Sept. 17, 1940. R. C. BALLARD 2,215,285

TELEVISION APPARATUS

Filed Aug. 15, 1931

Fig. 1.

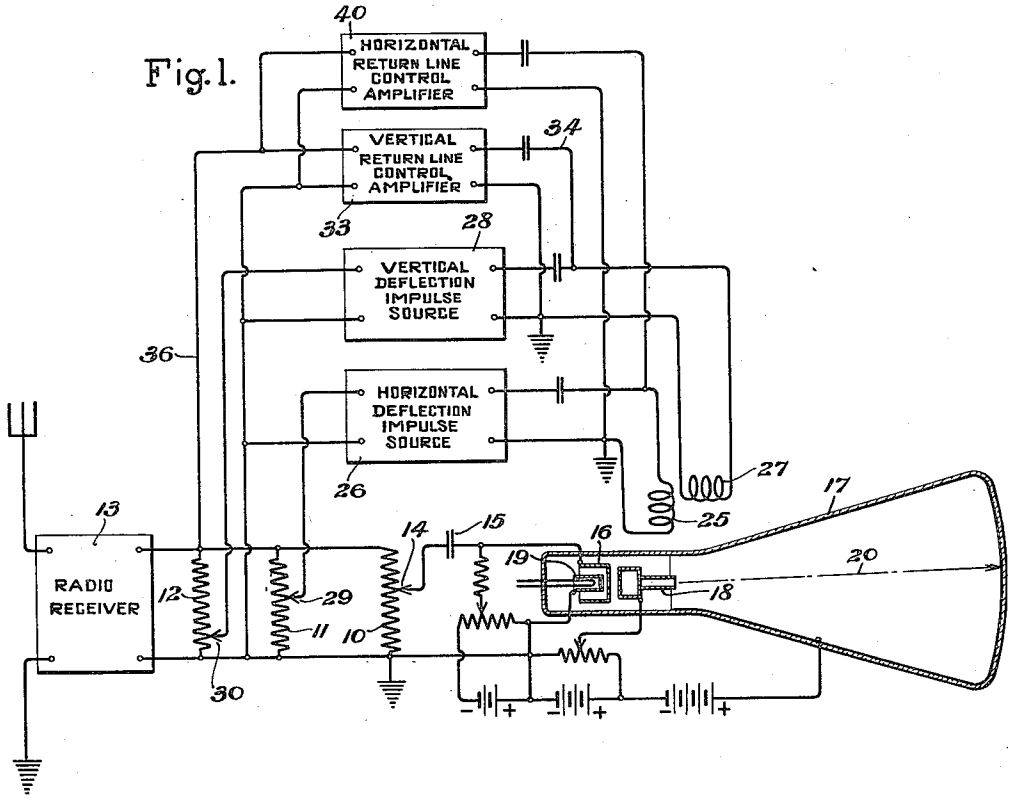


Fig. 2.

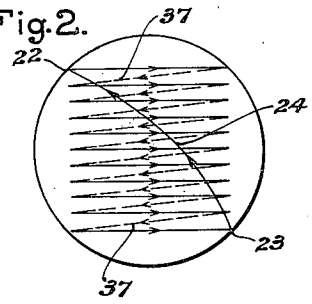
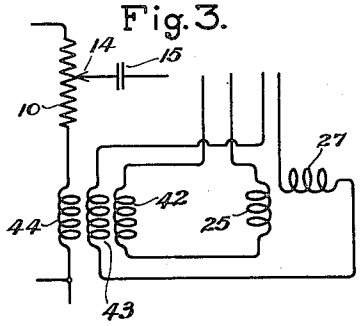


Fig. 3.



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UNITED STATES PATENT OFFICE

2,215,285

TELEVISION APPARATUS

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Application August 15, 1931, Serial No. 557,244

35 Claims. (Cl. 178—7.5)

My invention relates to television systems and methods of operation therefor.

In a television system employing a cathode ray tube to reproduce the picture at the receiver, the fluorescent screen of this tube is usually scanned by the cathode ray, say from left to right and top to bottom, as one reads a book. After tracing each horizontal left-to-right line, the beam is rapidly returned to the beginning of the next line. Its return path, referred to as the horizontal return line, causes an objectionable light trace on the screen. Upon reaching the bottom of the picture, the beam must return to the top in order to scan the next picture. Again, its return path, referred to as the vertical return line, is visible as an undesirable light trace on the screen.

One of the objects of my invention is to eliminate these undesirable return lines.

Another object of my invention is to provide an improved television system wherein better contrast in the picture is obtained than has been possible under similar operating conditions, with the various systems proposed heretofore.

Other objects and advantages will hereinafter appear.

In accordance with my invention, in a television system wherein a cathode ray tube forms part of the receiving station, electrical effects developed locally in an operating circuit of this station, incidental to normal operation thereof, are utilized to substantially cut off the ray during predetermined intervals.

Further, in accordance with my invention, in a television receiving station including a cathode ray tube and means for deflecting the ray horizontally and vertically, electrical effects, developed incidental to the operation of the ray-deflecting means, are utilized to substantially cut off the ray during the return periods in both the horizontal and vertical directions.

Further, and more particularly, in accordance with my invention, in a television receiving system including a cathode ray tube and associated electromagnetic deflecting coils, a voltage wave of the same general shape as that occurring across these coils is impressed upon the grid of the tube to substantially cut off the ray during the return periods in the ray-deflecting cycles.

My invention resides in the system and method of operation of the character hereinafter described and claimed.

For the purpose of illustrating my invention, an embodiment thereof is shown in the drawing, wherein

Figure 1 is a diagrammatic view of a television receiving system embodying my invention;

Fig. 2 is an elevational view, looking toward the left in Fig. 1; and

Fig. 3 is a diagrammatic view, illustrating a modification.

The receiving station in Fig. 1 is of the same general type disclosed in the copending application by Arthur W. Vance, Serial No. 544,959, and filed June 17, 1931, now Patent No. 2,137,039 granted Nov. 15, 1938. The picture signals and the horizontal and vertical synchronizing impulses are taken from the resistances 10, 11, and 12 connected in parallel to the output terminals of a suitable radio receiver 13. For the purpose of reproducing a picture in accordance with the received picture signals, the same are taken from the resistance 10 by an associated contact 14, and applied by way of a condenser 15 to the grid 16 of a cathode ray tube 17. The usual anode 18 and the electron-emitting cathode 19, and the grid 16 of this tube are supplied with the usual operating potentials, as indicated.

The ray 20 is caused to scan a fluorescent screen at the large end of the tube, and along a path similar to that shown in Fig. 2, that is, along a saw-tooth path from the point 22 to the point 23, and thence along a vertical return path 24 back to the starting point 22. The ray is deflected horizontally by electromagnetic coils 25 connected across the output terminals of a suitable source 26 which causes a saw-tooth current wave of the desired frequency to pass through these coils.

The ray is deflected vertically by electromagnetic coils 27 connected across the output terminals of a suitable vertical source 28 which causes a saw-tooth current wave of the desired frequency to pass through these coils.

The horizontal synchronizing impulses, taken from the resistance 11 by an associated contact 29 and applied to the source 26, and the vertical synchronizing impulses taken from the resistance 12 by an associated contact 30 and applied to the source 28, operate in the well known manner to maintain deflection of the ray 20 in synchronism with operating action at the transmitting station.

The voltage wave across the vertical deflection coils 27 comprises positive impulses occurring once every picture frame. These impulses occur during vertical deflection of the ray 20 from the point 23 back to the starting point 22.

For the purpose of utilizing these impulses to cut off the ray during this period, and thus eliminate the vertical return line 24, the voltage wave across the coils 27 is applied to the grid circuit of a suitable amplifier 33 through a connection 34 from the plate circuit of the last tube in the vertical deflection source 28. The voltage wave in the plate circuit of the amplifier 33 is the same shape as the voltage wave across the coils 27, but 180 degrees out of phase therewith and, therefore, comprises negative impulses occurring once every picture frame. This reversed wave is applied to the grid 16 by a connection 36. The negative voltage impulses occurring between the picture frame periods are thereby made effective to impress a negative bias on the grid 16 of sufficient amplitude to substantially cut off the ray 20 during the vertical return line period. The vertical return line 24 is thereby eliminated.

For the purpose of also eliminating the horizontal return lines 37, the voltage wave across the horizontal deflecting coils 25 is utilized in a similar manner. This voltage wave appears in the plate circuit of the last tube in the horizontal deflection source 26, and comprises positive voltage impulses occurring at a frequency equal to that of the horizontal scanning frequency. This wave is reversed by a suitable amplifier 40 and applied to the grid 16 of the tube 17 through the connection 36.

From the foregoing, it will be seen that in my improved system electrical effects, in the form of the negative voltage impulses referred to, and which are developed locally at the receiving station incidental to operation of the ray-deflecting means, are utilized to substantially cut off the ray 20 to eliminate both the vertical return line 24 and the horizontal return lines 37.

As a modification, the same result as in Fig. 1 may be obtained by omitting the amplifiers 33 and 40 and impresssing the voltage waves, across the coils 25 and 27, on the grid circuit of the tube 17 by induction, as shown in Fig. 3. For this purpose, the coils 42 and 43 are connected in series, respectively, with the coils 25 and 27, and inductively coupled to a coil 44 in the grid circuit of the tube 17. The polarities, or relative positions of the coils 42 and 43 with respect to the coil 44, are such that the voltage impulses impressed on the grid 16 are negative.

As a modification of the induction method in Fig. 3, it is proposed to place suitable pick-up coils on the legs of the usual core for the deflecting coils 25 and 27, and to suitably connect these pick-up coils in the grid circuit of the tube 17, for example, in series with the resistance 10.

Where the picture signal amplifier forming part of the radio receiver 13 is in proximity to the vertical deflection source 28, the last tube of this amplifier may be used in lieu of and serve the same purpose as the amplifiers 33 and 40 in Fig. 1, in which case the connection 36 would supply the grid circuit of this last tube by a suitable connection.

If the deflection sources 26 and 28 are constructed or adjusted so that the voltage waves across the coils 25 and 27 are of the proper polarity, these waves can be impressed directly on the grid circuit of the tube 17, or at a reduced amplitude on the grid circuit of the amplifier tube forming part of the receiver 13 and which is second in line from the tube 17. In either case, the voltage impulses impressed on the control grid 16 will be negative, and effective accordingly to cut off the ray 20 to eliminate the return lines 24 and 37.

The electrical wave for controlling elimination of the ray 20 may be taken from any suitable circuit forming part of the receiving station, and impressed on another circuit to effect the desired control action. For example, the voltage waves in the plate circuits of any suitable stages in the deflection sources 26 and 28, may be utilized.

I believe myself to be the first to provide a television system wherein the receiving station embodies a cathode ray tube, and wherein electrical effects are developed locally in an operating circuit of the receiving station to substantially cut off the cathode ray during predetermined intervals.

While I have disclosed a particular embodiment of my invention, it will be understood that various changes within the conception of those skilled in the art might be made without departing from the spirit of my invention or the scope of the claims.

I claim as my invention:

1. In the art of television wherein a cathode ray tube forms part of the receiving station and operates to reproduce the transmitted picture, the method of operation which comprises receiving picture and synchronizing signals, developing a cathode ray and directing the same at a screen, deflecting the ray to cause it to scan the screen, developing under the control of the received synchronizing signals electrical impulses independently of the transmitting station and locally in an operating circuit of the receiving station, and utilizing said impulses to substantially cut off the cathode ray at predetermined intervals during the scanning action.

2. In the art of television wherein a cathode ray tube forms part of the receiving station, and wherein means is provided for deflecting the ray to cause the same to scan screen structure; the method of operation which comprises developing a cathode ray and directing the same at the screen structure, deflecting the ray to cause it to scan the screen structure utilizing electrical effects developed incidental to operation of the ray-deflecting means to substantially cut off said ray during a predetermined period in the ray-deflecting cycle.

3. In the art of television wherein a cathode ray tube is used at the receiving station, and wherein deflecting coils effect scanning movement of the ray; the method of operation which comprises developing a cathode ray and directing the same at a screen, deflecting the ray to cause it to scan the screen, and utilizing the voltage wave across said coils to render the cathode ray substantially non-effective during predetermined periods in the scanning cycle.

4. In a television receiving system, cathode ray apparatus, screen structure on which a picture is reproduced, means for causing scanning movement of the ray, and means controlled by said first-named means for eliminating the return lines which would otherwise be visible incidental to the scanning action.

5. In a television receiving system, cathode ray apparatus having screen structure on which a picture is reproduced, means for causing the ray to scan said structure along substantially horizontal and vertical return lines in the scanning cycle, and means controlled by said first-named means and operating to suppress the ray to eliminate said lines.

6. In a television system, cathode ray appara-

tus for reproducing a picture, means including an electron tube for supplying said apparatus with picture signals, means for causing scanning movement of the ray, and means also including said tube controlled by said second named means to suppress the ray during a predetermined period in the scanning cycle.

7. In a television system, cathode ray apparatus for reproducing a picture, screen structure forming part of said apparatus, means including an electron tube for supplying said apparatus with picture signals, and ray deflecting means for causing the ray to scan said structure and operating to supply the grid circuit of said tube with electrical impulses effective to cause suppression of the ray during a predetermined period in the scanning cycle.

8. In a television system, cathode ray apparatus for reproducing a picture and provided with a screen, electromagnetic coils for deflecting the ray across said screen, means including an electron tube for supplying said apparatus with picture signals, means for energizing said deflection coils and causing electric current of substantially saw tooth wave form to flow therethrough to deflect the cathode ray, and a connection for impressing on the grid circuit of said tube a voltage wave representing substantially a first derivative of the current flowing through said coils.

9. In the art of television wherein picture signals are supplied to the grid circuit of cathode ray apparatus to reproduce a picture on a screen, the method of operation which comprises developing negative voltage impulses locally at the receiving station and independently of the received picture signals, and supplying the impulses so developed to said circuit during periods when the ray is not effective for picture-reproduction purposes, supplying picture signals to the grid circuit of the tube, and deflecting the ray to cause it to scan the screen.

10. In the art of television wherein picture signals are supplied to the control electrode circuit of cathode ray apparatus to reproduce a picture on a screen, and wherein electromagnetic coils are utilized to deflect the ray, the method of operation which comprises supplying picture signals to the control electrode circuit of the tube, deflecting the ray to cause it to scan the screen, and impressing upon said circuit a voltage derived from the voltage wave across said coils.

11. In the art of television wherein picture signals are supplied to the control electrode circuit of cathode ray apparatus to reproduce a picture on a screen, and wherein electromagnetic coils are utilized to deflect the ray, the method of operation which comprises supplying picture signals to the control electrode circuit of the tube, deflecting the ray to cause it to scan the screen, and impressing by induction upon said circuit a voltage derived from the voltage wave across said coils.

12. In the art of television wherein a cathode ray tube forms part of the receiving station and operates to reproduce the transmitted picture, the method of operation which comprises receiving picture and synchronizing signals, developing a cathode ray and directing the same at a screen, deflecting the ray to cause it to scan the screen, developing, at the receiving station, electrical impulses independently of the transmitting station, but under the control thereof and locally in an operating circuit of the receiving station, and utilizing said impulses to control operating action at said receiving station.

13. In the art of television wherein cathode ray apparatus is employed to reproduce a picture and wherein means including an electrical system comprising at least one tube is employed to cause the electron ray developed wthin the scanning apparatus to scan a target element in reproducing the picture, the method of operation which comprises directing the electron ray upon the target element, deflecting the electron ray under the control of the energy in the electrical system to cause the ray to scan the target element, and utilizing a portion of the voltage wave in the output circuit of the electrical system used for deflecting the ray to render the ray substantially non-effective with respect to the target element during predetermined periods in the scanning cycle.

14. In a television system, cathode ray apparatus wherein a cathode ray is developed, electrode structure, means for directing the developed ray toward the electrode structure, means for causing the ray to scan said structure, and means controlled by said first-named means for rendering the ray substantially non-effective during predetermined periods in the scanning cycle.

15. In a television system, cathode ray apparatus wherein a cathode ray beam is developed, electromagnetic means for deflecting the ray, means for causing a sawtooth current wave to flow through said ray-deflecting means, means including an electron tube for supplying said apparatus with picture signals, and a connection for impressing on the grid circuit of said tube a voltage wave which substantially represents a first derivative of the current wave flowing through said ray-deflecting means.

16. In the art of television wherein a cathode ray tube having therein means to develop a cathode ray beam and a control electrode to control the intensity of the cathode ray beam is utilized and wherein the developed cathode ray beam is deflected to scan a predetermined area, the method of operation which comprises directing the developed cathode ray beam toward the predetermined area, developing electrical energy for deflecting the cathode ray beam according to a predetermined deflection pattern to cause it to scan the predetermined area, developing negative voltage impulses under the control of the said developed electrical energy locally at the receiving station and independently of received signals, supplying the impulses so developed to the control electrode circuit of the cathode ray tube at predetermined and substantially identical time intervals in each scanning cycle to substantially suppress the cathode ray during the said periods.

17. In the art of television wherein cathode ray apparatus having therein means to develop a cathode ray is utilized, and wherein means including a multi-stage electron tube system are employed to cause the ray to scan electrode structure contained within the tube; the method of operation which comprises developing a cathode ray and directing the same at the electrode structure, deflecting the ray to cause it to scan the electrode structure, and utilizing the voltage wave in the plate circuit of one of the tubes comprising said system to render the ray substantially non-effective with respect to said structure during predetermined periods.

18. In the art of television wherein cathode ray apparatus is utilized, and wherein the ray is de-

flected by an electrical system comprising at least one electron tube; the method of operation which comprises developing a cathode ray and directing the same at a screen, deflecting the ray to cause it to scan the screen, and utilizing the voltage wave in the plate circuit of said tube to control the intensity of said ray.

19. In a television system, cathode ray apparatus provided with a target element, complementary elements for deflecting the ray back and forth across said target element, a generator of an electrical wave comprising at least one electron tube, means for supplying said electrical wave to said deflecting elements, means for controlling the intensity of the ray, and means connected between said control means and the plate circuit of a tube of said generator to suppress the ray during predetermined periods of the deflection thereof.

20. A system for deflecting electron passage in a cathode ray tube, comprising in combination a cathode ray tube provided with electron passage deflecting elements and a fluorescent plate, saw tooth voltage generating means consisting of a condenser connected with a direct current source to be charged thereby at a substantially constant rate and a vacuum valve connected across the terminals of said condenser for short circuiting said condenser periodically, means for generating periodical impulses which are used to control the discharge of said short circuiting valve, and means actuated from the deflecting means and in circuit with said deflecting element and associated with the grid circuit of said cathode ray tube for eliminating the return path of the image on the fluorescent plate.

21. In a television system, cathode ray apparatus including structure activated by the ray, means for causing scanning movement of the ray over said structure, and means controlled by said first named means for eliminating return lines which would otherwise be visible at the receiver incidental to the scanning action.

22. In the art of television wherein a cathode ray tube having therein a target element is utilized and wherein scanning movement of the ray relative to the target is effected by deflecting means across which a voltage wave is applied; the method of operation which comprises developing a cathode ray and directing the same at the target element of said cathode ray tube, deflecting the ray to cause it to scan said target, and utilizing a portion of such voltage wave to render the cathode ray substantially non-effective during predetermined periods in the scanning cycle.

23. In a television system, cathode ray apparatus wherein a cathode ray beam is developed, means including at least one electron tube for deflecting the ray, and means for controlling the ray intensity in accordance with the voltage wave in the plate circuit of said tube.

24. The method of scanning a picture area with a cathode ray beam which comprises exposing said said beam to the influence of a scanning current which would normally cause said beam to repeatedly traverse said area in two directions, and utilizing a derivative of said current to substantially extinguish said beam in one direction of its traverse of the area.

25. A method of scanning a picture area with a cathode ray beam which comprises exposing said beam to the influence of a scanning current which would normally cause said beam to repeatedly traverse said area relatively slowly in one direction and relatively rapidly in another direction, and deriving energy impulses from the scanning current for substantially extinguishing said beam during the rapid portion of the cycle.

26. The method of scanning a target area in a tube wherein a cathode ray beam is developed, which comprises exposing said beam to the influence of a scanning current which would normally cause said beam to repeatedly move in two directions to cause said area to be scanned, and utilizing a derivative of said current to substantially extinguish said beam in one direction of its motion.

27. The combination with a system for electrical transmission of pictures employing a cathode ray beam for scanning a target element, of means for deflecting the beam across said target element at a substantially uniform rate and returning said beam to its initial position at a higher rate, and means actuated by said deflecting means for interrupting said beam during the return motion thereof.

28. The combination with a system for electrical transmission of pictures employing an electron beam for scanning a target element, of a coil for establishing a magnetic field for deflecting the electron beam, means for exciting said coil by a current having a wave form comprising substantially straight lines of unequal slope, and means for impressing a voltage induced by the steeper of the current slopes in opposition to the electron beam to interrupt said electron beam during the periods of return deflection.

29. The combination with a system for electrical transmission of pictures employing a cathode ray tube wherein a target area is scanned, of means for deflecting the cathode ray to cause said target area to be scanned in one direction at a substantially uniform rate and returning said cathode ray to its initial position at a higher rate, and means actuated by said deflecting means for interrupting said cathode ray during the return motion thereof.

30. The combination with a system for electrical transmission of pictures employing an electrical discharge tube wherein a target area is scanned by an electron beam, of a coil for establishing a magnetic field for deflecting the said electron beam to cause said area to be scanned, means for exciting said coil with a current having a wave form comprising substantially straight lines of unequal slope and means for impressing a voltage induced by the steeper of the current slopes in opposition to the electron beam to interrupt said electron beam during the periods of return deflection.

31. In combination with a cathode ray device including an electron gun for projecting a concentrated cathode ray beam of substantially elemental cross-sectional area at the point of impact upon a target element positioned to receive the beam and to respond thereto at the area of beam impact, means to cause traversal of the cathode ray beam across the target, and means controlled by the first named means for eliminating the return lines which would otherwise cause undesired response from the target element.

32. In combination with a cathode ray device including an electron gun for projecting a concentrated electron beam of substantially elemental cross-sectional area at the point of impact upon a target element positioned to receive the beam and to respond thereto at the area of beam impact, means to normally cause traversal of the cathode ray beam across the target along a sub-

stantially saw-tooth pattern so that traversal of the target by the beam occurs relatively slowly in one direction and relatively rapidly in the other direction, and means controlled by the first named means for eliminating traces of the beam which would cause undesired response from the target element during the rapid portion of the target traversal.

33. In combination with a cathode ray device including an electron gun for projecting a concentrated cathode ray beam of substantially elemental cross-sectional area at its point of impact upon a bi-dimensional target element positioned to receive the beam and to respond thereto at the area of beam impact, means to deflect the said beam so as normally to cause a back and forth traversal of the target by the said cathode ray beam in one plane of motion, a second means to deflect the said beam so as normally to cause a back and forth traversal of the target by the said cathode ray beam in a substantially mutually perpendicular plane of motion at a rate substantially slower than the deflection in the first plane of motion, each of said beam deflections relative to the target at the two rates following a saw-tooth pattern and operating simultaneously to cause traversal of substantially the complete target by the beam so that the beam motion relative to the target is bi-directional and a complete bi-dimensional traverse of the target occurs only after a pre-determined number of beam deflections at the more rapid rate, and means controlled by each of the deflection controlling means for eliminating the beam return traces normally occurring during the back traversal in each of the two directions of deflection, which beam return traces would otherwise cause an undesired response from the target element.

34. In a system wherein is included a cathode ray device having an electron gun for projecting a concentrated cathode ray beam of substantially elemental cross-sectional area upon a target element positioned to receive the beam and to respond thereto as the area of beam impact the method steps which comprise developing electrical energy to cause a traversal of the cathode ray beam across the target along a substantially saw-tooth pattern, and deriving electrical energy from the energy developed to control the beam traversal for eliminating the return lines which would otherwise cause undesired response from the target.

35. In a system wherein is included a cathode ray device having an electron gun for projecting a concentrated cathode ray beam of substantially elemental cross-sectional area at its point of impact upon a bi-dimensional target element positioned to receive the beam and to respond thereto at the area of beam impact, the method steps which include normally deflecting the said beam to cause a back and forth traversal of the target thereby in one plane of motion, normally deflecting the said beam to cause a back and forth traversal of the target thereby in a substantially mutually perpendicular plane of motion at a rate substantially slower than the deflection in the first plane of motion, controlling the beam deflections relative to the target so that the deflections occur at two different rates and so that each follows a saw-tooth pattern and simultaneously operates to cause traversal of substantially the complete target by the beam so that the beam motion relative to the target is bi-directional and a complete bi-dimensional traverse occurs only after a pre-determined number of beam deflections at the more rapid rate, and controlling the beam under the influence of the deflection control so as to eliminate the beam return traces normally occurring during the back traversal in each of the two directions of deflection, which beam return traces would otherwise cause an undesired response from the target element.

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