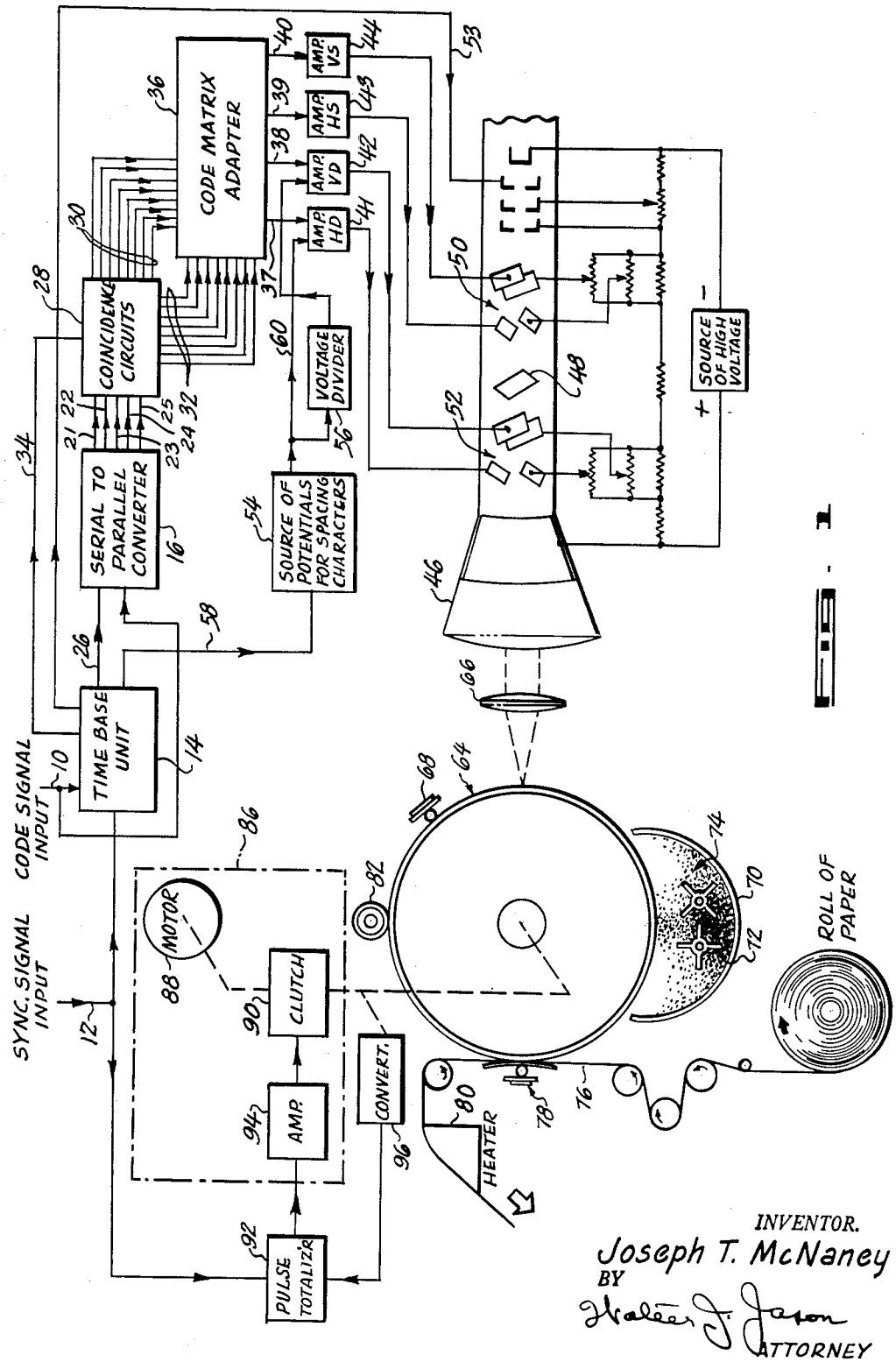
Feb. 28, 1956 J. T. McNANEY 2,736,770

PRINTER

Filed June 25, 1952

3 Sheets-Sheet 1



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Feb. 28, 1956 J. T. McNANEY 2,736,770

PRINTER

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FIG. 3

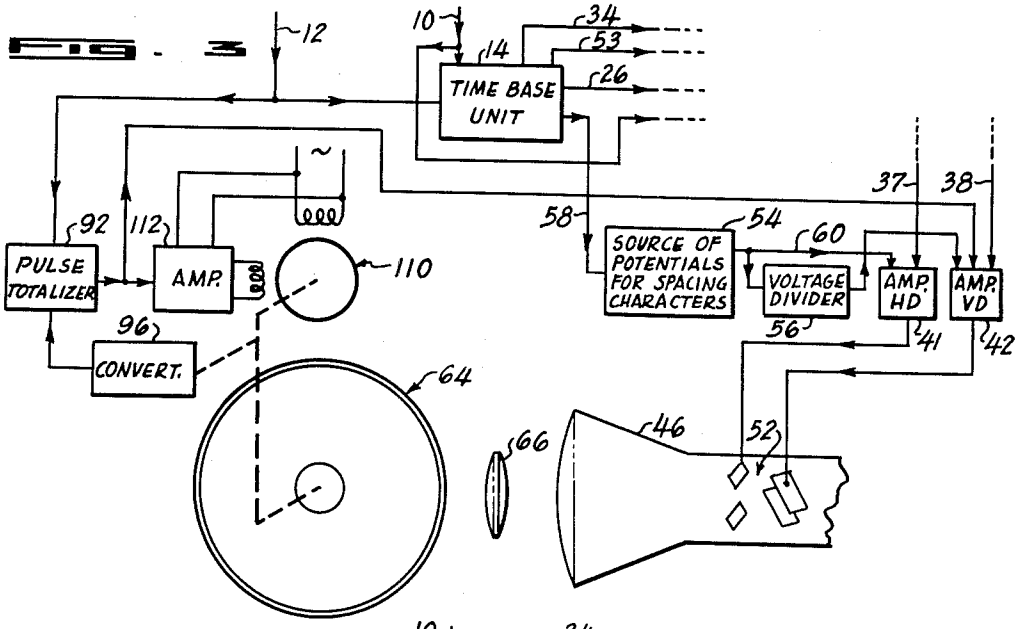
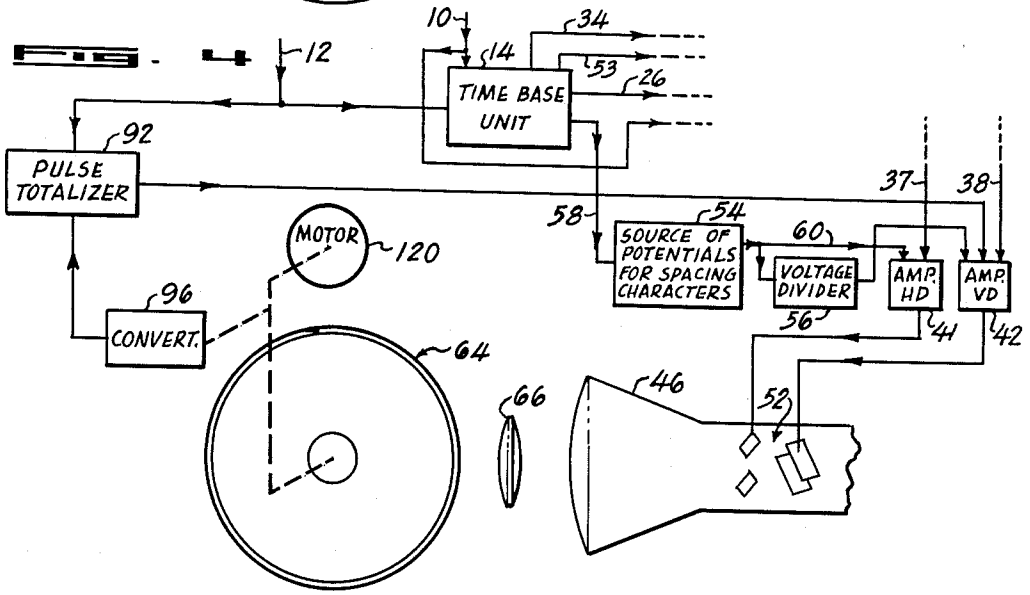


FIG. 4



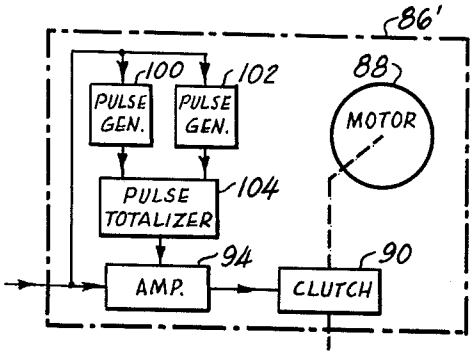


FIG. 2

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3 Sheets-Sheet 3

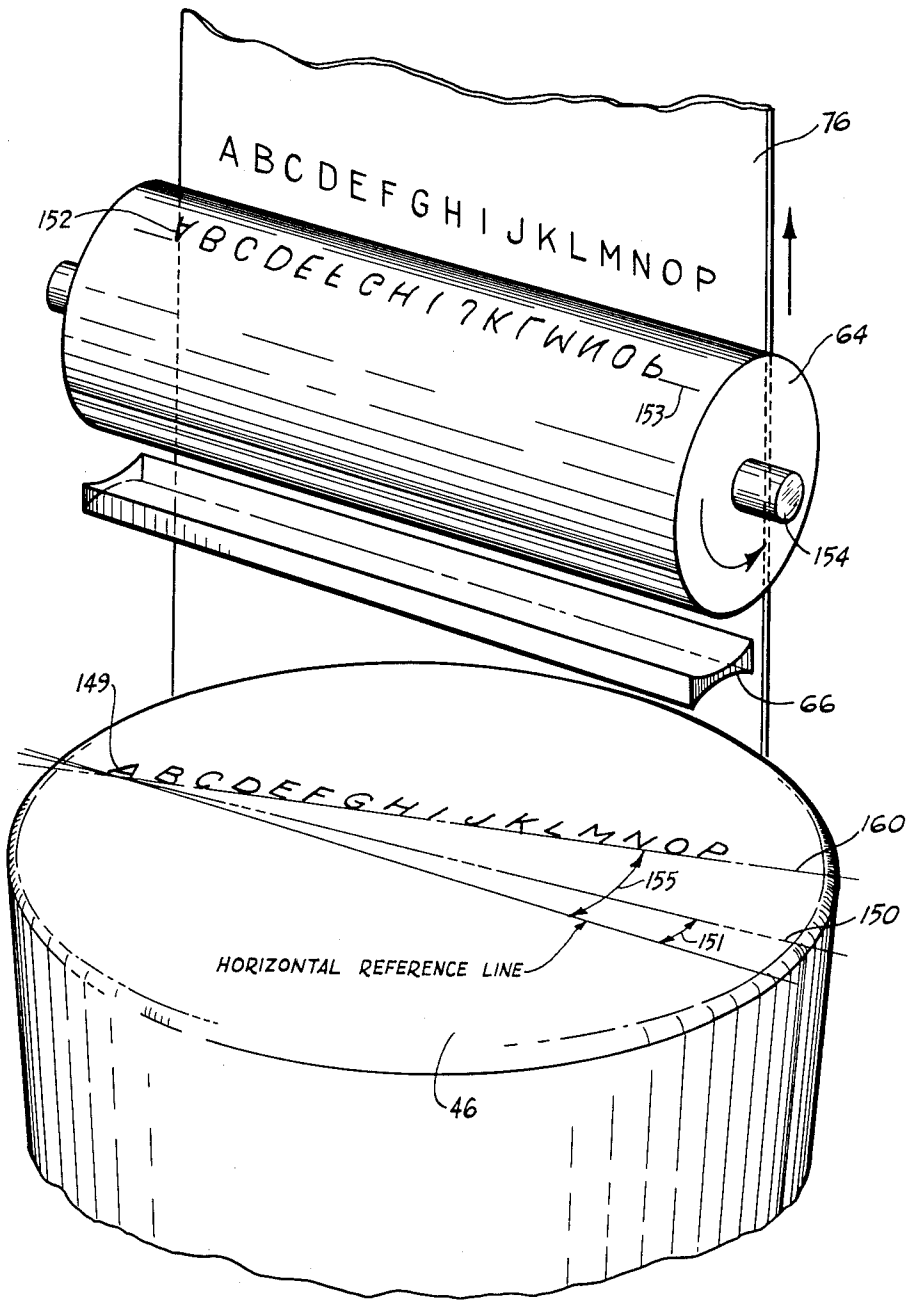

FIG. 5

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United States Patent Office 2,736,770 Patented Feb. 28, 1956

2,736,770

PRINTER

Joseph T. McNaney, San Diego, Calif., assignor, by mesne assignments, to General Dynamics Corporation, a corporation of Delaware

Application June 25, 1952, Serial No. 295,589

10 Claims. (Cl. 178—15)

This invention relates to printers and particularly to improved apparatus for recording information represented by code signals.

Printers for providing a record of information represented by code signals (such as the five-digit binary code signals employed in teletypewriter systems) ordinarily employ mechanisms which actuate type members in response to the code signals. The speed of such printers is limited by the speed at which the mechanisms respond to the code signals, and hence they are not suitable for high-speed printing.

The printer of my invention employs an electronic arrangement for displaying information represented by code signals and a dry photographic printer for providing a printed record of the displayed information, so that high-speed printing may be effected.

In accordance with my invention, a cathode-ray tube is employed to selectively display images of characters in accordance with the received code signals, a moving electrostatically charged photoconductive member is disposed to receive light from the images so that the member is selectively discharged to provide a record of the images, and the images in the electrostatic charge on the photoconductive member are transferred to a printed record on ordinary paper by a dry photographic process.

The orientation of the images on the screen of the cathode-ray tube is synchronized with the movement of the photoconductive member so that the images are recorded at predetermined locations on the photoconductive member, say along lines which are disposed substantially perpendicularly with respect to the direction of movement of the photoconductive member so that the images which are transferred from the photoconductive member to the printed record, are printed in predetermined spatial arrangement.

In a preferred embodiment of the invention, the movement of the photoconductive member is synchronized with the code signals so that the photoconductive member moves at a substantially constant speed with respect to the reception rate of the code signals, and the required orientation of the images is achieved by synchronizing the spatial arrangement of the images on the screen of the cathode-ray tube with the reception rate of the code signals.

In another embodiment of the invention, the required orientation of the images on the screen of the cathode-ray tube is achieved by controlling the orientation of the images with a control signal which represents the speed of movement of the photoconductive member with respect to the reception rate of the code signals. With this arrangement, the movement of the photoconductive member need not be accurately synchronized with the reception rate of the code signals.

To provide a readily readable and intelligible printed record of the information represented by the coded signals, the latent images or characters in the electrostatic charge on the photoconductive member are reversed. Thus, when the latent images on the photoconductive member are transformed to visible images on the printed record, wherein a reversal of the images takes place, the images will appear in their normal orientation. A reversed image on the photoconductive member may be realized by either establishing a reversed image on the

screen of the cathode ray tube or by establishing a normal image on the screen and with the use of known optical techniques the images which are focused on the photoconductive member may be reversed. The method of reversing or transferring the images presented on the screen of the cathode ray tube to the light sensitive member forms no part of the present invention. Image reversal may also be accomplished by reversing the image on the screen of the tube through reversal of the character shaping matrix within the tube.

The invention is explained with reference to the drawings, in which:

Fig. 1 is a diagram showing one embodiment of the printer of my invention;

Fig. 2 shows a modification of the servo control of Fig. 1 which provides more precise synchronization of the movement of the photoconductive member with respect to the reception rate of the code signals;

Fig. 3 shows an alternative servo control and synchronization arrangement for the printer of Fig. 1;

Fig. 4 shows another synchronization arrangement for the printer of Fig. 1; and

Fig. 5 shows a representative arrangement of character images oriented on the screen of the tube and their appearance in successive stages on the photoconductive member and the paper.

The printer of my invention may be arranged to respond to various types of code signals, but for the purpose of this disclosure it will be assumed that the code signals are pulse signals of the five-digit binary type such as are employed in teletypewriter systems and that synchronizing pulse signals are provided in conjunction with the code signals. The synchronizing pulse signals occur at a substantially constant rate and a synchronizing pulse occurs at the beginning of each of the five digits of the binary code.

By way of example, the information to be printed may be recorded by means of a teletypewriter and then transferred to a memory unit which serves as a storage medium, from which the stored information and the synchronizing signals are transmitted to the printer in the form of pulse signals and at a high speed.

In the printer of my invention, the code signals are applied to an electronic circuit which serves to produce predetermined potentials in response to the respective code signals, and these potentials are employed to cause images of the characters represented by the code signals to be displayed on the screen of a cathode-ray tube.

The printer has an input circuit **10** for receiving the code signals and an input circuit **12** for receiving the synchronizing signals. Both the code signals and the synchronizing signals are applied to a time base unit **14** which serves to control the sequence of operations of the code conversion circuit which provides the control potentials for the cathode-ray tube. The time base unit **14** comprises a multivibrator and binary counter circuit which responds to the code and synchronizing signals and produces control signals, which are described below, at its output circuits.

The code signals are also applied to a serial-to-parallel converter **16** which responds to each of the five-digit code signals and provides simultaneous signals at its five output circuits **21** to **25** in accordance with the character represented by the respective code signals. For example, if the five-digit code signal representing the letter J is pulse, pulse, space, pulse, space, the circuits **21**, **22**, and **24** will carry simultaneous signals representing pulses, and the circuits **23** and **25** will carry signals representing spaces.

After the serial-to-parallel converter responds to each character to be printed, it is restored by a signal from the time base unit which is conveyed by the circuit **26**.

The circuits 21 to 25 are connected to a set of coincidence circuits 28 which have two sets of output circuits 30 and 32. The coincidence circuits comprise a plurality of sets of diodes arranged to respond to the simultaneous signals in the circuits 21 to 25, and they serve to produce a signal at one circuit of each of the two sets of output circuits 30 and 32 in response to each set of simultaneous signals in the circuits 21 to 25, the two output circuits selected being determined by the character to be printed.

After the coincidence circuits respond to each character to be printed, they are restored by a signal from the time base unit which is conveyed by the circuit 34.

The circuits 30 and 32 are connected to a code-matrix adapter 36 which serves to provide potentials which are employed to control the beam of the cathode-ray tube. The code-matrix adapter 36 comprises a matrix of electronic gates arranged so that one of the gates is actuated in response to each set of signals which occur in the circuits 30 and 32.

As shown by way of example in the drawing, each of the sets of output circuits 30 and 32 comprises eight circuits. With this arrangement, sixty-four gates are employed in the code-matrix adapter, and one of the sixty-four gates is actuated in response to each set of signals which occur in the circuits 30 and 32.

Each of the gates of the code-matrix adapter serves to actuate an electronic circuit which provides four potentials representing the character to be printed, and these potentials appear at the output circuits 37 to 40 of the code-matrix adapter.

The potentials are amplified by the amplifiers 41 to 44, and the outputs of the amplifiers are applied to the deflection plates of a cathode-ray tube 46.

The cathode-ray tube is of the general type disclosed in my U. S. Patents Nos. 2,275,017 and 2,283,383 and it is known by the name Charactron.

The cathode-ray tube is provided with a matrix 48 located along the path of the electron beam of the tube.

The matrix 48 is provided with openings therein shaped like the letters, numerals, or characters desired to be printed. The diameter of the electron beam produced by the tube is sufficient to overlay one and only one of the letters, numerals, or character shaped openings in matrix 48. The horizontal and vertical selection amplifiers 43 and 44, respectively, develop the voltages, which when applied to selection plates 50 will cause the electron beam to be directed to the desired area on matrix 48 to overlay the shaped aperture or opening of the letter, numeral, or character to be displayed on the screen of the tube and recorded. The electron beam emanating from matrix 48 has a cross sectional configuration shaped in accordance with the character shaped aperture or opening of matrix 48 through which the beam passed. The shaped electron beam is then directed against the fluorescent screen of the tube at a location controlled by signals applied to deflection plates 52 at this location. The screen is bombarded by the character shaped electron beam and the light image is generated which corresponds to the cross-sectional shape of the impinging electron beam. The beam, of course, is shaped in the configuration of the aperture of matrix 48 through which it was directed. The cathode ray tube utilized herein does not scan the character to produce the individual letter, numeral, or character desired. However, it should be understood that such scanning may be used to effect the illumination of a single character and still be within the bounds of this invention. The electron beam is directed over the selected character shaped aperture whether illuminated in whole or scanned part by part in matrix 48 and is then directed to the desired position on the fluorescent screen. Scanning as such, therefore, is not a required element in effecting the display and recording of successive characters.

Successive code signals establish appropriate successive selection voltages which voltages are serially applied to selection plates 50. The electrostatic fields established thereby, successively deflect the beam to the different areas on matrix 48 to produce the various shaped electron streams which serve to make up the total message. Positioning of the successive characters upon the display screen is accomplished by the fields established by deflection plates 52.

The intensity grid of the cathode-ray tube receives a pulse from the time base unit over a circuit 53 for each code character received by the time base unit, and the beam of the cathode-ray tube is gated on in response to each of the pulses.

The horizontal selection amplifier 43 and the vertical selection amplifier 44 provide the potentials required for selecting the characters, and the horizontal deflection amplifier 41 and the vertical deflection amplifier 42 provide the potentials required for positioning the characters on the screen of the tube.

The output circuits 37 and 38 provide potentials which when amplified and applied to the deflection plates 52 cause the respective characters to be displayed at one side of the screen of the tube 46. The horizontal spacing and vertical positioning of the characters on the screen of the tube is controlled by the source 54 of potentials for spacing characters and by the voltage divider 56.

The source 54 of potentials for spacing the characters receives a pulse from the time base unit over the circuit 58 for each pulse code character received by the time base unit. The source 54 serves to repeatedly provide a series of stepped potentials at its output circuit 60, which potentials are applied to the horizontal deflection amplifier 41. These potentials control the output of the amplifier and hence the potentials applied to the horizontal deflection plates so as to cause the successive characters to be spaced horizontally across the screen of the tube 46.

By way of example, the source 54 may be a voltage adding circuit controlled by a ring counter which counts thirty-two times and then restores to its initial condition from which the next count starts. With such an arrangement, thirty-two horizontal character spaces are provided at the screen of the tube.

The photoconductive member which serves to record the displayed characters is moved continuously while the characters are being displayed on the screen of the cathode-ray tube. Hence, the vertical spacing of the successive characters which are displayed on the screen of the cathode-ray tube must be staggered so as to cause the characters to be recorded on the photoconductive member along lines which are disposed perpendicularly with respect to the direction of movement of the photoconductive member. Since the photoconductive member is moved continuously during the period, the character images 149 are being displayed on the screen of the cathode ray tube 46, and it will be apparent, as shown in Figure 5, that where the rate of display of character images 149 with respect to the velocity of the photoconductive member 64 is constant during a complete line 150 or 160 of character images, the center line of the images will trace a straight line 150 or 160 on the screen of the tube 46. This imaginary line will have a slope 151 or 155 dependent upon the ratio of velocities of the displayed images and rotational movement of the photoconductive drum 64. The latent images 152 appearing on the photoconductive drum will appear in a straight line 153 parallel to the axis 154 of the drum 64. Even though changes occur in the rate of incoming synchronizing signals, which may be part of the coded signals, or in drum speed, if the rate of display of images on the screen of the tube 46 and drum speed remain synchronized, the slope 151 or 155 of the line of displayed images 149 on the screen will remain constant and the line 153 of latent images 152 on the photoconductive drum 64 will

remain parallel to its axis **154**. However, if during the display of a line of images the rate of incoming code signals varies with respect to the velocity of the drum, a deviation from the synchronized condition may exist which can cause errors in the positioning of the displayed image on the photoconductive drum. As will be described hereinafter in conjunction with Figures 3 and 4, compensation may be provided to correct this misalignment by detecting the error signal derived from a comparison of drum speed with the rate of incoming signals and utilizing this signal to adjust the voltages applied to the deflection means of the cathode ray tube to effectuate vertical position compensation of the displayed image. Thus, instantaneous or rapid fluctuations of either the incoming coded signals or the velocity of the drum are compensated for by off-setting the affected displayed image or images from the constant linear slope established during uniform synchronized conditions, for example, slope **151** to slope **155** with the line of latent images projected on the photoconductive drum will remain perpendicular to the axis thereof.

In the embodiment of the invention shown in Fig. 1, the movement of the photoconductive member is synchronized with the code signals and hence the amount of vertical stagger for the successive characters may also be synchronized with the code signals. The vertical stagger is achieved by applying the output of the voltage divider **56** to the vertical deflection amplifier **42**. The source of potentials **54** repeatedly provides a series of stepped potentials, and a fractional part of each series of the stepped potentials is provided by the divider **56** and applied to the vertical deflection amplifier **42** so as to cause the vertical spacing of the successive characters to be staggered one step for each character. In other words, the voltage divider **56** serves to cause the successive characters to be displayed along a line which is disposed at an angle with respect to the horizontal axis of the screen of the cathode-ray tube, so as to cause the characters to be recorded along lines which are disposed perpendicularly with respect to the direction of movement of the photoconductive member.

A conventional source of high voltage and electrical network for supplying potentials to the various electrodes in the cathode-ray tube is shown in the drawing and will not be described here.

It will be apparent that a cathode-ray tube having an electromagnetic deflection system may be employed instead of the electrostatic deflection system shown in the drawings.

Also, it will be apparent that various code conversion circuit arrangements may be employed to provide the potentials required to select and position the various characters which are portrayed on the screen of the cathode-ray tube. A code conversion circuit of the type shown diagrammatically in Fig. 1 is disclosed in my co-pending application Serial No. 340,245 which was filed on March 4, 1953, and reference may be had to that application for details of one suitable form of circuitry.

The characters which are displayed on the screen of the cathode-ray tube **46** are recorded on ordinary paper by an electrostatic dry printing process which is known by the name Xerography. Reference may be had to U. S. Patents No. 2,221,776 to Carlson and No. 2,573,881 to Walkup et al. for a detailed description of the printing process.

A drum **64** is disposed to receive light from the images which are displayed on the screen of the tube, and the light rays are focused by a lens **66**.

The outer periphery of the drum consists of an electrically conductive backing, such as metal sheet or foil, and the outer surface of the conductive backing is coated with a photoconductive insulating material. The photoconductive coating is a non-conductor of electricity in the dark, but becomes conductive when exposed to light.

An electrode **68** is connected to a source of high potential (not shown), and it serves to apply an electrostatic charge to the photoconductive member. When the charged photoconductive member moves through the location at which the images are focused, the light of the images discharges the photoconductive member in accordance with the configuration of the images so that they are recorded as discharged areas in the electrostatically charged surface.

A receptacle **70** and an agitator **72** serve to cause particles of electroscopic powder **74** to impinge upon the photoconductive surface of the drum while it rotates. The electroscopic powder is charged so that it adheres to the discharged image areas and it is repelled from the charged areas on photoconductive member. Thus, the electroscopic powder reproduces the images which are electrostatically recorded on the drum.

Preferably, the paper **76** to which the recorded images are transferred is in the form of a long strip. The paper is moved in synchronism with the drum **64**, and it contacts the surface of the drum as it moves past the drum.

An electrode **78** serves to apply an electrostatic charge to the paper **76**, and the charge is of proper polarity to attract the powder on the image areas of the drum, so that the images are transferred from the drum to the paper.

A heater **80** is provided for causing the powder images on the paper strip to fuse into the paper so as to provide a permanent printed record of the images.

A cleaning device **82** serves to remove surplus electroscopic powder from the drum after each transfer operation.

The drum **64** is driven by a motor and control arrangement **86** so that the movement of the drum is synchronized with the reception rate of the code signals.

The shaft of a motor **88** is coupled to the shaft of the drum **64** through a clutch **90** which provides an adjustable amount of slippage in the coupling between the motor and the drum. By way of example, the clutch **90** may be a magnetic type such as that disclosed in U. S. Patent No. 2,575,360 of J. Rabinow.

A pulse totalizer **92** and an amplifier **94** serve to produce the control voltages for regulating the amount of slippage in the clutch and causing the movement of the drum **64** to be synchronized with the reception rate of the code signals.

The pulse totalizer **92** receives pulse signals from two sources and produces an output signal which represents the difference between the number of pulses received from the two sources.

By way of example, the pulse totalizer may be a bidirectional ring counter of the type disclosed by F. H. Martens on pages 424 and 425 of The Review of Scientific Instruments for June 1949, with the counter arranged to provide a direct current output signal which varies in polartiy and in magnitude in accordance with the difference between the number of pulses received from the two sources.

An alternative circuit for the pulse totalizer is a pair of summing circuits which are periodically and simultaneously gated on and off, with the outputs of the summing circuits connected to a comparator which provides an output signal which varies in polarity and in magnitude in accordance with the difference between the outputs of the summing circuits.

One of the sources of pulse signals for the pulse totalizer **92** is the synchronizing signal input circuit **12**. The other source of pulse signals is a converter **96** which is coupled to the drum **64** and which serves to provide pulse signals at rates which are proportional to the speed of rotation of the drum **64**. By way of example, the converter **96** may be a tachometer having its output connected to a pulse generator so as to control the frequency of the pulses produced by the pulse generator.

Thus, the pusle totalizer **92** receives the synchronizing pulse signals from circuit **12** and pulse signals from the

converter 96, and it produces a control signal which is employed to control the slippage in the clutch 90 so as to cause the pulse signals from the converter 96 to be of the same frequency as the synchronizing pulse signals received from the circuit 12. Hence, the rotation of the drum 64 is synchronized with the reception rate of the code signals.

Since the movement of the photoconductive member on the drum is synchronized with the reception rate of the code signals and since the orientation of the characters which are displayed on the screen of the cathode-ray tube is also synchronized with the reception rate of the code signals, the information which is recorded on the paper 76 is printed along lines and the lines are equally spaced.

The servo control arrangement shown in Fig. 1 causes a slight error in the movement of the printed record with respect to the received code signals because of the error signal required in the servo system. Fig. 2 shows a modification of the servo control of Fig. 1 which serves to provide more precise synchronization in this respect. The arrangement shown in the block 86' of Fig. 2 may be substituted for the arrangement shown in the block 86 of Fig. 1 if such synchronization is desired.

In the arrangement shown in Fig. 2, the amplifier 94, the clutch 90, and the motor 88 function in the same manner as the elements 94, 90 and 88 shown in Fig. 1. However, an auxiliary servo loop is provided so as to eliminate the delay introduced by the error signal which controls the servo action.

The auxiliary servo loop comprises a pair of pulse generators 100 and 102, and a pulse totalizer 104. The generator 100 is arranged to produce pulse signals only when positive error signals are applied to its input circuit, and the generator 102 is arranged to produce pulse signals only when negative error signals are applied to its input circuit. The outputs of the pulse generators 100 and 102 are applied to the pulse totalizer 104, which in turn provides an output signal having its magnitude and polarity determined by the difference between the number of pulses produced by the pulse generators 100 and 102.

The output of the pulse totalizer 104 is employed to control the amplifier 94 so as to eliminate the delay introduced by the error signal which is applied to the input of the amplifier.

The time constant of the auxiliary servo loop should be less than that of the main servo, say 25% less, so as to avoid causing the servo control to hunt.

Fig. 3 shows an alternative arrangement for synchronizing the operation of the printer with the code signals. In this embodiment of the invention, a less complex servo control is employed to synchronize the movement of the drum 64 with the code signals, and the vertical orientation of the characters on the screen of the cathode-ray tube 46 is modified so as to correct for any inaccuracies in the synchronization which would result in improper positioning of the characters on the printed record.

In this embodiment of the invention, a two-phase motor 110 is employed to actuate the drum 64, and the shaft of the motor is coupled directly to the shaft of the drum.

The error signal output of the pulse totalizer 92 is applied to a servo amplifier 112 which controls the energy which is applied to one winding of the motor and thereby controls the speed of the motor 110. With a servo control of this type, the speed of the motor is approximately synchronized with the reception rate of the code signals.

The error signal output of the pulse totalizer 92 is also applied to the vertical deflection amplifier 42, and it serves to cause the amplifier 42 to modify the amplification of the vertical correction signals which are produced by the voltage divider 56. The vertical correction signals are modified in accordance with the magnitude and polarity of the error signals produced by the pulse totalizer 92 to cause the information to be displayed on the screen of the cathode-ray tube so that it is lineally positioned when it is recorded on the drum 64.

Fig. 4 shows another arrangement for synchronizing the operation of the printer with the code signals. In this embodiment of the invention, no synchronization is provided between the speed of the drum 64 and the reception rate of the code signals. However, the vertical orientation of the characters which are displayed on the screen of the cathode-ray tube 46 is controlled so as to cause the characters to be lineally positioned when they are recorded on the drum 64.

A motor 120, which runs at a substantially constant speed, is employed to actuate the drum 64. The error signal output of the pulse totalizer 92 is applied to the vertical deflection amplifier 42 to modify the amplification of the vertical correction signals which are produced by the voltage divider and cause the information to be displayed on the screen of the cathode-ray tube so that it is lineally positioned when it is recorded on the drum 64.

The arrangement shown in Fig. 4 serves to cause the displayed information to be printed along lines on the recording paper, but it does not control the spacing between the successive lines which are printed.

It will be apparent that the printing arrangements disclosed herein are not limited to use with the photoconductive member located on a drum. The printing arrangements may employ a photoconductive member located on a belt or on an elongated strip if desired.

I claim:

1. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for synchronizing movement of the photoconductive member and orientation of the display of images on the screen of the tube whereby the images are recorded at predetermined locations on the photoconductive member.

2. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for controlling selectively movement of the photoconductive member and orientation of the display of images on the screen of the tube whereby the images are recorded in lineal alignment on the photoconductive member.

3. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for synchronizing the movement of the photoconductive member with orientation of the display of images on the screen of the tube whereby the images

are recorded in lineal alignment on the photoconductive member.

4. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, means responding to the synchronizing signals for varying orientation of the display of images on the screen, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for synchronizing the movement of the photoconductive member with the orientation of the display of images on the screen of the tube to record the images in lineal alignment on the photoconductive member.

5. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, means responding to the synchronizing signals for varying vertical and horizontal orientation of the display of images on the screen, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for controlling movement of the photoconductive member at a substantially constant speed in synchronism with the orientation of the display of images on the screen of the tube and recording the images on the photoconductive member along lines disposed substantially perpendicularly with respect to the direction of movement of the photoconductive member.

6. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, means responsive to the synchronizing signals for varying vertical and horizontal orientation of the display of images on the screen, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for controlling the movement of the photoconductive member and the vertical orientation of the display of images on the screen of the tube whereby the images are recorded in lineal alignment on the photoconductive member.

7. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for controlling selectively movement of the photoconductive member and orientation of the display of images on the screen of the tube to record the images on the photoconductive member along lines disposed substantially perpendicularly with respect to the direction of movement of the photoconductive member.

8. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, means responsive to the synchronizing signals for varying vertical and horizontal orientation of the display of images on the screen, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing substantially constant speed movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for controlling the vertical orientation of the display of images on the screen of the tube whereby the images are recorded in lineal alignment on the photoconductive member.

9. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for synchronizing movement of the photoconductive member and orientation of the display of images on the screen of the tube whereby the images are recorded in lineal alignment on the photoconductive member and dry printing means for transferring the images which are recorded on the photoconductive member to a printed record.

10. A recorder capable of responding to a source of input information, which source of input information includes code signals and synchronizing signals, said recorder comprising means for selectively displaying images on the screen of a cathode ray tube in response to the code signals, a movable photoconductive member charged and disposed to receive light from the screen of the tube so that the member is selectively discharged to record the images which are displayed on the screen of the tube, means generating rate signals for sensing movement of the photoconductive member while the images are being recorded, means comparing the synchronizing signals with the rate signals for synchronizing movement of the photoconductive member and orientation of the display of images on the screen of the tube to record the images in lineal alignment on the photoconductive member and an auxiliary servo-loop responsive to the comparing means for furnishing control of the movement of the photoconductive member to eliminate the delay introduced by the rate signal generation.

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