United States Patent

Lew et al.

[15] **3,638,541**

[45] **Feb. 1, 1972**

[54] METHOD FOR RECORDING JUSTIFIED LINES OF TYPOGRAPHIC CHARACTERS

[72] Inventors: **Dong W. Lew**, Briarcliff Manor, N.Y.; **Ralph A. Proud, Jr.**, Sommerset, N.J.

[73] Assignee: **Harris-Intertype Corporation**, Cleveland, Ohio by said Proud

[22] Filed: **Nov. 20, 1968**

[21] Appl. No.: **784,987**

[52] **U.S. Cl.** **95/4.5**, 178/6

[51] **Int. Cl.** **B41b 19/08**

[58] **Field of Search** 95/4.5; 178/6

[56] **References Cited**

UNITED STATES PATENTS

2,624,798	1/1953	Dinga	95/4.5 X
3,090,828	5/1963	Bain	95/4.5 X
3,267,454	8/1966	Schaaf	95/4.5 X
3,278,683	10/1966	Ashby	95/4.5 X
3,307,459	3/1967	Proud	95/4.5

OTHER PUBLICATIONS

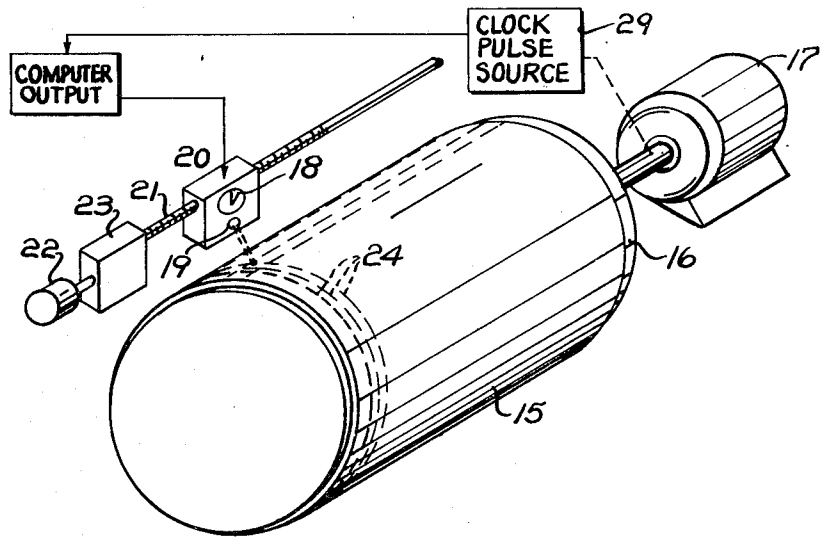
IBM Technical Disclosure Bulletin, Vol. 11 No. 1, June, 1968

Primary Examiner—Samuel S. Matthews
Assistant Examiner—Monroe H. Hayes
Attorney—Yount & Tarolli

[57] **ABSTRACT**

In the present method a digital computer receives a "raw" test input, which it justifies line by line, and stores in its memory the coded identity and location of each typographic character in the justified text. Also stored in the computer memory are the character-generating data for every typographic character which may appear in the text. The computer is programmed to scan its memory electronically in accordance with the scanning operation of a photographic recorder to provide binary output signals to the recorder which cause the latter to record narrow segments of the typographic characters at the proper locations on the record page.

2 Claims, 3 Drawing Figures



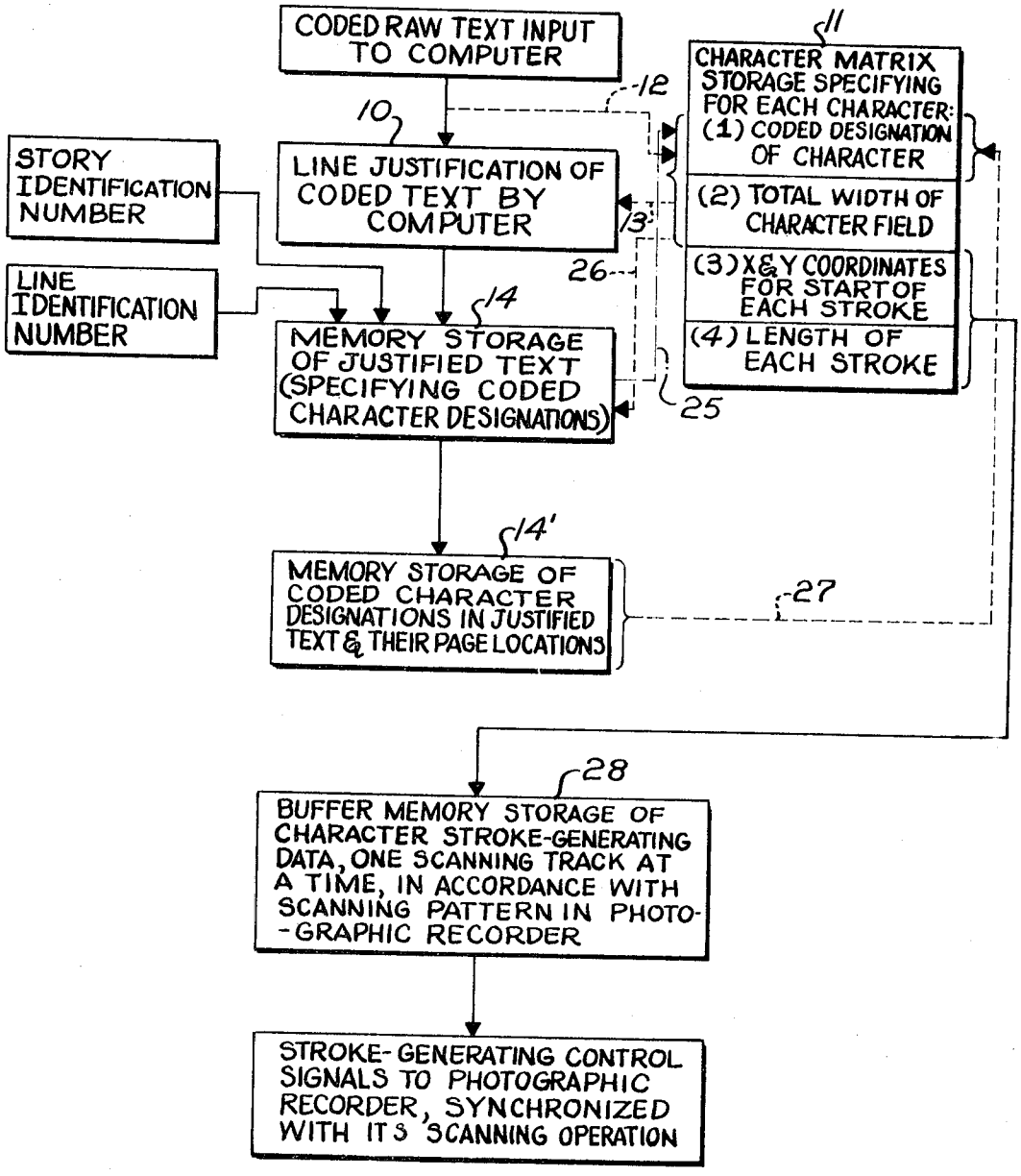


FIG. 1

INVENTORS
DONG W. LEW
RALPH A. PROUD JR.
BY
Yount, Flynn & Tarolli
ATTORNEYS

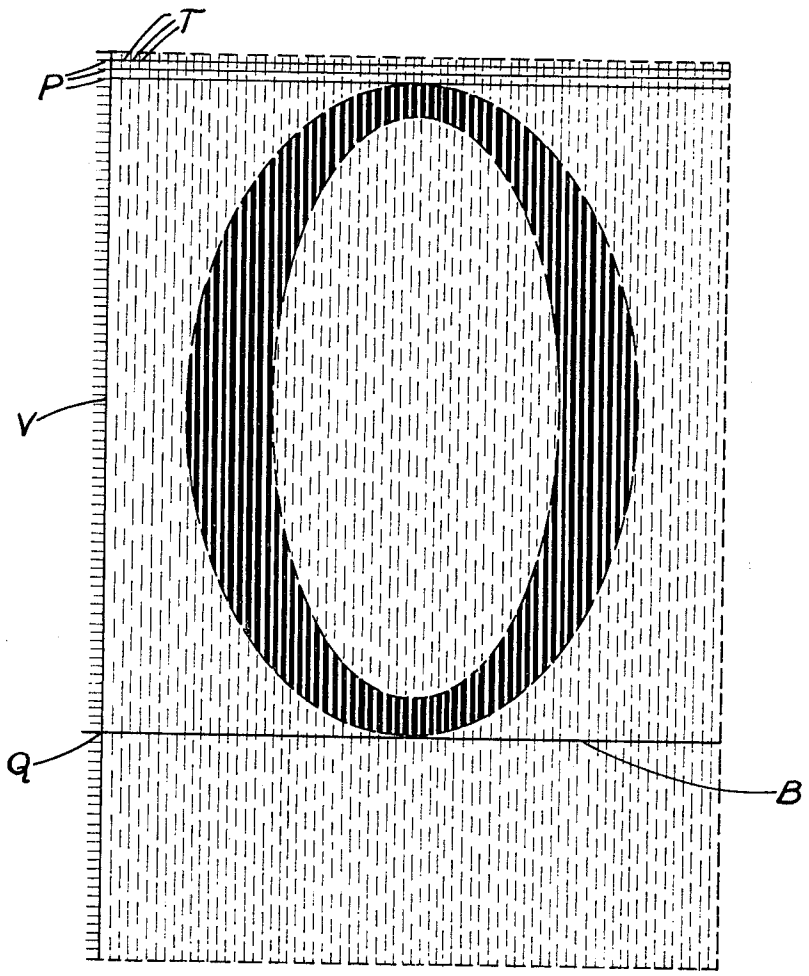


FIG. 2

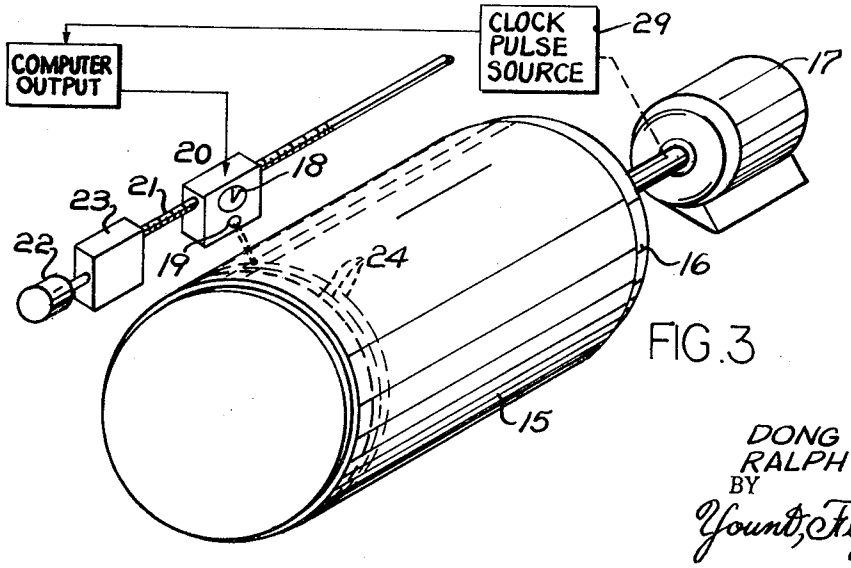


FIG. 3

INVENTORS
DONG W. LEW
RALPH A. PROUD JR
BY
Yount, Flynn & Tarolli
ATTORNEYS

METHOD FOR RECORDING JUSTIFIED LINES OF TYPOGRAPHIC CHARACTERS

This invention relates to a system and method for recording a series of justified lines of typographic characters or the like so as to make up part or all of one or more columns of text, such as for a newspaper page.

In conventional typesetting practices, using either hot metal techniques or photographic typesetting, complete typographic characters are composed and assembled with the ultimate objective of producing a plate-making mat or a photographic negative which can be used to produce a printing plate by known techniques.

One facsimile-type system now in use for newspaper printing provides a transmitter having a master copy of the printed page wrapped around a motor-driven drum. This master copy is scanned photoelectrically along a continuous helical path composed of side-by-side, narrow scanning tracks, each extending almost vertically on the page. The system has a receiver, which may be located remote from the transmitter, having a photographic film wrapped around a motor-driven drum whose rotation is synchronized with that of the transmitter drum. A light source at the receiver scans a similar helical track on the film, and this light source is flashed in accordance with the output signals from the photoelectric device at the transmitter, so as to reproduce on the film at the receiver a facsimile or replica of the master page at the transmitter. While this system has advantages for the reproduction of a printed page at a remote location, it still requires that the master copy of the page at the transmitter be composed by one of the conventional typesetting techniques.

The present invention is directed to a novel system and method which facilitates the composition of one or more columns of justified lines of typographic text, such as to make up a newspaper page, by the use of a digital computer which operates in conjunction with a scanning photographic recorder to eliminate the need for either conventional typesetting of this text or photoelectric scanning of a master copy of this text.

In accordance with the present invention, after processing the "raw" text to provide line justification, the justified text is stored in the computer memory along with data specifying the position on the page of each justified line of text, and the coded designation of each typographic character in each justified line of text. The computer also has stored in its memory the character-generating data for all typographic characters which may appear in the text. These character-generating data specify the coded designation of each character and the digital information from which the character may be generated as a series of narrow strokes. The system also includes a scanning photographic recorder having a predetermined scanning pattern. The computer is operated to provide buffer memory storage of the character-generating strokes for readout in a sequence corresponding to the scanning pattern in the recorder so as to provide binary digital output signals which control the energization of the light source in the recorder so as to record photographically along the scanning tracks there the narrow segments which make up the typographic characters in the several lines of text.

Accordingly, it is a principal object of this invention to provide a novel and improved system and method for photographically recording segmentally a series of lines of typographic characters under the control of a digital computer.

Another object of this invention is to provide such a system and method in which the computer provides a sequence of output bits for controlling the photographic recording of narrow segments of the typographic characters on a photographic record medium.

Another object of this invention is to provide such a system and method in which the output bits from the computer which control the recording are synchronized with the scanning of the photographic record medium so that the recorded segments are properly positioned to provide the desired justified lines of print of the photographic characters on the record medium.

Another object of this invention is to provide such a system and method which is particularly advantageous for use in the preparation of the master copy of a newspaper page at relatively high speed.

Further objects and advantages of this invention will be apparent from the following detailed description of a presently preferred embodiment with reference to the accompanying drawing in which:

FIG. 1 is a flow sheet illustrating in general outline the operation of the present system and method;

FIG. 2 is a view depicting schematically the matrixlike rectangular field for a typographic character; and

FIG. 3 is a schematic block diagram illustrating the operation of the photographic scanning recorder from the output of the computer in accordance with the present invention.

Referring to the flow chart of FIG. 1, in the present system and method the so-called "raw" text in binary-coded digital from (for example, the punched tape or magnetic tape output from a keyboard-operated device of known design) is fed into a general purpose computer. This "raw" text is composed of a sequence of groups of binary digits designating typographic characters, including letters and numbers, arranged to provide a series of text words, with spaces between the words and proper punctuation, corresponding to the text to be recorded.

The computer is programmed by any suitable known technique, the details of which are not part of the present invention, to rearrange this "raw" text into a series of successive justified lines which will appear as horizontal lines of type spaced apart vertically one after the other in the selected column on the final printed page. The computer justifies each such line by providing the proper word spacing to fill out the line, the beginning and end of each line, and any word hyphenation which may be necessary at the end of a line. This justification step is indicated by the block **10** in FIG. 1. In this line justification process the computer will insert after each word an interword space code and one or more digital codes designating the actual size of the interword space.

In this justified text stored in the computer, the different characters are merely designated by their respective coded designations, which are not capable of generating the strokes or segments which compose the character. For this latter purpose, the computer memory stores a plurality of character-generating matrices, each containing the digital information from which the corresponding typographic character may be generated.

The complete page on which the text is the appear, such as a newspaper page, may be considered as a rectangular major matrix composed of a series of closely spaced, substantially vertical coordinate lines and a series of closely spaced, horizontal coordinate lines intersecting the vertical coordinate lines at closely spaced "dot" locations. In one practical embodiment, there may be 800 to 1,000-dot locations (or coordinate intersections) per inch in both the horizontal and vertical directions on the page.

The position on the page of any given line of print may be designated by specifying the location horizontally across the page of the left-hand margin, or start, of the line of print and the location vertically on the page of the horizontal baseline of the line of print.

Referring to FIG. 2, each letter or number character in a typographical font may be regarded as being contained within the outline of a rectangular field, which is bounded by the dashed lines in this Figure. This character field constitutes a minor matrix which may occupy a particular location on the major (page) matrix.

Each character field has a horizontal baseline B, which will coincide with the baseline of the line of print in which that typographic character appears, and a substantially vertical side reference line V located at the left side edge of the field. The intersection between the baseline B and the side reference line V constitutes a reference point Q for the complete character field.

All decimal numbers, all capital letters and most lower case letters are located entirely above the horizontal baseline B, but some lowercase letters, such as "y," have depending portions which extend below the baseline. However, in all cases each number or letter character is contained entirely within the minor matrix constituted by its field. The respective fields for the different letters and numbers have the same vertical height, but they differ in their respective horizontal widths in accordance with the width of the character itself.

Referring to FIG. 1, the character matrix memory storage 11 in the computer contains all the information necessary to generate individually the respective character field of every typographic character which might possibly appear in the text, and for every size and style of type which may be selected.

Referring to FIG. 2, as an illustrative example, the capital letter "O" is shown within its rectangular field which, as stated, will constitute a minor matrix within the major (page) matrix. This character matrix may be regarded as being composed of a series of closely spaced, substantially vertical tracks T, which occur in evenly spaced succession horizontally from left to right across the field, and a series of vertically spaced, horizontal intersections on each track T. For convenience of illustration, in FIG. 2 only the first three horizontal intersections at the top of the field are designated by the horizontal lines P. The remaining horizontal intersections are designated by the short lines to the left of the side reference line V. The almost vertical tracks T and the horizontal intersections P in the character field correspond to certain of the intersecting coordinate lines on the major (page) matrix. The entire character field may be "scanned" electronically in raster fashion by proceeding in succession down each of the vertical tracks T through each of horizontal intersections P in succession.

The horizontal and vertical coordinates of the beginning (i.e., upper end) of each vertical stroke which forms a narrow line segment of the character (indicated by the heavy lines in FIG. 2) may be specified by a number designating its Y-coordinate distance from the baseline B and a number designating its X-coordinate distance from the left-hand edge V of the character field. Along with this coordinate information, the length of the stroke may be specified in terms of the number of successive coordinate positions P along a vertical track T which it occupies in the character field. The coordinates of its starting point and the length of the stroke constitute all the information necessary to generate the stroke.

The character matrix storage 11 contains, in addition to the data specifying the X- and Y-coordinates for the start of each stroke in the character and the length of the stroke, a coded designation of the typographic character and data specifying the total horizontal width of the field of that character. As already stated, this width will be different for different typographic characters.

In the already mentioned line justification of the coded text, the computer refers to its character matrix storage for the character field width of each character whose coded designation appears in the text by first matching each character code designation appearing in the raw text with the corresponding character code designation in the character matrix storage 11, as indicated by the dashed line 12 in FIG. 1, and then determining from the latter the character field width for controlling the line justification operation, as indicated by the dashed line 13.

The line-justified text, still containing only the coded designation of the characters and not the character-generating data, is stored in the computer memory, as indicated by the block 14 in FIG. 1. At this time a story identification number is added at the beginning of the text story, and a line identification number is added at the beginning of each line of the justified text, these story and line identification numbers being stored in the memory along with the line-justified text.

Referring to FIG. 3, in this particular embodiment of the present system the computer is intended to control the operation of a facsimile-type, light spot scanning printer of known design which may be, for example, the receiver in a "Pressfax" system sold by Westrex Communications, Division of Litton Industries, New Rochelle, New York. In this printer the record medium is a photographic film 15 which is wrapped around a cylindrical drum 16. Preferably, this film provides the entire master of the newspaper page, from which copies may be reproduced by known techniques not forming part of the present invention. The drum is driven by an electric motor 17 to provide small step-by-step increments of rotational movement of the drum periphery, such as 0.001 inch. A light source 18 is connected to the computer output to be energized or not energized by the latter, depending upon whether the computer output signal is binary one or binary zero at the time. When energized, the light source flashes a small spot of light of high intensity through a suitable focusing lens system 19 onto the incremental area of the film 15 which is then directly opposite the light source.

The light source 18 and its lens system 19 are mounted in a housing 20 which is threadedly coupled to a lead screw 21 extending across the axial length of the film drum 15 parallel to the latter's rotational axis. This lead screw is driven at an extremely slow speed from an electric motor 22 through reduction gearing 23 such that the light source 18 is displaced to the right axially along the drum a very small distance (e.g., 0.001 inch) for each rotation of the drum. Consequently, the light source 18 scans a continuous helical path of substantially vertical tracks 24 which are closely spaced apart horizontally across the film 15.

Referring again to FIG. 1, the binary output signals which control the operation of the scanning recorder are obtained by processing the information contained in the different sections 11 and 14 of the computer memory as follows:

First, there is added to the justified character code text (block 14) the data designating the location of each character matrix field along each line of the text. This is done by matching each encoded character designation appearing in the justified text in the memory section 14 with the corresponding character code in the character matrix storage 11, as indicated by the dashed line 25 in FIG. 1. Then, from the information on the total width of this character matrix, which is contained in the memory section 11, the computer determines the position horizontally along the line of justified text of the side reference line V of the character matrix field for each character appearing in that line of text, designating this position digitally, as indicated by the dashed line 26 in FIG. 1.

For the purpose of simplifying this discussion, it may be assumed that the successive lines of text are to be evenly spaced apart a preselected distance vertically down the column. Therefore, by specifying the vertical position of the baseline of the first line of the text, and knowing the vertical spacing between successive lines of the text, the vertical position of every other line may be specified, knowing the line identification number for the line. The page location of the baseline for each justified line of encoded character text is stored as a Y-coordinate number in the computer memory.

Accordingly, the computer now has stored in its memory, as indicated by the block 14' in FIG. 1, the following information on the justified text:

1. the vertical position on the page of each horizontal line of print of the text;

2. the coded designations of the typographic character in the lines of print; and

3. the respective positions of the typographic characters along the lines of print in which they are to appear.

It will be evident that the page location of the reference point Q of every character field matrix on the major (page) matrix is completely defined by specifying the Y-coordinate position on the page matrix of the line of text in which that character appears and the X-coordinate position along that line of this reference point Q for the character field matrix.

With the encoded characters and their page positions having been stored in the computer memory, as indicated by block 14', the characters themselves may be generated, one

vertical stroke at a time down through the successive lines of text, in accordance with the sequence of the described scanning lines **24** in photographic recorder (FIG. **3**), by reference to the data in the character matrix storage (block **11**, FIG. **1**) which specify:

a. the X and Y (horizontal and vertical) coordinates for the start of each vertical stroke with respect to the reference point Q for that character field; and

b. the length of each vertical stroke.

The computer scans through the information contained in its coded character storage memory **14'** in accordance with the scanning tracks **24** to identify each character and its page position. Then, by matching the selected character in block **14'** with the corresponding character code in memory block **11**, as indicated by the dashed line **27** in FIG. **1**, it determines from the latter the data on the X- and Y-coordinates for the start of each stroke and the length of each stroke in the character. This processing provides the following information for storage in a buffer memory in the computer, as indicated by the block **28** in FIG. **1**:

1. a coded designation of the page position of the side bearing line V of each character;

2. a coded designation of the X- and Y-coordinates of the start of each vertical stroke necessary to make up the character; and

3. a coded designation of the length of each stroke, expressed as the number of vertically spaced coordinate positions P during which the light **18** in the photographic recorder is to remain on (or off).

Preferably, in order to minimize the required capacity of this buffer memory, this information is stored for only one vertical scanning track **24** at a time, or for only a fraction of one scanning track. Preferably, also, this buffer memory is a rapid access memory, such as a magnetic disc or core memory, in which the information for one scanning track, or part of a scanning track, is stored by parallel input to control all the character strokes which are to occur in that scanning track. This buffer memory provides a serial output of successive binary signals which are synchronized with the drive motor **17** in the scanning recorder so that the binary signals applied to the light **18** will correspond to its instantaneous page position along a particular scanning track **24**.

Preferably, the storage of these binary signals in the buffer memory, in response to the described processing of the data contained in the computer memory sections designated by blocks **14'** and **11**, takes place ahead of the corresponding scanning position of the light **18** along the scanning tracks. However, the readout of these signals to control the energization of light **18** is synchronized with the latter's scanning position. Such synchronization may be provided by a clock pulse source **29** (FIG. **3**) which produces a control signal at each incremental rotation position of the drum **16** for causing the buffer memory in the computer to deliver the next binary output signal to the light **18**.

From the foregoing it will be evident that the disclosed embodiment of the present system and method makes advantageous use of the digital computer to process the data on the "raw" (unjustified) text input to provide the correct sequence of digital output signals for operating the scanning photographic recorder to record the narrow segments or strokes of the typographic characters to provide, at the completion of the photographic scanning, one or more columns of justified printed text properly positioned on the page.

While a presently preferred embodiment of this invention has been described with reference to the accompanying drawings, it is to be understood that the invention may be embodied in arrangements differing from the particular embodiment disclosed. For example, if desired, the scanning photographic recorder may embody a cathode-ray tube which records on film. Also, if desired, the scanning in the photographic recorder may be along the lines of text, instead of substantially perpendicular to them, as disclosed.

Having described our invention, we claim:

1. A method of recording a series of justified lines of text on a record page comprising the steps of:

storing in the memory of a digital computer digital information designating the page position of each justified line of text and the line position and identity of each typographic character appearing in the text;

storing in the memory of the computer, for each typographic character that may appear in the text, digital information for generating narrow segments which make up the entire typographic character;

selecting the typographic characters from the computer memory in a sequence corresponding to a predetermined scanning pattern along adjoining narrow tracks across the lines of text;

reading out from the computer the digital information for generating narrow segments of the selected characters in a sequence corresponding to the order in which those character segments appear in the lines of text when the latter are scanned in accordance with said predetermined pattern;

and scanning a photographic record page rotating on a drum with a photographic recorder in accordance with said predetermined pattern and operating said recorder in response to the segment-generating signals readout from the computer to record photographically on the record page the respective character segments as they appear in the sequence determined by said predetermined scanning pattern.

2. A method of recording a series of justified lines of text on a record page comprising the steps of:

storing in the memory of a digital computer digital information designating the page position of each justified line of text and the line position and identity of each typographic character appearing in the text;

storing in the memory of the computer, for each typographic character that may appear in the text, digital information for generating successive narrow segments of the typographic character;

scanning with a photographic recorder a photographic record page on a rotating drum along successive adjoining narrow tracks which "cross" lines of text to be reproduced, each extending through the desired page positions of narrow segments of a succession of typographic characters;

identifying in the computer memory the narrow character segments in the order of their occurrence in said scanning tracks;

and operating said scanning photographic recorder, which scans said record tracks on the record page in succession, to record said character segments in the order of their occurrence in said scanning tracks.

* * * * *