United States Patent

Eichelberger

[15] **3,696,388**

[45] **Oct. 3, 1972**

[54] **APPARATUS FOR GENERATING CHARACTERS**

[72] Inventor: **William E. Eichelberger,** 4700 Glen Forest Drive, Raleigh, N.C. 27609

[22] Filed: **Dec. 18, 1970**

[21] Appl. No.: **99,342**

[52] **U.S. Cl.** .... **340/324 A,** 315/18

[51] **Int. Cl.** **G06f 3/14**

[58] **Field of Search** .... 340/324 A

[56] **References Cited**

UNITED STATES PATENTS

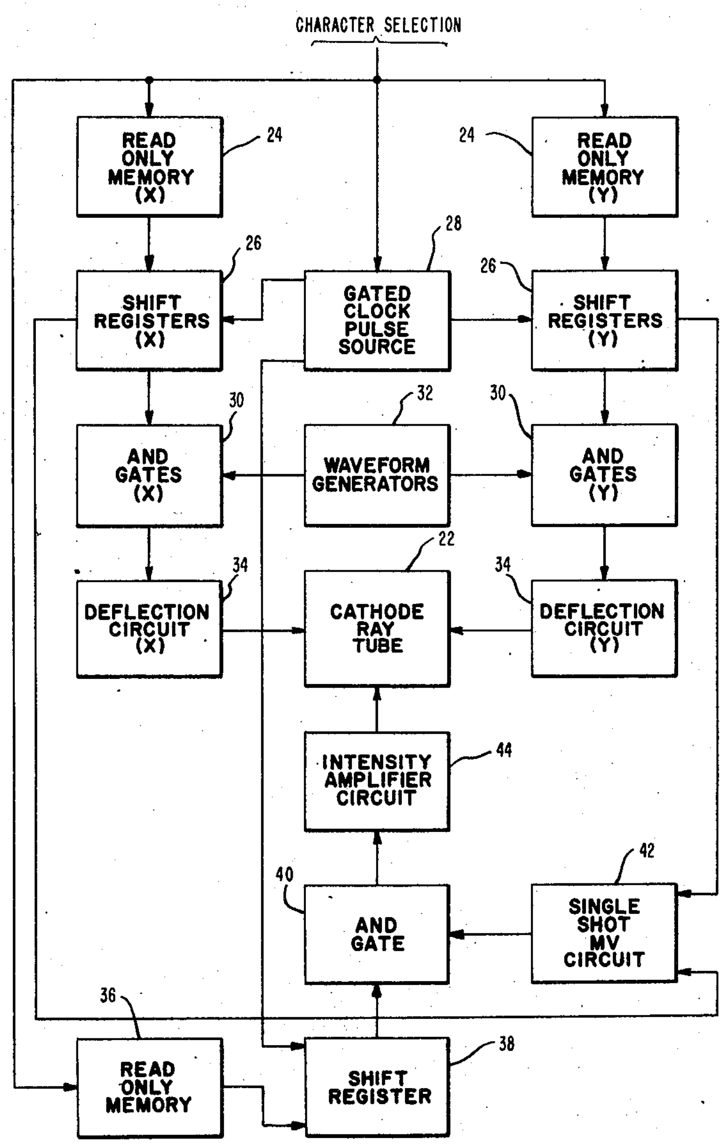
3,335,416	8/1967	Hughes	340/324 A
3,594,756	7/1971	Granberg et al.	340/324 A
3,394,367	7/1968	Dye	340/324 A
3,441,722	4/1969	Gloess	235/151
3,283,317	11/1966	Courter	340/324 A

Primary Examiner—David L. Trafton
Attorney—Clarence R. Patty, Jr., Walter Zebrowski and Woodcock, Washburn, Kurtz & Mackiewicz

[57] **ABSTRACT**

Characters are displayed on the screen of a cathode ray tube. The cathode ray tube electron beam is deflected in a trace representing the character to be displayed by sequentially applying various waveforms to the cathode ray tube deflection circuit. Digital control circuitry including a read only memory having segment deflection commands for each character to be displayed, shift registers set by the deflection commands, and AND gates enabled by the shift registers control the sequential application of the various waveforms to the deflection circuit. An additional shift register set by the deflection commands of the read only memory, a single shot multivibrator, and an associated AND gate control the intensity of the electron beam during the trace.

7 Claims, 14 Drawing Figures



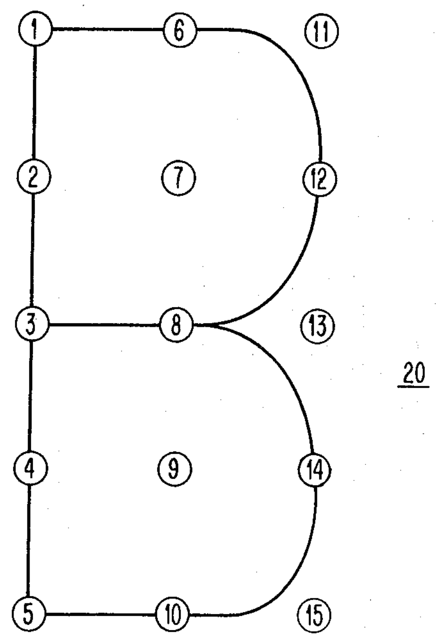

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
20

FIG. 1

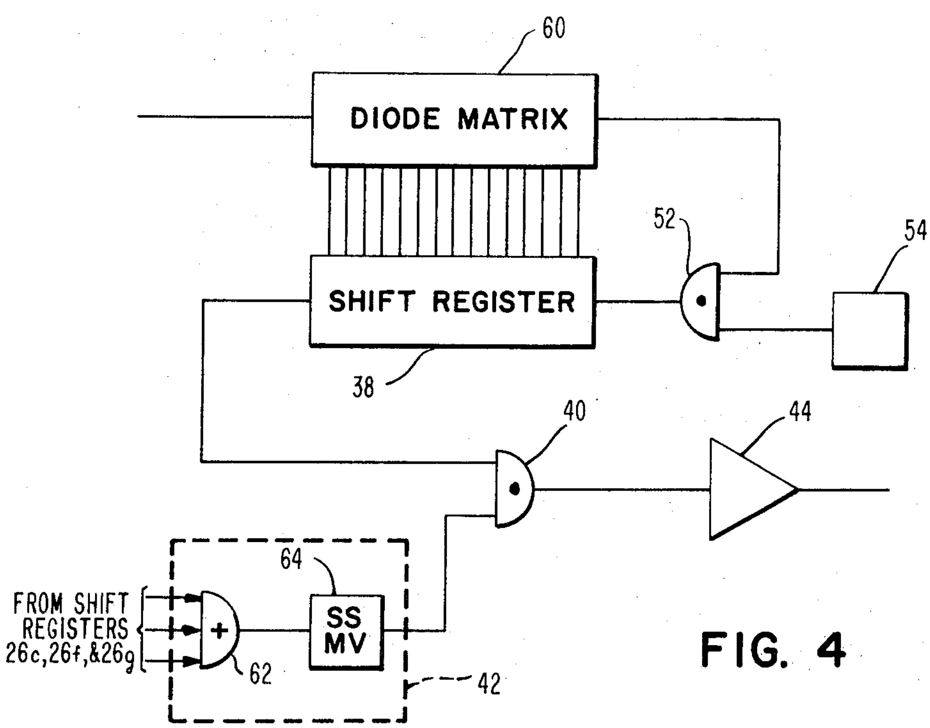

60
DIODE MATRIX
52
54
SHIFT REGISTER
38
40
44
64
FROM SHIFT REGISTERS 26c,26f,&26g
+
SS MV
62
42

FIG. 4

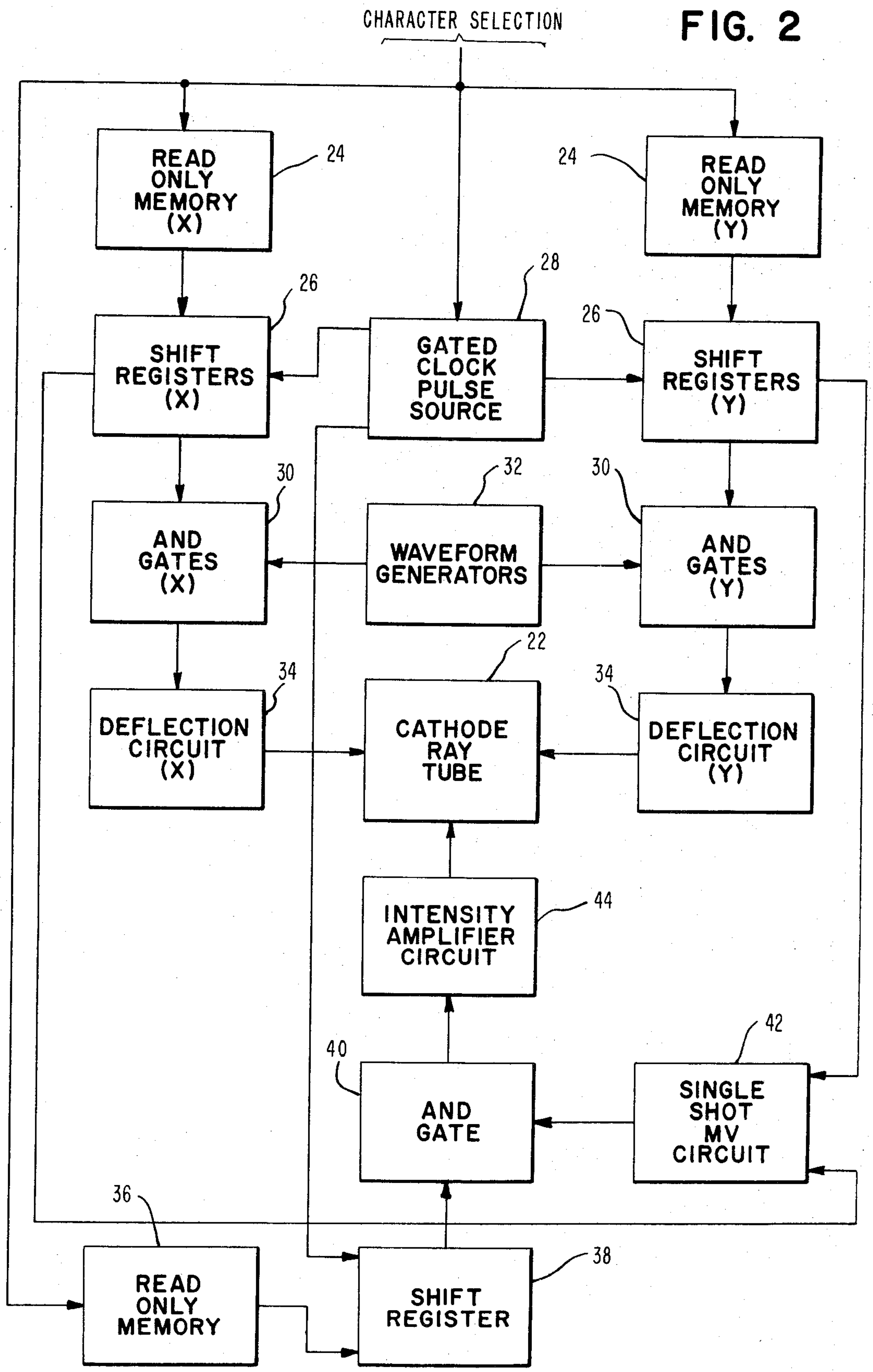
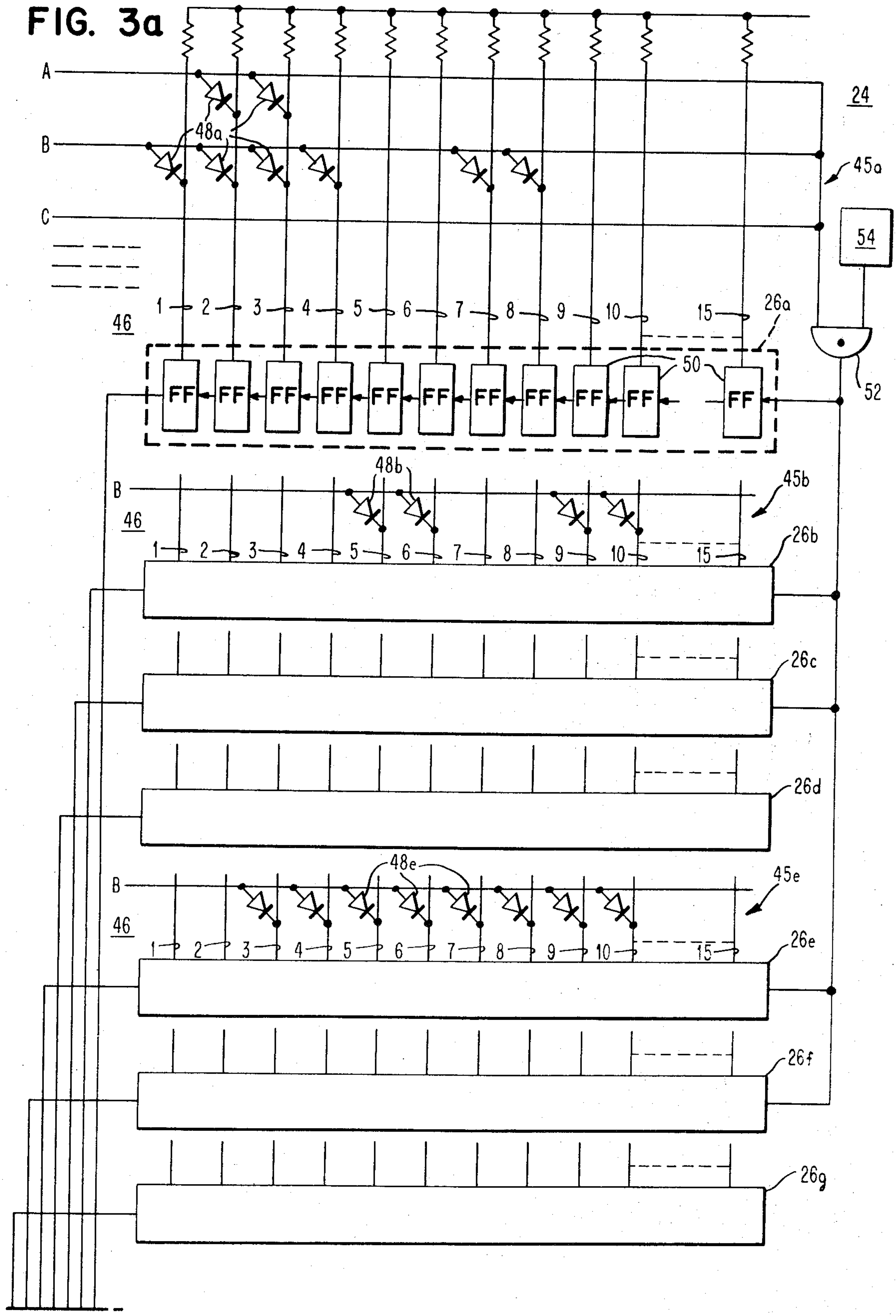

CHARACTER SELECTION
READ ONLY MEMORY (X)
24
READ ONLY MEMORY (Y)
24
SHIFT REGISTERS (X)
26
GATED CLOCK PULSE SOURCE
28
SHIFT REGISTERS (Y)
26
AND GATES (X)
30
WAVEFORM GENERATORS
32
AND GATES (Y)
30
DEFLECTION CIRCUIT (X)
34
CATHODE RAY TUBE
22
DEFLECTION CIRCUIT (Y)
34
INTENSITY AMPLIFIER CIRCUIT
44
AND GATE
40
SINGLE SHOT MV CIRCUIT
42
READ ONLY MEMORY
36
SHIFT REGISTER
38

FIG. 2

FIG. 3a


A
B
C
24
48a
45a
54
1
2
3
4
5
6
7
8
9
10
15
26a
46
50
52
FF
48b
45b
26b
26c
26d
48e
45e
26e
26f
26g

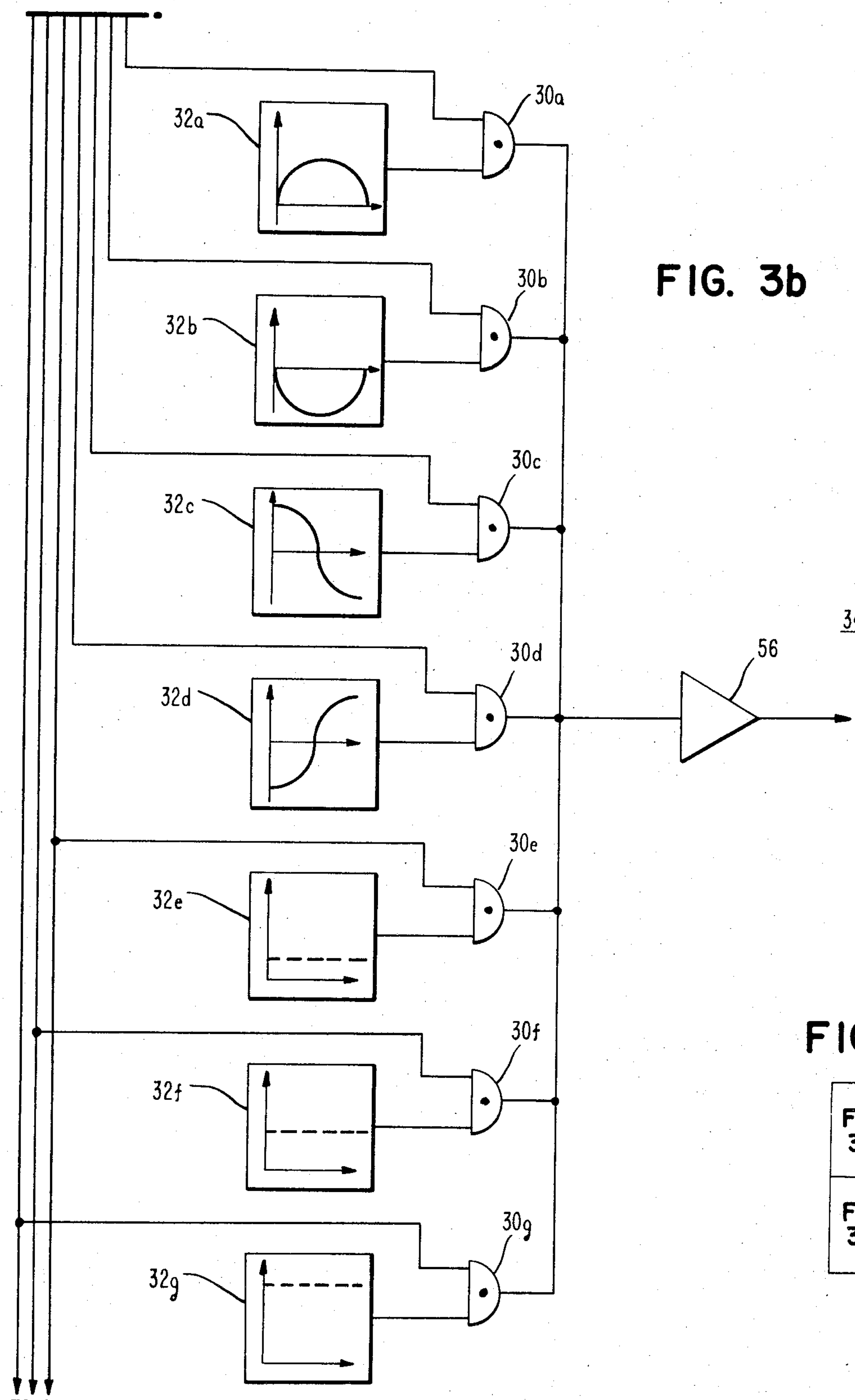

30a
32a
30b
32b
30c
32c
30d
32d
34
56
30e
32e
30f
32f
30g
32g
TO SINGLE SHOT
MV CIRCUIT 42

FIG. 3b

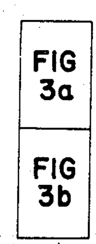
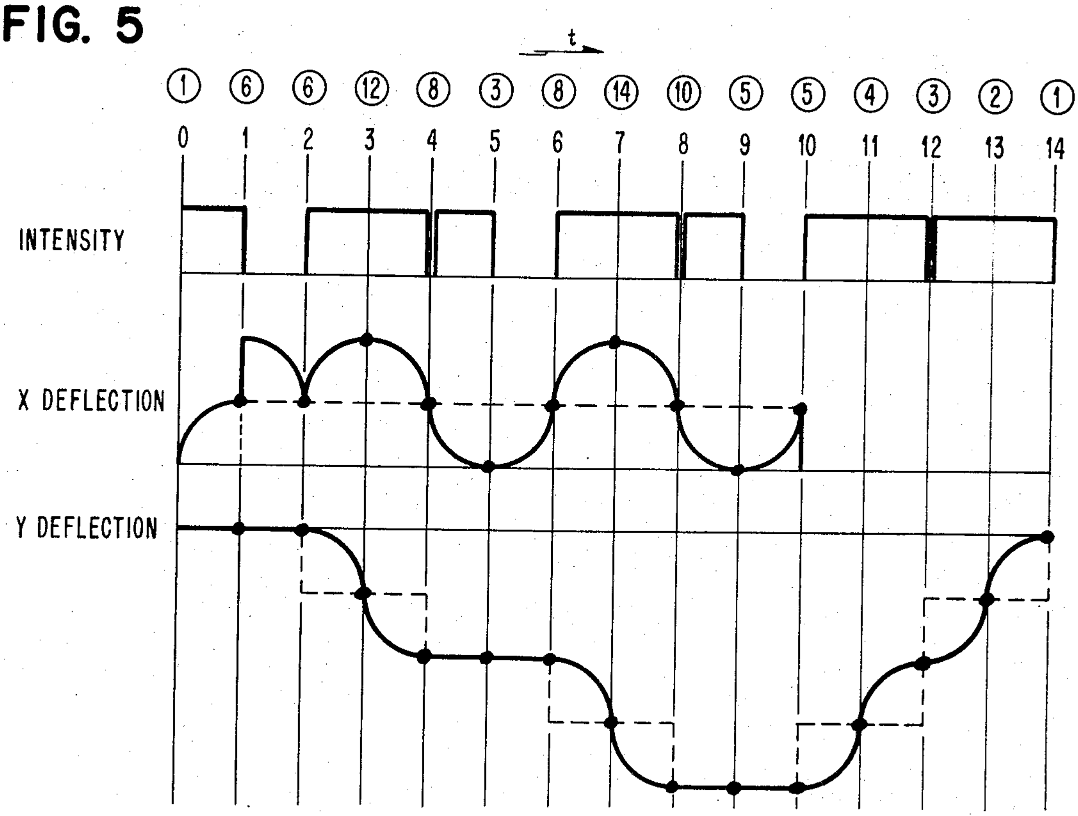


FIG
3a
FIG
3b

FIG. 3

FIG. 5


t
①
⑥
⑥
⑫
⑧
③
⑧
⑭
⑩
⑤
⑤
④
③
②
①
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
INTENSITY
X DEFLECTION
Y DEFLECTION

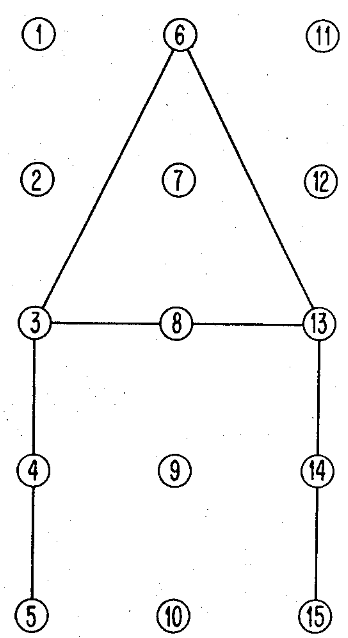

①
⑥
⑪
②
⑦
⑫
③
⑧
⑬
④
⑨
⑭
⑤
⑩
⑮

FIG. 7

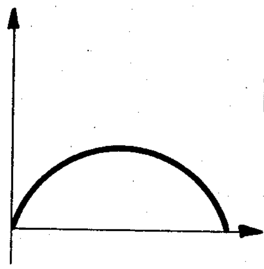


FIG. 6a

FIG. 6b

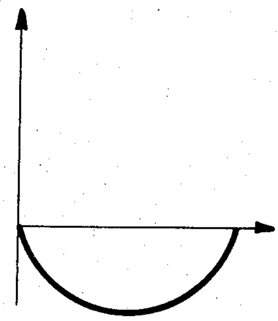


FIG. 6c

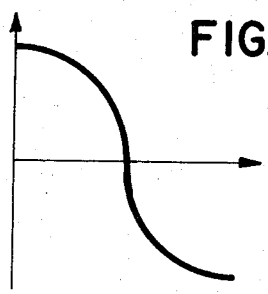


FIG. 6d

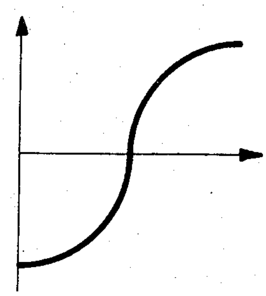


FIG. 6e

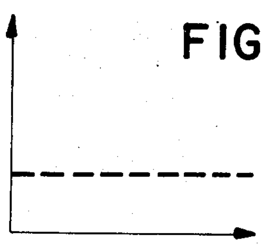
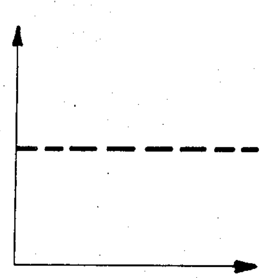


FIG. 6f



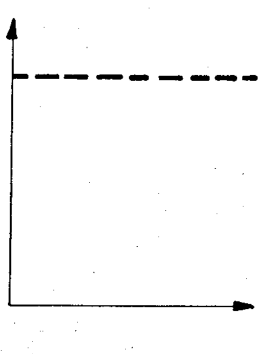


FIG. 6g

APPARATUS FOR GENERATING CHARACTERS

BACKGROUND OF THE INVENTION

This invention relates to character generators.

In one type of prior art character generator known as a dot matrix generator, predetermined patterns of dots in a dot matrix are used to form the characters of a font. Columns and rows of dots are sequentially addressed in order to activate the appropriate dots in the predetermined pattern of each character. Since the sequential addressing and relatively non-critical timing of the dot matrix generator is convenient and economical from a design point of view, this type of generator represents the most widely used technique for alphanumeric character generation. However, the spaces between the dots of the matrix result in characters having insufficient shape detail for easy distinguishability from character to character. The lack of distinguishability is particularly true for lower case alphabetic characters.

Another type of prior art character generator is a stroke generator. In a stroke generator, an electron beam is deflected in response to an analog signal developed by combining sine and cosine generators with electronic integrators. The resulting deflecting forces on the electron beam, which are comparable to the sequential addressing and digitally controlled dot-matrix generators, form patterns on a screen by a method and a means similar to those utilized in generating the well known Lissajous' patterns. The characters produced by stroke generators are generally superior to those produced by dot matrix generators as far as shape detail is concerned since curves or small segment straight line approximations of curves can be generated. However, the electronic integrators which are utilized to develop an analog signal in the stroke generators are prone to drift with a resulting variance in particular characters with time. The electronic integrators are also costly.

SUMMARY OF THE INVENTION

It is a general object of this invention to provide a generator for characters having sufficient shape detail for easy character distinguishability.

It is another object of this invention to provide a generator for producing characters which do not vary with time.

It is a further object of this invention to provide a character generator which is relatively economical.

In accordance with these and other objects, a character tracing electron beam of a display device such as a cathode ray tube is deflected from position-to-position of the display device screen by sequentially applying various deflection waveforms to a beam deflection means associated with the display device. The various deflection waveforms are sequentially applied to the deflection means under the control of a deflection control means including a plurality of register means which selectively store position-to-position segment deflection commands generated by a read only memory for each character to be displayed screen. An intensity control means which is also responsive to the segment deflection commands may be provided for applying an intensity control signal which is variable from position-to-position of the character trace.

BRIEF DESCRIPTION OF THE DRAWINGS

For still further objects and advantages of the invention, reference should be made to the following description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a schematic representation of a character displayed on a generator display screen;

FIG. **2** is a block diagram of a character generator system embodying the invention;

FIG. **3** illustrates the relationship of FIGS. **3***a* and **3***b* which are schematic diagrams of the beam deflection circuitry in the system of FIG. **2**;

FIG. **4** is a schematic diagram of the beam intensity control circuitry of the system of FIG. **2**;

FIG. **5** illustrates waveforms generated by the circuitry of FIGS. **3** and **4**;

FIGS. **6**(*a–g*) illustrate individual waveforms utilized in generating the composite waveforms of FIG. **5**; and

FIG. **7** is a schematic representation of another character displayed on the generator display screen.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. **1** schematically illustrates a screen **20** of a display device such as a cathode ray tube. The screen **20** which comprises a continuum of material capable of emitting light energy under electron bombardment is subdivided into a matrix of positions **1–15**. The electron beam generated by the display device is traced through segments between a preassigned pattern of positions corresponding to a particular character to be displayed. In the case of the character B, the electron beam is traced through positions **1–6**, **8**, **10**, **12**, and **14** as shown.

A system for generating the position-to-position character trace will now be discussed with reference to FIG. **2** wherein the screen **20** of FIG. **1** is the anode of a cathode ray tube **22**. In order to move the electron beam from position-to-position segments while tracing out a character, deflection circuitry for both horizontal or X axis and vertical or Y axis deflection is provided.

The segment deflection or positioning commands which control the deflection from position-to-position for each character are stored in read only memory means (ROM's) **24** (X & Y). Characters which may be transmitted from a remote digital computer are decoded so as to selectively enable one line at the input of each memory means **24** as will be described with reference to FIG. **3***a*. After the character to be generated has been selected at the input to each memory means **24**, the positioning commands for that particular character are applied to X and Y axis digital deflection control means including shift registers **26**(X & Y), a source of gated clock pulses **28**, AND gates **30**(X & Y), and waveform generators **32**.

As will be described with reference to FIG. **3***a* and **3***b*, the positioning commands are utilized to set the various flip-flop stages of the shift registers **26**. As the gated clock pulses are applied to the input to the shift registers **26**, the AND gates **30** are sequentially enabled so as to sequentially apply various waveforms to the cathode ray tube deflection circuits **34**(X & Y).

In order to control the intensity of the electron beam during the movement from position-to-position in the character trace, digital intensity control circuitry is provided. As shown in FIG. 2, the intensity control circuitry also includes a read only memory 36 which provides intensity control commands corresponding to the segments of particular character selected. The intensity commands are then applied to a digital intensity control means comprising a shift register 38, an AND gate 40, and a single shot multivibrator circuit 42. The various stages of the register 38 are set by the intensity control commands so as to sequentially enable the AND gate 40 in response to pulses from the gated clock pulse source 28. The output of the AND gate 40 is selectively enabled by the output of the multivibrator circuit 42 in response to the output of the shift registers 26(X & Y). An intensity amplifier circuit 44 is coupled to the output of the AND gate 40 for appropriately amplifying the intensity control signal before application to the cathode ray tube 22.

The specific digital circuitry which may be utilized in achieving the position-to-position X axis deflection of the electron beam will now be discussed with reference to FIGS. 3*a* and 3*b*. It will be appreciated that substantially identical circuitry is utilized for Y axis deflection. As shown in FIG. 3*a*, the read only memory 24 comprises diode matrices 45(*a-g*) each having a plurality of input lines A, B, C...for each of the alphanumeric characters to be generated and a plurality of output lines 46(1–15), one output line for each of the matrix positions. (For purposes of simplification and clarity, only matrices 45*a*, *b*, & e have been shown.) When a particular character is selected, i.e. a particular input line is enabled, diodes 48 (*a-g*) associated with various output lines 46 become conductive in response to an input signal on one of the input lines A, B, C . . . to set the corresponding flip-flop stages 50 of the shift registers 26(*a-g*). Simultaneously, an AND gate 52 is enabled by the input signal on the one input line so as to pass a train of gated clock pulses from a source 54.

The output of each of the shift registers 26(*a-g*) sequentially and selectively enables AND gates 30(*a-g*) associated with various waveform generators 32(*a-g*) as shown in FIG. 3*b*. Depending upon the character selected, one or more of the AND gates 30(*a-g*) may be enabled by one or more of the shift registers 26(*a-g*) so as to superimpose or sum various waveforms before application to an amplifier 56 of the deflection circuit 34.

In order to achieve an appropriate composite waveform for deflection in a horizontal or vertical direction, waveform generators 32(*a-g*) generate the waveforms shown in FIGS. 6(*a-g*) respectively. The various waveforms are set forth in the table below:

FIG. 6*a*	Sin (0°–180°)
FIG. 6*b*	Sin (180°–360°)
FIG. 6*c*	Cos (0°–180°)
FIG. 6*d*	Cos (180°–360°)
FIG. 6*e*	D.C. one unit
FIG. 6*f*	D.C. two units
FIG. 6*g*	D.C. four units

In order to provide a detailed description of the operation of the digital circuitry of FIGS. 3*a* and 3*b*, the generation of the character B as shown in FIG. 1 will now be described with reference to the horizontal or X deflection composite waveform shown in FIG. 5. With the character B selected, the diodes 48*a* associated with output lines 46–1, 2, 3, 4, 7, & 8 become conductive to set the first, second, third, fourth, seventh, and eighth flip-flop stages 50 of the shift register 26*a*. Similarly, the diodes 48*b* become conductive to set the fifth, sixth, ninth, and tenth flip-flop stages of the shift register 26*b* and the diodes 48*e* become conductive to set the third through tenth flip-flop stages of the shift register 26*e*. Simultaneously, the gated clock pulses begin to enter the shift registers 26 so as to sequentially enable the AND gates 30*a*, 30*b*, and 30*e*.

As shown in FIG. 5, where the matrix positions are shown across the top of the diagram and position 1 is the undeflected beam position, the X deflection waveform begins at time t=0 when the AND gate 30*a* is enabled by the output of the shift register 26*a* so as to apply a sin (0°–180°) waveform from the waveform generator 32*a* to the deflection circuit 34. The AND gate 30*a* remains enabled through time t=1 when the AND gate 30*e* is enabled. This superimposes, or adds the DC one unit waveform of the generator 32*e* to the sin (0°–180°) waveform of the generator 32a.

At times t=2–4 and 6–8, the AND gate 30*a* is again enabled. At time t=4–6 and 8–10 the AND gate 30*b* is enabled to apply the sin (180°–360°) waveform from the waveform generator 32*b* to the deflection circuit 34. Throughout the time t=1–10, the sinusoidal waveforms from the generators 32*a* and 32*b* are superimposed on the DC one unit waveform from the generator 32*e* since the AND gate 30*e* remains enabled throughout this period of time. None of the AND gates 30(*a-g*are enabled from times t=10–14.

Although the specific Y axis deflection circuitry is not shown in FIGS. 3*a* and 3*b*, the circuitry would be identical except for the coding of the diode matrices 45(*a-g*). In order to generate the Y deflection waveform shown in FIG. 5, the Y deflection diode matrices 45 of the memory 24(Y) would appropriately set the flip-flop stages of the Y deflection shift registers 26*c*, *d*, *e*, *f*, and *g*. From time t=2–4, the AND gates 30*c* and 30*e* would be enabled. From time t=4–6, only the AND gate 30*f* would be enabled. From time t=6–8, the AND gates *30c*, *e*, and *f* would be enabled with the AND gate 30*g* enabled from time t=8–10. From time t=10–the AND gates 30*d*, *e*, and *f* are enabled with the AND gates 30*d* and e being enabled from time t=12 to t=14.

FIG. 5 also shows the intensity control waveform which is generated by the intensity control circuitry shown in block diagram form in FIG. 2 and in somewhat further detail in FIG. 4. The specific circuitry comprises the memory 36 including a diode matrix 60 associated with the shift register 38. After a particular character has been selected at the input to the diode matrix 60 the AND gate 40 is sequentially enabled so as to apply an appropriate intensity control signal to the intensity amplifier circuit 44. When the character B is to be generated with the intensity control signal of FIG. 5, the first, third, fourth, fifth, seventh, eighth, ninth, eleventh, twelfth, thirteenth, and fourteenth flip-flop stages of the register 38 will be set by signals at the output lines of the diode matrix 60.

The intensity control circuit as shown in FIG. 4 comprises the single shot multivibrator circuit 42 which is stimulated by pulses from either the X or Y shift registers 26*e*, 26*f*, and 26*g*. By applying the output of the shift registers 26*e*, 26*f*, and 26*g* to an OR gate 62, a single shot multivibrator 64 is stimulated by the initial application of any DC waveform to the deflection circuits 34(X & Y). The multivibrator **64** which is normally in the high state, drops to the low state for only a few microseconds (deflection settling time) when stimulated by the OR gate **62** connected to the shift registers **26***e*, **26***f*, and **26***g*. When the multivibrator **64** drops to the low state, the AND gate **40** drops to the low state regardless of the output of the shift register **38**. As a result, the intensity control circuit cuts the electron beam of the cathode ray tube **22** off, for a short period of time, while the deflection is settling to a new DC level.

As shown in FIG. **5**, the intensity control signal is in the low state at times t=4, t=8, t=12 as a result of the multivibrator **64** operating in conjunction with the OR gate **62**, the AND gate **40**, and the amplifier **44**. These times represent the initial application or onset of DC waveforms **6***e*, **6***f*, and **6***g*. Although times t=1, t=2, t=6, and t=10 also represent the initial application of the DC waveforms, the effect of the multivibrator **64** is masked since the intensity control signal is in the low state in response to the output of the shift register **38**. The electron beam is therefore essentially turned off at those points in time where a DC waveform is initially applied so as to prevent displaying stray deflections of the electron beam due to deflection waveform discontinuities.

In order to more fully explain the manner in which a position-to-position character trace is achieved, the trace of the character B will now be described with reference to FIGS. **1**, **5**, and **6**. In the following discussion, it will again be assumed that position **1** of FIG. **1** represents the point of zero beam deflection along both the *X* axis and the *Y* axis.

At time t=0, the sin (0°–180°) waveform of FIG. **6***a* is applied for X deflection simultaneously with the DC waveform of an intensity control signal at the upper level. During the period between t=0 and t=1, the electron beam is traced between position **1** and position **6** as indicated in FIG. **5** and shown in FIG. **1**.

At time t=1, the intensity control signal is reduced to the low state to allow the sin (0°–180°) waveform of FIG. **6***a* to complete its cycle. At time t=1, the one unit DC waveform of FIG. **6***e* is also applied for X deflection. It appears from FIG. **1** that the electron beam remains at position **6** at time t=1 even through a composite X deflection waveform has been applied which does move the electron beam off position **6**. Although the electron beam does move from position **6**, this movement is not seen on the screen **20** since the intensity control signal is in the low state.

At time t=2, the sin (0°–180°)waveform of FIG. **6***a* is again superimposed upon or added to the one unit DC waveform of FIG. **6***e* for X deflection and the cos (0°–180°) waveform of FIG. **6***c* is superimposed upon the one unit DC waveform of FIG. **6***e* for Y deflection. These waveforms continue through the period of time t=2–with the intensity control signal being in the high state. During this period, the trace moves from position **6** through position **12** and on to position **8**.

At time t=4, the sin (180°–360°) waveform of FIG. 6b is superimposed on the one unit DC waveform of FIG. **6***e* for X deflection while the two unit DC waveform of FIG. **6***f* alone provides the Y deflection as the electron beam moves from position **8** to **3**. The control signal drops to the low state momentarily at time t=4. At time t=5, the control signal again drops to the low state to allow the electron beam to retrace from positions **3** to **8** without displaying the retrace on the screen of FIG. **1**. The trace from position **8** through position **14** down to position **10** is achieved by again applying the sin (0°–180°) waveform of FIG. **6***a* for X deflection superimposed upon the one unit DC waveform of FIG. **6***e* over the period t=6–8. Y deflection is achieved for this period by superimposing the cos (0°–180°) waveform of FIG. **6***c* on the one unit and two unit DC waveforms of FIGS. **6***e* and **6***f*.

The trace from position **10** to position **5** is achieved between the time t=8–9 by superimposing the sin (180°–60°) waveform of FIG. **6***b* on the one unit DC waveform of **6***e* for X deflection and utilizing the four unit DC waveform of FIG. **6***g* alone for Y deflection. The intensity control signal drops to the low state momentarily at time t=8. At time t=9, the intensity control signal goes to the low state while the cycle of the sin (0°–180°) waveform of FIG. **6***b* is completed. This prevents the screen **20** from displaying any departure from position **5**.

Finally, the trace of the character B is completed by moving the electron beam from positions **5** through **4**, **3**, **2**, and back to **1**. Since no X deflection is needed, the X deflection signal remains at zero. In order to achieve the necessary Y deflection, the cos (180°–360°) waveform of FIG. **6***d* is superimposed upon the one unit plus two unit DC waveforms of FIGS. **6***e* and **6***f* for times t=10–12. At time t=12, the cos (180°–360°) waveform of FIG. **6***d* is superimposed upon the one unit DC waveform of FIG. **6***e*. During the period from time t=10–the intensity control signal remains in the high state except for a momentary drop to the low state at time t=12.

The diode matrices **45** for X and Y deflection and the diode matrix **60** for intensity control are set forth below in chart form for both the characters B and A. The lines *a–g* of the deflection charts represent the shift registers **26**(*a–g*) respectively and columns **1–15** represent the various stages of the shift registers **26**(*a–g*. An "X" indicates a diode connection between input lines B or A and lines **46**(**1–15**) of the various shift registers **26**(*a–g*). Similarly, the single line in the intensity control charts represent the various stages **1–15** of the shift register **38**. An "X" indicates a diode connection in the matrix **60** between a B or A input line and a stage of the shift register **38**.

X DEFLECTION FOR CHARACTER B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	X	X	X	X			X	X							
b				X	X				X	X					
c															
d															
e		X	X	X	X	X	X	X	X	X					
f															
g															

Y DEFLECTION FOR CHARACTER B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a															
b															
c			X	X			X	X							
d												X	X	X	X
e			X	X			X	X				X	X	X	X
f					X	X	X	X				X	X		
g									X	X					

INTENSITY CONTROL FOR CHARACTER B

```
  1 2 3 4   5 6   7 8   9 10 11 12 13 14 15
  X     X X X X X X X       X   X    X   X
```

X DEFLECTION FOR CHARACTER A

```
    1 2 3 4   5 6   7   8 9 10 11 12 13 14 15
a
b
c                 X X
d         X X          X X
e         X X     X X X X
f             X              X  X
g
```

Y DEFLECTION FOR CHARACTER A

```
    1   2 3   4 5   6 7   8 9 10 11 12 13 14 15
a
b
c             X X             X    X
d   X X X X
e   X X X X X X               X    X
f         X X X X X X X X
g
```

INTENSITY CONTROL FOR CHARACTER A

```
    1   2 3   4 5   6 7   8 9 10 11 12 13 14 15
a   X X X X X X X X            X   X
```

Appropriate diode matrices **48** and **60** for tracing other characters on the matrix of FIG. **1** will be apparent in view of the foregoing illustrations.

In order to generate certain characters including the character A in classical form, it may be desirable to add additional diode matrices, shift registers, AND gates, and waveform generators. For example, the character A as formed on the position matrix of FIG. **7** includes a pair of inclined lines extending from positions **3** to **6** and **13** to **6**. These inclined lines may not be formed with the waveforms of FIGS. **6**(*a–g*). In order to provide such inclined lines, ramp generators may be utilized.

Even the character generator depicted in FIGS. **3***a* and **3***b* is somewhat defficient with respect to the character B. In this connection, it will be noted that the straight-line trace from positions **1** to **6** was achieved by a sinusoidal waveform. By utilizing the sinusoidal waveform, in particular the sin (0° – 90°), the rate of trace decreased from position **1** to position **6**. In some instances, such an irregular rate of trace or slewing rate may be noticable to the eye. It is therefore preferable to utilize a ramp waveform providing a constant slewing rate. In this connection, the frequencies of the sinusoidal waveforms must be matched to one another and matched to the period of any ramp waveform generators utilized.

In the embodiment described, there is no attempt to minimize the logic circuitry. The logic circuitry required may be reduced by providing further encoding and decoding combinations, especially in the shift registers.

Although the invention has been described in terms of a particular embodiment, various changes and modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

What is claimed:

1. A character generator system comprising:

a display device including a screen means and an electron beam generating means;

a beam deflection means for deflecting said electron beam through position-to-position segments of a character trace;

a plurality of waveform generators producing a plurality of different waveforms for use by said beam deflection means in deflecting said electron beam through said position-to-position segments of a character trace;

a deflection memory means for storing position-to-position segment deflection commands representing the sequential and selective application of said different waveforms to said beam deflection means for each of the characters to be displayed, said memory means selectively reading out said segment deflection commands for the particular character to be displayed; and

a digital deflection control means including a plurality of deflection register means associated respectively with said plurality of waveform generators, said plurality of deflection register means being coupled to said memory means so as to store said segment deflection commands for said particular character to be displayed, each of said register means storing a plurality of said segment deflection commands representing the sequential and selective application of the waveform produced by said associated waveform generator for said particular character to be displayed, said digital deflection control means controlling the application of said waveforms to said beam deflection means in response to said segment deflection commands stored in each of said deflection register means.

2. The character generator system of claim **1** wherein each of said deflection register means comprises a shift register having a plurality of stages respectively set in response to said plurality of segment deflection commands, said digital deflection control means further comprising a plurality of deflection gate means associated with and coupled to each of said shift register means respectively, each said gate means being sequentially and selectively enabled by the output of said associated shift register means so as to sequentially and selectively apply the waveform produced by said associated waveform generator to said beam deflection means in response to said plurality of segment deflection commands.

3. The character generator system of claim **1** further comprising:

an intensity memory means for storing position-to-position segment intensity control commands representing the sequential and selective application of an intensity control signal to said electron beam generating means for each of the characters to be displayed, said intensity memory means selectively reading out said segment intensity control commands for the particular character to be displayed; and

digital intensity control means including an intensity register means coupled to said intensity memory means so as to store a plurality of said segment intensity control commands for the particular character to be displayed, said digital intensity control means generating an intensity control signal corresponding to said segment intensity control commands stored in said intensity register means.

4. The character generator system of claim 3 wherein said intensity register means comprises a shift register having a plurality of stages set in response to said segment intensity control commands stored in said intensity memory means, said digital intensity control means further comprising gate means sequentially and selectively enabled by the output of said intensity shift register, said intensity control signal being generated at the output of said intensity gate means.

5. The character generator system of claim 4 wherein said digital intensity control means further comprises a single shot multivibrator circuit having an input coupled to at least one of said deflection shift register means and an output coupled to said intensity gate means so as to momentarily decrease the beam intensity at the onset of a pulse from the output of said at least one said deflection shift register.

6. The character generator system of claim 1 wherein said different waveforms generated by said waveform generator include sinusoidal waveforms and D.C. waveforms, said deflection registers associated with said waveform generators producing said D.C. waveforms having an output coupled to said intensity gate means.

7. The character generator system of claim 1 wherein said deflection memory means is a read only memory comprising diode matrices connecting two sets of lines, one set of said lines corresponding to different characters and the other set of said lines corresponding to the position-to-position segment deflection commands.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,388 Dated October 3, 1972

Inventor(s) William E. Eichelberger

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 63, delete "screen".

Column 4, line 44, "t=10-" should be -- t=10-12 --.

Column 5, line 60, "t=2-" should be -- t=2-4 --.

Column 6, line 15, "(180 - 60°)" should be -- (180-360°) -

Column 6, line 35, "t=10-" should be -- t=10-12 --.

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents