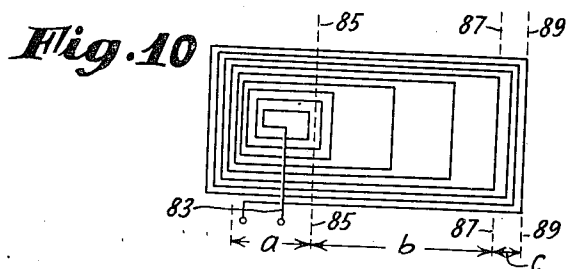
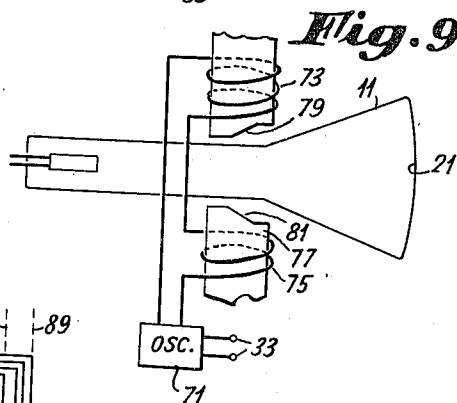
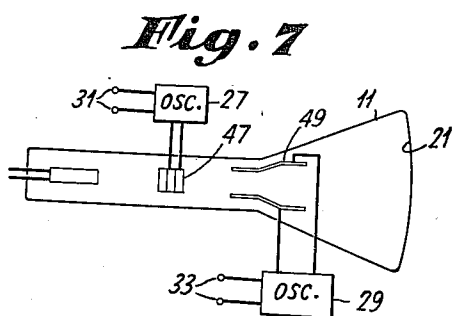
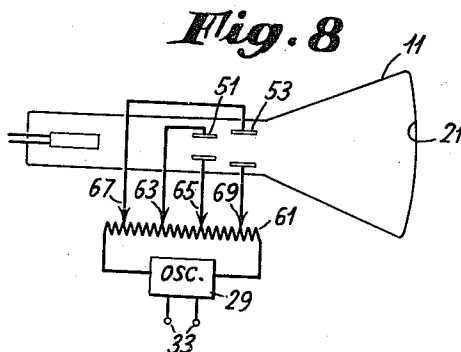
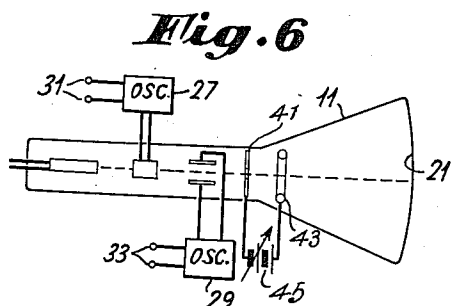
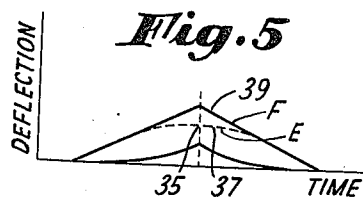
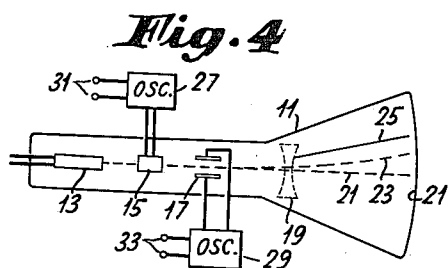
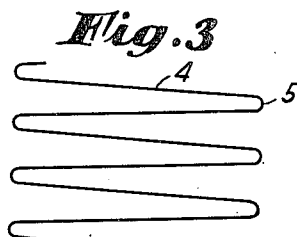
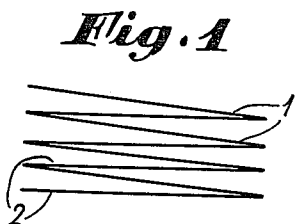


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E. BRUCHE
ELECTRONIC DEVICE
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2,237,651



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ELECTRONIC DEVICE

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ration of New York

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10 Claims. (Cl. 250—27)

This invention relates to electronic devices and more particularly to cathode ray tubes and electrode structures for such tubes, together with an improved method and means to deflect a concentrated cathode ray.

In using cathode ray tubes for television, for example, or oscillographic work, it has been usual to supply means for deflecting the beam in one or two directions linearly with respect to time, either in only one direction, that is, from left to right, or from top to bottom, for example, or linearly deflecting the beam left to right, right to left, top to bottom, and bottom to top. For this purpose it has been necessary to develop what is known as a saw-tooth voltage wave, i. e. to develop a voltage whose amplitude increased linearly with time and then decreased linearly with time, or to increase linearly with time and abruptly return to zero at the end of a predetermined time depending upon the frequency. Such voltages having been developed, are applied to electrostatic deflecting electrodes positioned parallel to the axis of the cathode ray tube, and between which electrodes the cathode ray passed. Alternatively, if magnetic deflection is desired, a saw-tooth wave of current was developed. Such a current wave would increase linearly with time and abruptly decrease to zero at the end of a predetermined time interval, or else increase linearly with time and then decrease linearly with time at the end of a predetermined time interval. Such a current wave was then applied to magnetic deflecting coils positioned perpendicular to the axis of the tube for deflecting the cathode ray. Great difficulties are attendant in the production of such saw-tooth waves. These difficulties arise from the fact that the frequencies present in such a saw-tooth wave, as deduced from resolving the wave into its sinusoidal components of a Fourier Series, become exceedingly great where strict linearity of the wave as a function of time is desired. Thus, for example, in a modern television system where the horizontal sweep circuit has a fundamental frequency on the order of 10,000 cycles harmonic components as high as the hundredth harmonic is necessary, which results in a frequency on the order of a million cycles. It will be readily appreciated that not only must the component of this frequency be present with proper amplitude, but the phase difference between this harmonic and the fundamental frequency must also be kept invariant as the wave is fed from the generator through the deflecting circuit. The problem is one, there-

fore, attendant with great difficulties and has involved the necessity of many correcting circuits in order to produce such a wave. The additional circuits necessary, add to the over-all complexity of the television transmitter and receiver and give rise to large costs both for the initial installation and for maintenance.

The use of sinusoidal waves for deflection circuits solve the problem arising from complexity of circuits, but as proposed in the prior art, introduced distortion in the reproduced picture, inasmuch as the sinusoidal wave deflections had a tendency to make the center of the picture fainter in luminosity than the edges due to the non-linearity of the sweeping voltage. My invention overcomes this deleterious effect of distortion in reproduction, at the same time reserving all the benefits accruing from the use of a sinusoidal wave. In accordance with my invention, I supply a sinusoidal wave to an appropriate electrostatic, electromagnetic deflection system such that the deflection circuit automatically produces a deflection with respect to the supplied voltage or current which is complementary to the sinusoidal wave supplied to the system, so that over-all linearity of deflection results, thereby overcoming the distortion of the type described above, and at the same time obtaining the benefits arising from the simplicity of supplying a sinusoidal wave, the benefits being simplicity of apparatus, greater ease in maintenance of synchronization, and reduced cost of initial installation and maintenance.

Turning now to the drawing, my invention will be described in detail. In the drawing,

Figs. 1 through 3 show graphical representations of a portion of the patterns resulting from asymmetrical linear deflections, symmetrical linear deflections, and sinusoidal deflections respectively;

Fig. 4 shows in schematic form the broad concept of my invention;

Fig. 5 is a graphical representation of the resultant deflection with respect to time of the combination of the sinusoidal wave and the deflection system according to my invention;

Fig. 6 shows one embodiment of my invention wherein an auxiliary deflecting field is supplied;

Figs. 7 and 8 show modifications of the embodiment of my invention shown in Fig. 6 where electrostatic deflecting systems are used, while

Figs. 9 and 10 show modifications of my deflecting system for use in electromagnetic deflecting systems.

In accordance with my invention, an aux-

iliary deflection of the cathode ray beam is supplied or superimposed upon the deflection arising from the application of sinusoidal voltage or current, depending upon whether or not electrostatic or electromagnetic deflection is contemplated. In order to provide an over-all linear deflection upon the fluorescent screen, I have discovered that this auxiliary and additional deflection of the beam should be proportional to the third power of the radial distance measured from the axis of the beam at which the electron beam enters the deflecting system. That is to say that as the beam is deflected from its axial position, the auxiliary field comes into action to deflect it in accordance with the third power of the distance that the beam is deflected from the axis. Under such conditions an initial sinusoidal deflection of the beam results in a linear deflection of the beam on the screen after passing through this auxiliary field.

Accordingly, it is one of the purposes of my invention to provide a new and improved method and means for deflecting a cathode ray beam.

Another object of my invention is to provide a simplified cathode ray beam deflection system and method utilizing sinusoidal waves, and producing non-distortionless deflection therefrom.

A further object of my invention is to provide a new, novel, and improved electrode system for electrostatic deflection of a cathode ray beam.

A still further object of my invention is to provide a new and improved electromagnetic deflection system for deflecting the cathode ray beam.

Other and further objects of my invention will become clear upon a consideration of the detailed description of my invention as follows:

Turning now to the drawing, it will be seen in Fig. 1 that when an asymmetrical saw-tooth wave is supplied to the deflection system of conventional cathode ray tubes, the pattern of the scanning path increases linearly from left to right at a relatively slow rate and decreases from right to left at a relatively high rate. The resultant pattern shown in Fig. 1 is obtained from simultaneously deflecting the beam in mutually perpendicular directions at two different rates of speed so that the horizontal deflections are relatively great relative to the vertical deflection. In Fig. 2 a symmetrical saw-tooth wave supplied to the same type of deflecting system produces a scanning pattern in which the travel from left to right and right to left is identical, while at Fig. 3 the use of two sinusoidal waves deflecting the beam in mutually perpendicular direction is shown. It will be noticed in this case that since the rate of deflection along the right and left hand edge has decreased, that there will result much greater intensity of light along the edges, since the cathode ray beam impinging upon a luminescent screen acts for a longer time at the ends of the path travel than it does through the center of the pattern. However, the combination of the sinusoidal wave with my new and improved method and means of deflection results in converting the pattern on the luminescent screen shown in Fig. 3 to that shown in Fig. 2, which pattern results in linear reproduction across the entire surface of the screen. In Fig. 4 I have shown schematically a cathode ray tube 11 equipped with an electron gun 13 for producing a beam of electrons which are focused upon the luminescent screen 21 on the end wall of the tube 11. Intermediate the electron gun and the

luminescent screen there is provided two parallel electrostatic deflecting electrode systems 15 and 17 through which the beam of electrons passes. Connected to the electrode deflecting systems are the oscillators 27 and 29 respectively, which may be of any conventional type to produce sinusoidal wave shapes and which may be synchronized in methods well known in the prior art, by feeding controlling impulses to the oscillators at the terminals 31 and 33 respectively. Intermediate the luminescent screen 21 and the last deflection system 17, there is provided an electron lens of a dispersive or negative type, which lens is symmetrical with respect to the axis of the cathode ray tube. The lens is so chosen as to provide an electrostatic field which varies in accordance with the third power of the radial distance from the axis. Under such conditions the electron beam in its undeflected position coincides with the axis of the tube shown as 21. Under the influence of voltage from the oscillator 29 the beam, in the absence of the electron lens 19, would be deflected, for example, to follow the path 23. However, the presence of the lens 19 aiding the auxiliary deflection thereto, actually causes the beam to take the position 25. Since the superimposed deflection provided by the auxiliary electron optical system 19 varies as the cube of the radial distance, the difference in deflection between 23 and 25 will be greater, the further away from the axis that the beam is deflected. Accordingly, where sinusoidal waves are employed, as the voltage balances up to its peak value, the beam is deflected by the auxiliary system at a much greater rate, although it is deflected by the main deflecting systems 15 and 17 at a much slower rate than when the beam is close to the axis of the tube. Since the two deflections are additive, the auxiliary beam tends to compensate for the decrease in deflection of the main deflecting system with the over-all result of providing a linear deflection across the entire face of the luminescent screen 21. This effect is shown in Fig. 5 where curve 35 shows the deflection as a function of time for one of the main deflecting systems, such as 17, for example, while line 37 shows the deflection resulting from the auxiliary system 19, while 39 shows the deflection resulting from the combination of the auxiliary and main deflections. It will be noticed in this case that the graph 39 results in a symmetrical saw-tooth.

In Fig. 6 I have shown one embodiment of my invention in which the auxiliary deflection field is provided by positioning beyond the deflecting plates 17 an apertured diaphragm 41 and a ring-electrode 43. The diaphragm 41 is connected to the ring electrode 43 through a battery 45. By suitably dimensioning the aperture, in the electrode 41, and the diameter in the ring electrode 43, a divergent electrostatic field is provided which has its radial component varying substantially as a third power of the radial distance from the axis about which both the electrodes 41 and 43 are symmetrically placed. By suitably varying the potential 45 supplied between these electrodes, the auxiliary deflection field can be made to be complementary to that of the deflecting fields of the electrode systems 15 and 17. It will be noticed that this system provides an auxiliary deflecting system which is symmetrical about the axis so that regardless of the direction of deflection, whether vertical or horizontal, the proper correction is added to provide linear deflections.

Alternatively, the arrangement shown in Fig. 7 may be used in this embodiment. The deflecting plates themselves are so shaped as to provide the necessary auxiliary field. The electrode systems 47 and 49 are so shaped that the beam on first entering the space between the plates, undergoes its major deflection. Thereafter the field progressively varies due to the divergence of the plates, and thereafter becomes substantially constant but of smaller magnitude. Accordingly, the combination of the sinusoidal voltage and the non-linear deflection of the beam between the electrostatic deflecting plates, cause the beam to execute a linear traversal of the luminescent screen 21.

A still further modification is shown in Fig. 8 in which there is actually provided for each of the horizontal and vertical deflection circuits two sets of deflecting electrodes, one with greater spacing than the other and positioned in register with but removed therefrom, and supplied from the same potential source with different potentials. Due to the edge effects between the two pairs of electrostatic deflecting plates 51 and 53 respectively, a radial component is provided such as to produce a complementary deflection to that produced by the supplied sinusoidal wave to provide linear deflection across the luminescent screen 21. To provide the difference in potentials and proper magnitudes from a single source, the potentiometer 61 is provided and the plates, deflecting electrodes 51, and variable taps 63 and 65 are also provided, while the taps 67 and 69 are provided for the plates 53. By providing individual taps for each of the plates, potential difference between the upper plates is determined by the position of the taps 67 and 63, while the potential difference between the lower plates of the electrode systems 51 and 53 are provided by the position of the taps 65 and 69. By suitably varying the taps, the proper amount of auxiliary deflection can be superimposed upon the main deflecting plates 51 to provide linear deflection across the screen 21. It will be understood, of course, that a similar pair of deflecting electrodes, and resistor with variable taps may be provided to replace the deflecting system for producing the mutually perpendicular deflection to take the place, for example, of the electrodes 15 shown in Fig. 6.

Where it is desired to use electromagnetic deflection, suitable electromagnets for deflecting the beam may be provided, in which the pole pieces are suitably shaped to provide the complementary characteristic necessary to produce the linear deflection across the screen. One such form I have shown in Fig. 9 in which the tube 11 provided with a screen 21 has positioned external thereof, although the electromagnets may be provided within the tube, with pole faces positioned to provide a first portion of substantially constant intensity, and a second portion of varying intensity. An oscillator 71 supplies sinusoidal current to the windings 73 and 75, which are wound on a suitable magnetic core 77, the pole faces 79 and 81 being shaped substantially as shown.

Alternatively, I may use windings of the form shown in Fig. 10. In Fig. 10 the coil 83 is wound so as to provide in the region between the left hand edge and the line 85—85 to provide a high maintenance constant electromagnetic field. In the region between lines 85—85 and 87—87, the field is weaker and varies in intensity as the distance increases from 85—85 towards 87—87, and

finally becomes constant again in the region of 87—87 and 98—89. It will be understood, of course, that the axis of the coil is positioned perpendicular to the axis of the cathode ray tube, so that Fig. 10 shows a plan view of the coil winding. Such a coil produces substantially the same effect on the deflection of the cathode ray beam as that produced by the structures 73, 75, 77, 79, shown in Fig. 9.

Having described my invention, what I claim is:

1. The method of converting sinusoidal deflections of a cathode ray beam projected along the axis of and within a cathode ray tube into linear deflections which comprises the steps of deflecting the beam sinusoidally, and simultaneously deflecting the beam in accordance with the radial distance of the beam from the axis of the cathode ray tube.

2. The method of converting sinusoidal deflections of a cathode ray beam projected along the axis of and within a cathode ray tube into linear deflections which comprises the steps of deflecting the beam sinusoidally, and simultaneously deflecting the beam in accordance with the third power of the radial distance of the beam from the axis of the cathode ray tube.

3. In combination, a cathode ray tube having a luminescent screen, means to project a beam of electrons within the tube upon the screen, a source of sinusoidal wave energy, means for producing a specially non-uniform deflecting field within the tube for deflecting the beam, and means to feed said field producing means from the source of sinusoidal wave energy, said field producing means being related to said source to produce deflections of said beam on said luminescent screen which vary linearly with respect to time.

4. In combination, a cathode ray tube having a luminescent screen, means to project a beam of electrons within the tube upon the screen, a source of sinusoidal wave energy, electrostatic means for producing a specially non-uniform deflecting field within the tube for deflecting the beam, and means to feed said field producing means from the source of sinusoidal wave energy, said field producing means being related to said source to produce deflections of said beam on said luminescent screen which vary linearly with respect to time.

5. In combination, a cathode ray tube having a luminescent screen, means to project a beam of electrons within the tube upon the screen, a source of sinusoidal wave energy, electromagnetic means for producing a specially non-uniform deflecting field within the tube for deflecting the beam, and means to feed said field producing means from the source of sinusoidal wave energy, said field producing means being related to said source to produce deflections of said beam on said luminescent screen which vary linearly with respect to time.

6. A cathode ray tube having a fluorescent end wall, an electron gun for projecting along the axis of the tube a beam of electrons toward the luminescent end wall, means for producing two specially uniform fields at right angles to each other for deflecting the beam of electrons, and means for producing an auxiliary specially non-uniform field which varies in accordance with the third power of the radial distance of the deflected beam from the axis of the cathode ray tube for further deflecting the beam.

7. A cathode ray tube having means to project a beam of electrons along the axis of the

tube toward a luminescent screen, a source of sinusoidal energy, means for simultaneously producing a spacially uniform field and a spacially non-uniform field for simultaneously deflecting the beam of electrons, said non-uniform field varying as the third power of the radial distance of the beam from the axis of the cathode ray tube, and means to supply energy from the sinusoidal source to the field producing means.

8. In combination, a cathode ray tube having means to project a beam of electrons along the axis of the tube and a target member, electromagnetic means for simultaneously deflecting the beam of electrons linearly with respect to the distance along said axis measured from a predetermined point thereon and in accordance with the third power of the radial distance of the beam from the axis of the tube, said deflections being so related to provide an overall deflection on said target member which is linear with respect to time.

9. In combination, a cathode ray tube having means to project a beam of electrons along the axis of the tube and a target member, elec-

tromagnetic means for simultaneously deflecting the beam of electrons linearly with respect to the distance along said axis measured from a predetermined point thereon and in accordance with the third power of the radial distance of the beam from the axis of the tube, and a source of sinusoidal energy connected to the electromagnetic deflecting means, said source and deflecting means being related to each other to provide a deflection on said target member which is linear with respect to time.

10. The method of producing linear deflections with respect to time of a cathode ray beam across a target area which comprises the steps of sinusoidally deflecting the cathode ray beam, subsequently directing the deflected beam through a spacially non-uniform field symmetrical with respect to the axis of the undeflected beam, maintaining said target area normal to the axis of said undeflected beam and impacting the directed deflected beam upon said target area.

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