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HAVING PARALLEL DELAY LINES

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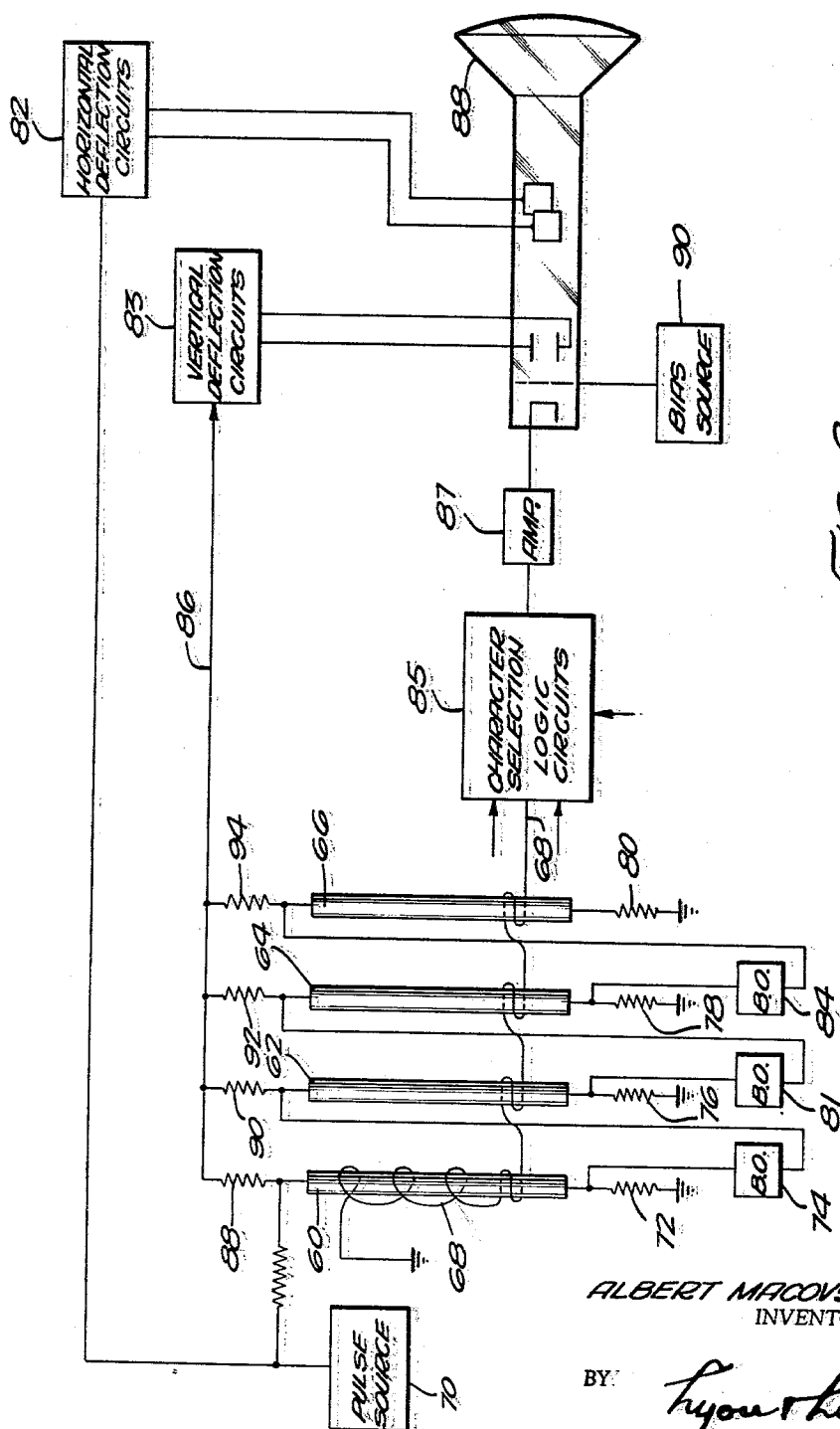


FIG. 2.

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CHARACTER GENERATOR FOR CRT DISPLAY HAVING PARALLEL DELAY LINES

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5 Claims. (Cl. 340-324)

This invention relates to electronic apparatus for generating character-representative signals and, more particularly, to an improvement in circuits for generating signals which may be displayed as characters.

An object of this invention is the provision of a simple circuit arrangement for providing signals which are easily displayable as characters.

Another object of this invention is the provision of an inexpensive character-signal generator.

Yet another object of the present invention is the provision of a useful character-signal-generator system.

These and other objects of the present invention may be achieved in a circuit arrangement wherein there is a delay line, preferably consisting of a plurality of sections of a delay line connected in series with one another. A pulse source is provided for applying a pulse to one end of the connected-together delay-line sections, and the output end of these delay lines is connected to ground through an impedance-matching load. A winding, which may be designated as a sense winding, is inductively coupled to the various delay-line sections at a number of different locations which are spaced along said delay line so that a pulse, which travels through the delay-line sections, induces a voltage in the sense winding at each one of the coupling locations. The pattern of coupling of the sense winding to the delay line is such as to provide a sequence of pulses spaced in a manner so that when applied, for example, to intensifying the beam of an otherwise blanked cathode-ray tube, wherein the beam is properly deflected, such cathode-ray tube will display an alpha-numeric character, as determined by the pattern of the coupling of the sense winding to the plurality of delay-line sections.

A different group of delay-line sections may be employed in combination with a different sense-winding pattern for each different alpha-numeric character desired to be represented. Alternatively, as many different sense windings as are feasible may be coupled on a single group of delay-line sections. Provision is then made for selectively connecting to the display device a desired one of the sense windings. Selection of a sense winding may be made, for example, by digital-selecting signals from a source.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a circuit diagram of an embodiment of the invention; and

FIGURE 2 is a circuit diagram of an alternative arrangement for the embodiment of the invention.

Reference is now made to FIGURE 1 of the drawings, wherein the embodiment of the invention is shown. Effectively, there is shown in the drawing a plurality of character-signal-generating circuits, which are connected to character-selection logic circuits, output of which is connected to a character-display device. In accordance with this invention, the character-signal generating circuits may comprise a plurality of distributed delay-line sections 10, 12, 14, 16, 18, with a sensing winding 24 coupled thereon. By way of illustration, the coupling of the sensing winding is such as to provide signals repre-

senting the character "S." These delay lines are connected in series. They are preferably disposed or arranged as a grid, since this enables a visual determination of the proposed coupling points of a sensing winding to the delay lines. One end of the serial-connected delay lines is connected to a pulse source 20. The other end of the serial-connected delay lines is connected through a matching characteristic impedance to ground. The delay lines are shown as being disposed parallel and adjacent to one another for convenience and compactness, although this need not be the case.

A sense winding 24 is coupled to the delay line sections 10 through 18. The simplest explanation of the method employed for coupling the sense winding to the delay-line sections is to indicate that, when the delay lines are disposed as a grid, the sense winding is given the shape of the character for which signals are desired. The sense winding may be considered as being physically laid over the five parallel delay-line sections and being inductively coupled to each delay-line section at the location of a crossing therewith. Thus, as shown in the drawing, the letter "S" is represented by the sense winding 24, and this sense winding is inductively coupled to the delay line section 10 at the three locations, respectively 24A, 24B, 24C, at which it crosses the delay-line section.

One end of the sense winding 24 is connected to ground; the other end of the sense winding is connected to character-selection logic circuits, represented by a rectangle 26. Also connected to the character-selection logic circuits is another sense winding 28 (which provides signals representative of the character "U") and 30 (which provides signals representative of the character "F"). It will be appreciated that as many sense windings as desired may be connected to the character-selection logic circuits. The character-selection logic circuits may comprise any arrangement for selecting one out of many inputs and connecting it to a single output. The selection may be made by signals such as digital signals from a character-selection signal source 28. The character-selection logic circuits may comprise, for example, a magnetic-core switch wherein all but a desired one of the magnetic cores is biased to prevent signal translation. Or, the character-selection logic circuits may constitute a selector switch or a plurality of relay contacts, wherein only one of the relay contacts is closed in response to character-selection signals. Or, the character-selection logic circuits may constitute a diode-selection matrix. All these circuits are well known and are thoroughly described in published literature.

Also shown, by way of example, are arrangements of the sense windings, respectively 28, 30, for providing a signal train representing the character "U" and another for representing the character "F." The sense winding 28 is inductively coupled to the delay-line sections, respectively 10A, 12A, 14A, 16A, and 18A. The coupling of the sense winding 28 to the delay-line sections 10A and 18A establishes the arms of the "U," and the base of the "U" is established by the coupling of the sense winding to the delay-line sections 12A, 14A, and 16A.

The sense winding 30 is inductively coupled to delay-line sections 12B, 14B, 16B, and 18B. Signals for the vertical-bar portion of the letter "F" are derived by means of the coupling of the sense winding 40 on the delay-line section 12B. Signals representing the top horizontal-bar section of the letter "F" are derived by the portion of the sense winding which is inductively coupled to delay-line sections 12B, 14B, 16B, and 18B. Signals representative of the other horizontal-bar section of the letter "F" are generated by the inductively coupled portions of the sense winding 30 on the delay sections 12B, 14B, and 16B.

Signals representing as many different characters as are desired may be generated in the manner exemplified. Each one of the sense windings, respectively 24, 28, and 30, are connected to the character-selection logic circuit 26. The output of the character-selection logic circuit 26 is applied to the brightness-control grid 42 of the cathode-ray display device 44. The cathode-ray display device is normally operated with the cathode-ray beam biased off by a bias source 46 which is connected to the cathode 48. A source of horizontal-deflection signals 50 are synchronized by pulses from the pulse source 20. A source of vertical-deflection signals 52 are synchronized also by pulses from the pulse source 20. The horizontal-deflection signals and the vertical-deflection signals are respectively applied to the horizontal- and vertical-deflecting electrodes of the cathode-ray tube 44. The vertical- and horizontal-deflection signal sources provide deflection signal outputs which provide a scanning raster on the cathode-ray tube face which resembles the grid formed by the delay-line sections. The amplitude of a scanning raster is determined by the size of the display desired for each character. Similarly, the frequency of the deflection signal is determined by the delay of the delay-line sections, as well as their number.

In order to operate the invention, the pulse source 20 is actuated to apply a pulse to the input to all of the serial-connected delay-line sections. The horizontal- and vertical-deflection signal sources 50, 52 start applying the deflection signals to the cathode-ray beam of the tube 44, which is normally biased off. Assuming that the letter "S" is selected by the character-selection logic circuits, in response to signals from the character-selection signal source 29, the sense winding 24 has induced therein a train of pulses as a result of the passage of the pulse from source 20 through the delay-line sections 10 through 18, which are connected in series. Each time a voltage is induced in the sense winding 24 the cathode-ray beam of the cathode-ray tube 44 is unblanked, whereby the cathode-ray beam strikes the screen of the cathode-ray tube. Now, if the horizontal-deflection signals deflect the cathode-ray beam horizontally over an interval required for the pulse applied to the delay-line sections 10 through 18 to traverse from one end to the other of these delay-line sections and if the vertical-deflection signals make five sweeps (corresponding to the five delay-line sections) for each one of the horizontal-deflection signals, then it should be appreciated that there will be displayed on a cathode-ray tube face a pattern of bright spots which represent the letter "S." The size of the letter "S" which is displayed is a function of the amplitude of the vertical- and horizontal-deflection signals.

It will be appreciated that a character generator of the type just described for providing signals representative of each character of the alphabet may be readily constructed. The character-selection logic circuits 26 can be actuated by signals from the source 29 to select the sensing windings in a sequence so that intelligible words may be spelled out. The vertical- and horizontal-deflection signals may have their amplitudes adjusted so that these words are displaced on a line across the face of the cathode-ray tube, and by other techniques well known in the art, such as adding a voltage having a staircase waveform to the horizontal-deflection signals whereby the cathode-ray tube face can display a plurality of lines of words.

The circuit diagram shown in FIGURE 2 is for an arrangement of the invention which shows how to obtain a number of synchronizing pulses from the character-signal generator for operating the display apparatus. This arrangement is preferred, since it minimizes the chances of the deflection circuits going out of phase with the generated signals. This is achieved by taking synchronizing signals from each delay-line section.

By way of illustration, a character generator for the letter "L" is shown. There are four delay-line sections

60, 62, 64, 66 employed, which are arranged in the form of a grid. A sensing winding 68 is shaped to form the letter "L" on the grid, and a coupling is made with a delay-line section at every intersection. One end of the first delay-line section 60 is connected to a pulse source 70, the other end being connected through a characteristic impedance 72 to ground. A pulse amplifier, but preferably a blocking oscillator 74, has its input connected to the end of the first delay-line section and its output connected to one end of the second delay-line section 62. Thus, when the blocking oscillator 74 has its input energized by the output of the first delay line section, it applies an amplified pulse to the input to the second delay-line section.

The just-described arrangement for the inter-connection of the first two delay-line sections is repeated for the remaining delay-line sections. Each of the delay-line sections 62, 64, 66 has one of its ends terminated in a characteristic impedance, respectively 76, 78, 80. A blocking oscillator 81, 84 respectively couples a preceding delay-line section to a succeeding delay-line section. Thus, a pulse applied from the pulse source to the first delay-line section is successively renewed at each succeeding delay-line section.

Output from the pulse source 70, as before, is applied to the horizontal-deflection circuit 82 to provide a synchronizing signal. However, synchronizing signals for the vertical-deflection circuits 83 are collected by a bus conductor 86, which is connected to an end of each of the delay-line sections through an isolating resistance, respectively 88, 90, 92, 94.

As previously explained, the output of the sensing winding 68 is applied through character-selection logic circuits 85 and a suitable amplifier 87 to the cathode-ray tube 88, to overcome the bias 90 applied thereto, which otherwise maintains the cathode-ray beam biased off. With the system described, each vertical-scanning line is initiated by a synchronizing pulse from each delay-line section, thus minimizing any possibility of drift or loss of phasing.

Instead of displaying the selected characters on the cathode-ray tube, it may be desirable to print out the characters whose signals are produced by the character generator. This may be accomplished by substituting, in place of the cathode-ray tube, an electrostatic-printing device, such as is shown and described in a patent to R. W. Crews and C. W. Barnes, Jr., No. 2,952,796, for "Electrostatic Printing Tube." This device essentially comprises a cathode-ray tube having a grid of wires in the face thereof over which the cathode-ray beam is deflected. Electrostatic writing paper is moved past the face of the cathode-ray tube, so that line-by-line writing thereon may be accomplished.

The delay-line sections 10 through 18 employed in the character-generator circuit are shown in the drawing as being arranged as a grid of parallel delay-line sections which are vertically disposed. Disposing the delay-line sections so that the grid lines are horizontal or at some angle relative to the horizontal is still to be considered within the scope of this invention, since the basic inventive principle is still used, namely, generating a train of character-representative signals from a sense winding inductively coupled at a plurality of predetermined locations to a delay line, to derive these signals from a pulse passing through the delay line. Also, using a single delay line, or one which is not disposed as a parallel grid of delay-line sections to which a sensing winding is coupled at a plurality of predetermined locations to derive character-representative signals from a pulse passing through the delay line, is to be considered as also coming within the scope of this invention.

Accordingly, there has been described and shown herein a novel, useful, and simple circuit arrangement for generating signals representing characters.

I claim:

1. A character-signal generator comprising a plurality of delay-line sections connected in series with one another, a sensing winding inductively coupled to said plurality of delay-line sections at a plurality of locations in accordance with a predetermined pattern, said predetermined pattern being determined by disposing said delay-line sections in the form of a grid and disposing said sensing winding over said grid in the shape of a character for which signals are desired, and connecting said sensing winding to said delay-line sections at the locations established by the intersections of said sensing winding with said delay-line sections, and means for applying a pulse to one end of said delay-line sections, whereby signals are induced in said sensing winding having a spacing determined by said coupling pattern.

2. An improved character-signal generator as recited in claim 1 wherein there are a plurality of said sensing windings coupled to said delay-line sections in different predetermined patterns for generating different character-signal trains, a character-display device, and means for selecting a desired one of said plurality of sensing windings for connecting to said character-display device for displaying signals induced therein.

3. A character generator comprising a plurality of groups of delay-line sections, each group of delay-line sections comprising a plurality of delay lines connected in series and arranged as a grid of parallel delay lines, a plurality of sensing windings, a different one of said plurality of sensing windings being inductively coupled to the delay-line sections in a different one of said groups of delay lines, each different sensing winding being shaped as a different predetermined character over a different one of said grids and being inductively coupled to the respective delay line sections forming said grid at locations at which intersections therebetween occur, means for applying a pulse to one end of all said delay-line sections, character-display means, and means for selecting a predetermined one of said sensing windings for connection to said character-display means.

4. The combination of a character signal generator and display device comprising a plurality of delay line sections connected in series with one another, a sensing winding inductively coupled to said plurality of delay line sections at a plurality of locations in accordance with a predetermined pattern, said predetermined pattern being determined by disposing said delay line sections in the form of a grid, disposing said sensing winding over said grid in the shape of a character for which signals are desired, and connecting said sensing winding to said delay line sections at the locations established by the intersections of said sensing winding with said delay line sections, means for applying a pulse to one end of said delay line sections whereby signals are induced in said sensing winding having a spacing determined by said coupling pattern, a cathode ray tube including a cathode ray beam and a screen, means for repetitively deflecting said cathode ray

beam along a first coordinate over the interval required for a pulse to traverse one of said delay line sections, means for deflecting said cathode ray beam along a second coordinate over the interval required for a pulse to traverse all of said delay line sections, means for biasing off said cathode ray beam, and means for applying the output signals of said sensing winding to said cathode ray tube to override the effects of said means for biasing off with said signals whereby the character determined by the pattern of the coupling of said sensing winding to said delay sections is displayed.

5. The combination of a character signal generator and display device comprising a plurality of groups of delay line sections, each group of delay line sections comprising a plurality of delay lines arranged as a grid of parallel delay line sections which are connected in series, a plurality of sensing windings, a different one of said plurality of sensing windings being inductively coupled to the delay line sections in a different one of said groups of delay lines, the manner of coupling being determined by shaping each different sensing winding as a different predetermined character over a different one of said grids of delay lines and inductively coupling to said delay lines at the locations at which each said sensing winding overlays the grid, the pattern of the coupling of each sensing winding being determined in accordance with a character for which representative signals are desired to be generated within said sensing winding, means for applying a pulse to one end of all said delay line sections, a character display means, means for selecting a predetermined one of said sensing windings for connection to said character display means, said character display means including a cathode ray tube having a cathode ray beam and a screen, means for repetitively deflecting said cathode ray beam along a first coordinate over the interval required for a pulse to traverse one of said plurality of delay lines in a group, means for deflecting said cathode ray beam along a second coordinate over the interval required for a pulse to traverse all of the delay lines in a group, means for biasing off said cathode ray beam, and means for applying the signal output of a selected one of said sensing windings to said cathode ray tube to override said means for biasing off whereby the character determined by the pattern of the coupling of said sensing winding to said selected delay line sections is displayed on said screen.

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NEIL C. READ, *Primary Examiner.*