Dec. 24, 1968 H. A. FERRIER, JR., ET AL 3,418,519

YOKE DRIVING CIRCUIT FOR CATHODE RAY TUBE DISPLAY

Filed Jan. 14, 1965 2 Sheets-Sheet 1

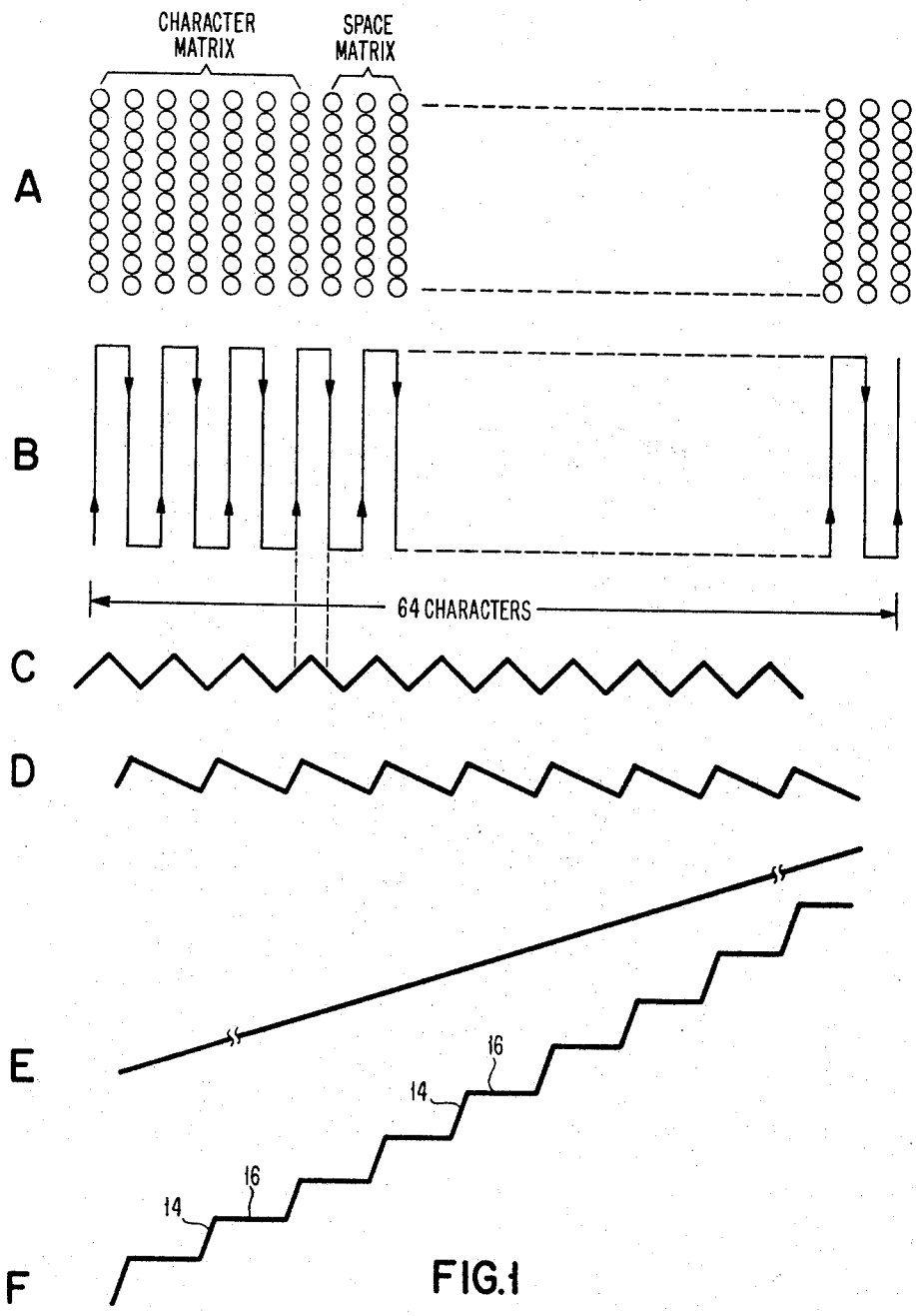


FIG.1

INVENTORS
HERMAN A. FERRIER, Jr.
PAUL V. McENROE

By *Arthur Decker*
ATTORNEY

YOKE DRIVING CIRCUIT FOR CATHODE RAY TUBE DISPLAY

Filed Jan. 14, 1965 2 Sheets-Sheet 2

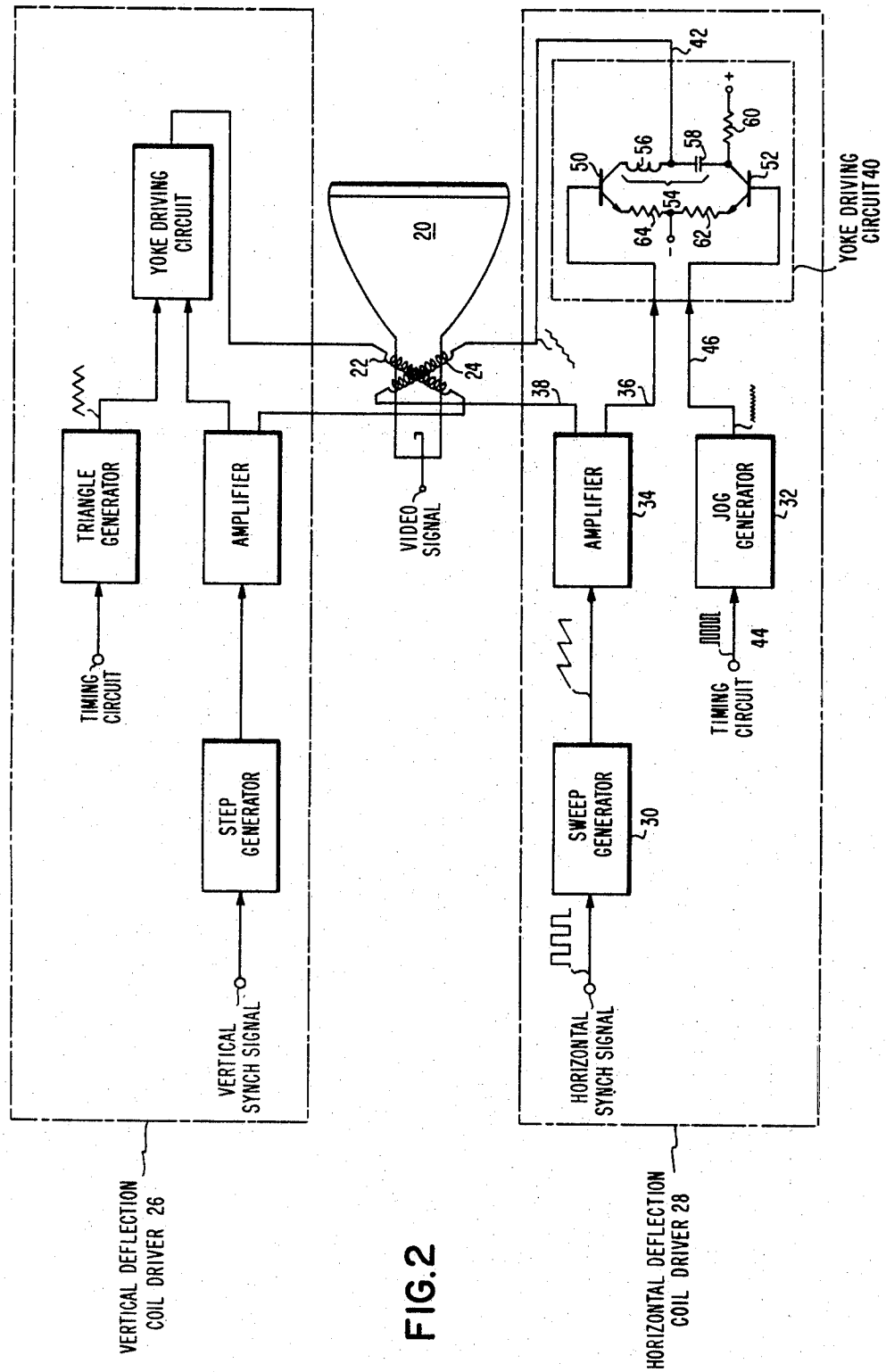


FIG. 2

United States Patent Office

3,418,519

Patented Dec. 24, 1968

3,418,519

YOKE DRIVING CIRCUIT FOR CATHODE RAY TUBE DISPLAY

Herman A. Ferrier, Jr., and Paul V. McEnroe, San Jose, Calif., assignors to International Business Machines Corporation, New York, N.Y., a corporation of New York

Filed Jan. 14, 1965, Ser. No. 425,451
7 Claims. (Cl. 315—27)

ABSTRACT OF THE DISCLOSURE

A cathode ray tube deflection signal generating system wherein high and low pulse repetition signals are fed through isolation filters to a single deflection coil for controlling the beam deflection.

This invention relates to waveshaping circuits, and more particularly, to the circuitry which generates the deflection voltages for the magnetic yoke of a cathode ray tube used as a display medium for alphanumeric information.

In typical cathode ray tube deflection circuits, it is often required that the electron beam be deflected in each direction, horizontal and vertical, at both low and high frequencies, and that generation of the deflecting waveshapes be by circuits using transistors. Typically, a magnetic yoke on the tube neck can be utilized for the low frequency deflection and electrostatic plates in the tube for the high frequency deflection; this requires a special cathode ray tube adapted for both types of deflecting devices. Alternatively, it is possible to use two magnetic yokes, one with high and the other with low inductance to accommodate the low and high frequency signals, respectively. This also requires a special tube, one with a long-neck so that both yokes may be mounted. If it is desired to use a typical picture tube as found in television receivers, to drive its single yoke at high power, a high frequency driver circuit is necessary. This technique is difficult to mechanize with semiconductor technology inasmuch as it requires a single transistor capable of performing at high frequencies while simultaneously dissipating high power, and a low output capacitance from the circuit so that the resonant frequency of the transistor output and the yoke winding is not too low.

An example of these specifications might be found in a display system which requires a high frequency, low amplitude scan of, for instance, one megacycle, superimposed on a main low frequency, high amplitude scan of, for instance, 100 cycles. Typically, the deflection coil energization may need to be a sawtooth wave of 2 amperes at 100 cycles plus a sawtooth wave of 100 milliamperes at one megacycle; the peak-to-peak voltage swing necessary for the former may be approximately 1 volt while the swing for the latter may be 20 volts. It is seen that a transistor capable of driving the above composite waveform must dissipate approximately 20 watts of power, have a reverse collector-emitter breakdown rating greater than 20 volts, have a gain-bandwidth product greater than 20 megacycles and have a low collector capacitance. Such transistors are very expensive, particularly when the reverse collector-emitter breakdown rating is necessary at a current of 2 amperes because of an inductive load.

The present invention concerns a circuit which is capable of mixing the aforementioned signals without requiring a high power, high frequency and/or low output capacitance transistor, yet will give adequate deflection for a high speed character display on a standard electromagnetically-deflected television-type cathode ray tube

having a single deflection yoke. It is applied to an alphanumeric display, the characters of the display being formed on the cathode ray tube screen in a dot matrix pattern. A slow sawtooth of current through the yoke horizontal coils deflects the beam across the tube horizontally to form a line of trace. During the horizontal retrace time the vertical current steps the beam down to its next line position. The vertical columns of the character matrices are produced by adding a high frequency triangular waveshape to the vertical sawtooth; this moves the spot up and down very rapidly as it crosses the face of the tube. The peak-to-peak amplitude of this triangle corresponds to the height of one character (about one-eighth inch) on the display; the frequency is set at the number of columns desired in the dot matrix per character. To produce high quality in the character appearance, these small strokes are made exactly vertical by stopping horizontal motion of the beam while the spot is moving up or down. This is accomplished by adding to the horizontal sawtooth a small amplitude, high frequency sawtooth of the same slope but opposite in direction. The sum of these currents in the horizontal deflection coil is a staircase waveshape. In order to handle these waveshapes, the circuit, for either vertical or horizontal deflection, comprises a pair of transistors, one capable of low frequency-high power operation and the other capable of high frequency-low power operation. The outputs of the transistors, after filtering, are combined in the yoke winding.

It is therefore an object of the present invention to provide an improved magnetic deflection system for cathode ray tube displays.

Another object of this invention is to provide a magnetic deflection system not requiring specialized components, such as long-necked cathode ray tubes, tubes incorporating electrostatic deflecting plates as well as magnetic yokes, etc.

Still another object of this invention is to provide a cathode ray tube display capable of presenting alphanumeric characters, the deflection for which requires high frequency-high power waveshapes.

It is another object of this invention to accomplish the above with transistorized circuitry.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention as illustrated in the accompanying drawings.

FIGURE 1 is a diagram showing the development of the waveshapes which are required in generating the character matrices also indicated in the figure, and

FIGURE 2 is a diagram, partially in block form and partially in schematic form, of the deflection system of the invention.

Portion A of FIGURE 1 shows a dot matrix for forming alphanumeric characters as contemplated by a preferred embodiment of the invention.

Character matrix **10** comprises seven columns and ten rows traversed by the cathode ray tube beam in the symmetrical square wave path indicated by portion B. Typically, 64 such character matrices may form a line of information across the face of the tube, each being about one-eighth inch square. Separation between character matrices is by 3 x 10 space matrices **12**, also traversed by the beam in the same path. It is thus seen that, in order to provide for the proper presentation of one character, five upward and five downward beam sweeps are required from the circuitry. As is known, by unblanking the cathode ray tubes during the traversal of a matrix, portions are made visible, and if the unblanking is timed to correspond to the configuration of an alphanumeric character, the character will be seen.

The rectangular beam path is produced as follows. The slow horizontal sweep signal, portion E of FIGURE 1, is fed to the horizontal deflection coil and causes the beam to traverse from left to right. During this sweep, a high frequency triangular wave, portion C of the figure, is fed to the vertical deflection coil such that the beam travels upward during positive slopes of the triangle and downward during negative slopes thereof. In order to avoid a slant to the columns of dots (i.e., a trapezoidal path of the beam) it is necessary to stop the horizontal motion during the vertical motion. This is accomplished by adding to the horizontal sweep (portion E) a small high frequency sawtooth wave, shown in portion D, having the same magnitude of slope as the former, but acting in opposition to it, and having a positive slope as high as possible in magnitude. The time for the beam to make its horizontal excursions is suitably short (portion B); the amplitude of the wave is set suitably to provide the desired spacing between matrix columns. The sum of the waves of portions D and E is shown in portion F, a staircase wave having a steep positive slope **14** during which the beam travels a short distance horizontally from left to right, and a zero slope **16**, during which the beam is directed sharply upward or downward by the vertical triangle, portion C. It is thus apparent that half the period of the vertical triangle is equal to that of the staircase; this is indicated by the waveshape sections marked by arrows, although in order to aid understanding, scaling has not been preserved in the figure.

FIGURE 2 presents a preferred deflection system for an electromagnetic cathode ray tube, the system embodying the present invention. Cathode ray tube **20** is shown in a typical installation, driven by a blanking video signal fed to its cathode, the electron beam being directed by a pair of deflection coils, vertical coil **22** and horizontal coil **24**, mounted in its yoke. Vertical and horizontal deflecting coil drivers **26** and **28** respectively, contain sufficiently similar circuitry to permit description of the latter only.

As is known in this technology, the display system provides certain timing signals to its deflection coil drivers. Thus, a horizontal synchronizing signal comprising, usually a pulse marking the beginning of each horizontal sweep and the formulation of each line of information on cathode ray tube **20**, is provided to sweep generator **30**, and a high frequency pulse marking each vertical excursion of the beam in the portion B waveshape of FIGURE 1, is provided to jog generator **32** from a timing circuit (not shown); the ratio of pulse repetition rates of these drives for 64 characters and spaces each in a 10 x 10 matrix, is on the order of 1:640.

Sweep generator **30** is of a known type comprising a capacitor charged with a constant current from a grounded base transistor; some positive feedback is usually fed around the transistor to insure linearity. This is synchronized and reset by the horizontal synchronizing signal pulse; the pulse saturates a transistor which then acts as a shorting switch across the capacitor. The transistor remains conductive only long enough to discharge the capacitor; then the capacitor recharges and the sweep begins again. The sweep generator has an emitter follower that drives power amplifier **34**.

Amplifier **34** is also well known, being found, for instance, in television sweep circuitry. Its output is push pull on lines **36** and **38**, the former leading to yoke driving circuit **40** and the latter connecting to horizontal coil **24**. It is thus seen that yoke driver circuit **40** is inserted in one of the push pull outputs, lines **36** and **42**, of amplifier **34**.

Jog generator **32** is a wave shaping circuit; for each pulse of the rectangular wave on its input line **44**, it emits a sawtooth pulse on line **46** as depicted in portion B of FIGURE 1. Such wave shaping circuitry is also sufficiently well documented in the literature and description herein need not be made.

Yoke driving circuit **40** is shown in preferred schematic form as including a pair of transistors **50** and **52**, the former, as discussed previously, capable of dissipating high power at low frequencies, whereas the latter is capable of high frequency operation (at low power levels). Transistors **50** and **52** are connected in circuits in which the driving signals are fed to the respective bases over lines **36** and **46**. High and low frequency isolation means between the transistors is provided by filter **54** comprising inductor **56** in the collector circuit of transistor **50** and capacitor **58** in the collector circuit of transistor **52** respectively. Horizontal coil **24** connects at one end to the junction of inductor **56** and capacitor **58** and at its other end to the output stage (including a positive source of voltage for the collector of transistor **50**) of amplifier **34**. As is customary, voltage supplies for the collector of transistor **52** and the emitters of the transistors is provided through resistors **60**, **62** and **64**.

With regard to operation of yoke driving circuit **40** as contemplated by the display system requirements already stipulated, the following circuit values are appropriate:

Horizontal coil **24**: 60μh.
Transistor **50**: 2N 3055.
Transistor **52**: 2N 2219.
Inductor **56**: 300μh
Capacitor **58**: 0.01μf.
Resistor **60**: 50Ω.
Resistor **62**: 10Ω.
Resistor **64**: 1Ω.
+ Supply Voltage: +24 v.
—Supply Voltage: 0 v.

Under these constants, transistor **52** is switched between conduction and saturation by the signal portion D of FIGURE 1, and the positive excursions of this signal require but 100 nanoseconds. During saturation, the rate of change of current in horizontal coil **24** due to the portion D signal, is approximately 150 ma./μsec. and during conduction, the rate will drop to about 12.6 ma./μsec. As a result, the positive excursions of the signal in portion F and the horizontal beam sweeps in portion B are very rapid and the horizontal sections in portion F and the vertical beam sweeps in portion B are relatively slow.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in the form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a display system in which information is presented on the screen of a cathode ray tube having an electromagnetically controlled electron beam, means to generate the deflection potential in a deflection coil of the yoke for the tube, operable on receipt of the sweep synchronizing signal, comprising:

a first generator for supplying a sweep signal relatively low in pulse repetition rate;

a second generator for generating a signal relatively high in pulse repetition rate and opposite in phase to the signal generated by said first generator; and

a yoke driving circuit including high and low frequency isolation means for receiving and transmitting said low and high pulse repetition signals while isolating each said generator from the signals of the other, said driving circuit acting responsive to the signals of said first and second generators to emit an essentially linear staircase signal.

2. The system of claim **1** in which said means to generate the deflection potential is provided for both the horizontal and vertical deflection coils of the yoke for the tube.

3. The system of claim **1** in which said yoke driving circuit includes a pair of active elements, one responsive

to the signal of said first generator and capable of operation at relatively high power and the other responsive to the signal of said second generator and capable of operating at relatively high frequency.

4. The system of claim 3 wherein said isolating means comprises a filter to isolate the outputs of said elements from each other.

5. The system of claim 4 in which said elements are transistors.

6. The system of claim 5 in which said first and second generators connect at the bases of said transistors and said filter connects at the collectors of said transistors and to the deflection coil.

7. The system of claim 1 and an amplifier connected between the output of said first generator and the input of said yoke driving circuit.

References Cited

UNITED STATES PATENTS

3,210,599	10/1965	Ward	315—27
3,201,611	8/1965	Mollinga	315—27
2,871,378	1/1959	Lohman	307—88.5
2,623,196	12/1952	Toulon	315—26
2,414,096	2/1944	Dimound	328—186

FOREIGN PATENTS

58,320	9/1946	Netherlands.

RODNEY D. BENNETT, *Primary Examiner.*

JOSEPH G. BAXTER, *Assistant Examiner.*

U.S. Cl. X.R.

307—228; 315—24, 26