Aug. 8, 1961 S. W. MOULTON 2,995,680

ELECTRICAL SYSTEM

Filed Jan. 9, 1959 2 Sheets-Sheet 1

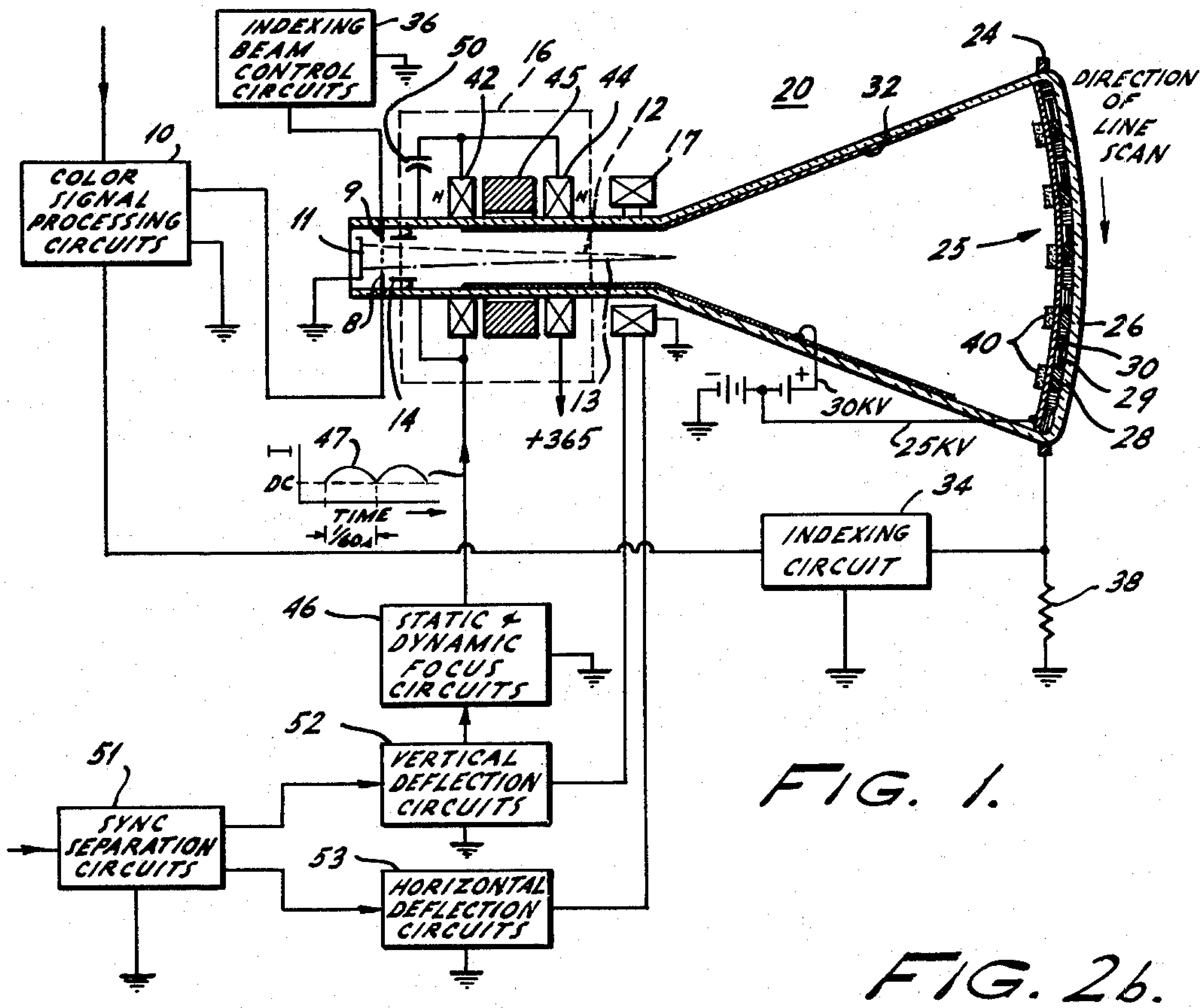
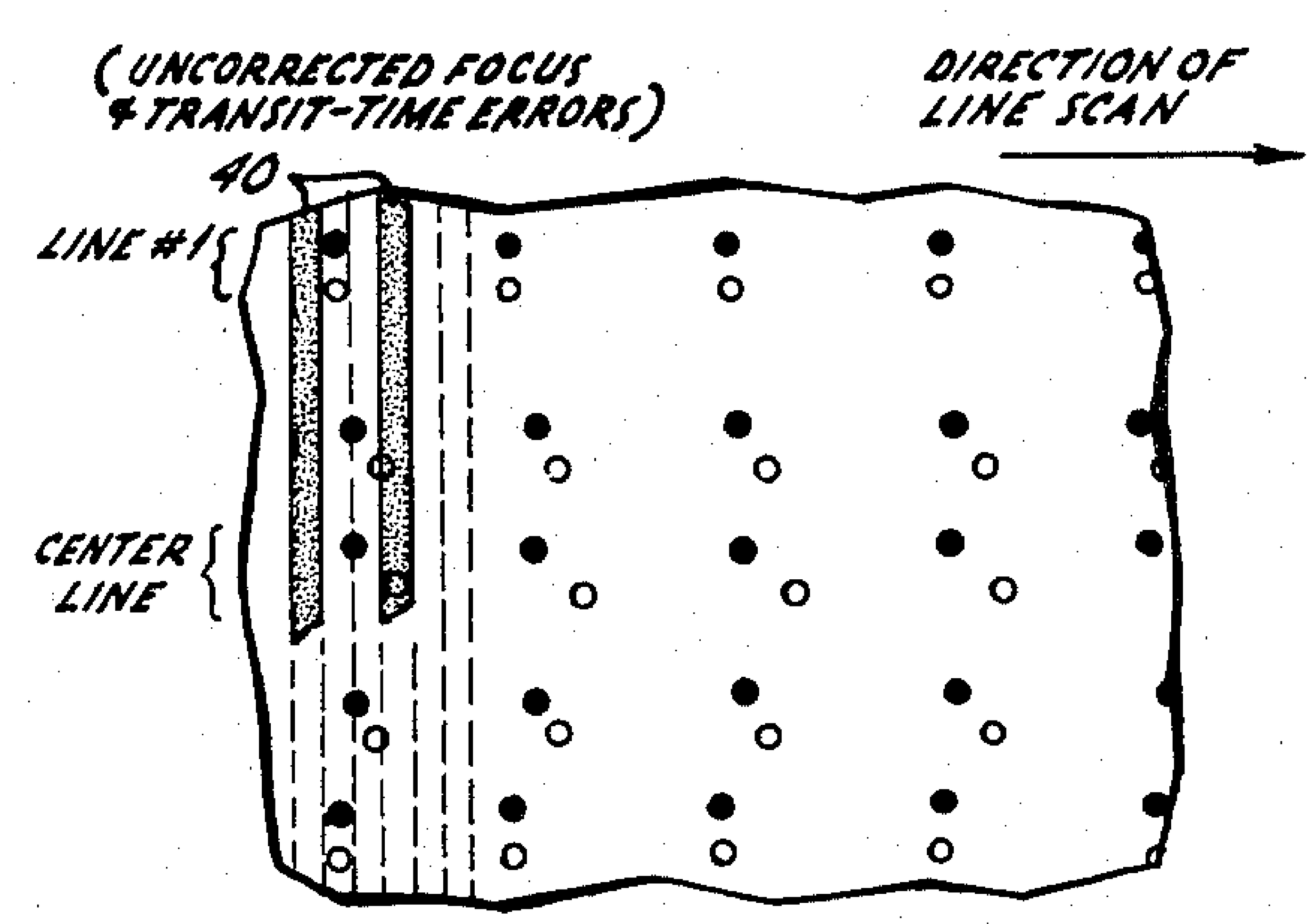
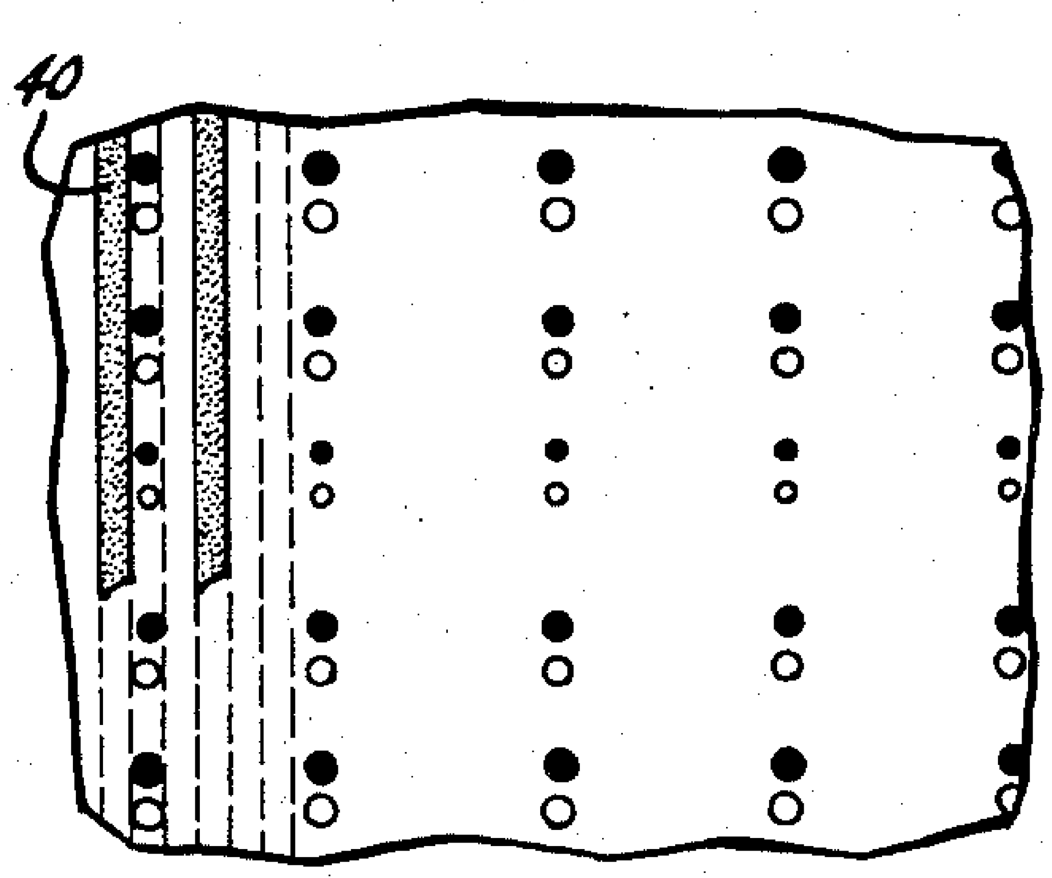



FIG. 1.

FIG. 2b.



● VIDEO BEAM 13
○ INDEXING BEAM 12

FIG. 2a.

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ELECTRICAL SYSTEM

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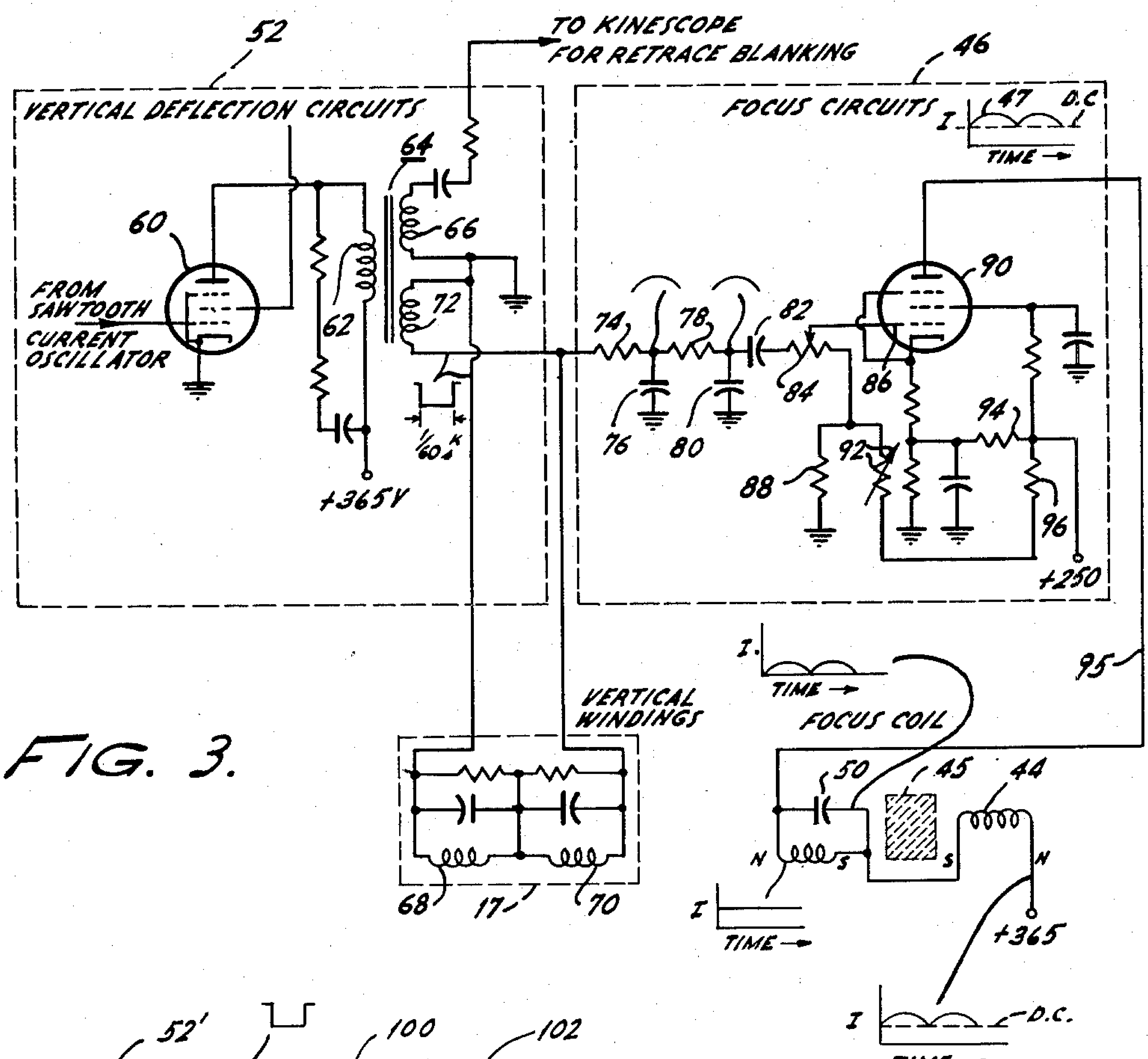


FIG. 3.

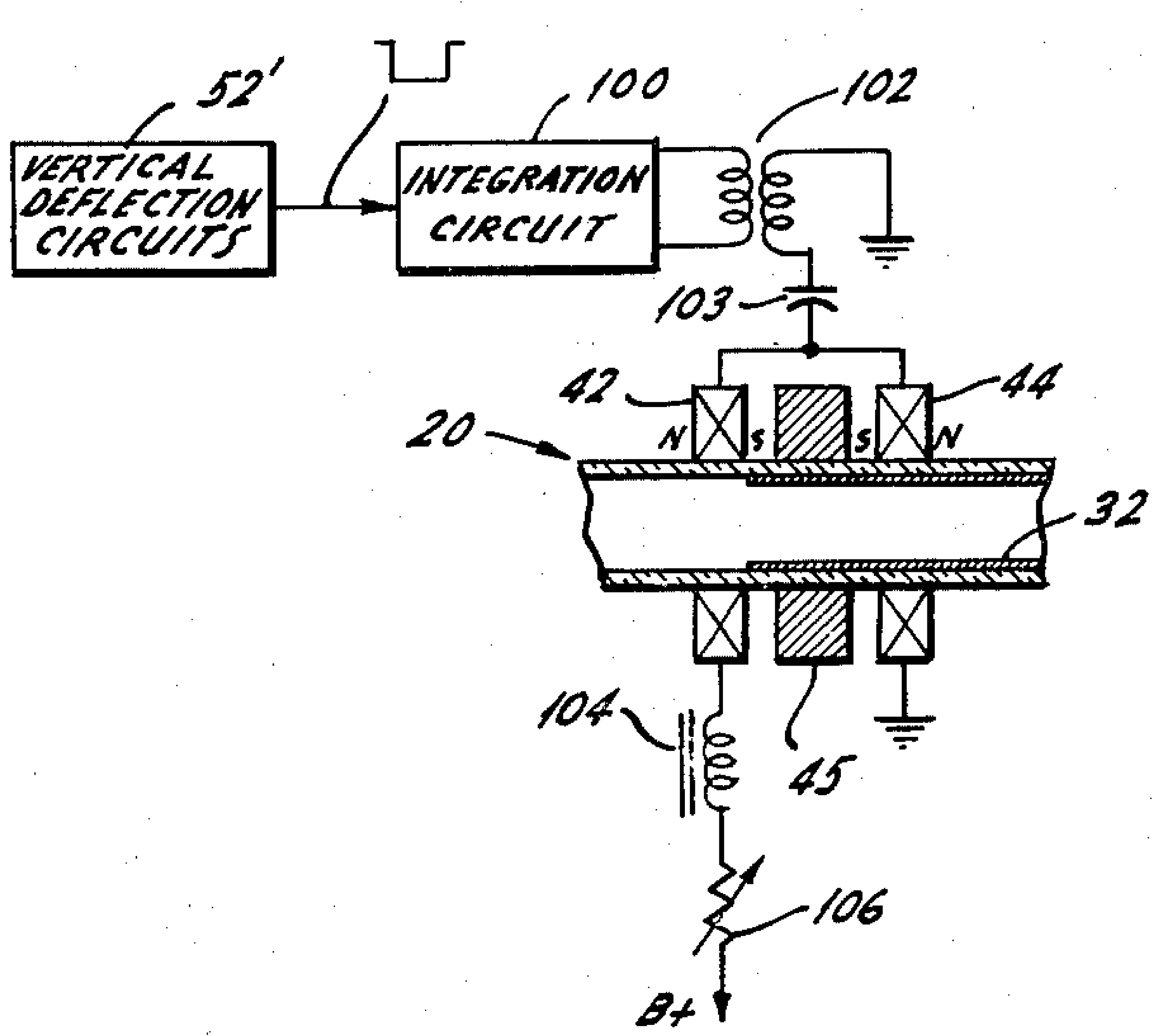


FIG. 4.

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# ELECTRICAL SYSTEM

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Filed Jan. 9, 1959, Ser. No. 785,976
16 Claims. (Cl. 315—31)

This invention relates to improvements in cathode ray tube systems and in particular to apparatus for preventing or overcoming the effects of certain types of errors which occur in cathode ray tubes in which a plurality of electron beams are produced. While not limited thereto my invention is particularly applicable to certain forms of cathode ray tubes suitable for use as the image reproducing devices in color television receivers, and it is with reference to this application that the invention will be described.

Certain cathode ray tubes include means for generating two or more electron beams which are shaped and accelerated toward a beam-intercepting structure by appropriate electromagnetic focussing and anode structures. The beam-intercepting structure is constituted of a screen having a plurality of groups of parallel strips of phosphor materials, each strip emitting light of a particular primary color when bombarded by an electron beam. On the rear surface of these strips a coating of an electron-permeable and light-reflecting material is deposited. On the other side of the latter material (or on another appropriate substrate) a plurality of indexing elements, which may also be in the form of strips, for example, are disposed in a predetermined geometrical relation to corresponding ones of the phospor strips. In one illustrative form these indexing elements may consist of a material such as MgO having a secondary emission characteristic which differs from that of the rest of the beam-intercepting structure.

Deflection means are provided which deflect the two beams in unison in a pattern of generally parallel paths which are substantially transverse to the elements of the beam-intercepting structure. The two beams are preferably very close to one another and aligned so that one is positioned just above the other.

One of the two beams is modulated in intensity by video signals corresponding to the color components of the scene televised and will hereinafter be referred to as "video beam." The video beam impinges upon successive ones of the phosphor strips of the beam-intercepting structure thereby producing a colored luminous image of the scene being televised.

The other of the two beams, which has a much smaller current than the average current in the video beam, impinges on the indexing elements and will be referred to hereinafter as the "indexing beam." Indexing signals are produced as a result of the emission of secondary electrons from the impinged-upon indexing elements. The secondary electrons are attracted and collected by a relatively positive collector electrode such as the conventional second anode coating within the tube. Variations in the potential of the beam-intercepting structure are caused thereby which are transmitted to external circuits to coordinate the position of the video beam on the phosphor screen with the intensity modulation of that beam so that when it strikes a red color-emissive strip, for example, its intensity will be modulated by a video signal whose amplitude corresponds to the red color content of an element of the scene being televised.

To insure precise coordination between the impingement of the video beam on the respective colored light-emissive strips and the modulation of the video beam in accordance with intelligence representative of these colors, it is often desirable during the scanning process to



maintain constant at all scanning points the component of displacemet between the two beams which extends in the direction of the line scan. Toward this end it may be desirable, for example, to have both the video and indexing beams traverse simultaneously the same phosphor strip at all points on the raster. When the orientation of the video beam is thus maintained constant with respect to that of the indexing beam, the beams are said to "track." However, it is often difficult, in practice, to insure that the two beams simultaneously impinge on the same phosphor strips at all points on the raster because of a number of distortions which arise in such cathode ray tubes.

One type of distortion which is particularly troublesome in cathode ray tubes of the type described results from the fact that the distance from the focussing field at which the electrons of the video beam come to a focus (hereinafter termed the "focal length of the beam") varies at different points on the raster. This varying focus condition is due to an electron-optical analogue of the optical aberration known as "curvature of field" which causes the spot of the video beam to have varying area depending on the part of the raster being scanned. The area of the spot will be directly proportional to the displacement of the part being scanned from the center of the raster. The focussing error results from the fact that, although the screen is deposited on a surface of a sphere, that sphere has a radius which is much larger than the distance from the center of deflection to the screen. It is therefore necessary to change the "focal length" to obtain better focus at all points on the screen. If the "focal length" is not changed, the video beam spot toward the top and bottom of the raster, for example, may overlap several adjacent phosphor strips simultaneously, thereby degrading the color purity of the reproduced image.

It has been previously known to change the "focal length" of the electron-optical system in a cathode ray tube dynamically as a function of the vertical and/or horizontal displacement of the beam to correct for this focussing aberration. In order to change the "focal length" as a function of vertical displacement, electromagnetic apparatus has previously been employed to produce an auxiliary axial magnetic field whose strength was varied from line to line. To avoid the rotation of the beams that any axial field introduces, the apparatus for producing the auxiliary field was often made in two parts which were so arranged that the respective axial magnetic fields produced thereby were mutually opposing. Thus, any rotation of the beams produced by the axial field of one part was offset by a counter-rotation by the other part.

Even if perfect focus at all points of the raster were attained, and the indexing and video beams did simultaneously impinge on the same strip at all scanning points the indexing signals produced in such a tube would not always accurately indicate the position of the beam because of a phenomenon known as "transit-time error." This error results from the fact that it takes longer for secondary electrons released from the central portions of the beam-intercepting structure by virtue of the impingement of the indexing beam thereupon to travel to the collector electrode than it does for secondary electrons released from the more peripheral portions of that structure. Consequently, the indexing signals derived in the scanning of successive lines, as measured from the beginning of those lines, do not bear a constant phase relation to one another. Thus when the indexing beam scans lines toward the top of the raster, the indexing signals produced will be advanced in phase with respect to the indexing signals produced when the indexing beam scans lines more toward the center lines of the raster. For this reason erroneous beam position-indicating information may be transmitted to the indexing system with the result that the beam intensity modulation will not be coordinated with the beam position and color reproduction errors will result. It has hitherto been demonstrated that if the horizontal component of displacement between the two beams in successive scanning lines is varied in a predetermined fashion, the variations in the phase of the indexing signals in successive line scans may be equalized. In other words, since the time required for electrons to travel from the index strip to the collector plate is shorter in lines nearer the top and bottom of the raster, the indexing beam may be made to lag somewhat behind the video beam in this region whereas as lines nearer the center of the raster are scanned the two beams are gradually made to approach vertical alignment. It is possible to make the indexing beam lag behind the video beam by imparting rotary motion to both of them in the manner disclosed in the copending application of James S. Bryan, Serial No. 535,092, filed September 19, 1955, now Patent No. 2,943,219. In that application the compensatory rotation of the two beams to account for the transit-time error as measured in a vertical direction was accomplished by the use of independent auxiliary electromagnetic means for producing an auxiliary axial magnetic field which varied as successive lines of the raster were scanned.

It would, of course, be possible to employ in addition to the conventional focussing device both a bi-partite, non-rotational, dynamic focussing device and an auxiliary electromagnetic device to correct for focussing and transit-time errors respectively. However, the use of a combination of these magnetic devices would be costly and might pose some problems because of the possible interaction of the electromagnetic fields produced thereby. Furthermore, manufacture of systems employing both types of corrective devices would be relatively expensive because the use of additional cathode ray tube components would entail additional alignment, adjustment and other assembly problems.

It is therefore a principal object of the present invention to provide an improved apparatus for obtaining faithful color reproduction of scenes televised in color.

It is another object of the invention to provide apparatus for compensating for certain errors arising in plural-beam cathode ray tubes of the type described in a simple, practicable, and inexpensive way.

Another object of the invention is to provide a simple means whereby apparatus used for focussing in cathode ray tubes of the type described may be cheaply and inexpensively modified to correct for transit-time error.

Still another object of the invention is to provide improved means for correcting both focussing and transit-time error in cathode ray tubes of the type described.

These objects, as well as others which will appear, are obtained, according to my invention by applying two current components to a bi-partite, electromagnetic (axial field) device. I apply one component to both parts for adjusting the focus of the beams without introducing any net rotation thereof, and another component just to one part of the device for rotating the beams in the manner desired, the latter component also producing dynamic focussing. In one form of the invention when both the vertical focussing and transit-time errors vary approximately the same as a parabolic function of vertical displacement of the line scanned, I apply to both parts a constant amplitude direct-current component for providing vernier adjustment of the static focus and additionally apply to just one part a parabolic A.-C. component for dynamic focus and rotation. I provide a very simple and convenient way of doing this by applying a composite current containing the two components to the device and by by-passing the A.-C. component capacitively around one part of the device. The corrective parabolic A.-C. component generates a varying axial electromagnetic field in passing through only one part of the device, thereby dynamically changing the focal point of the beams to correct for the vertical focussing error and also rotating them so as to correct simultaneously for the vertical transit-time error. The uniform amplitude direct current passing through both parts of the device, on the other hand, causes the generation of an axial magnetic field of constant strength and net non-rotational focussing characteristics.

The invention may also take other forms. For example, under certain conditions the focussing and transit-time errors may be disparate so that it may be desired to produce greater dynamic focussing effects than dynamic rotational effects. In this case both of the current components applied to the device may be alternating currents, but the component passing through one part may have an amplitude differing from that of the component passing through the other part. Some of these other forms will be considered in more detail below.

FIGURE 1 is a schematic and block diagram of a color television receiving system having a plural-beam cathode ray tube with which my invention may be employed;

FIGURE 2*a* is a schematic representation of the position of the two beams when scanning the screen of the cathode ray tube of the system shown in FIG. 1 in which focussing and transit-time errors occur;

FIGURE 2*b* is a schematic representation of a pattern of dynamic focus and rotation of two beams which overcomes the focussing and transit-time errors which occur in cathode ray tubes of the type shown in FIGURE 1;

FIGURE 3 is a schematic circuit diagram of some of the components of the system shown in block form in FIGURE 1; and

FIGURE 4 is a schematic and block diagram of part of a color television receiving system in which another form of my invention may be employed.

Referring to FIGURE 1 a color television receiving system is shown. Incoming color television signals which may be of the type approved for U.S. commercial television broadcast, for example, are applied to color signal processing circuits **10**. After being processed in circuits **10** the incoming color video signals are applied to one of two control grids **8** situated in front of the cathode **11** of tube **20**. A second control grid **9** is also located in front of cathode **11** and is connected to indexing beam control circuits **36**. The cathode **11** and the two control grids **8** and **9** produce a video beam **12** and an indexing beam **13**. An accelerating anode **14**, to which an appropriate positive potential may be applied, helps to provide impetus to both of the beams **12** and **13** which then pass through magnetic fields produced by apparatus shown within the dashed-line box **16**. Box **16** includes a non-rotational permanent focussing magnet **45** (i.e., a two-part axial magnet consisting of N-S and S-N magnets placed next to each other—the rotation caused by one being cancelled by the rotation introduced by the other) (or a rotational permanent magnet to compensate for beam-aperture misalignments in the electron gun, for example) which shapes the beams **12** and **13**. Box **16** also includes other components arranged and constructed according to my invention as will be explained in detail below. The beams **12** and **13** are deflected, in unison, by a conventional deflection yoke **17** in a series of generally parallel and rectilinear scanning paths (extending in the direction indicated) on the beam-intercepting structure **25**. The horizontal and vertical deflection windings of yoke **17** are respectively energized by horizontal and vertical deflection signals from circuits **53** and **52**. The latter circuits receive horizontal and vertical synchronizing pulses from the synchronizing signal separation circuits **51** to which the detected composite video signal may be applied from the video detector or other appropriate point in the receiver.

The structure **25** is deposited on the faceplate **26** of the tube **20** and is comprised of a plurality of phosphor strips **28**, **29** and **30** which respectively emit green, red and blue light in response to the impingement of electrons thereupon. On the rear surface of the phosphor strips 28, 29 and 30 a light-reflective and electrically conductive layer 35 is deposited. The layer 35, which may be made of aluminum, serves to increase the brightness of the image produced by the scanning of the phosphor strips and also helps to prevent the discoloration of the phosphor screen known as "ion spot." The layer 35 may be at a positive potential of 25 kv. for example, so as to attract the primary electrons of the beams 12 and 13. Deposited on the layer 35 behind and in register with each of the green-emissive phosphor strips 28 are indexing strips 40 which may be of magnesium oxide (MgO), for example. These strips 40, when impinged upon by the indexing beam 12 emit secondary electrons which are collected by the anode coating 32 to which a positive potential of about 30 kv. may be applied so as to attract the secondary electrons.

Around the rim of the faceplate 26 a metal ring 24 is located which is capacitively coupled to the aluminum layer 35 so that when secondary electrons are emitted from the indexing elements 40 a displacement current passes through the load resistor 38 thereby producing voltage variations or signals which are applied to the indexing circuits 34. The indexing circuits 34 in turn produce signals which are applied to the color signal processing circuits 10 in order to coordinate the position of the video beam 12 with the intensity modulation thereof. There are a number of particular ways in which this coordination may be effected, but since this aspect of the system shown in FIGURE 1 does not concern the present invention, further description of the details of any particular indexing or control system will be omitted herefrom.

Although the indexing beam 13 is primarily intended to impinge on the indexing strips so as to produce indexing signals, it also impinges incidentally on the phosphor strips as well. Therefore the average intensity of the indexing beam 13 is ordinarily maintained much lower than the average intensity of the video beam 12 so that the reproduced image is not desaturated by the impingement of the beam 13 on the phopshor strips.

On the other hand the video beam necessarily will impinge on the indexing strips 40 as well as on the phosphor strips 28, 29 and 30 and both beams will cause secondary electrons to be emitted. The indexing beam is therefore sometimes modulated at a single frequency well above the video frequency band thereby permitting convenient separation of those signals appearing across resistor 38 which result from impingement of the video beam from the "true" indexing signals produced by the scanning of the indexing strips. In such a case the indexing circuits 34 will contain a bandpass filter (not shown) tuned to the modulated indexing beam frequency on its sidebands so that only the signals due to the impingement of the indexing beam 13 are utilized.

It should be appreciated that the positions of the beams 12 and 13 are only shown schematically in FIGURE 1. In practice, the beam apertures in the control electrodes 8 and 9 are actually vertically aligned so that a line joining their centers will be substantially parallel to the direction in which the strips of the beam-intercepting structure 25 extend.

Within the box 16 is shown a bi-partite electromagnetic device consisting of two windings 42 and 44 connected in series but so arranged that their respective axial magnetic fields are oppositely polarized. As stated above it has hitherto been the practice to employ such a bi-partite, non-rotational auxiliary focussing device to correct for focus dynamically. Such a device, when energized by current having a substantially parabolic waveform, created a varying auxiliary axial magnetic field which effectively overcame the defocussing of the beams. If the axial field of the permanent magnet 45 is not of the desired strength a direct current component from focus circuits 46 may be supplied to the two windings 42 and 44 which collectively do not produce any net rotational effect on the beams since they are so constructed and arranged that the rotation caused by winding 42 is cancelled by a counter-rotation caused by winding 44.

In accordance with my invention, if the focussing and transit time errors vary substantially as a parabolic function of the vertical displacement of the line scanned, I also provide an A.-C. component of current from the circuits 46 which has the desired parabolic waveform. However, I supply this parabolic current component effectively only to winding 44 since I shunt it around winding 42 by inserting a condenser 50 which has a very low reactance at the frequency of the A.-C. component in parallel with winding 42. Thus, although the bi-partite device, insofar as the unchanging component of direct current applied thereto is concerned, produces a non-rotational field, it produces a rotational field insofar as the changing parabolic current applied only to winding 44 is concerned. The latter winding changes the focal point of the beams dynamically to correct for vertical defocussing errors and also rotates both the video and indexing beams thereby varying the horizontal component of displacement between them so as to correct for transit-time error in the vertical direction.

The operation of the invention will be better understood by reference to FIGURE 2*a* which illustrates how the two beam spots, in the absence of dynamic focussing, are distorted by a phenomenon analogous to the optical aberration known as "curvature of the field." Although the faceplate 26 of the cathode ray tube may be a section of a sphere, the distance from the center of deflection to screen 25 is much shorter than the radius of the sphere of which the faceplate is a section, hence the "focal length" of the electron-optical system will be different for lines scanned in the middle thereof than for lines scanned off-center, the required "focal length" increasing toward the upper and lower extremities of the raster.

As shown in FIGURE 1, the focussing magnet 45 supplies the main focussing field. Its field might be strong enough, for example, to focus the beams at a point just outside the tube. In such a case it will be necessary to augment its field by passing a unidirectional current of constant amplitude through the windings 42 and 44 so that the beams will focus properly (without any rotation thereof) at the top and bottom of the raster. The amplitude of the required D.-C. component of the composite current having the waveform 47 in FIGURE 1 is indicated by a horizontal broken line. However, as has been previously pointed out, for proper focus at the top and bottom of the raster the "focal length" of the beams should be greater than the "focal length" required to focus the beams in the center of the raster. Therefore, in order to achieve overall optimum focus of the beams in the vertical direction, it is necessary to shorten the "focal length" of the electron-optical system so that the beams will also focus in the center of the raster and to lengthen the "focal length" increasingly as lines further away from the center are scanned.

To accomplish this objective a parabolic component of current shown as waveform 47 in FIGURE 1 is supplied from focussing circuits 46 to the bi-partite device comprising windings 42 and 44. However, in accordance with the form of my invention shown in FIGURE 1, I supply this parabolic current effectively only to winding 44. By so doing the focal length of the beams is adjusted so that when the parabolic current is at a maximum, the focal length is shortest corresponding to the scanning of the central line of the raster, and when it is at either of its two minima (during any one field) the focal length is greater corresponding to the greater distance between the center of deflection and the points of impingement at the top and bottom of the raster. It should be especially noted that since the parabolic current component is not applied to winding 42, it will cause the beams to be rotated as a function of the changing field produced in response to that current. Thus the winding 44 produces a field which both rotates and focusses the beams dynamically as a function of the vertical displacement of the line scanned.

Even if the defocussing of the beams shown in FIGURE 2*a* is completely overcome so that the beam spot at all scanning points on the raster has a uniformly small area as shown at the center line of FIGURE 2*a*, other color reproduction errors may nevertheless arise despite the fact that the two beams everywhere impinge simultaneously on the same strip. As explained above, transit-time errors resulting from the different lengths of paths which secondary electrons must travel to reach the anode coating 32 after being liberated from the indexing strips 40 cause the phase of indexing signals to vary in successive scanning lines. Since any axial field will rotate an electron beam, the effect of passing the A.-C. parabolic current only through the winding 44 is not only to adjust the focus of the beams dynamically but also to rotate them.

FIGURE 2*b* depicts how the two beams will be rotated so that the distance between them, as measured in the horizontal direction, is varied in successive lines as a result of the change in the auxiliary electromagnetic field produced by the coil 44. During the scanning of the top and bottom lines of the raster the beams are substantially aligned in a vertical direction since the parabolic current component is at its minima so that only the D.-C. component of the composite current from the circuits 46 is primarily effective at this time. Since the parabolic (A.-C.) component of current applied to the bi-partite device increases in amplitude when the more central lines of the raster are scanned, the coil 44 will produce an increasing rotational effect on the two beams because the coil 42 is by-passed by the capacitor 50 insofar as the A.-C. component is concerned. Thus, in this region of the raster, the indexing beam 12 is caused to lead the video beam 13 by distances which increase to a maximum horizontal displacement when the center line itself is scanned. Consequently, although the secondary-electrons emitted from the indexing strips when more centrally located lines are scanned have a longer path to travel to the collecting layer 32 than do the secondary electrons emitted when higher and lower lines are scanned, they have a "head start," so to speak, and therefore will produce signals equalized in phase relative to corresponding signals generated by the scanning of upper and lower lines.

FIGURE 3 shows details of one practical circuit which corresponds to components shown schematically in FIGURE 1. Only the vertical output stage of the deflection circuits 52 is shown in box 52 since an explanation of stages ahead of it is not deemed necessary for proper understanding of the operation of the invention. The output tube 60 supplies an amplified current having a sawtooth waveform to the primary winding 62 of the vertical output transformer 64. From the secondary winding 66 the resulting rectangular pulse is applied to blank the tube 20 during the vertical retrace interval. This pulse is also applied to the windings 68 and 70 of the deflection yoke 17 for deflecting the beam in a vertical direction.

From the secondary winding 72 the negative voltage pulse is passed through a double integration circuit consisting of the resistors 74 and 78 and the condensers 76 and 80. The use of a two-step or double integration circuit permits obtaining a higher parabolic voltage wave than is attainable with just a single integrator. As a result of the integrating action of resistor 74 and condenser 76, the negative pulse applied thereto is shaped to become the waveform shown at the junction of resistor 74 and condenser 76, i.e., an imperfect parabola. When the latter voltage is applied to resistor 78 and condenser 80 it is again integrated thereby producing the substantially parabolic waveform shown at the junction of the latter two elements. This parabolic voltage wave is applied via the coupling capacitor 82 and the potentiometer 84 to the grid 86 of pentode 90.

The potentiometer 84 and the resistor 88 constitute a voltage dividing network which is used to provide the desired level of the parabolic voltage to the latter tube. Resistors 88, 96 and potentiometer 92 comprise another voltage dividing network for adjusting the amplitude of the direct current component through tube 90. The value of resistor 96 chiefly determines the D.-C. bias on the grid 86 whereas the variable resistance 92 provides a vernier adjustment thereof. The resistor 94 helps to determine the cathode bias for D.-C. through tube 90.

At the plate of the tube 90 there will appear the composite current waveform 47 shown which has both a D.-C. component depending on the operating parameters of the tube, and a parabolic A.-C. component superposed thereupon. This composite current is applied via lead 96 to the focus coil assembly comprising the winding 42 and 44 arranged in a non-rotational manner. The D.-C. component of the composite current supplied from the plate of tube 90 is applied to both of the windings 42 and 22 to augment the field produced by the permanent magnet 45 for adjustment of the total unvarying axial magnetic static focussing field. The A.-C. parabolic component is by-passed around the winding 42 by way of the by-pass condenser 50 and is applied only to the winding 44 which focuses and rotates the beam dynamically as a function of the vertical position of the line being scanned.

Another form of the invention is shown in FIGURE 4 wherein parts identical to those in FIGURE 1 bear identical numbers, and those somewhat similar bear corresponding numbers which are primed. In this form, the static and dynamic focus currents are not provided by a common circuit but rather are provided from separate circuits. Thus a rectangular pulse of current at the field frequency is supplied from deflection circuits 52′ to an integration circuit 100 which produces a current having a parabolic waveform. The latter current is effectively applied only to winding 44 via transformer 102 and condenser 103 since the choke 104 is chosen to have a value which presents a high impedance at the field frequency. An adjustable amount of direct current may be supplied to both windings 42 and 44 from the B+ supply via the potentiometer 106 and choke 104 to supplement the field of the permanent magnet 45 for static focus adjustment of the beams. If the resistance of the potentiometer 106 is high enough, it may even be possible to dispense with the choke 104 since the major portion of the parabolic current will flow principally in the winding 44. The A.-C. component of current applied only to winding 44 produces dynamic focussing and rotation in the same manner as illustrated in FIGURES 1 and 3 since the operating principle is the same as that of the latter.

While both forms of the invention previously described contemplate applying the varying component only to one part of the bipartite device it should be appreciated that certain cases may require that both parts be energized by a corrective varying curent but that one part receive a larger portion of that current. To illustrate, suppose that a certain kind of cathode ray tube has characteristics such that more dynamic focussing than dynamic rotation is needed. This condition may require a parabolic current to be applied to both parts of the device and also require provision for passing a greater amount of that current through one part than through the other. By so doing the smaller amplitude current through one part will cause a certain amount of dynamic focussing and rotation of the beams, but this rotation will be offset by the corresponding component of the larger amplitude current passed through the other part. The current in the other part exceeding this corresponding component will provide the only net rotation of the beams. The dynamic focussing, on the other hand, will result from the combined varying electromagnetic field produced by all the parabolic currents in both parts.

The invention may be practiced without the necessity of applying any constant amplitude D.-C. to the bi-partite device at all. Certain types of permanent magnet focussers may include means therein for changing the field thereof thus obviating the need for any D.-C. in the bi-partite device.

The main focussing magnet itself may be either of the rotational or non-rotational type, although in practice the latter is more widely used. The former might be used to correct beam aperture misalignment by introducing compensatory rotation of the beams.

It should also be appreciated that the present invention may be employed in a focussing assembly which does not include a permanent magnet to establish the main focussing field, but does include only a bi-partite, non-rotational electromagnetic device. In such a case the main focus adjustment may be made by regulating the amount of constant amplitude D.-C. component passed through both windings. An A.-C. component may be passed through just one of the windings as shown in FIGURES 1 or 4 to produce the desired dynamic focus and rotation effect.

While I have described my invention with reference to certain specific embodiments, I do not wish to be limited thereto, for obvious modifications will occur to those skilled in the art without departing from the scope of my invention.

What I claim is:

1. In a plural beam cathode ray tube system which employs a bi-partite electromagnetic device for producing an axial magnetic field, means for applying a first current component through both parts of said device for focussing said beams, and means for applying a second variable amplitude current component through only one part of said device.

2. The invention according to claim 1 wherein said first current component has a constant amplitude.

3. The invention according to claim 1 wherein said first current component has varying amplitude.

4. In a plural beam cathode ray tube system which employs a bi-partite non-rotational electromagnetic device for producing an axial magnetic field, means for applying a unidirectional current of constant amplitude through both parts of said device, and means for applying an alternating current only through one part of said device.

5. In a plural-beam cathode ray tube system which employs a bi-partite non-rotational electromagnetic coil for producing an axial magnetic field, means for causing one part of said coil to provide dynamic focussing and dynamic rotation of the beams, and means for causing both parts of said coil to provide static focusing of said beams.

6. The invention according to claim 5 wherein said dynamic focussing and rotation is a function of the displacement of the scanning paths of said beam as measured in a direction substantially transverse to the direction of said paths.

7. A magnetic assembly for a cathode ray tube in which a plurality of electron beams are produced, comprising a bi-partite electromagnetic device, the parts of said device being constructed and arranged to produce mutually-opposing and coaxial magnetic fields upon energization thereof, means for causing both parts of said device to produce substantially equal and opposing coaxial magnetic fields which are parallel to the axis of said tube, means for varying the intensity of said fields and means for causing only one part of said device to produce a magnetic field of predetermined varying intensity.

8. An electromagnetic assembly for a cathode ray tube comprising a bi-partite electromagnetic device having first and second parts constructed and arranged to produce substantially coaxial and mutually opposing electromagnetic fields extending generally parallel to the axis of said tube, and a capacitive path in parallel with one part of said device having negligible impedance at a predetermined frequency.



9. The electromagnetic assembly according to claim 8 wherein said predetermined frequency is the television field frequency.

10. A cathode ray tube focussing system comprising an electromagnetic device having two parts connected in series, said parts being arranged to produce equal and opposite coaxial electromagnetic fields generally parallel to the axis of said tube in response to energization thereof, means for applying a varying intensity current at the junction of said parts, means in series with said parts for passing a direct current of constant intensity through both of said parts, and means in series with both of said parts presenting a high impedance to said changing current.

11. The focussing system according to claim 10 wherein said means in series with both of said parts presenting a high impedance to said changing current comprises inductive means, wherein said varying intensity current varies at the television field frequency, and wherein said inductive means has a high impedance to currents at said field frequencies.

12. In a color television image-reproducing system including a dual-beam cathode ray tube wherein two electron beams are caused to scan a screen in successive lines for reproduction of the color image and for production of an indexing signal, one of said beams being the image-reproducing beam and the other being the indexing beam, a pair of windings constructed and arranged for the production of mutually-opposing beam-influencing magnetic fields, means for applying a first current component through both of said windings to effect static focussing of said beams, and means for applying a second current component through one only of said windings to effect dynamic focussing of the beams and also to effect relative displacement of the beams in the direction of line scanning during each scanning of said screen.

13. A color image-reproducing system according to claim 12, wherein the last-recited means applies a second current component whose amplitude varies in relation to the progression of the beams during each scanning of the screen.

14. A color image-reproducing system according to claim 12, wherein said windings are connected in series in respect to both of said current components, and the last-recited means includes a capacitor in parallel with one of said windings, said capacitor having negligible impedance at the field-scanning frequency.

15. A color image-reproducing system according to claim 12, wherein said windings are connected in series in respect to said first current component and in parallel in respect to said second current component, and the last-recited means includes an inductor in series with one of said windings in respect to both current components, said inductor having high impedance at the field-scanning frequency.

16. In a color television image-reproducing system including a dual-beam cathode ray tube wherein two electron beams are caused to scan a screen in successive lines for reproduction of the color image and for production of an indexing signal, one of said beams being the image-producing beam and the other being the indexing beam, there being inherent in such system tendencies to produce error in the beam focussing and error in the phase of the indexing signal, apparatus for substantially compensating for such errors, comprising a pair of windings constructed and arranged for the production of mutually-opposing beam-influencing magnetic fields, means for applying through both of said windings a first current component to effect static focussing of said beams in compensation for said beam focussing error, and means for applying through one only of said wind-

ings a second current component to effect dynamic focussing of said beams in further compensation for said beam focussing error and to effect relative displacement of the beams in the direction of line scanning during each scanning of said screen so as substantially to compensate for said indexing signal phase error.



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