information for red, blue and green primary colors. The electron beams 12 and 13 from the electron guns 10 and 11 are passed through a convergence lens element 14 to cause said beams to converge and cross at the point 15 within the picture tube.

A shadow mask 16 of metal or the like and having a large number of small openings 17 is positioned in a plane within the tube envelope 18 at a point intersecting the point 15 at which the electron beams 12 and 13 are converged. The electron beams 12 and 13 converging at the point 15 pass through one of the openings 17 of the shadow mask 16 and illuminate a red phosphor dot 19 and a blue phosphor dot 20 respectively. The phosphor dots 19 and 20 are symmetrically grouped on the face of the picture tube behind the opening 17 of the shadow mask 16. The diagrammatic illustration of the tube as shown in Fig. 1 is intended to be a top plan view showing the electron beams 12 and 13 in two horizontal deflected positions. When the electron beams 12 and 13 are horizontally deflected to pass through the opening 21 of the shadow mask 16 it is apparent that the focal length of the convergence lens 14 must be increased if the beams 12 and 13 are to converge and cross within the opening 21.

A static convergence voltage of about +9 kv., when applied to the convergence lens element 14, will produce a convergence of the electron beams 12 and 13 at the central point 15 for one typical condition of operation of the color television picture tube 18. However, the convergence voltage must be dynamically varied during the deflection of the electron beams in order to produce the dynamic variation of the convergence lens focal length as referred to in the foregoing.

The electron beams 12 and 13 are simultaneously deflected by horizontal and vertical deflection coils generally shown at 22. In order to obtain the proper dynamic variation of the focal length of the convergence lens 14 in accordance with the horizontally deflected positions of the electron beams 12 and 13, a convergence voltage having a dynamically varying waveform of approximate parabolic shape is applied to the convergence electrode 14 during the time that the electron beams 12 and 13 are horizontally deflected from one side of the shadow mask 16 to the other to produce a horizontal line. It should also be mentioned that the convergence voltage for the lens element 14 may be dynamically varied in accordance with the vertical deflection of the electron beams 12 and 13, although the present invention is not directly concerned with the manner of producing the dynamically varying convergence voltage that is synchronized with vertical deflection. The desired approximate parabolic waveform for the hynamic convergence voltage to be obtained by the circuit of the invention is shown by the curve 3a of Fig. 3 in the proper synchronism with the horizontal trace time and the retrace time for the electron beams.

The circuit of the invention is shown in Fig. 2 of the drawings wherein the horizontal deflection coils are shown at 25 and 26 to be connected at 27 and 28 to a source of horizontal deflection voltage. Connected in parallel with the horizontal deflection coils 25 and 26 is a network of high resistance elements 29 and 30. Resistance element 30 may be adjustable in order to provide a control of the amplitude of dynamic convergence voltage to be produced by the circuit of the invention. A resonant circuit comprising a coil 31 having a high permeability core and variable condenser 32 is connected by line 33 to the connection between high resistance elements 29 and 30. In such manner a small portion of the

horizontal deflection energy in the deflection coils 25 and 26 is applied to the resonant circuit including the coil 31 and condenser 32. The variable condenser 32 is adjusted to resonate the circuit at the frequency of the horizontal deflection voltage, which is, for standard television practice, 15,750 cycles per second.

The horizontal deflection voltage across the deflection coils 25 and 26 has a modified square waveform in order to produce the desired deflection current of sawtooth waveform in the deflection coils. The small portion of energy connected by line 33 to the resonant circuit 31 and 32, having the modified square wave voltage waveform is transformed by the resonant circuit 31 and 32 to a sinusoidally varying waveform. Such waveform is shown by the curve 3b of Fig. 3 together with the sawtooth waveform of current induced in the horizontal deflection coils. The phase of the sine wave voltage may be adjusted by tuning of the resonant circuit, as is well known, so that the waveform of the voltage during the horizontal trace time is approximately parabolic. Thus in effect the active portions of the sine wave as shown by the curve 3c of Fig. 3 is of the approximate correct waveform and synchronism to be used as a dynamically varying convergence voltage for the convergence lens 14 of a multi-gun color television cathode ray tube.

In order to provide a voltage step-up for the sinusoidally varying signal in the resonant circuit including the coil 31 and condenser 32, the coil 31 may be provided with the voltage step-up winding 34 to be connected by the coupling condenser 35 to the convergence lens 14 of the cathode ray tube. The static convergence voltage having a potential of about -9 kv. is connected through a high resistance 36 to be mixed with the dynamically varying convergence voltage from the coil 34. If desired, a dynamic convergence voltage which is synchronized with the vertical deflection system of the television receiver, as diagrammatically shown at 37, may be coupled through the coupling condenser 38 to the resistance 36 to thereby provide a complete control of the convergence lens focal length for all deflected positions of the electron beams.

Various modifications may be made within the spirit of the invention and the scope of the appended claims.

I claim:

1. In a television receiver which includes a cathode-ray picture tube having means for developing at least one cathode-ray beam therein, deflection elements associated with said picture tube and responsive to a cyclic deflecting signal for deflecting the beam, and a convergence control element associated with the tube for producing a convergence effect on the beam; a circuit for producing a dynamic convergence control signal for the convergence element including in combination, a resonant network adapted to be tuned to the frequency of the cyclic deflecting signal, means for coupling the deflection elements to said resonant network to impress thereon a cyclic voltage corresponding to the deflecting signal and thereby to cause said resonant network to develop a substantially sinusoidally varying dynamic convergence control signal, and means for applying the dynamic convergence control signal to the convergence control element.

2. In a color television receiver which includes a cathode-ray picture tube having means for developing a plurality of cathode-ray beams therein, deflection coil means associated with the picture tube and connected to a deflecting signal source to derive a cyclic deflecting signal for deflecting the beam, and a convergence control element associated with the tube, a circuit for producing a dynamic convergence control signal for the convergence element including in combination, a resonant network adapted to be tuned to the frequency of the deflecting signal, means for coupling the deflection coil means to said resonant network to impress thereon a cyclic voltage corresponding to the deflecting signal and thereby to

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cause said resonant network to develop a substantially sinusoidally varying dynamic convergence control signal, and means for applying the dynamic convergence control signal to the convergence control element.

3. In a color television receiver which includes a cathode-ray picture tube having means for developing a plurality of cathode-ray beams therein, a pair of series-connected deflection coils associated with the picture tube and connected to a deflecting signal source to derive a cyclic deflecting signal for deflecting the beams, and a convergence control electrode associated with the tube; a circuit for producing a dynamic convergence control signal for the convergence control electrode including in combination, a resonant network adapted to be tuned to the frequency of the deflecting signal, a resistive network connected in parallel with the deflection coils and having an intermediate tap connected to said resonant network for impressing thereon a cyclic voltage corresponding to the deflecting signal thereby to cause said network to develop a substantially sinusoidally varying dynamic convergence control signal, and means for applying the dynamic convergence control signal to the convergence control electrode.

4. In a color television receiver which includes a cathode-ray picture tube having means for developing a plurality of cathode-ray beams therein, a pair of series-connected deflection coils associated with the picture tube and connected to a deflecting signal source to derive a cyclic deflecting signal for deflecting the beams, said deflection coils developing a cyclic voltage thereacross corresponding to the deflecting signal, and a convergence control electrode associated with the tube; a circuit for producing a dynamic convergence control signal for the convergence control electrode including in combination, a resonant network including an inductance coil shunted by a capacitor and adapted to be tuned to the frequency of the cyclic voltage, a resistive network connected in parallel with the deflection coils and having an intermediate tap connected to said resonant network for impressing the cyclic voltage across said network to cause said network to develop a substantially sinusoidally varying dynamic convergence control signal, and means including a voltage-step-up winding series-connected to said inductance coil in said resonant network for applying the dynamic convergence control signal to the convergence control electrode.

5. In a color television receiver which includes a cathode-ray picture tube having means for developing a plurality of cathode-ray beams therein, a pair of series-connected deflection coils associated with the picture tube and connected to a deflecting signal source to derive a cyclic deflecting signal for deflecting the beams, said deflection coils developing a cyclic voltage thereacross corresponding to the deflecting signal, and a convergence control electrode associated with the tube; a circuit for producing a dynamic convergence control signal for the convergence control electrode including in combination, a resonant network having one side connected to a point of reference potential and including an inductance coil shunted by a capacitor, said resonant network adapted to be tuned to the frequency of the cyclic voltage, a fixed resistor and a variable resistor series-connected across the deflection coils and to said point of reference potential, the common junction of said resistors being connected to the other side of said resonant network for impressing the cyclic voltage across said resonant network to cause said network to develop a substantially sinusoidally varying dynamic convergence control signal, and means including a voltage step-up winding series-connected to said inductance coil in said resonant network for applying the dynamic convergence control signal to the convergence control electrode.

6. In a television receiver which includes a cathode-ray picture tube having means for developing at least one cathode-ray beam therein, deflection elements asso-

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ciated with said picture tube and responsive to a cyclic deflecting signal for deflecting the beam, and a convergence control element associated with the tube for producing a convergence effect on the beam; a circuit for producing a dynamic convergence control signal for the convergence element including in combination, resonant network means adapted to be tuned to the frequency of the cyclic deflecting signal, means for impressing on said resonant network means a cyclic voltage corresponding to the cyclic deflecting signal to cause said resonant network means to develop a cyclic dynamic convergence control signal, and means for applying the dynamic convergence control signal to the dynamic convergence control element.

7. In a television receiver which includes a cathode ray picture tube having means for developing a cathode ray beam therein and having horizontal deflection means associated therewith for producing a deflecting field varying cyclically at a predetermined frequency for deflecting the beam to various horizontal positions, an electron beam controlling lens system having a focal length which varies with the horizontal position of the beam including in combination, a resonant network tuned substantially to the predetermined frequency of the deflecting field, means for coupling the horizontal deflection means to said resonant network to impress thereon a cyclic voltage wave of the predetermined frequency thereby to cause said resonant network to develop a control wave at the predetermined frequency and of generally sinusoidal wave form, said control wave having a phase relation with respect to the deflection field such that said control wave includes portions of maximum amplitude occurring when the beam is substantially in a central deflected horizontal position, and means including said resonant network forming an electron beam controlling lens the focal length of which varies with the amplitude of said control wave.

8. In a television receiver which includes a cathode ray picture tube having means for developing a cathode ray beam therein and having horizontal deflection means associated therewith for producing a deflecting field varying cyclically at a predetermined frequency for deflecting the beam to various horizontal positions, a dynamic electron beam converging system for the electron beam of the cathode ray picture tube including in combination, a resonant network tuned substantially to the predetermined frequency of the deflecting field, means for coupling the horizontal deflection means to said resonant network to impress thereon a cyclic voltage wave of the predetermined frequency thereby to cause said resonant network to develop a control wave at the predetermined frequency and of generally sinusoidal wave form, said resonant network including adjustable tuning means for controlling the phase of said control wave, and convergence means including said resonant network forming an electron beam controlling lens the focal length of which varies with said control wave.

9. In a cathode ray tube image-reproducing system wherein electron beam energy is angularly deflected both horizontally and vertically relative to the longitudinal axis of the tube to scan a raster at a target electrode, means for effecting said beam deflections with at least one beam deflection being under the control of a wave having a substantially sawtooth form, a dynamic electron beam controlling system comprising, field-producing means disposed adjacent to the undeflected path of said electron beam energy, and means to produce a wave varying as a sinusoidal function of said one beam deflection and having the same frequency as said one beam deflection for energizing said field-producing means.

10. In a television receiver which includes a cathode-ray picture tube having means for developing at least one cathode-ray beam therein, deflection elements associated with said picture tube and responsive to a cyclic deflecting signal for deflecting the beam, and a convergence control element associated with the tube for

producing a convergence effect on the beam; a circuit for producing a dynamic convergence control signal for the convergence element including in combination, resonant network means adapted to be tuned to the frequency of the cyclic deflecting signal, passive coupling means for impressing on said resonant network means a cyclic voltage wave of modified square wave form corresponding to the cyclic deflecting signal to cause said resonant network means to develop a cyclic dynamic convergence control signal, and means for applying the dynamic convergence control signal to the dynamic convergence control element.

11. In a television receiver which includes a cathode-ray picture tube having means for developing at least one cathode-ray beam therein, deflection elements associated with said picture tube and responsive to a cyclic deflecting signal for deflecting the beam, and a convergence control element associated with the tube for producing a convergence effect on the beam; a circuit for producing a dynamic convergence control signal for the convergence element including in combination, resonant network means adapted to be tuned to the frequency of the cyclic deflecting signal, passive coupling means connecting said resonant network means to said deflection elements for impressing on said resonant network means the cyclic deflecting signal to cause said resonant network means to develop a cyclic dynamic convergence control signal, and means for applying the dynamic convergence control signal to the dynamic convergence control element.

12. In a cathode ray tube image-reproducing system wherein electron beam components are angularly deflected both horizontally and vertically relative to the longitudinal axis of the tube to scan a raster at a target electrode, and which system includes means for effecting the beam deflections with at least one beam deflection being under the control of a wave having a substantially sawtooth form with trace and retrace portions, a dynamic electron beam controlling system including, field-producing means disposed adjacent to the undeflected path of said electron beam components, and resonant network means coupled to the means for effecting beam deflection to produce a control wave having the same frequency as said one beam deflection for energizing said field-producing means, said control wave having portions of substantially parabolic wave form which coincide in time with the trace portions of the sawtooth deflection wave.

13. In a television receiver which includes a cathode ray picture tube having means for developing a cathode ray beam therein and having horizontal deflection means associated therewith for producing a deflecting field varying cyclically at a predetermined frequency for deflecting the beam to various horizontal positions, an electron beam controlling lens system having a focal length which varies with the horizontal position of the beam including in combination, resonant network means tuned to provide resonant action at the predetermined frequency of the deflecting field, means for coupling the horizontal deflection means to said resonant network means to impress

thereon a cyclic voltage wave of the predetermined frequency thereby to cause said resonant network means to develop a control wave, said control wave having a phase relation with respect to the deflection field such that said control wave includes portions of maximum amplitude occurring when the beam is substantially in a central horizontal position, said resonant network means including adjustable tuning means for controlling the phase of said control wave, and means including said resonant network means forming an electron beam controlling lens the focal length of which varies with the amplitude of said control wave.

14. In a television receiver which includes a cathode-ray picture tube having means for developing cathode-ray beam components therein and having horizontal deflection means associated therewith for producing a deflecting field varying cyclically at a predetermined frequency for deflecting the beam components to various horizontal positions, a dynamic electron beam converging system for the electron beam components of the cathode-ray picture tube including in combination, resonant network means tuned to provide resonant action at the predetermined frequency of the deflecting field, means for coupling the horizontal deflection means to said resonant network means to impress thereon a cyclic voltage wave of the predetermined frequency, whereby said resonant network develops a control wave at the predetermined frequency and having portions of substantially parabolic wave form, said resonant network means including adjustable tuning means for controlling the phase of said control wave, and convergence means including said resonant network means forming an electron beam controlling lens positioned along the undeflected path of the beam components and having a focal length which varies with the amplitude of said control wave.

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