Aug. 4, 1959 J. T. McNANEY 2,898,176

SYSTEM FOR EFFECTING TRANSFER OF CATHODE RAY TUBE DISPLAYS ONTO A RECORD MEDIUM

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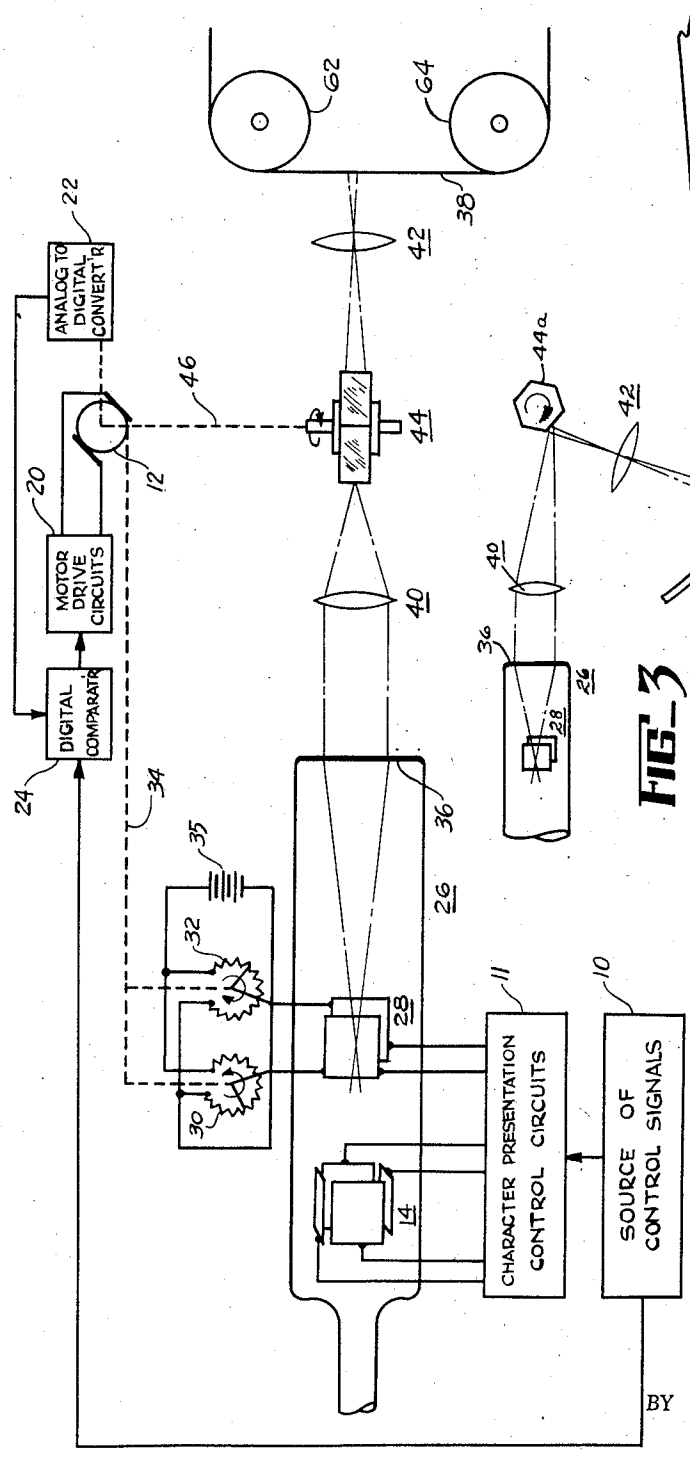

FIG_1

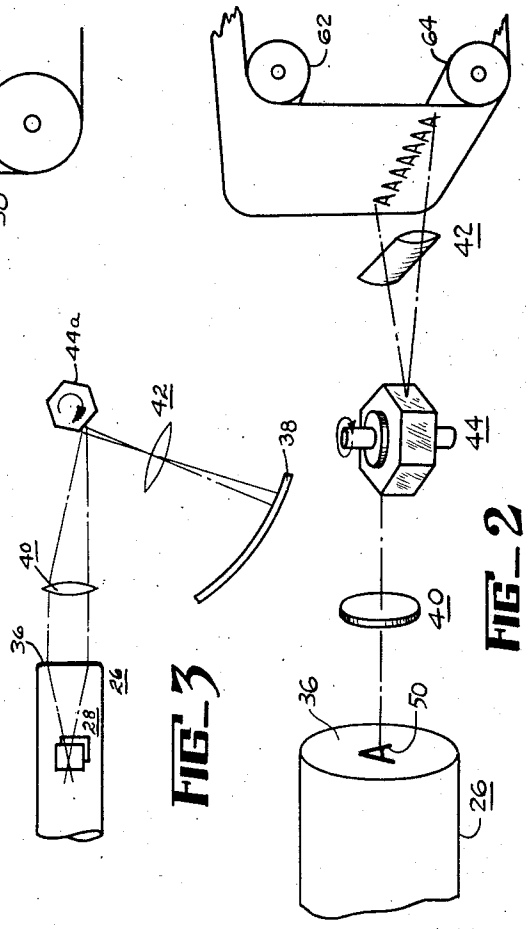

FIG_2

FIG_3

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SYSTEM FOR EFFECTING TRANSFER OF CATHODE RAY TUBE DISPLAYS ONTO A RECORD MEDIUM

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8 Claims. (Cl. 346—110)

This invention relates generally to a system for effecting optical transfer of a character from a cathode ray tube presentation to a record medium.

In present day data processing applications, it is of utmost necessity to effect rapid and accurate recordation of data upon record media from the computer output. Recordation of data has been effected by mechanical printers which print from the computer output upon a record medium in a line-at-a-time record. These printers, however, are generally too slow in their response to utilize information coming from a computer as rapidly as the computer can produce the information. Further, the printers are complex in structure and require excessive maintenance. It is for these reasons that cathode ray tubes employing various types of character generation have been used as output devices.

Such cathode ray tubes may generate characters by Lissajous character writing, bit-by-bit character building, beam shaping and various other techniques, all of which have as an end result, the presentation upon the screen of the cathode ray tube, characters corresponding to certain input information or code presented to the tube. Use of cathode ray tubes also permits real time utilization of the computer output, i.e., display the information as rapidly as the computer generates the output. Utilization of the characters displayed on the face of the cathode ray tube presents many difficulties. The display can be photographed. But immediate access to the recorded data is oft desired. Photographic devices which are capable of continuously photographing, developing and simultaneously printing the information, so that it is immediately usable and readable, may be sufficiently rapid in their responses to enable presentation of the information as rapidly as the computer can display it on the face of the tube. In addition, various xerographic recording media may also be rapid enough in response.

The present system offers a simple and rapid system capable of transferring characters from the tube and to preferably print the characters upon the record medium a character at a time aligning the characters in normal lineal line-at-a-time sequence. The present invention further accomplishes the desired line-at-a-time recordation at speeds far in excess of the mechanical printer approach and is substantially inertialess.

The invention generally includes a system in which there is displayed a screen of a cathode ray tube one or more characters in response to a source of control signals. The system includes a medium capable of receiving the characters for registration thereupon in a line of recordation. The cathode ray tube used, as stated, may generate displays upon its screen in any well known character generation technique, such as Lissajous, bit-by-bit character building, or shaped beam character displays such as shown in my U.S. Patent Nos. 2,735,956 and 2,761,988. There is associated with such tube a deflection system. The deflection system is capable of altering the position of each of the characters, after they are presented in an initial position on the screen, incrementally along a line

substantially parallel to the line of recordation. The position alteration of the characters may be effected in a horizontal direction on the screen, therefore, for exemplary purposes only this has been designated as the first line. The deflection system includes a deflection means within the tube and a variable or sawtooth voltage without. These variable voltages are presented to the deflection means to effect a similar incremental displacement for each character displayed on the tube screen to compensate for the continuous movement of a rotatable optical member during the time interval of each character display. The rotatable optical member is interposed intermediate the screen of the cathode ray tube and the record medium and receives the light image from the screen, retransmitting the light image to the record medium for recordation. As the optical member, which preferably has a plurality of faces, traverses a portion of its rotation, (i.e. one full face is presented to the screen), it effects the horizontal positioning of characters for one full line on the record medium. The sawtooth voltage is presented to the deflection means to provide a similar and reoccurring incremental deflection to the electron beam. This incremental deflection causes repositioning of each character displayed on the screen of the tube a predetermined and incremental amount sufficient to correct for the constant rotative effect of the face of the optical member. The continuing displacement from the same initial point on the screen of each succeeding character displayed upon the screen to compensate for the continuous rotation of the optical member permits the recordation of the successive light images of the characters upon the record medium at the desired place without the blurring of such image.

In addition to the aforestated objects and advantages, it is an object of the present invention to provide for continuing recordation of visual cathode ray tube images upon a record medium.

It is an object of this invention to provide a relatively simple, and trouble-free device for optically transferring light images from a display to a record medium.

It is an object of this invention to provide a system capable of responding substantially instantaneously to record light images presented at a high rate of speed.

It is an object of this invention to provide a high speed system capable of recording the output of electric data processing equipments.

It is an object of this invention to utilize light image outputs of electron data processing equipments and to effect their recordation in a substantially inertialess manner.

It is an object of this invention to provide a line-at-a-time recordation from a presentation of a light image character at a time, effecting lineal positioning of the successive characters.

Objects and advantages other than those set forth above will be apparent when read in connection with the accompanying specification and drawings, in which:

Figure 1 is a diagrammatic presentation of an exemplary system embodying the present invention;

Figure 2 is a view in perspective of a portion of Figure 1 showing the portion in greater detail;

Figure 3 is a schematic view, in reduced scale, showing another embodiment of the invention.

With reference to Figure 1, a source of control signals **10** is utilized and may be furnished by any well known electronic data processing equipment or an electronic computer. The control signals are usually binary code as used most frequently in digital computers, and usually include beside the information code, a synchronizing or control code. The control signals from the source **10** are simultaneously applied to a cathode ray tube **26** through

its character presentation control circuits 11 and to a digital comparator 24. The control circuits 11 may utilize the information code while the digital comparator 24 may utilize the synchronizing code.

Character presentation control circuits 11 may utilize any of the well known control circuitry necessary to the operation of the cathode ray tube for presenting characters by use of Lissajous, bit-by-bit character building, or beam shaping techniques. For exemplary purposes, the operation of a shaped beam tube is described. Its circuitry, such as disclosed in my copending application Serial No. 340,245 filed March 4, 1953, now Patent No. 2,850,723, issued Sept. 2, 1958, may be used as control circuits 11 to operate tube 26. The control circuits 11 are only symbolically connected to deflection plates 14 positioned within tube 26 to show that either the beam generation or its control of selection or build-up may be controlled by the control circuits. These same control circuits, of course, could also select the desired character in response to signals from the source 10 in the event the shaped beam tube is used, or, could present proper signals to deflection plates 14 to build characters bit-by-bit, or to write characters following Lissajous patterns.

Generally speaking, as shown in greater detail in Figure 2, a character 50, such as "A" is presented upon the face or screen 36 of cathode ray tube 26. Successive characters 50 will initially be presented at the same position on the screen 36. While in the specific embodiment, the character "A" is shown being projected across the recording medium 38, any character within the repertory of the system may be similarly projected, thereby permitting the projection of a line of selected characters that have a logical relationship. The character 50 may be projected through a simple lens 40 onto a rotatable optical member 44. Such projection, preferably, is onto a face of a multisided or multifaced prism 44 or mirror 44*a* as shown in Figures 2 and 3. The optical member, 44 or 44*a*, is capable of receiving the light images or characters 50 from the screen 36, and, in the case of the prism 44, will redirect the light images therethrough for presentation through a lens 42 onto a medium 38 capable of receiving and registering the light images of character 50 thereupon. Such medium or record medium 38 may utilize any of the well known means of recording light images, such as film, xerographic drums or plates, photo-sensitive media, or photo-electric media, all capable of accepting light images and recording them thereupon. Although the medium 38 is exemplified as a photosensitive film or paper, it is intended that such medium may also be in the form of a xerographic drum or plate.

As characters 50, such as "A" or other desired characters, are successively presented upon screen 36, lens 40 images the character onto a face of the optical member 44. The optical member 44 will then direct, in the exemplary showing, each successive character 50 (shown as "A") through lens 42, which, in turn, will image each character upon the medium 38 to record it thereon.

As the rotatable member 44 or 44*a* rotates, it is necessary, in order to present unblurred character displays upon record medium 38 to displace each character image a predetermined distance at a predetermined speed during the time interval of the illumination of the character images on the tube screen. The changing angle of presentation of the flat face of the continually rotating optical member to a non-moving character position on the face of the tube 26, would, without correction, cause travel, or blurring, of the finally displayed character on the recording medium. Incremental repositioning of the character 50 on the screen 36, therefore, will correct for the continual movement of the rotatable member 44, thereby keeping stationary the image of the character 50 presented on record medium 38.

The optical member 44 may be rotated by a control motor 12 of a conventional servo-motor type. Motor 12 is supplied with power and control from well known motor drive circuits 20. As the rotatable member 44 is rotated by the control motor 12, an analog to digital converter 22 senses the rotation of the member and furnishes digital information to the digital comparator 24. By way of example, converter 22 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. The digital comparator 24 which may, for example, be of the type disclosed by F. H. Martens on pages 424 and 425 of the Review of Scientific Instruments for June 1949, showing a bidirectional ring counter arranged to provide a direct current output signal which varies in polarity and magnitude in accordance with the difference between the number of pulses received from the two sources of digital information, namely, source 10 and converter 22. The difference, if any, effects the speed at which the motor drive circuits 20 will drive the motor 12.

The motor 12 may, for example, be geared directly, in a predetermined ratio, to control, in the exemplary showing of Figure 1, a pair of rotary potentiometers 30 and 32. While rotary potentiometers are exemplified, it should be understood that any controllable variable voltage device providing a substantially sawtooth voltage may be used. Potentiometers 30 and 32 which have impressed thereacross a predetermined voltage determined by the voltage source 35 providing a variable or sawtooth voltage to plates 28. The potentiometers 30, 32 and its circuits and drives, together with the deflection means 28 may constitute a deflection system which is capable of incrementally repositioning the characters horizontally from a common reference position or along the first line upon the screen. Deflection means 28 may, of course, be electrostatic or electromagnetic, but is exemplified in the showing as electrostatic.

As has been stated, such incremental repositioning of character 50 on screen 36 is necessary to compensate for the rotation of the optical member 44. As one face of the optical member is rotated past the screen 36, at least one sawtooth voltage is generated within the deflection system for each character 50 presented on the screen 36. Each face will accommodate one line of recordation upon the record medium 38. Assuming seven successive characters in lineal alignment along any line on medium 38, seven complete sawtooth voltages are generated for the rotation of the one face of member 44 past screen 36. Each character is displayed on the screen 36 at substantially the same initial position and is repositioned a predetermined incremental amount to compensate for the continuous movement of member 44. The image of the character is ultimately recorded upon the record medium a line-at-a-time. Where a series of lines of character information is to be recorded, a line-at-a-time, successive lines such as first and second lines, used for purposes of complete exemplification, are preferably parallel to each other provided the faces of the optical members are parallel to the screen 36 and the record medium 38.

It can be seen, from Figure 2, that as the face of the rotatable member presents itself to the screen 36, it does so at varying angles. These varying angles will, of course, effect varying redirection of the character either through prism 44, or from rotating mirror 44*a*. If incremental repositioning were not effected, the character "A" would move and appear blurred on the record medium 38. The deflection system, however, overcomes this rotative effect by the application to character 50 of proper deflection potentials. Images of the characters 50 are then successively displayed along side each other in the second line upon medium 38.

In operation then, as a set of digital signals are received or originated by the source 10 of control signals, the signals are simultaneously presented to the digital com-

parator 24 and the character presentation control signals 11. Control circuits 11 will cause the presentation within tube 26, upon screen 36, of the desired corresponding character 50, for example. The signals presented to digital comparator 24 will effect motor drive circuit 20 to operate motor 12. The control motor 12, through its gear train symbolically shown as 46 and 34 will effect operation of the rotatable optical member 44 and of the potentiometers 30, 32. The character 50 displayed upon the screen 36 is imaged by lens 40 upon a face of the optical member 44. As the face of the optical member 44 rotates past the screen 36, the potentiometers 30, 32 present appropriate sawtooth voltages to the deflection means 28, which means 28 effects incremental repositioning of the character 50 on the screen 36. The repositioning may be effected along the first line parallel to the second line of recordation upon record medium 38. As each character is presented in turn on the screen 36, rotation of potentiometers 30, 32 effects return of the voltage to zero, and, begins the voltage generation anew as the next character is presented on the screen 36. The potentiometers 30, 32 are merely an exemplary manner of effecting control of desired rise and decline of the variable or sawtooth voltage. One complete line of characters 50 along the line on screen 36, corresponds with the full rotation of one face of the member 44.

Motor 12 is rotated in response to control by motor drive circuit 20. Circuit 20 responds to command of comparator 24. Converter 22 senses motor speed in analog voltage form and converts it to digital information. The digital information from converter 22 is presented to the digital comparator 24. Comparator 24 then effects comparison of the speed of the motor 12 with the incoming digital information and is synchronized. The output of comparator 24 is presented to and controls motor drive circuit 20, thereby either speeding up or delaying motor 12 to coincide with the rate of display of characters.

The character 50, as projected upon rotatable member 44, is in the case of the prism, projected therethrough, or mirror 44*a* reflected therefrom, and imaged by lens 42 upon medium 38.

Medium 38 upon which the successively presented characters are lineally recorded as lines in substantially a column, may, of course, have a supply roll 62 and a take-up roll 64, or in the alternative, be driven by rollers 62, 64 providing a line-at-a-time advance.

The particular embodiment of the invention illustrated and described herein is illustrative only and the invention includes such other modifications and equivalents as may readily appear to those skilled in the art, within the scope of the appended claims.

I claim:

1. A system capable of registering characters upon a medium from a screen of a cathode ray tube, said system including said tube having said screen, said tube being capable of presenting characters upon said screen, a rotatable optical member capable of receiving said characters from said screen for redirection therefrom, a deflection system capable of incrementally repositioning said characters upon said screen for compensation of the rotation of said optical member, means operating said deflection system for controlling the application of incremental positioning of said characters on said screen in response to rotation of said optical member, said medium capable of receiving said characters for registration of said character thereupon, said optical member being adapted to cause lineal positioning of said characters as successively displayed upon the screen recording them upon said medium.

2. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube, said system including said tube having said screen, said tube being capable of presenting characters upon said screen, a deflection system capable of incrementally repositioning said characters along a first line upon said screen, a rotatable optical member capable of receiving said characters from said screen for redirection therefrom, means responsive to the rotation of said optical member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said optical member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system being adapted to incrementally reposition said character thereby compensating for rotation of said optical member.

3. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube, said system including said tube having said screen, said tube being capable of presenting characters upon said screen, a deflection system capable of incrementally repositioning said characters along a first line upon said screen, a rotatable multifaced prismatic member capable of receiving said characters from said screen for redirection therefrom, means responsive to the rotation of said prismatic member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said prismatic member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system being adapted to incrementally reposition said character thereby compensating for rotation of said prismatic member.

4. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube, said system including said tube having said screen, said tube being capable of presenting characters upon said screen, a deflection system capable of incrementally repositioning said characters along a first line upon said screen, a rotatable multifaced mirror member capable of receiving said characters from said screen for redirection therefrom, means responsive to the rotation of said mirror member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said mirror member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system being adapted to incrementally reposition said character thereby compensating for rotation of said mirror member.

5. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube, said system including said tube having said screen, said tube being capable of presenting characters upon said screen, a rotatable multifaced optical member capable of receiving said characters from said screen for redirection therefrom, a deflection system capable of incrementally repositioning said characters along a first line upon said screen for compensating for rotation of said optical member, means responsive to the rotation of said optical member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said optical member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system comprising at least a deflection means

for deflecting the character along the first line upon the screen, and a sawtooth voltage for actuating said deflection means, said sawtooth voltage having a time duration corresponding to the duration of presentation of one of the characters upon said screen.

6. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube in response to a source of control signals, said system including said tube having said screen, said tube being capable of responding to said source of control signals for presentation of characters upon said screen, a deflection system capable of incrementally repositioning said characters along a first line upon said screen, a rotatable optical member capable of receiving said characters from said screen for redirection therefrom, means responsive to the rotation of said optical member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said optical member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system being adapted to incrementally reposition said character thereby compensating for rotation of said optical member, and means under the control of said source of control signals for rotating said optical member and operating said incremental positioning means whereby the character presentation and the rotation of the optical member are synchronized.

7. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube in response to a source of control signals, said system including said tube having said screen, said tube being capable of responding to said source of control signals for presentation of characters upon said screen, a rotatable multifaced prismatic member capable of receiving said characters from said screen for redirection therefrom, a deflection system capable of incrementally repositioning said characters along a first line upon said screen for compensating for rotation of said prismatic member, means responsive to the rotation of said prismatic member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said prismatic member being adapted to cause

lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system comprising at least a deflection means for deflecting the character along the first line upon the screen, a sawtooth voltage for actuating said deflection means, said sawtooth voltage having a time duration corresponding to the duration of presentation of one of the characters upon said screen, and means under the control of said source of control signals for rotating said prismatic member and operating said incremental positioning means whereby the character presentation and the rotation of the prismatic member are synchronized.

8. A system capable of lineally registering characters upon a medium from a screen of a cathode ray tube in response to a source of control signals, said system including said tube having said screen, said tube being capable of responding to said source of control signals for presentation of characters upon said screen, a rotatable multifaced mirror member capable of receiving said characters from said screen for redirection therefrom, a deflection system capable of incrementally repositioning said characters along a first line upon said screen for compensating for rotation of said mirror member, means responsive to the rotation of said mirror member for controlling the application of incremental positioning of said deflection system to said characters upon said first line on said screen, said medium capable of receiving said characters for accepting and registering said character thereupon along a second line substantially parallel to said first line, said mirror member being adapted to cause lineal positioning of said characters successively adjacent each other along said second line upon said medium, said deflection system comprising at least a deflection means for deflecting the character along the first line upon the screen, and a sawtooth voltage for actuating said deflection means, said sawtooth voltage having a time duration corresponding to the duration of presentation of one of the characters upon said screen, and means under the control of said source of control signals for rotating said mirror member and operating said incremental positioning means whereby the character presentation and the rotation of the mirror member are synchronized.

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