March 8, 1949. G. HECHT 2,463,535

ELECTRON DISCHARGE DEVICE

Filed Dec. 13, 1946

FIG. 1

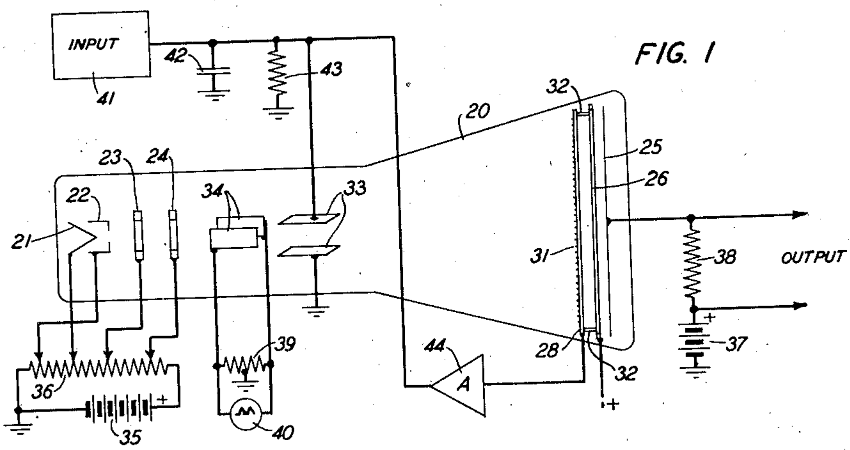


FIG. 2

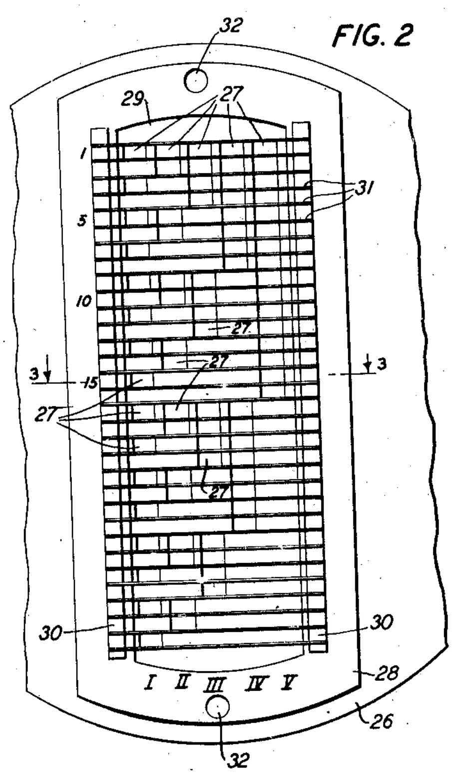


FIG. 3

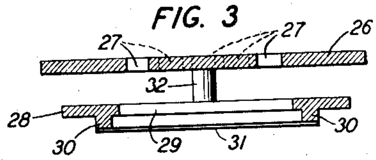
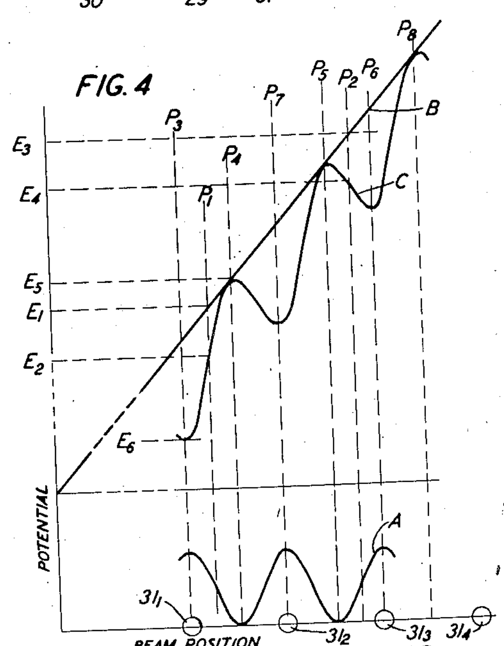


FIG. 4



INVENTOR
G. HECHT

BY [signature]

ATTORNEY

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ELECTRON DISCHARGE DEVICE

George Hecht, Astoria, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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20 Claims. (Cl. 315—21)

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This invention relates to electron discharge devices and more particularly to cathode ray devices, especially suitable for use in signal translating systems wherein speech or other complex waves are sampled at successive intervals and the samples are resolved into code pulse groups each corresponding to a respective sample amplitude.

In coding systems including a cathode ray discharge device of the type above indicated, the cathode ray or electron beam is deflected in one direction to an extent determined by the amplitude of the speech or other complex wave sample and is deflected or swept repeatedly in another direction, e.g. at right angles to the first direction. Interposed in the beam path is a coding electrode or mask having a plurality of rows of apertures therein, the apertures in the several rows being arranged in a prescribed manner such that when the beam is swept across the electrode or mask in the second direction above-noted the beam will pass over a different combination of apertures and masking areas for each of a plurality of positions to which it has been deflected in the first direction above noted. Thus, each wave sample is resolved into a code pulse group representative of the amplitude of the sample.

There is a possibility in such devices that during a sweeping cycle the beam position relative to the rows of apertures may change so that incorrect coding would result. Such change in relative position might result from electrical disturbances, for example disturbances such as to alter the effective deflecting force on the beam in the first direction noted sufficient to cause the beam to depart from the proper code position. Also such a change in relative position might result from a disturbance or alteration in the beam deflection system such as to vary the direction of the sweep of the beam across the rows of apertures in the coding electrode or mask.

One object of this invention is to assure deflection of the beam of a cathode ray device along a prescribed path despite disturbances effective upon the deflecting system.

More specifically, one object of this invention is to prevent incorrect coding in pulse code cathode ray devices.

Another object of this invention is to improve the signal or wave resolution in such devices.

In accordance with one feature of this invention, means are provided in a cathode ray device of the type above-described for holding the beam to a preassigned path during each sweeping cycle.

More specifically, in accordance with a feature

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of this invention, an auxiliary electrode is provided between the beam projecting gun and the coding electrode or mask and is so constructed and associated with the beam deflecting system that when the beam is deflected to a code position, it is held during the sweeping cycle to a path such that it will pass over only the combination of apertures and masked areas corresponding to that code position.

In one illustrative embodiment of this invention the auxiliary electrode is a grid having a plurality of parallel, substantially coplanar wires, each pair of adjacent wires defining an opening corresponding to a respective code position of the beam. The wires are mounted parallel to the direction of the beam sweep and are connected electrically through a feedback path to the deflection system which is effective to deflect the beam to the code positions. The signal or wave sample is applied to the system by way of a resistance-capacitance network in such manner that the beam is deflected to the proper coding position between two grid wires in accordance with the sample amplitude and the effective deflecting force then decreases so that the beam shifts to contact one of the grid wires. As a result of the contact, the deflecting force is altered, by virtue of the feedback from the grid, to hold the beam between the two grid wires during the sweep cycle whereby the proper code pulse group is produced.

The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 shows, partly in schematic and partly in diagram form, an electron discharge device illustrative of one embodiment of this invention;

Fig. 2 is a fragmentary plan view of the coding and auxiliary electrode assembly included in the device shown in Fig. 1;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 2; and

Fig. 4 is a diagram illustrating principles involved in the action of the auxiliary electrode.

Referring now to the drawing, the electron discharge device illustrated in Fig. 1 comprises an evacuated enclosing vessel **20** having at one end thereof an electron gun for projecting a concentrated electron beam toward the other end of the vessel. The gun, which may be of known construction, comprises a cathode **21**, a control electrode **22** and accelerating and focussing electrodes **23** and **24**.

Mounted within the vessel adjacent the other end thereof is an output electrode or target 25 to which the electron beam is directed. A coding electrode 26 is positioned in front of and parallel to the electrode 25 and may be a circular metallic plate having five parallel rows, I to V, of apertures 27 therein. Row I includes 16 substantially identical apertures equally spaced, the spacing between adjacent apertures in this row being substantially equal to the vertical dimension (in Fig. 2) of the apertures. Rows II, III and IV include eight, four and two apertures respectively, the apertures in each of these rows being substantially identical and equally spaced. Row V has but a single aperture. The several rows constitute a five-digit coding system enabling resolution of signals into thirty-two different code pulse groups.

An auxiliary electrode or grid is mounted adjacent the face of the coding electrode 26 toward the electron gun and parallel thereto and comprises a foundation member or plate 28 having therein a rectangular aperture 29 aligned with the coding electrode and of such dimensions as to expose the area of the electrode 26 including the apertures 27 to the electron beam. The plate 28 is provided with parallel raised portions 30 on two opposite sides of the aperture 29, between which parallel grid wires 31 extend. As shown in Fig. 2, the grid wires 31 extend normal to the vertical rows I to V and are positioned to define thirty-two parallel openings, certain of which are numbered (1, 5, 10 or 15) on the drawing. Each of these openings is opposite a corresponding aperture 27 in row I or opposite a solid area between two adjacent apertures in row I. Such alignment of the grid and apertures 27 may be realized and maintained by fabricating the coding and auxiliary electrodes as a unit, the two electrodes being joined by a plurality of insulating studs 32 affixed thereto as by cementing.

Two pairs of deflecting electrodes 33 and 34 in space quadrature are mounted adjacent the electron gun, the electrodes 33 being parallel to the grid wires 31.

As shown in Fig. 1, the electrodes constituting the electron gun are maintained at appropriate relative potentials by a battery 35 and potentiometer 36. The output electrode is held positive by a battery 37 connected thereto through the output resistor 38. The coding electrode 26 may be held at a positive potential. The deflector plates 34 are balanced to ground by way of the resistor 39 and have a sweep voltage to produce a linear sweep impressed therebetween by a source 40. The other deflector plates 33 are associated with the input circuit 41 through a storage condenser 42 and associated resistor 43 and are coupled to the auxiliary electrode through a feedback amplifier 44.

In the operation of the device, the speech or other complex wave to be coded is sampled repeatedly and potentials of amplitude determined by the samples are applied between the deflector plates 33 by way of the input circuit 41. For each sample the beam is deflected in the direction parallel to the rows I to V of apertures 27 in the coding electrode to a code position, 1 to 32, corresponding to the amplitude of the sample. Then, the beam is swept across the coding electrode in the direction normal to the rows I to V, by the deflector plates 34, whereby a pulse code, corresponding to the code position is produced at the output or target electrode 25.

As has been pointed out heretofore, the opening between each two adjacent grid wires 31 corresponds to a respective code position and code pulse group. In order that correct coding may be obtained, it is necessary that the beam remain between the proper two grid wires during each sweep period. The auxiliary electrode assures this condition.

Specifically, the signal sample voltage is applied to the deflector plates 33 by way of the condenser 42 so that the beam is deflected to the corresponding code position, i. e., between or in lateral alignment with the respective opening or solid area between two adjacent grid wires 31. As the beam is swept across the opening, the charge upon the condenser leaks off through the resistor 43 so that the deflecting potential between the deflecting plates 33 decreases and the beam contacts one of the grid wires. For example, if the beam is deflected initially to code position 5 and the polarity is such that a decrease in deflecting potential results in displacement of the beam downwardly in Fig. 2, when the deflecting potential decreases as the charge upon condenser 42 leaks off the beam will move into contact with the grid wire 31 bounding the lower edge, in Fig. 2, of the grid opening corresponding to code position 5.

When the beam thus contacts this wire, beam current flows to the wire noted and as a result the effective potential between the plates 33 is varied proportionately to the current by virtue of the feedback through amplifier 44. The polarities involved are correlated so that the effective deflecting potential increases as the feedback increases. Thus, when the beam contacts the grid wire the deflecting potential increases so that the beam tends to move away from this wire, i. e. upwardly in Fig. 2. Such motion results in decrease of the feedback and, hence, in the effective deflecting potential. As a consequence of the control of the deflecting potential by the auxiliary electrode or grid, the beam is held in the opening between the two grid wires to which it was deflected in accordance with the signal sample, during the associated sweep period, so that the proper code pulse group is produced. In effect, once the beam is deflected to a code position, it is held against, or substantially so, one of the grid wires defining the opening corresponding to that position.

The principles and relationships involved in the operation of the auxiliary electrode or grid and the feedback circuit are illustrated in Fig. 4. It is apparent that if the beam moved over the wires 31 of the auxiliary electrode, i. e., if it were deflected across these wires normal to the sweep direction, the current to the auxiliary electrode and, hence, the feedback voltage supplied to the deflector plates 33 would vary in the manner indicated by curve A in Fig. 4, being a maximum when the beam is centered on any grid wire and a minimum when the beam is midway between two adjacent grid wires. The absolute form of the beam position-feedback potential relation and the maximum and minimum values of this potential will be dependent, of course, upon the relative magnitudes of the beam diameter at the plane of the grid wires and the spacing between adjacent grid wires. For simplicity of illustration and discussion, the analysis given hereinafter is for the case where the beam is of such diameter that the minimum value of the feedback potential is zero. It will be understood, however, that the analysis is valid for other beam diameters.

The relation between beam position and deflecting potential effective between the deflector plates 33 is a linear one and is indicated by the line B in Fig. 4. Thus, for any beam position the deflecting potential between the plates 33 must fall on the line B. This potential comprises two components, namely the voltage due to the signal applied from the input circuit 41 and the feedback voltage. If the feedback is positive, and the minimum feedback voltage is zero, it is apparent that the relation between beam position and signal voltage is illustrated by the curve C in Fig. 4.

Assume that the beam center is at a position P_1, between the grid wires 31_1 and 31_2. In order to be at this position, the potential between the deflector plates 33 must be E_1. Hence, the signal voltage is of magnitude E_2 and the feedback voltage is (E_1-E_2).

If now the deflecting system including the plates 33 is disturbed in any manner such as to move the beam slightly toward the wire 31_2, i. e., to displace it to the right from position P_1 in Fig. 4, as might occur, for example, if the input signal increased, or because of misalignment of the opening between wires 31_1 and 31_2 and the corresponding code pulse sweep across the rows of apertures 27, it will be seen from Fig. 4 that the feedback potential would decrease so that the effective deflecting potential would decrease and the beam would be returned toward position P_1. If, on the other hand, the deflecting system is disturbed such that the beam moved (to the left in Fig. 4) toward wire 31_1, as would obtain if the signal voltage decreased somewhat, the feedback voltage would increase. Consequently, the deflecting potential would increase and the beam would be returned toward P_1.

It will be seen from this analysis that the position P_1 is a stable beam position, that is a departure of the beam in either direction, left or right in Fig. 4, from this position results in automatic adjustment of the deflecting potential between the plates 33 to return the beam to the position P_1. Similar analysis will show that any position of the beam between P_3 and P_4 or other point where the slope of curve C is positive is a stable position.

Consider now the conditions for the beam position P_2, which it will be noted is one for which the corresponding portion of the curve C has negative slope. For the position P_2, the deflecting potential between the plates 33 is E_3, the signal voltage is E_4 and the feedback potential is $(E_3—E_4)$. If the deflecting system were disturbed so that the beam moved from P_2 toward the grid wire 31_3, for example if the signal voltage increased slightly or misalignment of the type heretofore noted existed, the feedback voltage would increase and the beam would be deflected further to the right. Similarly, if the deflecting system were disturbed in the opposite sense to effect displacement of the beam from P_2 to the left in Fig. 4, the feedback voltage would decrease and the beam would be deflected further to the left. Hence, the position P_2 is an unstable one inasmuch as any displacement of the beam therefrom in either direction would result in alteration of the effective potential between the deflector plates 33 in the sense to effect further displacement of the beam in that direction. Similar analysis will demonstrate that any beam position between P_5 and P_6 or other point where the slope of curve C is negative also is an unstable one.

The possible continued displacement of the beam from an unstable position such as P_2 cannot continue indefinitely or beyond certain limits.

This will be clear from the following considerations. Assume that the deflecting system is disturbed in the sense to cause displacement of the beam from position P_2 to the left in Fig. 4. As has been pointed out above, the deflecting potential will change in the sense to cause further displacement of the beam to the left. Such displacement will continue until the beam reaches position P_5 or just to the left thereof. From what has been said heretofore, it will be noted that in thus passing to P_5 or just therebeyond to the left in Fig. 4, the beam reaches a position of stability between P_5 and P_7. Consequently, it will be held in such a stable position, in effect against the grid wire 31_2, during the sweep cycle.

Similarly, if the beam were displaced to the right from position P_2, as has been pointed out heretofore it would continue to move to the right. However, when it reached the position P_6 or just therebeyond, i e., between P_6 and P_8, it would be in a stable position and held, in effect, against the grid wire 31_3 during the sweep cycle.

As has been pointed out heretofore, each opening between two adjacent grid wires corresponds to a respective code pulse group. It is seen, therefore, that once the beam reaches a stable position, it is held in the grid opening, during the sweep cycle, corresponding to the stable position, whereby the respective code pulse group is produced.

As has been indicated heretofore, theoretically the beam can move from an unstable position such as P_2 to either of two stable positions, e. g. to between either P_6 and P_8 or P_5 and P_7, depending upon the polarity or sense of the disturbance. Practically, however, in a system such as illustrated in Fig. 1 movement of the beam to only one of the two possible stable positions occurs. This is due to the fact that the disturbance, if electrical is of the same polarity or sense, i. e. the input signal component of the deflecting potential between the plates 33 decreases as the charge upon the condenser 42 leaks off through resistor 43. The disturbance, thus, is such as to move the beam to the left, e. g. from P_2 to between P_5 and P_7. Hence, false coding is prevented. Once the beam reaches a stable position it is held there during the sweep cycle, i. e. is held in the proper grid opening even though the sweep voltage may not be such as to sweep the beam exactly parallel to the grid wires 31.

Furthermore, once the beam has reached a stable position, it will be held to sweep out the proper code pulse group despite variations in the input signal, within limits. For example, if the beam were at position P_1 in Fig. 4 it would remain in stability between positions P_3 and P_4, held against the grid wave 31_1, for variations in the input signal between E_6 and E_5.

The limits of the input signal variations for which this holding action will obtain despite such variations are determined by the maximum amplitude of the feedback voltage, that is, the greater the feedback voltage, the wider is the range of signal voltage variations permissible without resulting in shifting or jumping of the beam from one code position to another.

Another aspect of the action of the auxiliary electrode or grid is to be noted. Referring again to Fig. 4, it is evident that all initial beam positions between P_3 and P_7 will result in the code pulse group corresponding to the opening between grid wires 31_1 and 32_2. Similarly, beam positions between P_7 and P_8 will result in the code pulse group corresponding to the opening between grid wires 31_2 and 31_3. Thus, the range of input signals in effect is divided into discrete bands each of which corresponds to a respective code pulse group. That is to say, the input signals are quantized.

In the analysis given above, conditions have been investigated and demonstrated for various beam positions. Brief comment may be made upon various ways in which the beam may be deflected to an initial position in response to an input signal pulse. In some systems the feedback circuit may be closed or effective continuously and the beam deflected to its initial position in response to the input signal pulse always in the same direction, e. g. from a zero position. Alternatively or in other systems, the beam may be blanked and the feedback circuit continuously closed or the feedback circuit opened and the beam on continually until the deflection voltage across the plates **33** proportional to the input signal has been applied. For example, if the signal voltage pulse is of amplitude E_5 and the beam is blanked or the feedback circuit opened until this voltage obtains across the plates **33**, the initial position of the beam will be P_4. Then, if the beam is turned on or the feedback circuit is closed, because of the decrease in the signal voltage component of the deflecting potential, as the charge upon condenser **42** leaks off through resistor **43**, the beam will be held stable between P_3 and P_4.

As another example, consider the case where the beam is blanked or the feedback circuit opened until the input signal pulse of E_1 is applied to the deflector plates **33**. When the beam is then turned on or the feedback circuit is closed, the initial position of the beam will be at P_1. However, then because of the feedback voltage the effective deflecting voltage tends to increase. This movement may be offset in whole or in part by the decrease in the effective value of the signal pulse component of the deflecting potential due to dissipation of the charge upon condenser **42** through resistor **43**. In any case, for these conditions, the beam will be moved to and held stable at a position between P_3 and P_4.

As still another example, consider the case where the beam is blanked or the feedback circuit is opened until the input signal pulse voltage E_3 appears across the deflector plates **33**. Then when the beam is turned on, or the feedback circuit is closed, the beam is at position P_2, the deflecting voltage tends to increase because of the feedback voltage and tends to decrease because of the discharge of the condenser **42** through the resistor **43**. Whether the beam will move to the right, in Fig. 4, to a stable position between P_6 and P_8 or to the left to a stable position between P_5 and P_7 will be determined by the amplitude of the feedback voltage relative to the rate of decrease in effective signal pulse voltage due to discharge of the condenser **42**. Advantageously, to prevent false coding, the parameters involved are made such that the decrease in effective signal pulse due to discharge of condenser **42** predominates over the increment in deflecting potential due to the feedback voltage produced when the beam is turned on or the feedback circuit is closed.

One other case may be noted, namely that for an initial beam position between points such as P_3 and P_4 and very close to P_3. For this case the possibility exists that the beam may hop over the grid wire **31**, into the next code position. This possibility of false coding may be avoided by controlling the initial deflecting potential so that the beam is always moved deliberately initially to a stable position and correlating the feedback voltage and decay of the signal voltage to maintain the beam in such position throughout the sweep period.

Although the invention has been described as embodied in a five-digit coder device, it may be employed, of course, in other systems, for example in seven-digit coder devices providing 128 code pulse groups. In any such case, the auxiliary electrode or grid is constructed to provide an opening for each code position.

It will be understood, of course, that the particular device shown and described is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

Reference is made of the application Serial No. 715,900, filed December 13, 1946, of Raymond W. Sears wherein a related invention is disclosed and claimed.

What is claimed is:

1. An electron discharge device comprising a plurality of rows of targets, means opposite thereto for projecting an electron beam to said targets, deflection means for causing said beam to sweep across said rows of targets, a second deflection means for deflecting said beam in a direction at an angle to the direction of beam sweep, and means for confining said beam within a prescribed path while it is deflected by said first deflection means, said confining means comprising an auxiliary electrode opposite said beam projecting means and having openings therein conforming in configuration to said path and a feedback coupling between said auxiliary electrode and said second deflection means.

2. An electron discharge device comprising an electrode member having a directionally continuous edge portion of preassigned configuration, means opposite one face of said member for projecting an electron beam toward said electrode member, a row of targets beyond the other face of said member and opposite said edge portion, a first deflection means for deflecting said beam in the direction substantially normal to said portion, a second deflection means for deflecting said beam in another direction, and means for holding said beam substantially against said portion while it is deflected by said second deflection means, said holding means comprising said electrode member and a feedback coupling therebetween and said first deflection means.

3. An electron discharge device comprising an electrode member having an opening therein, one edge of said opening being substantially rectilinear means opposite one face of said member for projecting an electron beam thereto, means for deflecting said beam in the direction along said edge of said opening, means for deflecting said beam in a direction at an angle to said edge, and a feedback coupling between said electrode member and said second deflecting means.

4. An electron discharge device comprising a member having a plurality of rows of windows therein, means opposite thereto for projecting an electron beam to said member, a first deflection means for deflecting said beam in the direction parallel to one of said rows, a second deflection means for sweeping said beam across said rows, an auxiliary electrode between said member and said beam projecting means and having therein a plurality of openings extending in the direction of sweep of said beam, and a feedback coupling

between said auxiliary electrode and said first deflection means.

5. An electron discharge device comprising a member having a plurality of parallel rows of windows therein, means opposite thereto for projecting an electron beam to said member, an auxiliary electrode between said means and said member and having therein a plurality of openings having parallel edges extending transversely with respect to said rows, a first deflection means for sweeping said beam parallel to said edges, a second deflection means for deflecting said beam parallel to said rows, and a feedback coupling between said auxiliary electrode and said second deflection means.

6. An electron discharge device comprising a member having a plurality of parallel rows of apertures therein, means opposite thereto for projecting an electron beam to said member, a grid between said member and said means and including a plurality of parallel wires opposite said rows of apertures and extending transversely normal to said rows, a first deflection means for sweeping said beam across said rows, parallel to said wires, a second deflection means for deflecting said beam parallel to said rows, and a feedback coupling between said grid and said second deflection means.

7. An electron discharge device comprising an electrode having a plurality of parallel, rectangular openings therein, means opposite said electrode for projecting an electron beam to one face thereof, a first deflection means for sweeping said beam in the direction parallel to said openings, a second deflection means for deflecting said beam in the direction normal to the sweep direction to direct said beam selectively through any one of said openings, and means for controlling the deflecting force due to said second deflection means to hold said beam in any opening to which it is directed thereby, during a sweep period, said controlling means comprising said electrode and a feedback coupling therebetween and said deflection means.

8. An electron discharge device comprising a grid electrode having a plurality of parallel wires, means opposite thereto for projecting an electron beam to said electrode, means comprising a pair of deflector plates for deflecting said beam in the direction normal to said wires for selectively directing said beam between any pair of adjacent wires, means for sweeping said beam over said electrode in the direction parallel to said wires, and means for holding said beam against one of the pair of wires between which it is directed, during a sweep period, said holding means comprising said electrode and a feedback coupling between said electrode and said deflector plates.

9. An electron discharge device comprising means for projecting an electron beam, means for selectively deflecting said beam in one dimension to any one of a plurality of positions, means for sweeping said beam at an angle to said first dimension, means for resolving the beam current while the beam is at any of said positions during a sweep period into a corresponding pulse group, and means for preventing substantial departure of said beam from any position to which it is deflected in said dimension, during a sweep period.

10. An electron discharge device comprising means for projecting an electron beam, means for causing said beam to sweep in one direction repeatedly at a preassigned frequency, means for displacing said beam in another direction, means

responsive to the sweeping of said beam in said one direction for producing a code pulse group defining the displacement of said beam in said another direction, and means for limiting displacement of said beam in said another direction during each sweep period.

11. An electron discharge device comprising means for projecting a beam of electrically charged particles, means for causing said beam to sweep in one direction recurrently at prescribed periods, means for deflecting said beam in a second direction, means for resolving the beam during each sweep period into a group of pulses of character determined by the amplitude of beam deflection in said second direction, and means for holding said beam to a prescribed path during each sweep period.

12. An electron discharge device comprising means for projecting an electron beam, means for causing said beam to sweep substantially rectilinearly in one direction repeatedly at a preassigned frequency, means for deflecting said beam in the direction normal to said first direction, means for applying signal pulses to said deflecting means to deflect said beam in said normal direction proportionately to the amplitude of each pulse, means for converting the beam current during each sweep period into a code pulse group of character definitive of the signal pulse amplitude, and means for preventing deflection of said beam beyond a preassigned limit in said normal direction during each sweep period.

13. An electron discharge device comprising means for projecting an electron beam, means for sweeping said beam repeatedly in one direction at preassigned frequency, deflection means effective when energized to deflect said beam in a second direction at an angle to said one direction, input means for producing signal pulses, a network energized by said input means and coupled to said deflection means for applying thereto signals of maximum amplitude determined by the amplitude of said signal pulses and varying unidirectionally at a prescribed rate, and means for limiting displacement of said beam by said deflection means during each sweep period.

14. An electron discharge device in accordance with claim 13 wherein said limiting means comprises an electrode positioned in the beam path and a feedback coupling between said electrode and said deflection means.

15. An electron discharge device comprising means for projecting an electron beam, means for sweeping said beam repeatedly in one direction at preassigned frequency, deflection means effective when energized to deflect said beam in a second direction at an angle to said one direction, input means for producing signal pulses, resistance-condenser means coupled to said input and deflection means for converting each of said signal pulses into a decaying energizing pulse applied to said deflection means, and means for preventing displacement of said beam beyond a preassigned extent in said second direction during each sweep period.

16. An electron discharge device in accordance with claim 15 wherein said displacement preventing means comprises an auxiliary electrode in the beam path and means energized in accordance with the beam current to said auxiliary electrode for controlling the effective deflecting force due to said deflection means.

17. An electron discharge device comprising an electrode having a plurality of parallel openings therein, means for projecting an electron

beam to said electrode, means for sweeping said beam across said electrode in the direction parallel to said openings, repeatedly at preassigned periods, deflection means effective when energized to deflect said beam in the direction normal to said openings, an input circuit for producing signal pulses, means for converting each signal pulse into a unidirectionally varying signal applied to said deflection means, and means for holding said beam in the opening in said electrode to which it is deflected in response to energization of said deflection means by said varying signal, during each sweep period.

18. An electron discharge device in accordance with claim 17 wherein said converting means comprises a resistance-condenser network coupled to said input circuit and said deflection means for converting each signal pulse into a decaying signal applied to said deflection means.

19. An electron discharge device in accordance with claim 17 wherein said converting means comprises a resistance-condenser network coupled to said input circuit and said deflection means for converting each signal pulse into a decaying signal applied to said deflection means, and wherein said holding means comprises a feedback coupling between said electrode and said deflection means and poled to apply a feedback voltage to said deflection means in opposition to said decaying signal.

20. An electron discharge device comprising a coding member having a plurality of parallel rows of windows therein, means opposite thereto for projecting an electron beam to said coding member, an auxiliary electrode between said coding member and beam projecting means and having therein a plurality of openings extending in front of said rows and at right angles thereto, means for sweeping said beam repeatedly at a preassigned frequency parallel to said openings, a pair of deflector plates effective when energized to deflect said beam in the direction parallel to said rows, means for producing signal pulses, means comprising a resistance-capacitance network for converting each signal pulse into a decaying voltage between said deflector plates, and a feedback coupling between said auxiliary electrode and said deflector plates poled so that the feedback voltage opposes said decaying voltage.

GEORGE HECHT.

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