

[54] **DIGITAL TELEVISION CHARACTER GENERATOR**

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[22] Filed: **Apr. 19, 1972**

[21] Appl. No.: **245,412**

[52] U.S. Cl. **340/324 AD, 178/DIG. 6**

[51] Int. Cl. **G08b 5/36**

[58] Field of Search **340/324 AD; 178/DIG. 6**

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[57]

ABSTRACT

A means for causing characters such as numbers, letters and the like to appear on a CRT screen by selectively adding various combinations of narrow and wide electronic pulses to the raster scan of the CRT such that the characters are presented on the screen in either black or white, superimposed on any other image presentation.

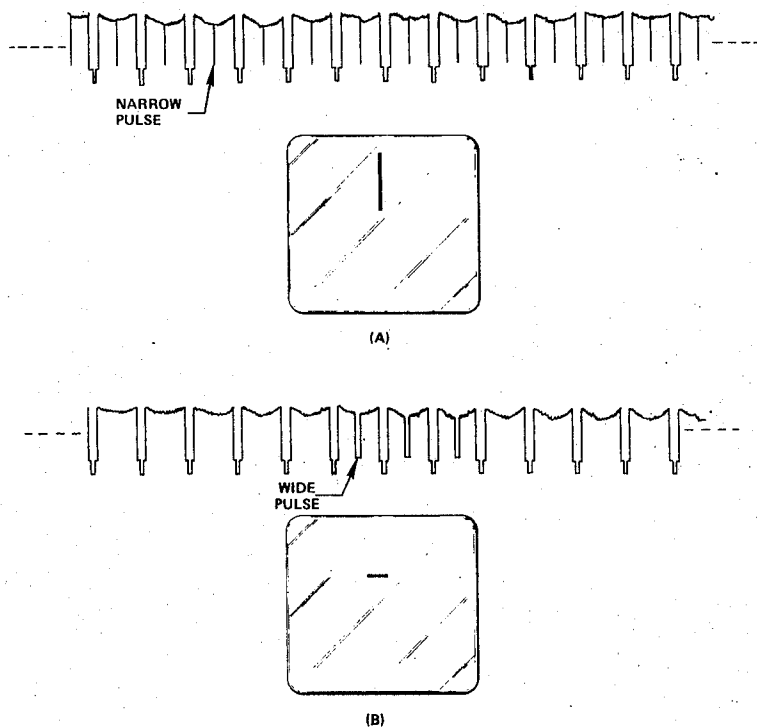
[56]

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UNITED STATES PATENTS

3,729,730 4/1973 Sevilla et al. 340/324 AD

7 Claims, 11 Drawing Figures



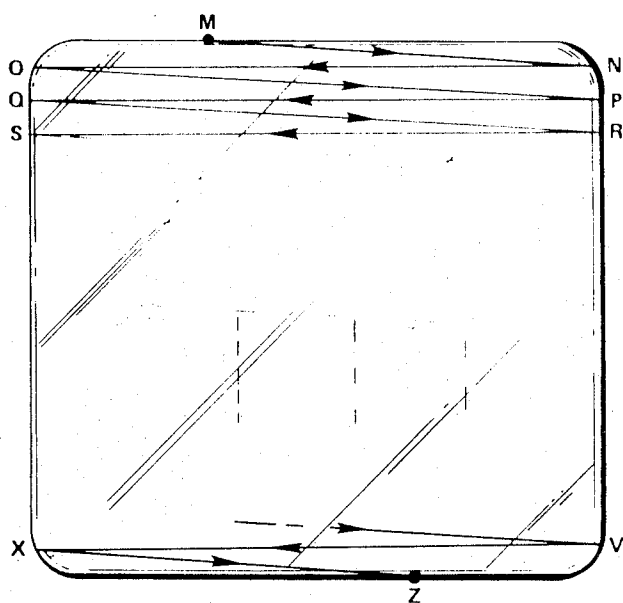
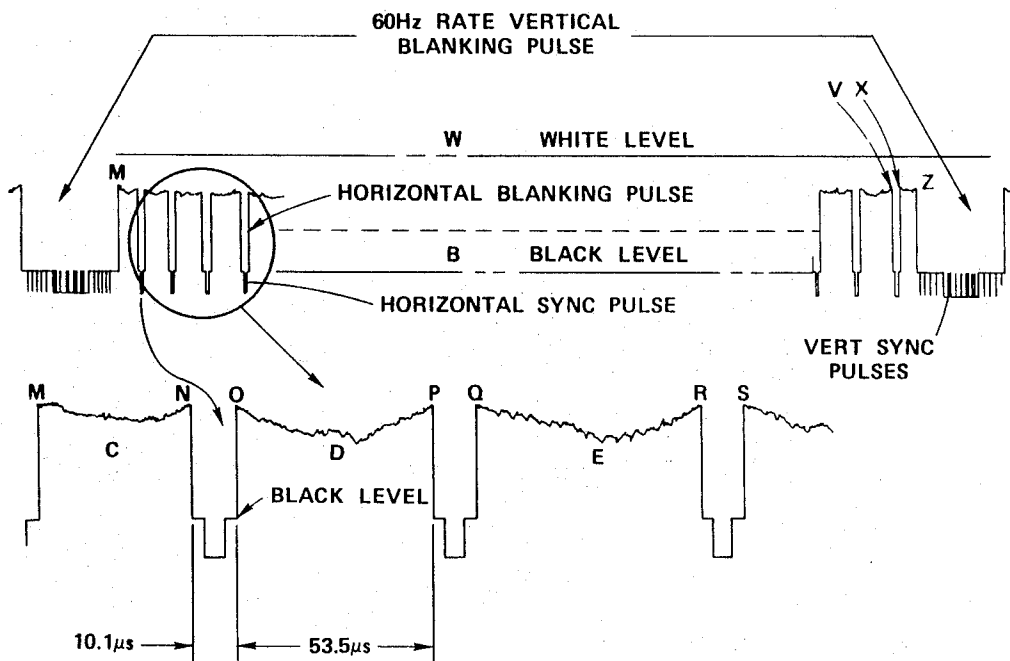


Fig.1

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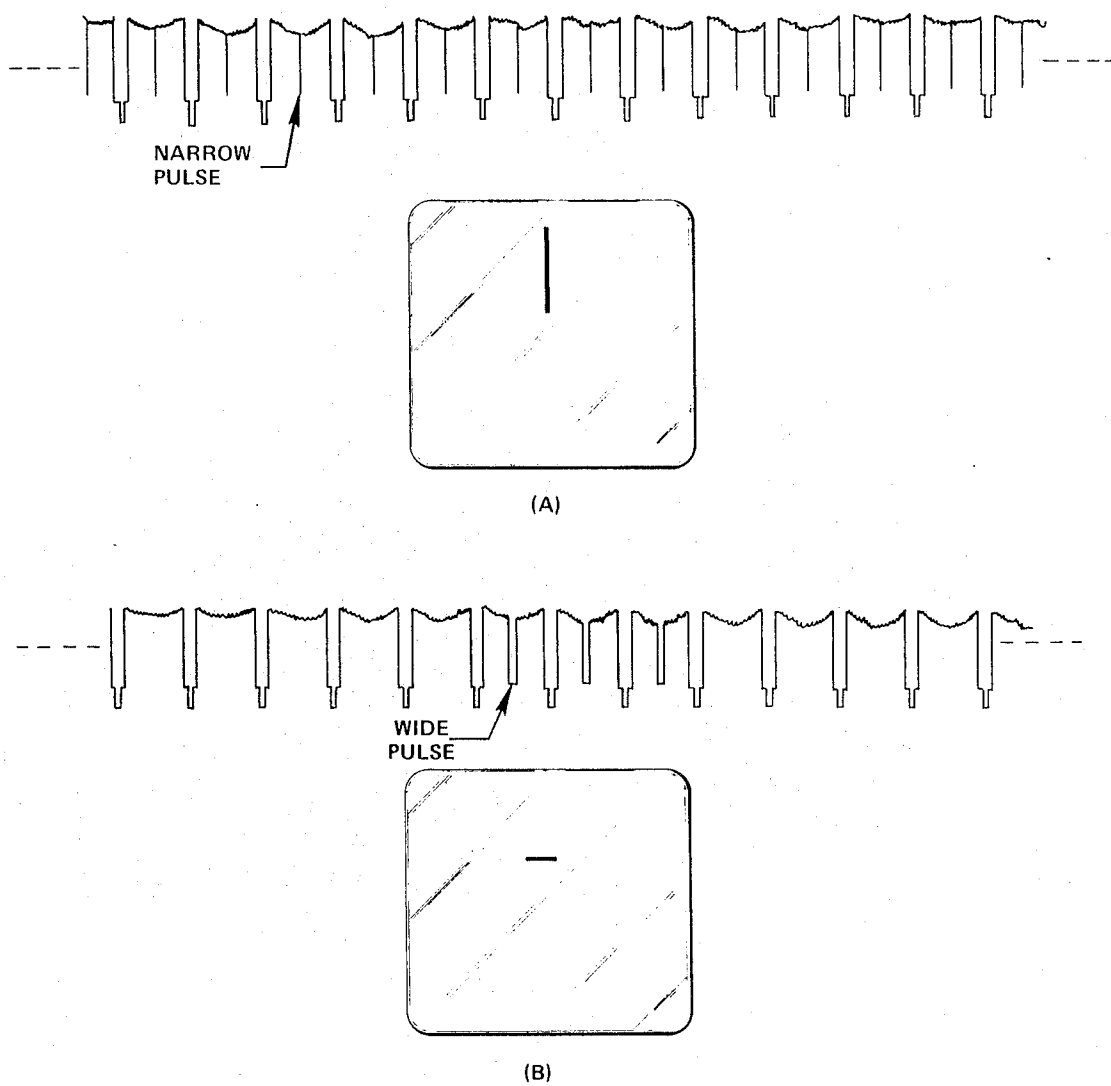


Fig.3

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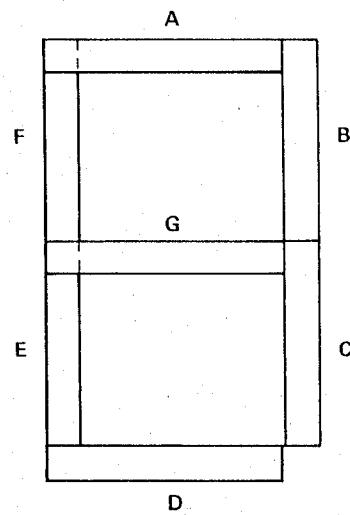


Fig. 4

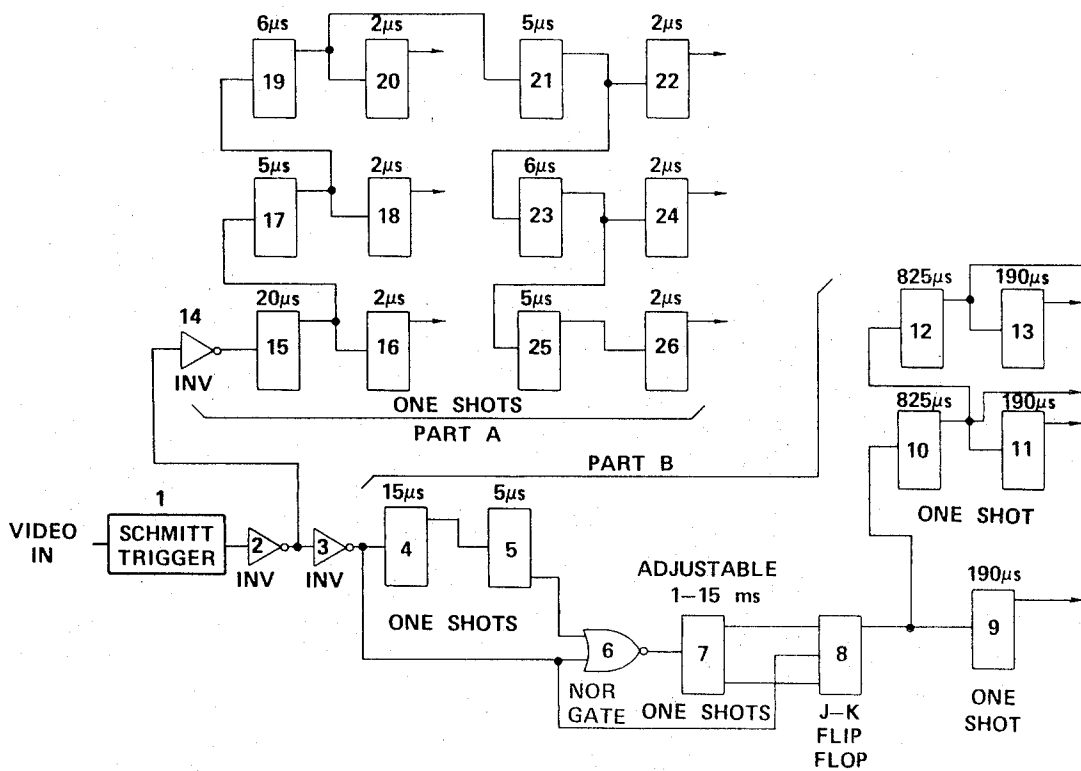


Fig.5

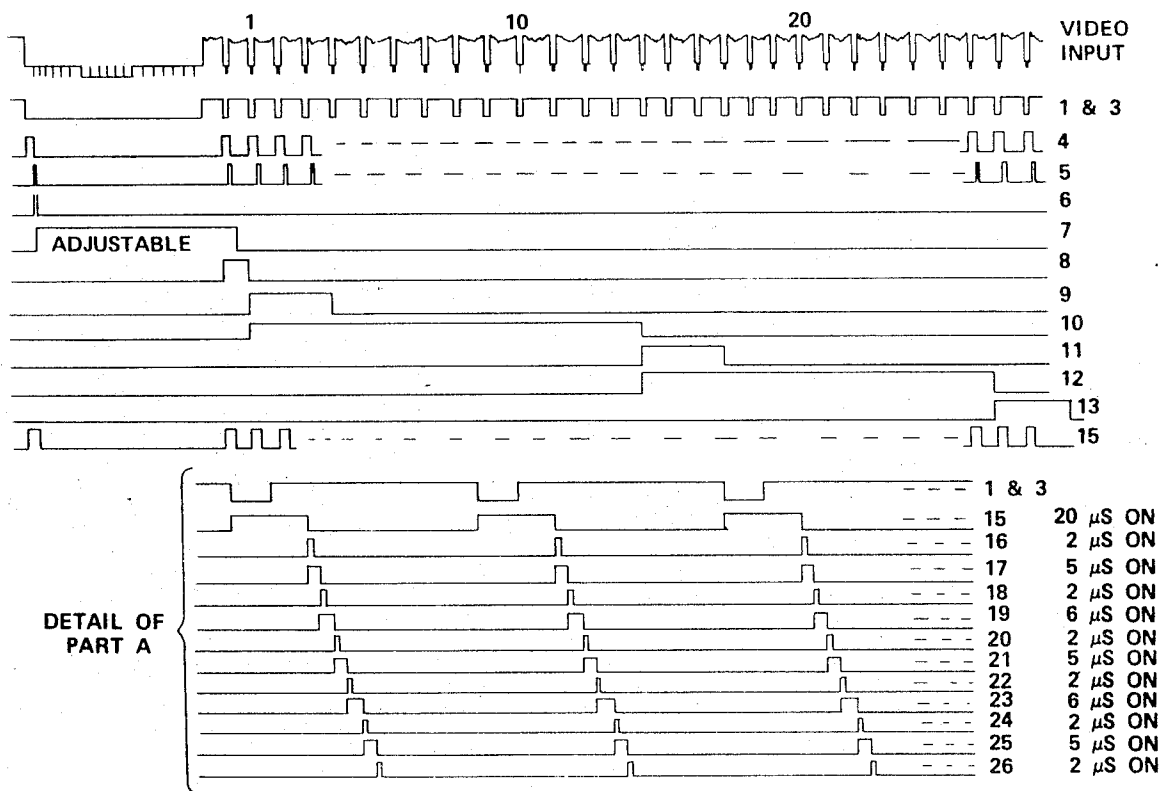


Fig.6

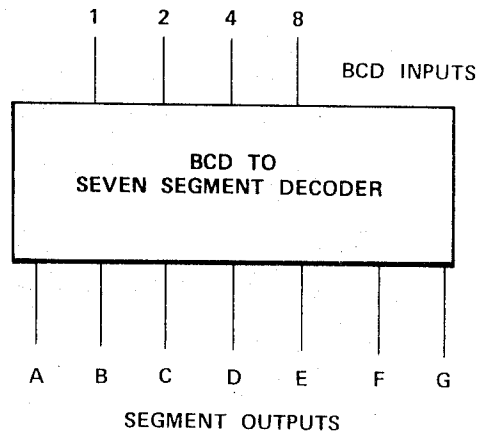


Fig. 7

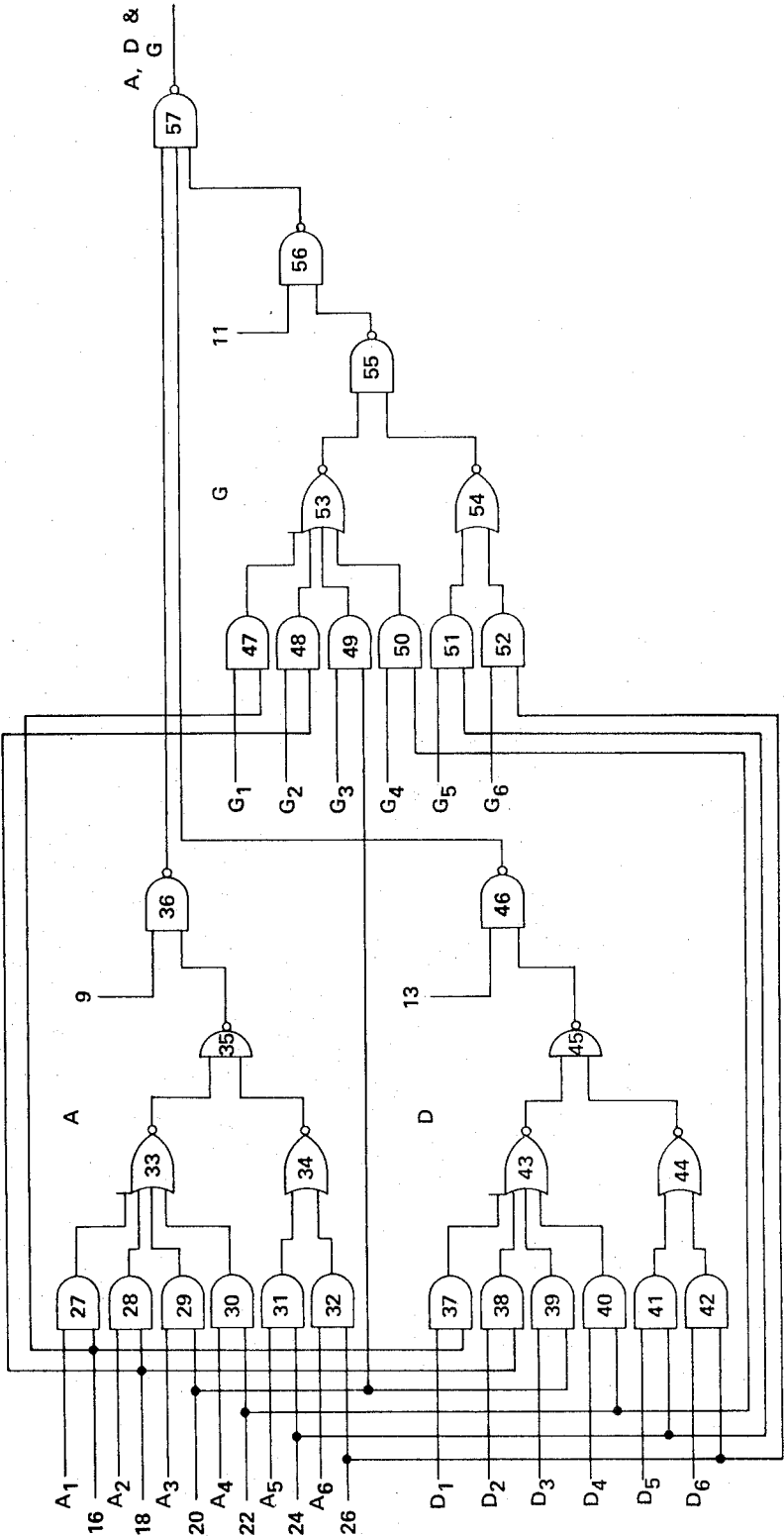


Fig. 8

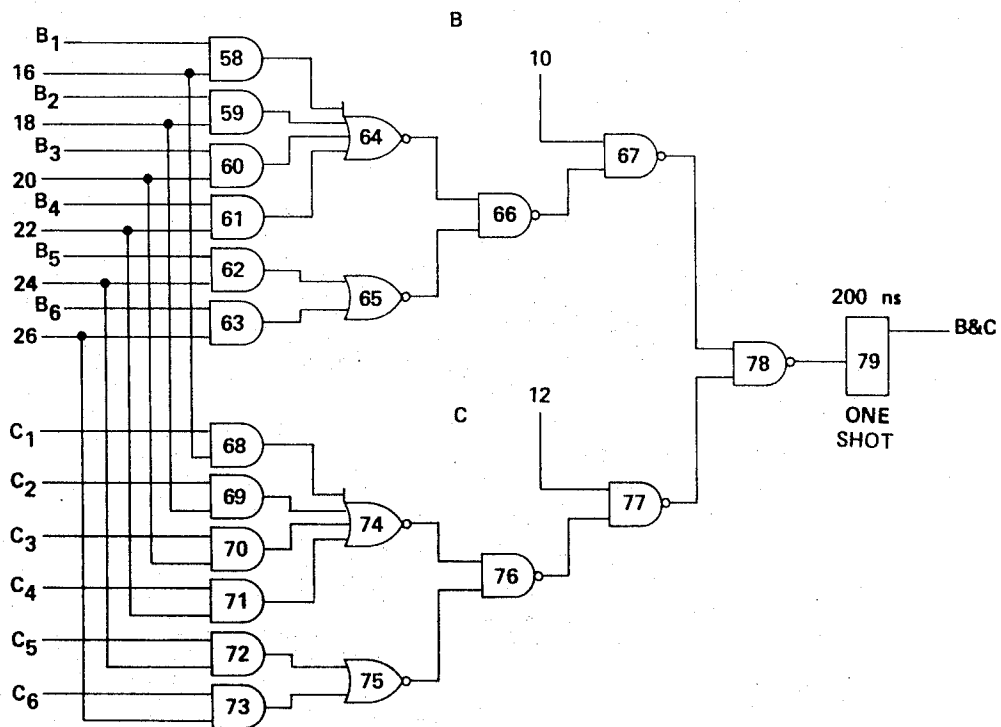


Fig.9

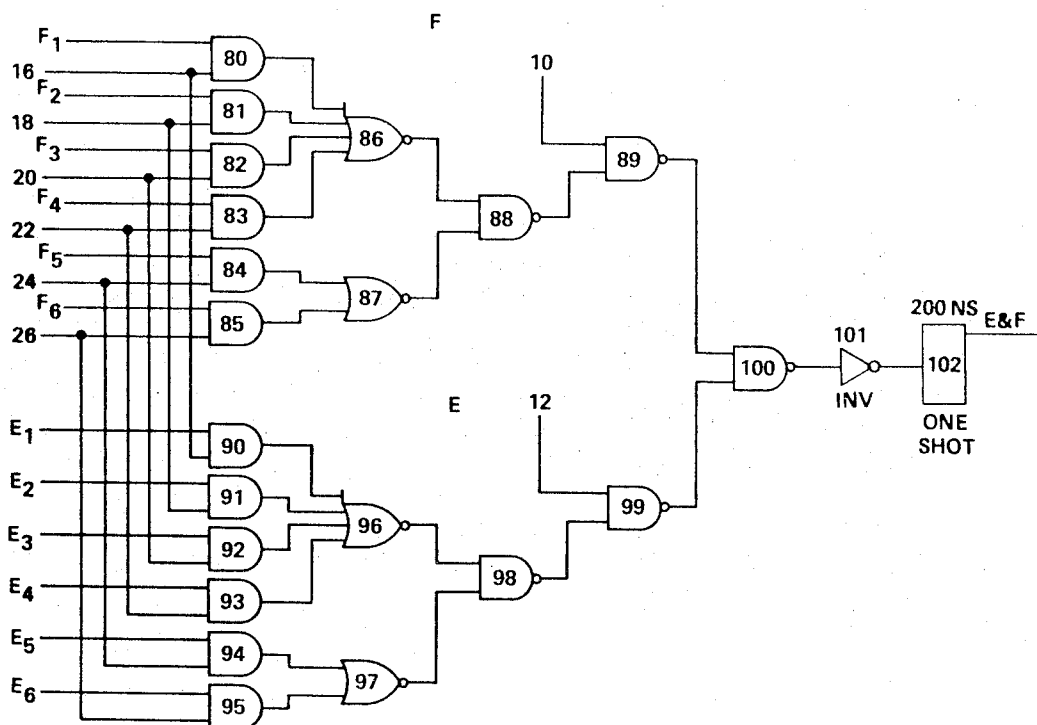


Fig.10

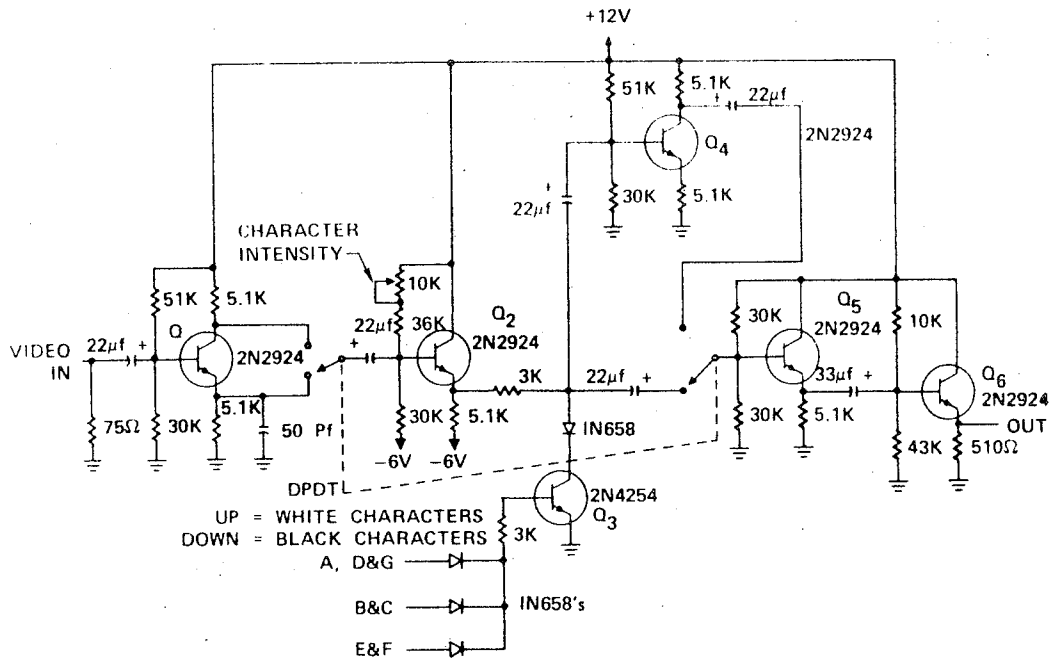


Fig.11

DIGITAL TELEVISION CHARACTER GENERATOR

BACKGROUND OF THE INVENTION

In the field of television character generation prior devices and methods have been time consuming, inconvenient, and costly. A long felt need has existed for an inexpensive, precise, simple, and easily applied method and apparatus for selectively presenting numbers, letters, or the like in a video display, either separately or simultaneously with other video data, such as a television picture.

Most prior methods use a second television camera to optically scan the desired characters or information, and then superimpose this data onto the original picture from the first television camera. The method is costly, imprecise, and difficult and time consuming to set up. It requires proper lighting conditions for the second camera, and in cases where nixie data displays are being observed, the glow as the characters change obscures the desired information for several hundredths of a second, which is undesirable especially where timing data is monitored.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic of the cathode ray tube face, showing the raster scan;

FIG. 2 is a simplified waveform diagram of a typical television signal;

FIG. 3 is a waveform diagram showing the method employed by the present invention for producing a vertical line (A) and a horizontal line (B) on the screen;

FIG. 4 is a plan view showing the seven line segments necessary to present any number from 0 through 9;

FIG. 5 is a block diagram of the character generator timing circuit of the preferred embodiment of the present invention;

FIG. 6 is a waveform diagram of the waveforms of the timing circuit of FIG. 5;

FIG. 7 is a block diagram showing the BCD to seven segment decoder;

FIG. 8 is a block diagram showing the gating circuit of the preferred embodiment of the present invention for segments A, D, and G of FIG. 4;

FIG. 9 is a block diagram showing the gating circuit of the preferred embodiment of the present invention for segments B and C of FIG. 4;

FIG. 10 is a block diagram showing the gating circuit of the preferred embodiment of the present invention for segments E and F of FIG. 4; and

FIG. 11 is a schematic diagram of the video gating circuit of the preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a method and apparatus for electronically displaying letters and numbers on a television screen simultaneously with the normal video information, if present. The invention generates a master pulse which is combined with the normal portion of the video signal, if present, and is used to place horizontal line segments on the television display. The beginning and end of this pulse is also used to trigger narrow pulses which form the vertical segments necessary to make the letters and numbers. The present invention is

less expensive than most prior devices, is easier and less time consuming to set up, produces easily readable characters or the like, and the characters can be changed more quickly than by the prior devices. Also, the present invention requires no special lighting equipment, as do most of the prior devices.

A brief, simplified description of a TV picture will be provided in order to aid in the understanding of the operation of the circuit. A television screen is shown in FIG. 1. The path the electron beam follows in sweeping out a picture is shown simplified on the screen. The electron beam moves from left to right across the screen, then rapidly back to the left edge. This is repeated over and over as it moves from the top to the bottom of the screen.

The letters in FIG. 1 identify portions of FIG. 2 which shows a simplified television signal. M and Z are the edges of the vertical blanking pulses which correspond in time to the top and bottom of the TV picture. During the vertical blanking pulses, the electron beam moves very rapidly from the bottom of the screen to the top. As it sweeps down the face of the screen, it passes back and forth in the sweeping manner shown in FIG. 1. The left and right hand edge of the screen correspond in time to the edges of the horizontal blanking pulses NO, PQ, RS, etc. The beam sweeps rapidly from the right hand edge of the screen back to the left hand edge during the pulse and then sweeps more slowly from the left to right hand edge during the time between the pulses. The picture information is the portions of signal, C, D, E, etc., appearing between these pulses.

The height of the signal shown in FIG. 2 determines the level of brightness, black corresponding to level B and white to level W. Levels in between correspond to the various grey shades between black and white. Thus as the beam swings from left to right across the screen, it produces the various shades present in a small horizontal increment of a television picture. All the increments lined up closely one under the other from top to bottom of the screen make up one complete picture.

As shown in FIG. 3, to produce a vertical black line electronically on the screen, a single narrow pulse of black level amplitude could be put at the same respective point between several consecutive horizontal blanking pulses. The dark points produced would line up vertically forming a vertical line, shown in FIG. 3A. Line length would depend on how many times the narrow pulse was repeated and line width would be a function of pulse width.

A wider pulse between only a few horizontal blanking pulses would electronically form a horizontal line or bar on the screen, shown in FIG. 3B. The length and width of the horizontal line would depend on pulse width and number of repetitions, respectively. White lines would be formed if white amplitude pulses were used.

By electronically positioning various combinations of narrow and wide pulses, the horizontal and vertical lines on the screen can be made to form various characters or numbers. This is the purpose of the Digital Television Character Generator.

FIG. 4 shows the possible line combinations generated to make up each character or number on the screen. There are seven line segments compatible with current BCD-to-seven-segment decoders. BCD stands for binary coded decimal.

A master pulse of proper width placed at exactly the same point between horizontal blanking pulses produces all other pulses necessary for both the horizontal and vertical lines. The front edge is used to trigger narrow pulses to produce the E and F segments and the rear edge triggers pulses for B and C. The master pulse itself forms the A, D, and G segments. Various other signals are also needed to gate the pulses at the proper time. If the character generator is designed to produce six characters horizontally, as is the later described generator, there will be six master pulses between horizontal blanking pulses.

In an operative embodiment, character height was arbitrarily picked at about 10 percent of raster size. Since there are 262.5 horizontal lines of picture information between the top and bottom of the screen in a standard EIA interlace television signal, about 25 lines were used for total character height. ("Lines" here means the picture information between two horizontal blanking pulses.) Three lines were picked for establishing thickness of the horizontal segments, and 13 lines were used for the height of each vertical segment. This means that the master pulses for horizontal segments are repeated three times and the narrow pulses at the front and rear are repeated 13 times for each vertical segment. The master and narrow pulse widths are set at 2 microseconds and 200 nanoseconds respectively. This allowed for centering and spacing of the six characters on the screen.

FIG. 5 shows the timing portion of the preferred embodiment and FIG. 6 shows the waveforms. The video input signal is fed into Schmitt trigger 1 which strips the signal, leaving only blanking pulse waveform 1 in FIG. 6. Inverters 2, 3, and 14 buffer the stripped signal and drive one shots 4 and 15.

Taking part A of the circuit shown in FIG. 5 first, each negative going edge of signal 1 triggers 15 which goes high. Twenty microseconds later it goes low triggering one shot 16 and 17. One shot 17 goes low 5 microseconds later triggering 18 and 19. This action continues, each odd numbered one shot triggering the next odd and respective even one shot. The outputs of the even one shots are the master pulses used to form the horizontal segments A, D, and G of the six characters. The odd numbered one shots determine the spacing of the characters.

Taking part B of the circuit, each negative going edge of the stripped signal triggers one shot 4. Fifteen microseconds later it triggers 5 which goes high for 5 microseconds. The inverted output 5 is combined with the stripped input signal in NOR gate 6 to produce a single pulse each time a vertical blanking pulse occurs. Six triggers one shot 7 which stays high for an adjustable period of 1 to 15 milliseconds. During the time 7 is high, flip flop 8 goes high on the first negative going edge of the stripped signal 3. When 7 returns to the low state, 8 goes low on the next negative going edge of signal 3. This triggers one shots 9 and 10. Ten going low triggers 11 and 12, which triggers 13. The outputs of the odd one shots 9, 11, and 13 are used to gate the even one shots of part A to form character segments A, G, or D, respectively. The outputs of one shots 10 and 12 are used to gate the pulses that form the B, C, E, and F character segments. Adjusting one shot 7 varies the time between the vertical blanking pulse and the start of these gating signals, thus varying the distance of the characters from the top of the screen.

FIG. 7 shows the BCD to seven segment decoder which adapts the input control signal into circuit control information. The state of a given output depends on which inputs are high. For inputs equal to a number from 0 to 9 the output segments corresponding to the number would go high. For example, if the 2 input line was high, the A, B, G, E, and D output lines would go high. Since there are four inputs, there are more outputs than the numbers 0 to 9, but they will not be discussed here.

There are six decoders in the circuit to form the six numbers or characters on the TV screen. Each decoder is used with one respective master pulse to produce only the character segments for that particular position on the screen. For example, the first character decoder is used with master pulse 16 from the timing circuit; the second character decoder is used with 18, etc.

The gating circuit for the A, D, and G horizontal character segments is shown in FIG. 8. Three identical circuits are used for the A, D, and G sections respectively. The input circuit of each section is made up of six two-input AND gates.

Taking the A section first, each decoder A segment output is coupled to one input of an AND gate in the A section. The master pulse used with each decoder is connected to the other input of each respective AND gate. The six master pulses between each pair of horizontal blanking pulses enter the six gates in sequence. If the respective decoder A output is high, the pulses will be coupled through NAND gate 35 to gate 36. Signal 9, occurring once between vertical blanking pulses, gates 36 allowing only three inverted repetitions of each master pulse from 35. These will eventually form the A character segments on the TV screen.

In the G section, the master pulses are coupled through gate 55 to gate 56 if their respective decoder G outputs are high. Signal 11 gates three inverted repetitions of each pulse from 55. However, they occur later than the A section pulses so as to form the G character segments a short distance below the A segments on the screen. The D section functions in the same manner.

The inverted master pulses from the A, D, and G sections are combined and inverted again in NAND gate 57. The output of this gate will produce all the horizontal segments for each character on the screen.

FIG. 9 shows the B and C segment gating. It uses the same basic gating circuitry as the previous A, D, G, section. The six master pulses between each pair of horizontal blanking pulses are fed consecutively to one input of each AND gate in each section. The other input of each gate is the B or C segment output of the respective decoder.

For the B section, any decoder B outputs going high allow the respective master pulses to pass through gate 66 to NAND gate 67. The other input of gate 67, signal 10, occurs once between each pair of vertical blanking pulses and allows 13 inverted repetitions of each master pulse from gate 66.

The same action occurs in the C section except signal 12 begins gating pulses from gate 76 at the same time 10 disables the B portion of the circuit.

These inverted master pulses are coupled to NAND gate 78 which inverts them back to their original form. The negative going edge of the signal triggers one shot 79 forming very narrow 200 nanosecond pulses at the

back edge of the master pulses. These pulses will form the B and C segment on the screen.

The E and F segment circuit shown in FIG. 10 operates in almost the same manner except the E and F decoder outputs determine which inverted master pulses will reach NAND gate 100.

NAND gate 100 combines the two inputs, inverting them back to normal master pulses. They are then inverted again by inverter 101 so that the negative going edge that triggers one shot 102 coincides with the front edge of the master pulses. The 200 nanosecond pulses from 102 will then begin at the front edge of the master pulses to form the E and F character segments on the screen.

The final portion of the television character generator is the video gating circuit shown in FIG. 11. There are two paths in the circuit controlled by a DPDT switch. The lower position produces black characters, the other white characters.

Assume the switch is in the lower position. The video signal from the source is fed into Q_1 . The signal on Q_1 's emitter is essentially the same as the input and is coupled to Q_2 an emitter follower with adjustable base bias. The output of Q_2 is the same as the input except the DC level may be adjusted slightly about ground by the potentiometer in the base circuit. This signal is DC coupled to transistor gate Q_3 . A diode is placed in series with the collector of Q_3 to prevent back biasing of Q_3 if the signal from Q_2 goes below ground. The inputs of Q_3 are the three signals from the ADG, BC, and EF gating circuits discussed previously.

When input pulses are present, Q_3 grounds the signal from Q_2 . Varying the potentiometer in Q_2 's base circuit varies the DC level of the emitter signal, in effect making the ground level pulses imposed by Q_3 coincide with the dark grey or black level of the video signal. This signal is coupled through emitter followers Q_5 and Q_6 to give a low output impedance. The output signal is the original video signal with superimposed dark level pulses to form black characters on the TV screen.

With the switch in the upper position, white characters are produced. The video input on Q_1 is inverted at the collector and coupled to Q_2 . The DC level of the inverted output on Q_2 's emitter is adjusted so that as Q_3 grounds the signal, white level pulses are produced. This inverted signal is inverted again in Q_4 and coupled through Q_5 and Q_6 to the output.

The output is the original video information with superimposed white level pulses to produce white characters on the TV screen.

The device described places six characters in line on the television screen, but more or less are possible. To add a character in the same line requires the following: (1) The addition of two one shots in part A of FIG. 5. The odd numbered one shot determines spacing, the even one forms the master pulse. (2) The addition of a BCD to seven segment decoder for each character. And, (3) an additional two-input AND gate on each of the seven character segment gating circuits. One input on each gate is the new master pulse; the other is the respective decoder segment output.

When one line is insufficient, more lines of characters can be added: (1) the same master pulses are used as in the first line of characters. (2) A BCD to seven segment decoder is required for each new character. (3) For each new line, an additional one shot and flip flop, like 7 and 8 in FIG. 5, are triggered from NOR

gate 6 to produce a pulse shortly after one shots 9 through 13 have finished their sequence for the preceding line. This pulse is combined with signal 8 in an OR gate so both signals will trigger one shots 9 through 13. Thus these one shots provide part of the gating signals for each line on the screen. (4) These signals and the decoder segment outputs for each line of characters are enabled so they enter the segment gating circuits only when the respective line of characters is to be generated.

If decoders with more than seven segments were used, the circuitry could be modified to generate many more characters or symbols including the complete alphabet. It is also possible to have the characters move in sequence across the screen, if desired. Other methods of gating and producing the necessary signals for the character generator are possible and may be used if they satisfactorily perform the desired functions.

The preferred embodiment is described in terms of a specific generator showing the specific timing values and relationships in the belief that a single operative embodiment will convey to the scientist and artisan, alike, a better understanding of the present invention than would many examples of its possible applications. As a result, the present invention should not be considered limited to the specific embodiment described, but should include its reasonable alternatives, such as modifications of the character size, use of memories for character access and storage, use of multiplexers with only one decoder, and its other possible applications.

What is claimed is:

1. An apparatus for superimposing symbols on a cathode ray tube display, comprising:

a cathode ray tube having a controllable electron beam and means for controlling said electron beam including horizontal and vertical blanking pulse generators; and

electronic signal producing means coupled to said cathode ray tube for providing an electrical, symbol input signal to said tube in synchronism with the control of said controlling means, including means for generating electronic pulses during the interval between the horizontal blanking pulses of said beam controlling means such that a plurality of consecutive narrow generated pulses forms a vertical image on said cathode ray tube and a plurality of consecutive, relatively wide generated pulses forms a horizontal image on said tube, having decoding means for converting selectable binary coded inputs into at least one of eight possible electrical symbol segments and a digital timing circuit for synchronizing said segments with said control to form at least one preselected symbol on said display, wherein said timing circuit includes triggering means coupled to said beam controlling means for coupling only said blanking pulses to the remainder of said timing circuit, and a first set of a plurality of one-shot multivibrators coupled to said decoding means to form the horizontal and vertical segments of said symbols and a second set of a plurality of one-shot multivibrators coupled to said decoding means to establish the spacing between adjacent symbols;

such that the information in said symbol signal is presented for viewing by said cathode ray tube.

2. The apparatus of claim 1 wherein said pulse generating means produces a first pulse which pulse select-

ably forms a horizontal image; a second pulse selectively responsive to the first edge of said first pulse, and which form a vertical image; and, a third pulse selectively responsive to the second edge of said first pulse, and which forms a vertical image.

3. The apparatus of claim 1 wherein said apparatus presents six characters horizontally on said tube.

4. The apparatus of claim 3 wherein said characters are numbers.

5. The apparatus of claim 4 wherein said presentation is in white.

6. The apparatus of claim 4 wherein said presentation is in black.

7. The apparatus of claim 1 wherein said first set includes a first and second one-shot multivibrator for

each symbol to be presented and the first one-shot for the first symbol is coupled to said triggering means and provides a preselected time delayed output, and the second one shot for the first symbol and the first one-shot for the next symbol are coupled to said time delayed output; and said second set includes means coupled to said triggering means for providing a pulse during the interval between the vertical blanking pulses of said beam controlling means, which pulse is adjustable in time for selecting the vertical position of the symbols on said display, and at least one one-shot multivibrator coupled to said pulse providing means for each symbol to be presented for gating its respective symbol and presenting the selected symbol on said display.

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