April 4, 1961 J. E. GAFFNEY, JR 2,978,608

CHARACTER SYNTHESIZING TUBE

Original Filed Dec. 24. 1956 5 Sheets-Sheet 1

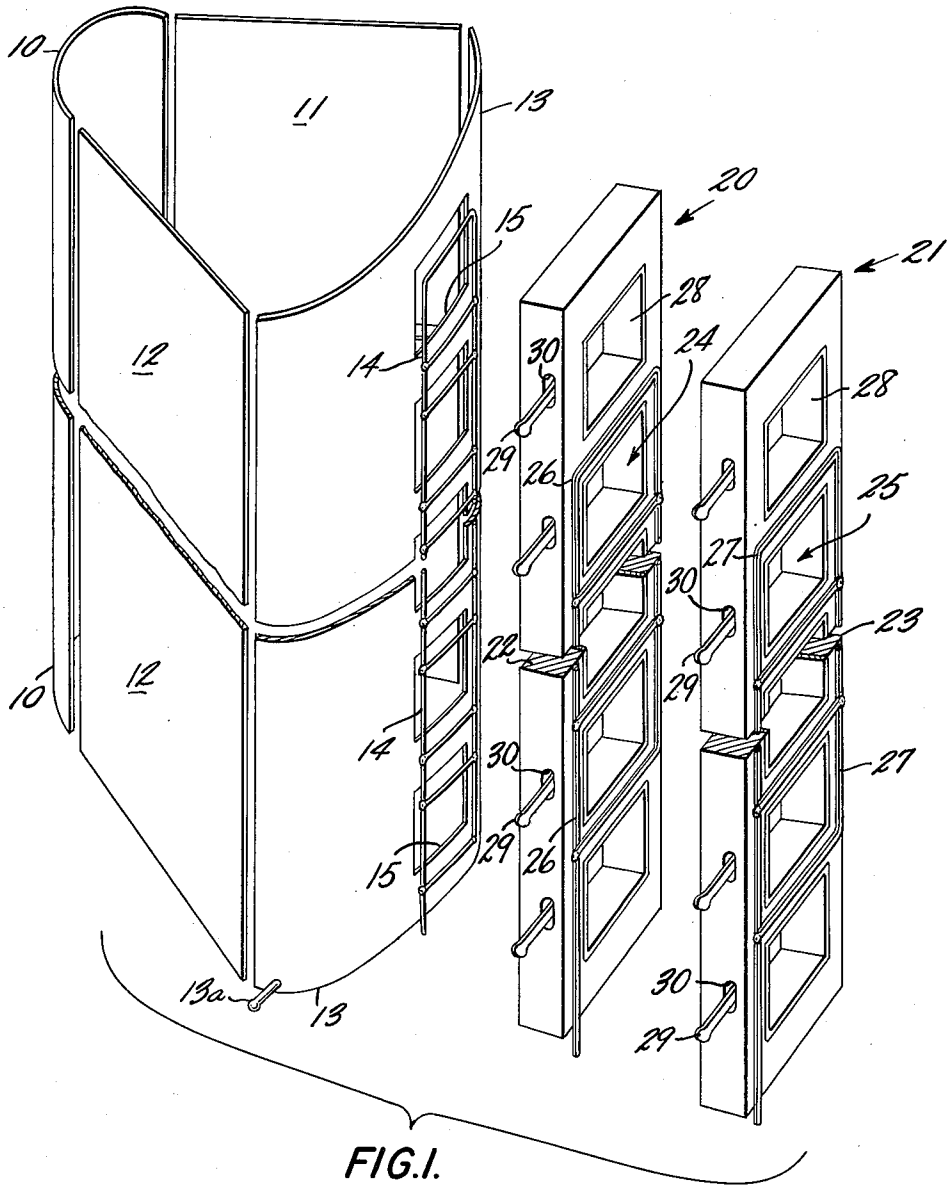


FIG. I.

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CHARACTER SYNTHESIZING TUBE

Original Filed Dec. 24, 1956 5 Sheets-Sheet 2

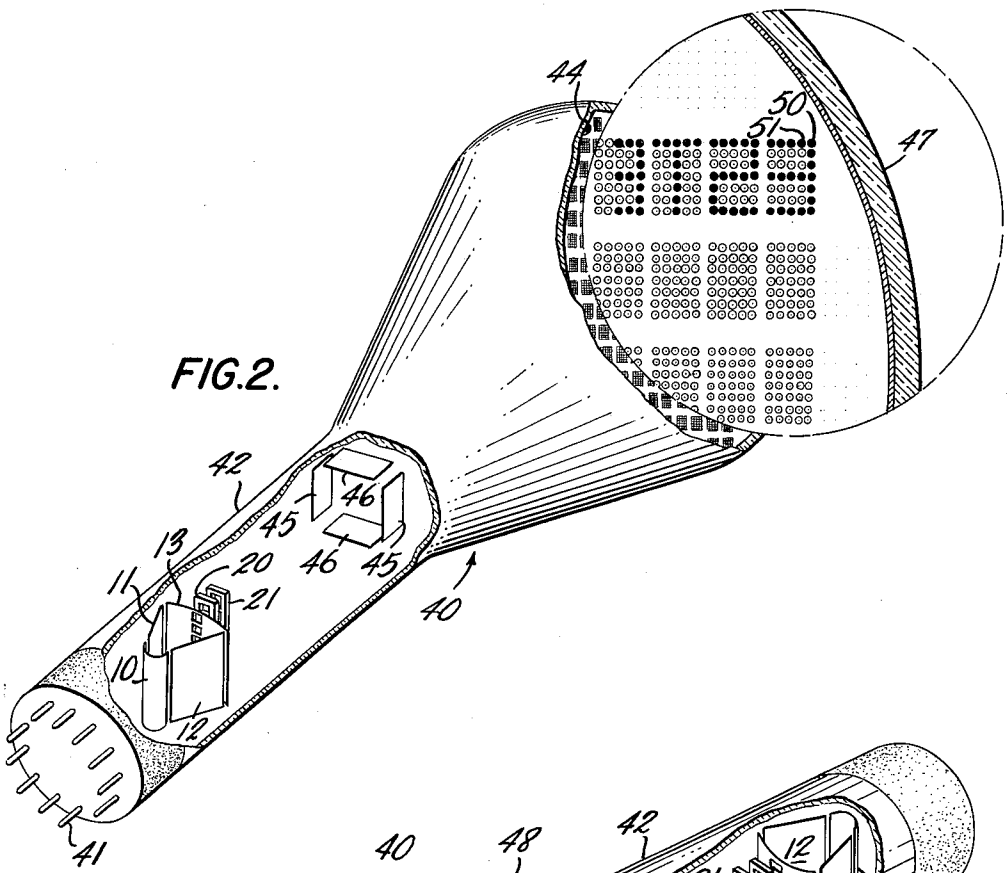


FIG.2.

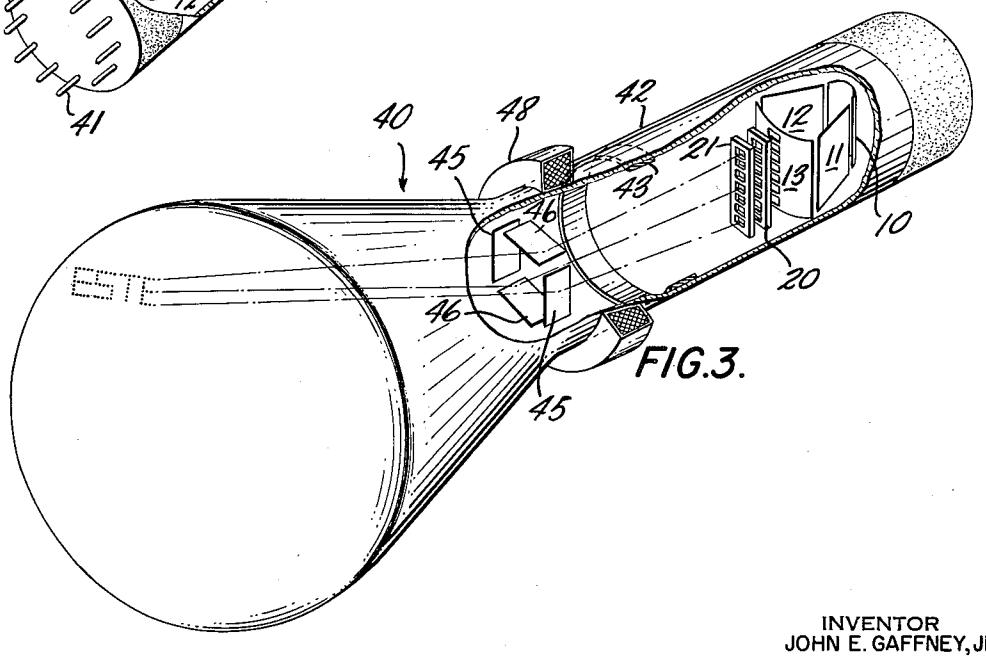


FIG.3.

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CHARACTER SYNTHESIZING TUBE

Original Filed Dec. 24, 1956 5 Sheets-Sheet 3

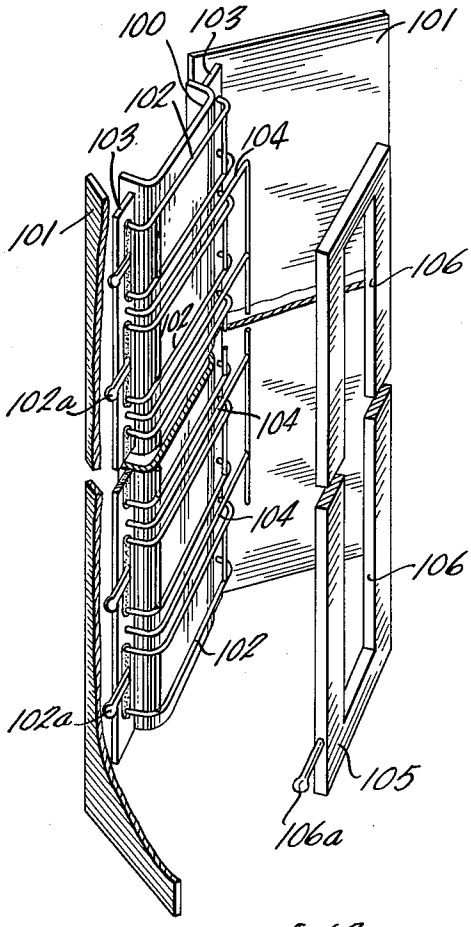


FIG. 4.

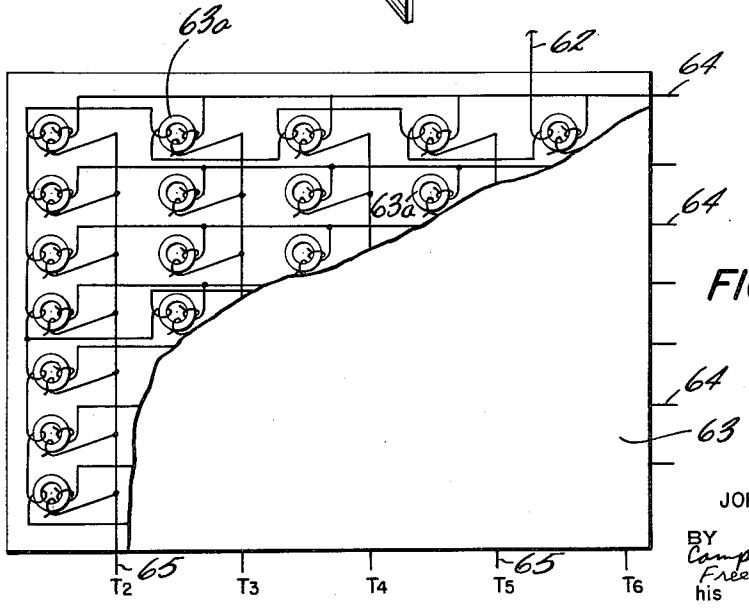


FIG. 5A.

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CHARACTER SYNTHESIZING TUBE

Original Filed Dec. 24, 1956 5 Sheets-Sheet 4

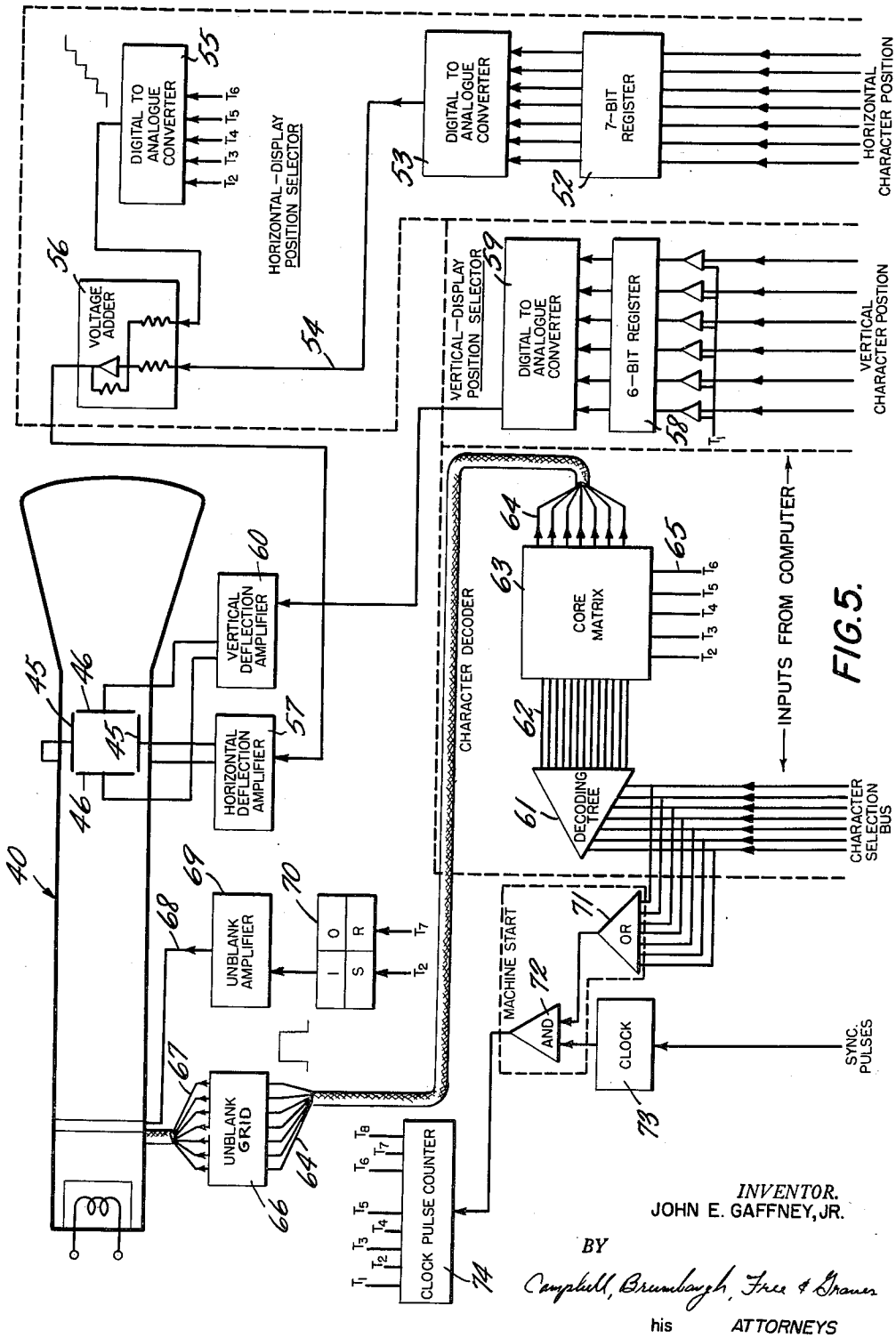


FIG. 5.

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CHARACTER SYNTHESIZING TUBE
Original Filed Dec. 24, 1956 5 Sheets-Sheet 5

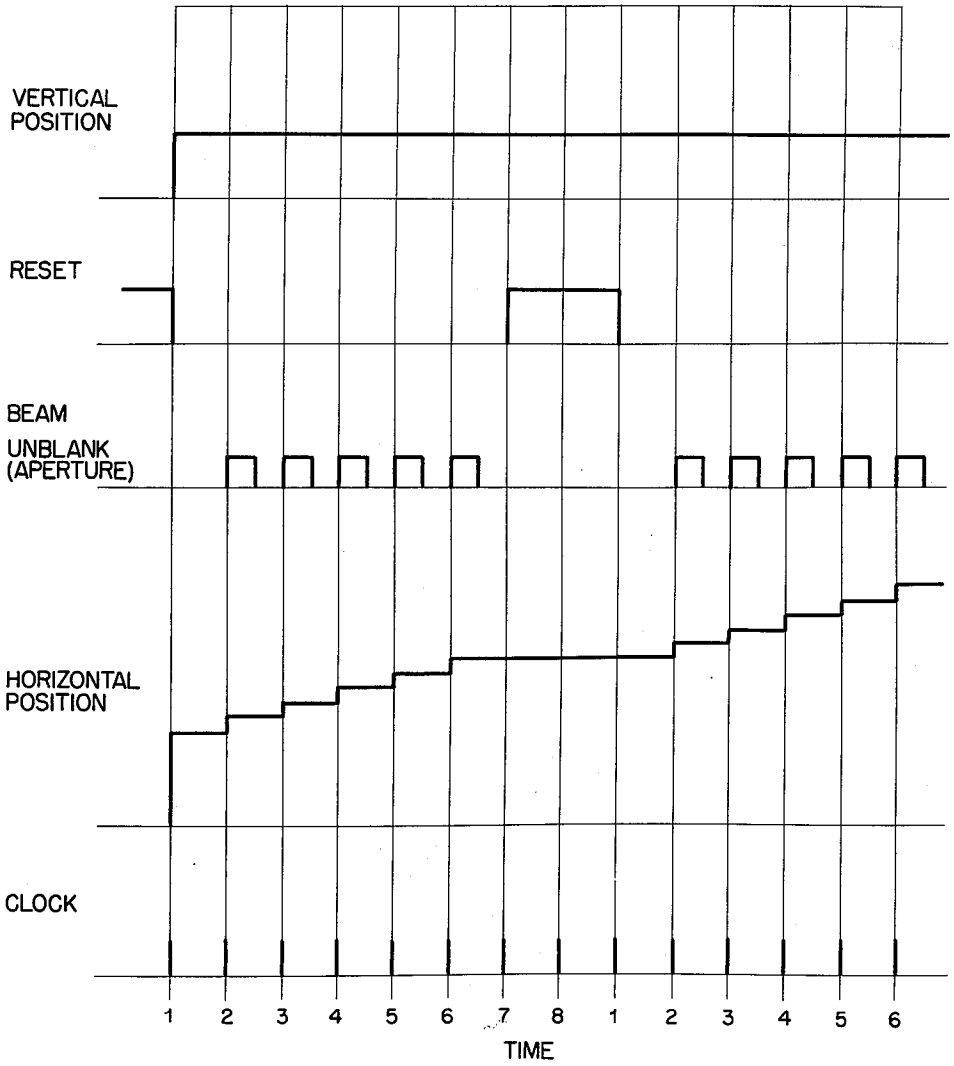


FIG.6.

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United States Patent Office 2,978,608
Patented Apr. 4, 1961

2,978,608

CHARACTER SYNTHESIZING TUBE

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Continuation of application Ser. No. 630,386, Dec. 24, 1956. This application Oct. 2, 1959, Ser. No. 844,144

15 Claims. (Cl. 315—22)

This invention generally relates to indicating devices and, more particularly, to a cathode ray tube for synthesizing characters on a display screen. This application is a continuation of and was copending with my earlier filed application, Serial No. 630,386, filed December 24, 1956.

In one prior indicator of the cathode ray tube type, one of a whole roster of selectable characters must be chosen by a set of selecting deflection coils. All but one of these possible character forming beams are off the axis of the tube, thereby necessitating the application of specialized focusing fields to counteract the radial nonuniformity of the electric accelerating field produced between the cathode and the anode of the tube due to the use of a plurality of divergent beams. Both the focusing and the selecting deflection fields present technical difficulties which are overcome by the present invention.

Another disadvantage which is overcome by the present invention is the effect of the nonhomogeneity of the electric or magnetic deflection fields acting upon the character representing beam of the cathode ray tube. In prior devices, the various beams emanate from different geographical locations on the cathode and, therefore, the effect of the electric or magnetic deflection fields on all possible characters is not uniform.

Accordingly, it is one of the objects of the present invention to provide a character synthesizing tube in which any one of the selected characters originates from the same on-axis position.

Another object is to provide a character synthesizing tube of the above character with either a plurality of memory elements in which information is to be stored, or a fluorescent screen on which characters are visible, or both;

A further object of the present invention is to provide a character representing device in which the electric or magnetic deflection fields have the same effect on each character produced;

A still further object of the present invention is to provide a device for visually producing predetermined characters in response to an electric signal in which the disadvantages of heretofore known devices are overcome.

These and other objects are accomplished in the character synthesizing tube of the present invention by providing a cathode ray tube with a plurality of independent electron beams capable of being focused upon an incremental area on the tube screen. Obviously, the electron beams may be obtained by using separate electron guns but, for practical purposes, a single electron gun is preferred.

To obtain the desired separate electron beams from a single electron gun, the emitter or cathode is constructed to present a relatively small lateral dimension and any desired length. In other words, the cathode is much longer than it is wide. Such a cathode ray beam generator provides a single beam which is then subdivided into a plurality of vertically spaced-apart smaller independent beams in a lineal array acted upon separately by an electron lens.

The control of each electron beam is provided by suitable circuitry external to the tube. By sweeping the beam array across the screen area alloted to each character, and at the same time cutting predetermined electron beams "on" and "off," a desired character may be produced on the screen. Although the inventive character synthesizing tube is unique in its ability to scan the screen in line sequence, discrete positions on the screen may be selected by the application of suitable control voltages or, indeed, any desired sequence and any desired speed may be selected. The character synthesizing tube is useful, therefore, in selecting any one of many memory elements in which information is stored and retained. In such an application the conventional luminescent screen may be replaced by a memory screen made up of many memory elements from which information may be selected at random due to the fact that the beams are "off" until a selected time on the sweep cycle, or the beam may be left "on" to pass in turn from one to the other of the memory elements in a predetermined order.

Other objects and advantages of the present invention will become apparent to one skilled in the art to which the invention pertains from the following detailed description of the preferred embodiment thereof described with respect to the accompanying drawings, in which:

Figure 1 is a perspective view, greatly enlarged, illustrating one embodiment of a cathode ray beam generator in accordance with the present invention;

Figure 2 is a perspective view, partially in section, of a cathode ray tube incorporating the invention and illustrating the position of the beam generator, and partially in magnified section to illustrate the illumination of selected spots on the inner face of the cathode ray tube screen to represent selected characters;

Figure 3 is a perspective view partially in section of the cathode ray tube of Figure 2 taken from another angle;

Figure 4 is a view in perspective, greatly enlarged, of another cathode ray beam generator;

Figure 5 is a circuit diagram illustrating one arrangement of components to operate the character synthesizing tube of the present invention;

Figure 5A is a partial schematic diagram of a magnetic core matrix illustrated in Figure 5; and

Figure 6 is a timing chart illustrating the relative timing of control pulses and voltages in the operation of the present invention.

Referring to the perspective view of Figure 1, a typical embodiment of the present invention provides a cathode ray beam generator for developing any desired number of vertically spaced-apart electron beams to be focused in a vertical array on an incremental area of a cathode ray tube screen. Included in the generator is a long narrow cathode **10** emitting electrons in a fan-shaped beam as determined by side-deflecting plates **11** and **12**. A conventional arrangement for indirectly heating the cathode **10** may be utilized. It has been found that for optimum beam density the plates **11** and **12** should be at an angle of approximately 135° with each other.

To subdivide the single electron beam, a curved anode plate **13** provided with a terminal **13***a* is positioned between the flared ends of the deflecting plates **11** and **12**. Since one embodiment of the cathode ray beam generator utilizes seven separate electron beams, seven vertically spaced-apart apertures **15**, rectangular in shape, for example, are provided along the central axis of the anode plate **13**. Of course, the apertures may be circular or of any other desired configuration. The electron beam

passing through each aperture in the anode plate 13 is shielded from interacting field effects of the electron beams passing through adjacent apertures by interconnected electrical conductors 14 adjacent to the apertures, such conductors preferably being maintained at ground potential. In this manner, seven separate and distinct electron beams are provided which may be controlled independently of each other. Of course, seven separate electron emitters may be substituted for the above arrangement although such a system would be more complex and expensive than the above-described structure.

Considering next the control of the seven electron beams, each beam is either "on" or "off." That is, any predetermined electron beam either passes through a grid structure or electron lens to a screen, described hereinafter, or it is cut off entirely. To achieve the latter effect, the electron beam may be defocused by suitable elements. Another arrangement to cut off the beam involves the provision of an electron mirror effect to reflect the electrons entirely. An electron mirror acts identically upon an electron beam as does its optical counterpart on light. This is accomplished by providing a potential distribution which decelerates and reverses the direction of flow of the impinging beam of electrons.

The beam defocusing type of control, on the other hand, achieves the desired control by defocusing the beam sufficiently with an electron lens along the axis of the beam path. This simply causes the beam to be imaged at some spot beyond the aperture plane, causing an apparent disappearance of the spot from the display screen. For the purposes of the present invention, however, the electron mirror type of beam control is preferred although it is understood that other systems may be used.

The primary prerequisite to successful electron beam control is to provide isolation of each beam from the others in order that it may be turned "on" or "off" without interfering with the other beams. That is, the field effect of one set of beam control electrodes as well as the space charge effect produced by the electron beam upon which it acts must be minimized. To this end, elongated grids 20 and 21, forming an electron lens, utilize supporting dielectric material, indicated generally by the numerals 22 and 23, to provide a plurality of rectangular apertures 24 and 25, respectively, preferably equal in number to the cathode apertures 15. Permanently interconnected electrical conductors 26 and 27 on the grids 20 and 21, respectively, form closed loops about each of the apertures 24 and 25 to isolate the electron beams passing therethrough from any appreciable interacting field effects, their effect being identical with that of the electrodes 14.

The grid control elements comprise electrically conductive facings 28 supported by the dielectric material in the apertures 24 and 25. Each of the facings 28 receives a control voltage from a terminal 29 extending through an opening 30, separate electrical conductors (not shown) connecting each terminal 29 to separate pins 41 (Figure 2) extending from the base of a cathode ray tube 40. Thus, only seven connections for each of the two grids are required. Through these simplified connections, a control voltage may be maintained independently at each of the grid apertures. In certain instances, all of the terminals of one of the grids may be tied to a common potential.

If desired, each of the apertures may contain a fine wire mesh at the potential of the conductive facings 28. It will be understood that such wire mesh may be used with or without the facing 28. In addition, the grid control elements may be self-supporting in which event the dielectric structure may be eliminated.

Under normal operation of the tube, the control elements 28 at the apertures 24 and 25 are maintained at such potentials that the beam formed by the related cathode aperture 15 is in an "off" condition. When an appropriate signal is received at related terminals 41, predetermined apertures are unblanked and that beam is focused on the tube screen at a point determined by a separate beam deflection circuit to be described hereinafter. More particularly, if the electron mirror effect is used, the facings 28 in the grid 21 may be maintained at a fixed positive potential of, for example, 200 volts, and the facings 28 in the grid 20 may be held normally at a negative 200 volt potential. By applying a positive 150 volt potential to selected facings 28 on the grid 20, selected beams may be turned "on." This demonstrates the electron mirror effect, the surface of the mirror being between the grids 20 and 21.

With the provision of seven vertically spaced-apart electron beams, each being capable of separate and independent control, the next requirement for the operation of the present character synthesizing tube is that the seven beams, as a unit, be deflected horizontally and vertically to a predetermined position on the tube screen.

Referring now to Figure 2 of the drawings, the cathode 10, the beam forming plate 13 and the grids 20 and 21 are shown in operating position within an evacuated container 42 of the cathode ray tube 40. It should be understood that the size of the cathode, anode and grid structures has been greatly exaggerated in Figures 2 and 3 in the interests of clarity. In practice, the apertures 24 and 25 in the grids 20 and 21 may be on the order of .010 to .030 inch square, for example. Electrical connections (not shown) are provided between each of the separate components within the evacuated container 42 and the pins 41, only a representative number of which are shown for simplicity. As such connections are well known in the art, a detailed description thereof is deemed unnecessary here.

A second anode 43 (Figure 3) may be provided in the envelope 42 in accordance with conventional cathode ray tube construction in order to accelerate the electron beams, a final accelerating aquadag coating 44 on the tube interior also being useful.

The deflection of the electron beams is controlled by horizontal deflection plates 45 and by vertical deflection plates 46, such beams thereby impinging on desired areas of a screen 47. A conventional phosphorescent coating may be provided on the screen. If desired, a storage type screen may also be utilized in which event the information may be read from the screen by scanning it.

A magnetic field may be provided by a coil 48 (Figure 3) to reduce the beam column height by converging the beams, as shown in Figure 3, to reduce the character size. In other instances such a magnetic field may be employed to increase the column height by diverging the electron beams, if desired.

Another arrangement to provide a plurality of independent electrons beams spaced apart in a lineal array is shown in Figure 4. In this structure, a cathode 100, indirectly heated in a conventional manner, is flanked by a pair of side baffles 101. Grids 102 spaced from and extending in front of the cathode 100 are supported by strips 103, separate grids being energized through terminals 102*a* to control electrons emitted from separate areas of the cathode. A fine wire mesh may be provided across the opening defined by the wires of each individual grid, if desired. It will be understood that the grid-cathode structure has been greatly enlarged, the distance between horizontal grid wires being on the order of .015 to .030 inch, for example.

To isolate the electron beams and minimize interacting field effects, grounded conductors 104 extend in front of the cathode 100 between each pair of grids 102.

A first anode 105 also includes a longitudinal aperture 106 to limit the width of the electron beam array provided by the cathode-grid structure. The entire cathode ray tube may be controlled by suitably varying the potential of this anode by a connection to a terminal 105*a* thereon.

The theory of operation of this beam forming structure

will be understood when it is compared to a conventional three element vacuum tube. Thus, each of the grids **102** forms with an area of the cathode and the anode **105** a triode controlled by appropriately varying the cathode-grid potential gradient. Furthermore, by setting the potential on the anode **105** sufficiently low, the generation of an electron beam is prevented regardless of the grid-cathode potential.

To illustrate the manner in which the single column electron beam array is deflected, a suitable voltage applied between the horizontal deflection plates **45** and between the vertical deflection plates **46** directs the array, for example, to a column **50** on the screen **47**, as shown by the magnified section of Figure 2. Solid dots indicate an "on" beam and blank circles indicate the spot where that electron beam would have been focused had it not been blanked "off."

In column **50**, all seven of the vertically spaced-apart electron beams are "on" as indicated by the seven solid dots on the screen **47**. By changing the voltage between the horizontal deflection plates **45** while holding the voltage constant between the vertical deflection plates **46**, the single column of seven electron beams is deflected to the next column position **51**. Coincident with the change in horizontal position of the beams, the second, third, fifth and sixth electron beams, counting downwardly from the top, are cut "off," as indicated by the small blank circles in the column **51**. Thus, only the top, middle and bottom beams impinge upon the screen. The seven beams are continuously stepped across the screen **47** as predetermined beams are cut "on" and "off" at a rapid rate to form the selected characters. In the example shown in Figure 2 of the drawings, the letter E is printed at the first character position with the letters S, T, and a partially formed E, following the T. In Figure 3, the letters formed on the screen **47** appear from the front with the electron beam array shown in a position to complete the second letter E.

The timing of the beam array shift is shown in the timing chart of Figure 6 which will be explained in greater detail hereinafter. As the voltage on the vertical deflection plates **46** is held constant, the horizontal position voltage is varied in a sequential step fashion to move the single column electron beam array across the selected character position.

For the purpose of further illustrating the invention, it will be assumed that the cathode ray tube **40** has sufficient area on its display screen **47** for an array of 128 characters across by 64 characters down. Such an array has been chosen arbitrarily for use in the proposed character synthesizing tube although the invention is not limited to any particular array or number of characters. Since each character position on this tube screen is composed of five vertical columns of seven spots (spaces at which each beam may be focused), a total display is divided into 1024 ($8\times128_Q$ vertical column spaces of 64 horizontal arrays of 7 rows. Each character will physically occupy five of the eight lines of its character space. These lines correspond in the time chart to T_2–T_6 of a given machine cycle while the other three of the eight lines correspond to T_1, T_7 and T_8 of the machine cycle, which increments are reserved for a reset operation.

One circuit arrangement for operating the character synthesizing tube **40** is illustrated in Figure 5 of the drawings. Considering first the operation of that portion of the block diagram enclosed by broken lines and labeled horizontal display position selector, during the time intervals T_7 and T_8 of the machine cycle preceding the generation and display of the next character, a computer (not shown) sends into a register **52** a binary coded positioning signal which corresponds to one position out of the 128 horizontal positions on the tube face on which it is desired that the next character appear. The binary coded positioning signal is transformed by a digital-to-analog converter **53** to provide a voltage on a line **54** that will index the selected character at column **2** of a given character space, column **1** actually comprising space between adjacent characters.

Another digital-to-analog converter **55** produces a horizontal position step voltage, indicated in the time sequence chart of Figure 6, to step the electron beam array across the tube face **47**. The converter **55** does this incrementally since it steps the output voltage when pulses are fed to it at times T_2 to T_6. The stepped voltage is added to the horizontal positioning voltage from the line **54** by an analog voltage adder **56**, the composite voltage being fed into a horizontal deflection amplifier **57** which, in turn, energizes the plates **45** to move the beam array horizontally, step by step, across the selected character position.

To determine on which line the characters are to be formed, a predetermined vertical deflection of the electron beam array must be obtained. In response to suitable binary code signals from the computer, a register **58** positioned in a unit termed a vertical-display position selector produces output signals if such coded signals are received coincidentally with time T_1 pulses. A digital-to-analog converter **59** receives the binary signals from the register **58** and generates a voltage providing the desired vertical deflection for one of the 64 selectable rows of characters. The vertical deflection voltage is amplified by a suitable amplifier **60** and applied to the vertical deflection plates **46** of the tube.

At the same time that horizontal and vertical positioning signals are being applied to the deflection plates, predetermined ones of the seven electron beam are unblanked (turned "on") at selected intervals. The control of the unblanking is initiated by a binary coded character signal from a character selection bus leading from the computer. This coded signal is applied to an appropriate decoding tree **61** which is composed of magnetic cores or diodes, in a unit labeled character decoder. The decoding tree **61** selects and applies a voltage pulse to one of sixty four, for example, character selection output wires **62** corresponding to the coded character from the computer.

The wires **62** selectively couple energizing potentials to a core matrix **63** which generates coded output signals on seven output conductors **64** corresponding to the seven vertical electron beam positions. For example, the core matrix **63** may take the form of the circuit shown in Figure 5A. Five columns of seven high remanence magnetic cores **63***a* form the matrix, the output conductors **64** being connected to individual windings on the cores in corresponding rows. A second connection to the core windings has been omitted since it merely leads to a suitable potential. Five input conductors **65** receiving pulses at times T_2 to T_6, as shown in Figure 5, energize windings on corresponding columns of the magnetic cores **63***a*.

The manner of connecting a single character selection output conductor **62**, representing the letter "E," has been illustrated in Figure 5A. Thus, the conductor **62** leads to windings on the cores **63***a* corresponding to the dots that must be illuminated to form an "E," namely the top, middle and bottom rows and the left column.

In operation, a potential is maintained on the "E" conductor **62** while that character position is scanned. However, the cores **63***a* will not be switched by such potential alone since corresponding windings will not furnish the required switching magnetomotive force. Energization of the T_2 conductor **65** by a pulse at time T_2 adds an additional coercive force to the left column of cores, this being sufficient to switch them and provide output voltages on all the conductors **64** at this instant.

The circuit designated unblank grid **66** is a simple diode circuit normally maintaining the beam control electrodes at such potential that the several beams are blanked out. At this time, suitable output lines **67** will be energized to unblank the beams required to illuminate a portion of the selected character. More specifically, the

output lines will supply potentials to the grid facings **28** in Figure 1 or the grids **102** in Figure 4.

While the electron beam array is being moved from one character position to another, or to a new row, a suitable blanking potential is applied to a control electrode by a conductor **68**. For example, the control electrode may be the plate **13** in Figure 1 or the anode **105** in Figure 4. This potential is normally furnished by an unblanked amplifier **69**. A set-reset circuit **70**, which may comprise a trigger circuit stable in two conditions, supplies a continuous D.-C. voltage at level "1" to the amplifier **69** in response to a pulse at time T_2 to unblank the tube **40**. A further pulse received by the trigger **70** at time T_7 turns off the D.-C. voltage and restores the circuit to its "0" condition so that a blanking signal is carried on the line **68**. The interval during which the tube is blanked in this manner for reset is indicated in Figure 6 by the legend "Reset."

At the same time that a signal representing a particular character to be printed on the screen is fed into the decoding tree **61**, the same signal is fed into an "OR" circuit **71** in a machine start unit, as shown in Figure 5. The "OR" circuit **71** is of the type which provides an output signal if there is a pulse on any one of the input leads. The output of the "OR" circuit is fed into an "AND" circuit **72** also receiving pulses from a clock **73** synchronized with the computer. The "AND" circuit **72** provides an output pulse at each instant that pulses from the clock **73** and from the "OR" circuit **71** coincide. Each output pulse from the "AND" circuit **72** causes a clock pulse counter **74**, which may comprise a ring counter, to advance one step and supply pulses on the outputs T_1 to T_8 at the corresponding times. These pulses are supplied to various units in the systems, as described above, so that the indicator circuits are synchronized with the computer.

It will be evident from the foregoing that the indicator circuits incorporating the inventive cathode ray tube **40** may be substituted for a conventional printer to display the output of a computer. A high speed camera may be synchronized with the computer to obtain information from the tube screen **47**. If a storage type screen **47** is used, it may be scanned to provide signals representative of the output information.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to the preferred embodiment, it will be understood that various omissions, substitutions and changes in the form and details of the device illustrated, and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

I claim:

1. A cathode ray tube indicator comprising an evacuated envelope enclosing an electron beam generator providing a plurality of independent beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the beam generator and the screen to control the position of the electron beam array on the screen, and grid means adjacent the electron beam generator to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected along the screen to form selected characters thereon.

2. A cathode ray tube indicator comprising an evacuated envelope enclosing cathode means to provide an electron beam, electrode means in the path of the beam to subdivide it into a plurality of independent beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the electrode means and the screen to control the position of the electron beam array on the screen, and grid means adjacent the electron beam generator to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected along the screen to form selected characters thereon.

3. A cathode ray tube indicator comprising an evacuated envelope enclosing a cathode source of electrons, beam forming electrode means adjacent to said cathode to provide a plurality of independent electron beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the beam forming electrode means and the screen to control the position of the electron beam array on the screen, grid means in the path of said plurality of electron beams to turn selected ones "on" and "off" as they are deflected along the screen to form selected characters thereon.

4. A cathode ray tube indicator comprising an evacuated envelope enclosing a cathode source of electrons, beam forming electrode means adjacent to said cathode to provide a plurality of independent electron beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the beam forming electrode means and the screen to control the position of the electron beam array on the screen, grid means adjacent to the beam forming electrode means including two electrodes each formed by a lineal array of apertures, first electrically conductive elements adjacent to each of the apertures to shield the plurality of electron beams one from the other and minimize interacting field effects, second electrically conductive elements defining the apertures adapted to receive beam control potentials to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected along the screen to form selected characters thereon.

5. A device as defined in claim 4 in which said two grid electrodes are formed of a dielectric material providing said apertures, the second electrically conductive element comprising a facing on the interior of said apertures.

6. A device as defined in claim 4 in which the second electrically conductive elements include a wire mesh in said apertures.

7. A cathode ray tube indicator comprising an evacuated envelope enclosing a cathode source of electrons, beam forming electrode means adjacent to said cathode to provide a plurality of independent electron beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the beam forming electrode means and the screen to control the position of the electron beam array on the screen, grid means including two electrodes each formed by a lineal array of apertures, first electrically conductive elements adjacent to each of the apertures to shield the plurality of electron beams one from the other and minimize interacting field effects, second electrically conductive elements defining the apertures adapted to receive beam control potentials, and terminal means to connect each of said second conductive elements to external control circuits for providing said control potentials to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected across the screen to form selected characters thereon.

8. A device as defined in claim 7 in which said two grid electrodes are formed of a dielectric material providing said apertures, the second electrically conductive element comprising a facing on the interior of said apertures.

9. A device as defined in claim 7 in which the second electrically conductive elements include a wire mesh in said apertures.

10. A cathode ray tube indicator comprising an evacuated envelope enclosing an elongated cathode source of electrons, beam forming electrode means adjacent to said cathode to direct said electrons into a fan-shaped beam, plate means interposed across the fan-shaped beam to divide it into a plurality of independent electron beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the cathode source and the screen to control the position of the electron beam array on the screen, and grid means adjacent to the plate means to turn selected ones of said plurality of electron beams "on" and "off" as they are

deflected across the screen to form selected characters thereon.

11. A cathode ray tube indicator comprising an evacuated envelope enclosing an elongated cathode source of electrons, beam forming means adjacent to said cathode to direct said electrons into a fan-shaped beam, plate means interposed across the fan-shaped beam to divide it into a plurality of independent beams spaced apart in a lineal array, a screen to receive the electron beam array, deflection means between the cathode source and the screen to control the position of the electron beam array on the screen, grid means adjacent to the plate means including two electrodes each formed by a lineal array of apertures, first electrically conductive elements adjacent to each of the apertures to shield the plurality of electron beams one from the other and minimize interacting field effects, second electrically conductive elements defining the apertures adapted to receive beam control potentials to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected along the screen to form selected characters thereon.

12. A cathode ray tube indicator comprising an evacuated envelope enclosing a cathode source of electrons, a plurality of grids adjacent to said cathode source, said grids controlling the emission of electrons from a plurality of areas on the cathode to provide a plurality of independent electron beams spaced apart in a lineal array, a plate positioned in front of the grids in the path of the electron beams having an aperture elongated in the direction of the array to limit the width of the electron beam array, a screen to receive the electron beam array, deflection means between the plate and the screen to control the position of the electron beam array on the screen, the grids adapted to receive beam control potentials to turn selected ones of said plurality of electron beams "on" and "off" as they are deflected along the screen to form selected characters thereon.

13. A device as defined in claim 12, in which electrically conductive elements are positioned between the grids to shield the plurality of electron beams one from the other and minimize interacting field effects.

14. A method of producing selected characters on a cathode ray tube screen comprising the steps of providing a plurality of spaced apart electron beams in a lineal array, stepping the beam array across the screen, and turning selected ones of the beams "on" and "off" as they are stepped across the screen to form selected characters thereon.

15. A method of producing selected characters on a cathode ray tube screen comprising the steps of providing a supply of electrons, dividing the electrons into a plurality of spaced-apart electron beams in a lineal array, stepping the beam array across the screen, and turning selected ones of the beams "on" and "off" as they are stepped across the screen to form selected characters thereon.

References Cited in the file of this patent

UNITED STATES PATENTS

2,691,156	Saltz et al.	Oct. 5, 1954
2,734,187	Rajchman	Feb. 7, 1956
2,741,722	Shields	Apr. 10, 1956
2,760,108	Wilson et al.	Aug. 21, 1956