United States Patent

Brehm

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[54] **METHOD TO PRODUCE SYMBOLS COMPOSED OF STRAIGHT LINES ON THE SCREEN**

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[73] Assignee: **Siemens Aktiengesellschaft,** Berlin and Munich, Germany

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[30] **Foreign Application Priority Data**

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

[51] **Int. Cl.** **H01j 29/76**

[58] **Field of Search** .....340/324.1, 324 A; 315/18

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[57] **ABSTRACT**

A cathode ray system for producing visible symbols comprised of straight lines including means for producing digital information indicative of the symbols to be produced, digital analog-converters for generating voltage values in response to the digital information supplied thereto and means for applying the output voltages from the digital analog-converter to the deflection system of a cathode ray tube. The cathode ray beam is scanned in the horizontal direction and the output voltages from the digital analog-converter are applied to image deflection coils for deflecting the beam in the vertical direction. The voltage applied to the image deflection coils is a step-like voltage of the required pattern to produce the desired symbol on the screen of the tube. During portions of the sweep when writing is not required, dark scanning is employed.

13 Claims, 13 Drawing Figures

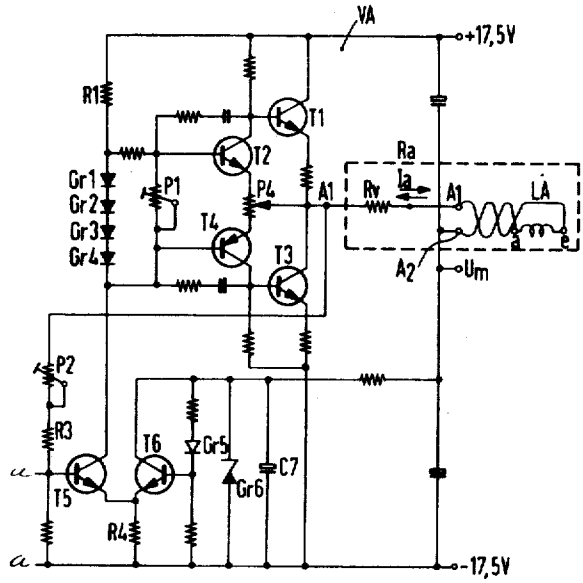

Fig.1

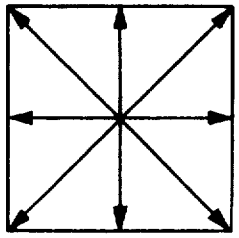

Fig. 2

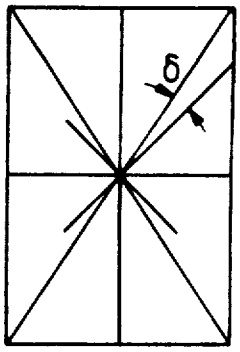

Fig. 3

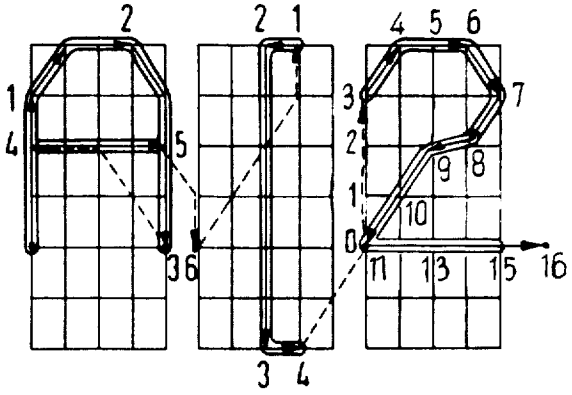

Fig.4a

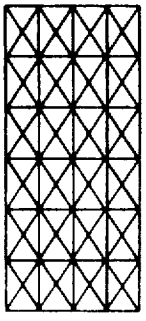

Fig.4b

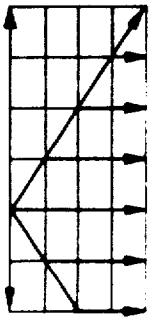

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Fig. 6

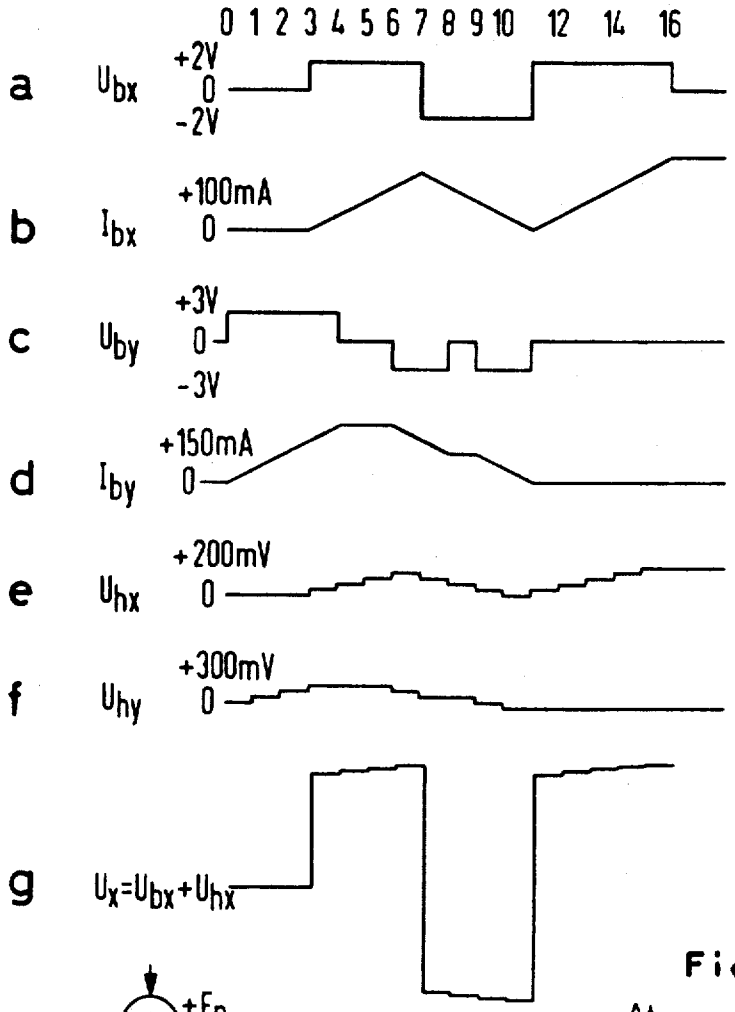

Fig. 5

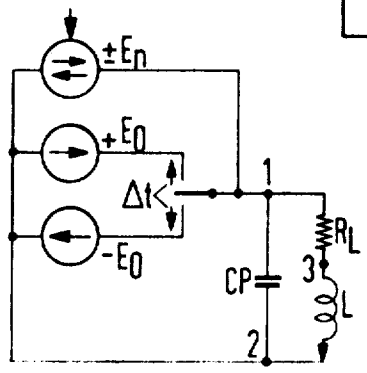

Fig. 5a

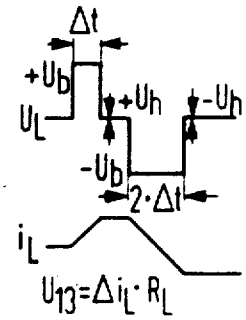

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Fig. 7

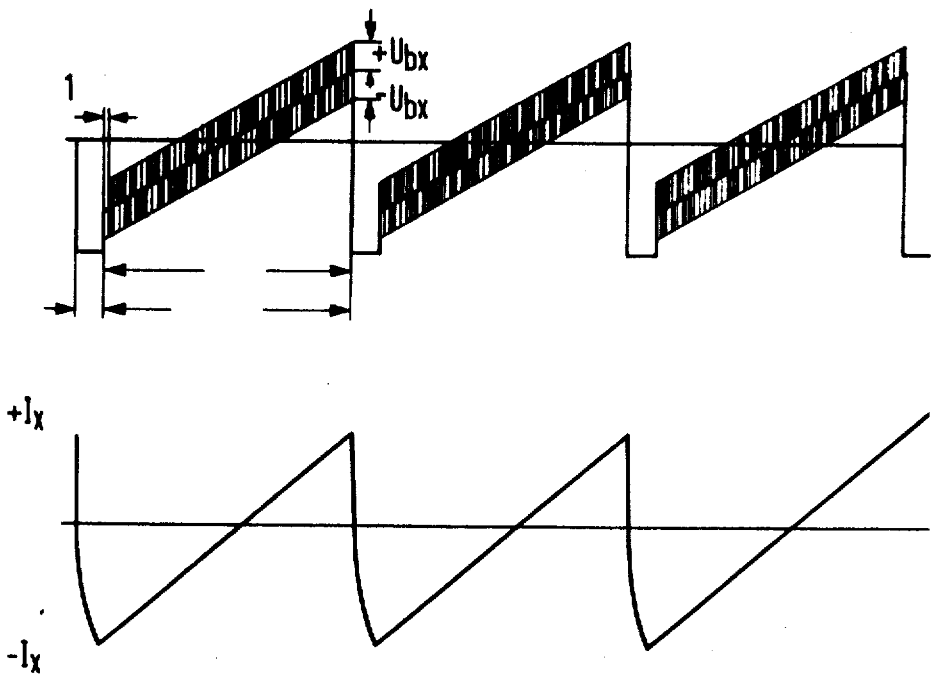

Fig. 8

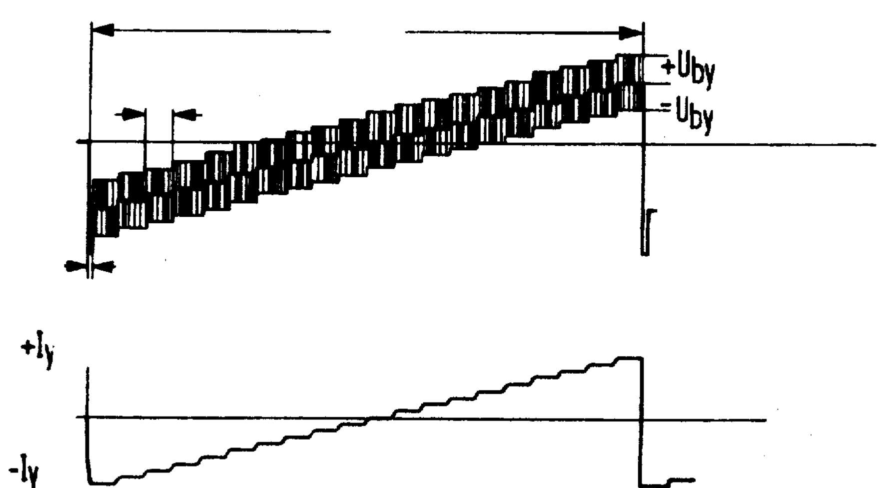

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Fig. 9

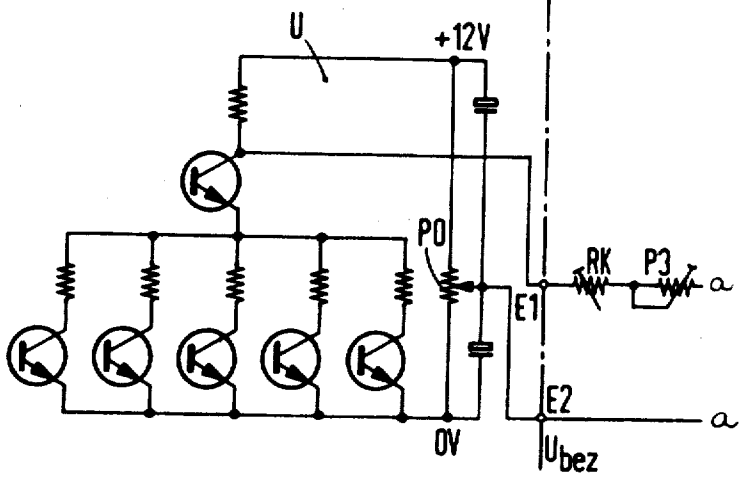

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Fig. 9a

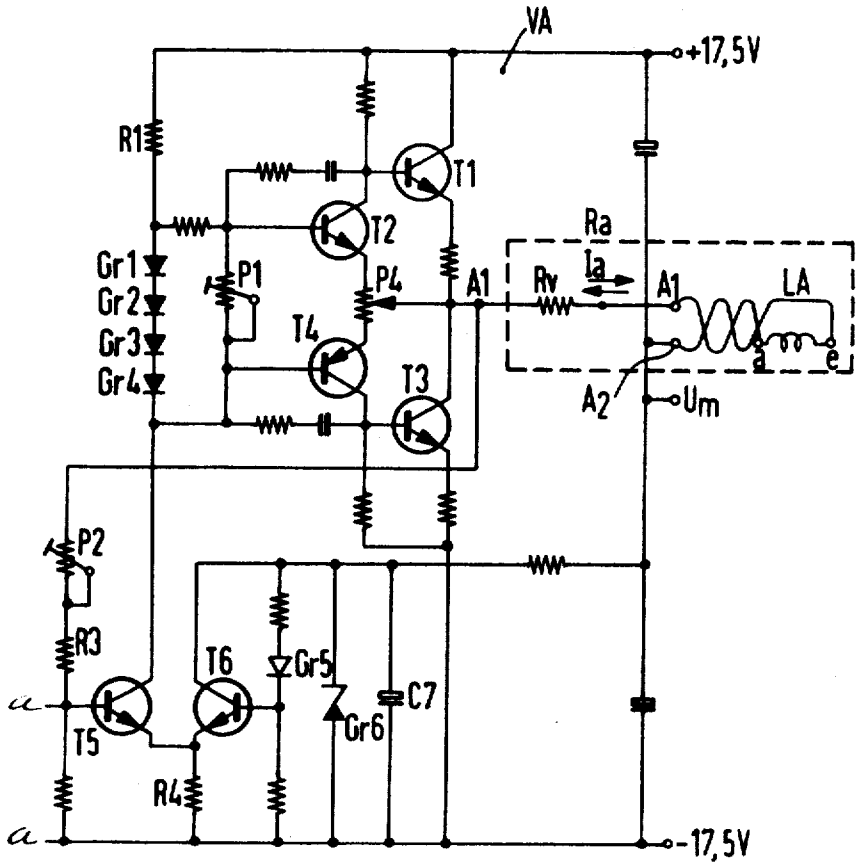

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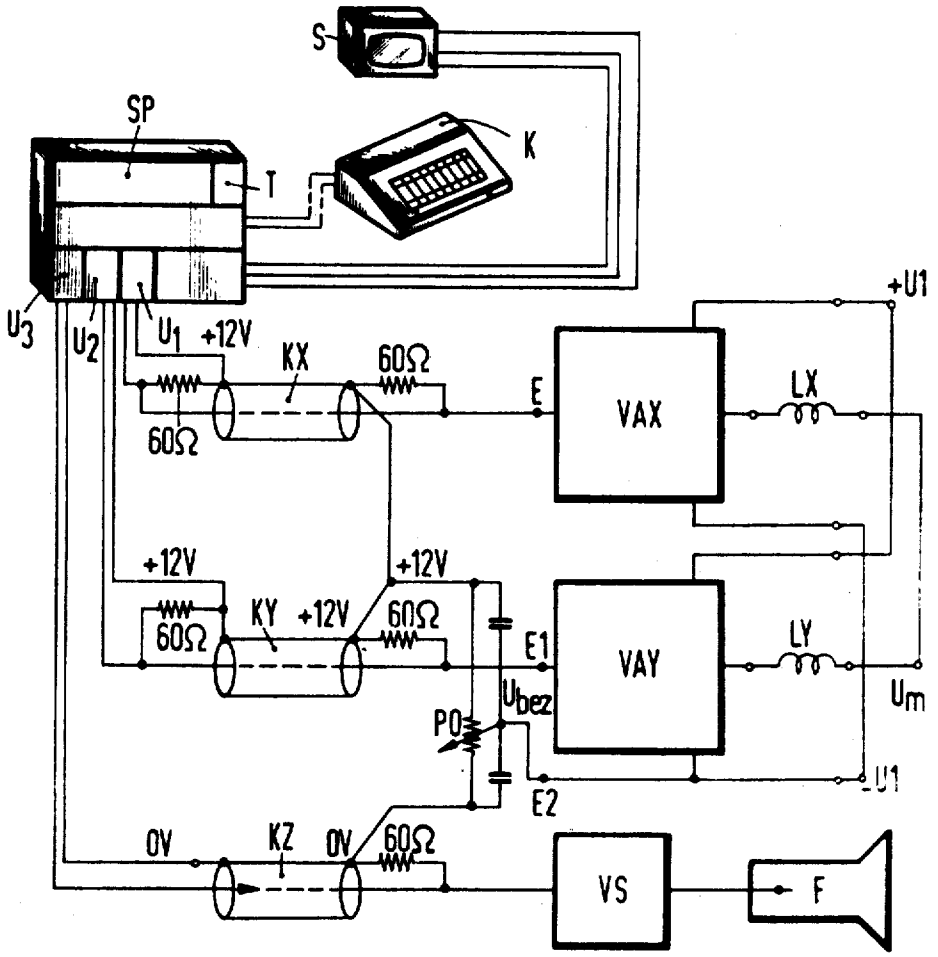
Fig.10



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METHOD TO PRODUCE SYMBOLS COMPOSED OF STRAIGHT LINES ON THE SCREEN

BACKGROUND OF THE INVENTION

Field of the Invention

The field of art to which this invention pertains is cathode ray devices which are used directly to produce visual information corresponding to digital or numerical data.

SUMMARY

An important feature of the present invention is the provision of means for directly utilizing numerical data to produce a visual indication of that data on a cathode ray screen.

It is another feature of the present invention to provide means for applying a signal to the deflection circuit of a cathode ray tube which signal establishes the required deflection for directly producing visual images of numerical data.

It is an important object of the present invention to provide an improved means for directly viewing digital information or the like on the screen of a cathode ray tube.

It is another object of the present invention to utilize step voltages as developed at the output of a digital analog-converter to control the sweep of a cathode ray beam for the purpose of reproducing visual data on the screen thereof.

It is also an object of this invention to provide a cathode ray display device which includes horizontal and vertical deflection systems wherein image information is applied to the vertical deflection system to display data on the screen of the tube.

It is a further object of this invention to provide a cathode ray display system as described above wherein the symbols or characters appearing on the screen are comprised of straight line portions.

Still another object of the present invention is to provide a cathode ray display system as described above wherein the symbols or characters displayed are supplied as digital signals to a digital analog-converter and from there to the deflection amplifier of the cathode ray tube.

These and other objects, features and advantages of the present invention will be understood in detail from the following description and the associated drawings wherein reference numerals are utilized to designate a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and additional details are explained below on the basis of the drawings.

FIG. 1 shows the basic scan for a symbol to be presented in quadratic or square shape.

FIG. 2 shows a more expedient form of the basic scan in the form of a rectangle placed on its smaller side.

FIG. 3 shows the writing of symbols with difference coordinates.

FIG. 4*a* shows the possible orbits in a basic symbol scan.

FIG. 4*b* shows the possible orbits from a basic position when only a difference coordinate is indicated.

FIG. 5 shows a circuit for controlling a deflection coil.

FIG. 5*a* shows the relationship between voltage and current in the deflection coils.

FIG. 6 shows the course of the voltages and currents in a deflection coil when writing symbols.

FIG. 7 shows the course of current and voltage in the deflection coils during one line.

FIG. 8 shows the course of current and voltage in the picture deflection coil.

FIGS. 9 and 9*a* show the circuit diagram of a deflection amplifier.

FIG. 10 shows the interconnection of the deflection amplifiers in the scope of a survey diagram of a data transmission installation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention relates to a method for producing symbols composed of straight lines on the screen of a television picture tube.

Various methods are already known for making symbols visible on the picture screen of a cathode ray tube. Even illustrations, like circuit diagrams, and curves, can be made visible. These methods depend upon the use of a cathode ray tube of special design. This special design requires considerable expenditure which is avoided by other methods using simpler cathode ray tubes. The latter methods use cathode ray tubes with electrostatic deflection, as used for example in cathode ray oscillographs. According to the prior art it is also known to combine electro-magnetic and electrostatic deflection in devices to show writings on picture screens of cathode ray tubes, but this too is comparatively expensive.

The invention solves the problem of creating an indication of symbols composed of straight line sections on the screen of a cathode ray tube, permitting the use of mass produced television picture tubes and thus allowing the use of visual devices favorable in price, for example, for data end stations. The method according to this invention offers the further advantage that an ordinary deflection system may be used so that for this relatively costly component, a favorable price is available.

This invention is based on the realization that a different type of control for the deflection coils is necessary. In current television receivers the cathode ray is guided along a narrow scanned area in lines and modulated according to the prevailing brightness of individual picture elements. The method according to the present invention is basically different in contrast thereto, as will be pointed out in detail.

The present invention is characterized by the fact that signals placed in a storer as digital information are converted via digital analog-converters into voltages such as step voltages, said signals being amplified and fed as acceleration voltages and holding voltages along with the sawtooth-like deflection voltage for line and image deflection to the deflection coils of a television picture tube in such a manner that within a high definition scan the written symbols or characters appear composed of straight fragments due to the bright scanning of the cathode ray by means of signals likewise taken from the storer.

The writing of the symbols on the picture screen in detail is accomplished in such a manner that the electronic ray is deflected according to a differential coor-

dinate, by moving the luminous point in horizontal and vertical paths and in paths extending parallel to the corresponding scan diagonal, said orbits being part of a basic symbol scan. The "differential coordinates" are the X and Y coordinates from the starting point to the end point of a particular line segment. During the detours and connecting paths within or between the symbols dark scanning is provided.

According to one embodiment of the invention the deflection coils are controlled with an impressed voltage, that is the output of the deflection amplifier has a low internal resistance. According to a further improvement of the method according to the invention the signals for the positioning of the symbol in the line and for the individual parts comprising straight portions are supplied as digital signals via a digital analog-converter to the output amplifier in the form of hold and acceleration voltages. This may be accomplished in such a manner that the writing of the symbols themselves is achieved only by means of acceleration voltages. According to an expedient embodiment of the method according to the invention the voltage impulses for the writing and positioning are derived from a central pulse source.

The method according to the invention requires special deflection amplifiers. One embodiment of the invention is characterized by the fact that the deflection amplifiers contain push-pull transistors controlled by galvanically coupled preliminary transistors.

A further improvement of the arrangement according to the invention provides that the preliminary phase of the deflection amplifier is controlled by an input transistor whose base electrode is fed a counter-coupling voltage from the amplifier output.

According to another feature of the invention provisions are made for impressing on the emitter electrode of the input transistor a constant voltage superimposed by a component compensating for the temperature behavior of said transistor.

A simplification as to temperature compensation results from the fact that the input transistor has a joint compensating emitter resistance with an additional transistor, between whose emitter and collector a Zener diode is placed and which has a silicon diode in its collector-base branch accomplishing the temperature compensation of the input transistor.

FIG. 1 represents the basic scan of a symbol composable from straight sections according to the so-called slate pencil method. Each symbol or curve section is composed of a sequence of straight sections extending either parallel to the axis or at 45° to the axis. If the basic scan is a rectangle, as shown in FIG. 2, the lines parallel to the diagonals extend at an angle of 45°. The straight lines of which the symbols are composed begin or terminate at the dots of a basic symbol scan. The electron ray does not pass through all possible orbits of a symbol matrix, as shown in FIG. 4*a*, but merely the actually required orbits, wherein detours and connecting lines are dark scanned as shown in FIG. 3. It should be emphasized that the method of writing differential coordinates as shown in FIG. 4*b* brings about a reduction of the expenditure in digital output signals. By proper alignment and juxtaposition of strokes, illustrations, circuit diagrams, curves, etc. can be reproduced on the picture screen.

The equivalent circuit of a deflecting coil is shown in FIG. 5 as an inductivity L with a resistance RL in series and a capacity CP in parallel with the series circuit. In the customary deflection system for visual data units it is contemplated to control the deflection coil according to the method of "current impression." However, this method has disadvantages when symbols are to be written within microseconds, and the coil circuit must be attenuated to avoid super vibrations. Thus, in the method according to the invention the method of the so-called "voltage impression" is proposed. The demand exists here, for example, to write a partial stroke of a symbol 1 mm long within 0.6 microseconds by the ray. If the time constant of the deflection coil circuit, that is the relation of inductivity to resistance, is high, a linear variation of current takes place when the constant voltage is changed within a brief time interval.

If by increasing the voltage at the coil a certain rise of current is achieved, the current value can be maintained with the aid of a much lower "holding voltage." These conditions are reported and represented in FIG. 5*a*. The writing voltages superimposed on the deflection voltages comprise acceleration and holding voltages which for brief times, that is impulse-wise, are to be fed for example from a central rhythm. The holding voltages bring about the maintaining of attainable current values if the ray is to stay at one point.

For example during the line return the line deflection coil is given the holding voltage for the basic value of the following line. The return of the scan from the end point in a line to the beginning point in a line occurs at the same time as the return of the scan from the last line to the first line and the required voltage and return time are selected such that the deflection current reaches the required value for the first line of scan.

FIG. 6 shows the deflection voltages during the writing of the numeral 2 as shown in FIG. 3 and the currents flowing through the deflection coils. The acceleration voltage in line direction (x-direction) is shown in line a. Line b shows the magnitude of the current in the line deflection coil due to the acceleration voltages. Line c shows the acceleration voltage in image direction (y-direction), and the magnitude of the current in the image deflection coil is represented in line d. The magnitude for the holding voltage in the line and deflection coils are shown in FIG. 6, lines e and f. The overall magnitude of the voltage at the line deflection coil, that is the sum total of acceleration and holding voltage is shown in FIG. 6g.

FIG. 7 shows a graph of the voltage in a line deflection coil for several line periods. This shows that the holding and acceleration voltage values required to represent the symbols are superimposed over a somewhat sawtooth-like basic voltage. If no symbols are written, a symbol current results from the deflection coil with a magnitude shown in FIG. 7. FIGS. 8*a* and 8*b* indicate the step-like magnitude of the voltage and the current through the picture deflection coil.

In order to achieve the above explained magnitude of current and voltage in the deflection coils, a special deflection amplifier is required, as already emphasized, which converts voltage changes at its input into amplified voltage changes at its output, whereby a low internal resistance of the amplifier is required.

FIG. 9 shows such a deflection amplifier, with the output signals of a digital analog-converter U consisting of voltage values being supplied at the input terminals E1, E2 of said amplifier. The circuit of the analog digital-converter U is in the prior art and is not part of this invention and accordingly need not be discussed in detail. It has been proven to be expedient to feed the voltage for the deflection amplifier VA (FIG. 9*a*) and for the additional deflection amplifier of the apparatus from a single potential-free source. Thereby the negative pole (−17.5 volts) of this feed voltage source is connected to the input terminal E2, which in turn is placed at the tap of a potentiometer PO connected between the potentials OV and + 12 volts at the digital analog-converter U. Points *a*—*a* in FIG. 9 are connected to points *a*—*a* in FIG. 9*a*.

The voltage values of the digital analog-converter U are fed to the deflection amplifier VA at the base electrode of its input transistor T5 (FIG. 9*a*). The potentiometer P3 makes possible an adjustment of the line width and/or picture height. RK is a cold conductor (for example Siemens P330–D1) which normally has a low resistance of 70 ohms and is connected with the cooling plate for example of the terminal phase transistors T1 and T3 in a heat-conductive relationship. At temperatures leading to thermal overload of the transistors T1 and T3, the resistance of the cold conductor RK increases such that the input amplitude to the amplifier VA is lowered. This protection against thermal overload at too high an ambient temperature or at increased input amplitude also protects the terminal phase transistors and if necessary other parts sensitive to temperature without preventing a harmless short-timed overloading. Thus, as desired frequently in sound frequency amplifiers, a large modulation range is possible without having to fear damage due to thermal overload.

The terminal phase of the deflection amplifier VA comprises a pair of output transistors T3 and T1, whose base electrodes are connected galvantically with the collector electrodes of the preliminary phase transistors T2 and T4. The complementary first stage transistors T2 and T4 receive their control voltage in turn through galvanic connection of their base electrodes with the collector of the input transistor T5. The base bias is derived from four silicon diodes Gr1 . . . to Gr4. The potentiometer P1 thereby allows for the precise adjustment of the holding current which is necessary for the proper operation of the amplifier VA. The deflection coil LA is connected between the output terminals A1 and A2.

A compensating resistance RV precedes the output terminal A1. A counter coupling path containing the potentiometer P2 and the resistance R3 being connected to the end of said compensating resistance. The output holding voltage can be adjusted with the potentiometer P2.

By using the silicon diodes Gr1 to Gr4 to generate the base bias for the transistors T2 and T4 a far-reaching temperature compensation can be accomplished. However, a precise temperature compensation of the input transistor T5 is required. For that purpose it is given a fixed emitter voltage due to the fact that the transistor T6 and the transistor T5 have a joint emitter resistance. The collector electrode of transistor T6 is coupled to the Zener diode Gr6 which in cooperation with the condenser C7 generates a constant voltage. A silicon diode Gr5 is provided for temperature compensation of the transistor T6 between its base and collector; its temperature-dependent resistance causes a compensation of the temperature path of the transistor T5 via the coupling resistance R4.

In many cases it is necessary to design the viewing unit as small and light as possible. That is why it is desired to arrange many of the required electrical circuit building blocks physically separate from the viewing unit. The method according to the invention complies with this demand because the viewing unit can be connected with the deflection amplifiers via concentric cables of 300 meters in length for example with the amplifiers and/or the digital analog-converters.

FIG. 10 illustrates the structure of an installation for the transmission of data to the picture screen of a television tube F. The console K contains a keyboard to feed the symbols to be presented on the tube F. However, it is possible to replace the console K with any data delivering unit, for example, a data processing installation, telegraphy receivers, or the like. The console K is connected with a storer Sp containing a quartz controlled rhythm transmitter T and emitting the digital signals needed to write the symbols of the picture screen of the television tube at the proper moments. Several viewing units may be connected to the storer Sp.

In the embodiment represented in FIG. 10 an additional viewing unit S is shown which is arranged for input control in proximity of the console K and likewise connected to the digital analog-converters U1, U2, U3. For remote indication on the picture screen of the television tube F a concentric conduit KX, KY is provided in each case between the digital analog-converters U1 and U2 on the one hand and the deflection amplifiers VAX and VAY on the other hand, while the signals used to scan the ray of the picture tube F are supplied from the digital analog-converter U3 via a third concentric conduit Kz to the control amplifier VS. The feeding of the amplifiers VAX and VAY is accomplished by a potential-free feed voltage −U1, +U1, wherein the pole −U1 is connected to a potentiometer PO.

The storer SP shown in FIG. 10 may be combined into one unit with the rhythm impulse transmitter T and the associated generators to produce the signals for the basic deflection in picture and line direction. Fifty or 60 cycles are selected expediently as picture deflection frequencies. The line frequency depends on the number of lines to be transmitted. The deflection coils are identified by reference designations LX and LY.

THE INVENTION CLAIMED IS:

1. A system for generating symbols on the screen of a cathode ray tube comprising:

means for generating digital signals corresponding to the information to be displayed,

converter means for translating said digital signals into voltage waveforms corresponding to the sweep pattern required to be taken by the cathode ray to produce the desired illustration on the screen of the cathode ray tube,

said voltage waveforms having a step-like configuration to generate symbols on said cathode ray

screen composed of substantially straight line portions, and

means for coupling said step-like waveforms to one of the deflection systems of said cathode ray tube,

said cathode ray tube having a deflection amplifier and the output signals from said converter being fed to said deflection amplifier to control the sweep of said cathode ray,

said deflection amplifier having a push-pull transistor output phase and a galvanically coupled preliminary transistor phase.

2. In a system for generating symbols on the screen of a television picture tube wherein the symbol information is fed to a memory in digital form and converted by means of digital analog-converters into a step-like voltage waveform which is coupled along with the sawtooth deflection voltage to the deflection coils of the picture tube in such a manner that the symbols on the picture tube are composed of straight lines, a deflection device comprising a push-pull amplifier having a pair of amplifier devices, sources of positive and negative voltage, the amplifier devices coupled between said sources with one being coupled to the positive source and the other to the negative source, deflection coils, said deflection coils having one terminal coupled to a center tap between said sources of voltage and having the other terminal coupled to an output of the push-pull amplifier.

3. A deflection device in accordance with claim 2 wherein the outputs of the digital analog converters are DC coupled to the point of connection between the deflection coil and the push-pull amplifier.

4. A deflection device in accordance with claim 3 wherein a resistance is placed in series with the deflection coil between the coil and the point of connection with the push-pull amplifier.

5. A deflection device in accordance with claim 2 wherein each of said amplifier devices has a preliminary phase amplifier element which is DC coupled to the inputs thereof.

6. A deflection device in accordance with claim 5 wherein the preliminary amplifier devices of the deflection amplifier have an input transistor coupled thereto, said input transistor having a base electrode coupled to both the output of the digital analog-converter and to a point located between the deflection coils and output of the push-pull amplifier.

7. A device in accordance with claim 6 wherein the input transistor has an additional transistor coupled to the emitter thereof and wherein a Zener diode is coupled between the emitter and collector of said additional transistor and wherein a temperature compensating diode is coupled to said additional transistor to provide temperature compensation for said input transistor.

8. A device in accordance with claim 7 wherein a series of temperature compensating diodes are coupled between the collector of said input transistor and the input of said preliminary amplifiers to provide temperature compensation for said amplifiers.

9. A device in accordance with claim 8 wherein a temperature dependent resistance is coupled between the base of said input transistor and the output of said digital analog-converter and wherein said temperature-dependent resistance is in heat-conductive relationship with at least one of the amplifier devices of the deflection amplifier to protect against temperature overload.

10. A system for generating symbols in accordance with claim 1 wherein said preliminary phase of said deflection amplifier has an input transistor and wherein said input transistor has its base electrode coupled in feedback relation with the output of said amplifier.

11. A system for generating symbols in accordance with claim 10 wherein said input transistor and an additional transistor have a joint compensating emitter resistance, a Zener diode coupled between the emitter to collector electrodes of said additional transistor and a silicon diode connected in its collector base branch causing temperature compensation for said input transistor.

12. A system for generating symbols in accordance with claim 11 wherein said input transistor is connected galvanically with the output of said converter.

13. A system for generating symbols in accordance with claim 12 wherein a cold conductor is coupled to the input of the said amplifier, said cold conductor being connected in a heat-conductive manner to at least one of said preliminary phase transistors of the amplifier.

* * * * *