United States Patent

[11] 3,626,824

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[54] **COMPOSING METHOD AND APPARATUS**
9 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** 95/4.5, 355/40
[51] **Int. Cl.** **B41b 27/18**
[50] **Field of Search** 95/4.5; 355/40

[56] **References Cited**

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3,267,454	8/1966	Schaaf	95/4.5 X
3,273,476	9/1966	Haynes	95/4.5

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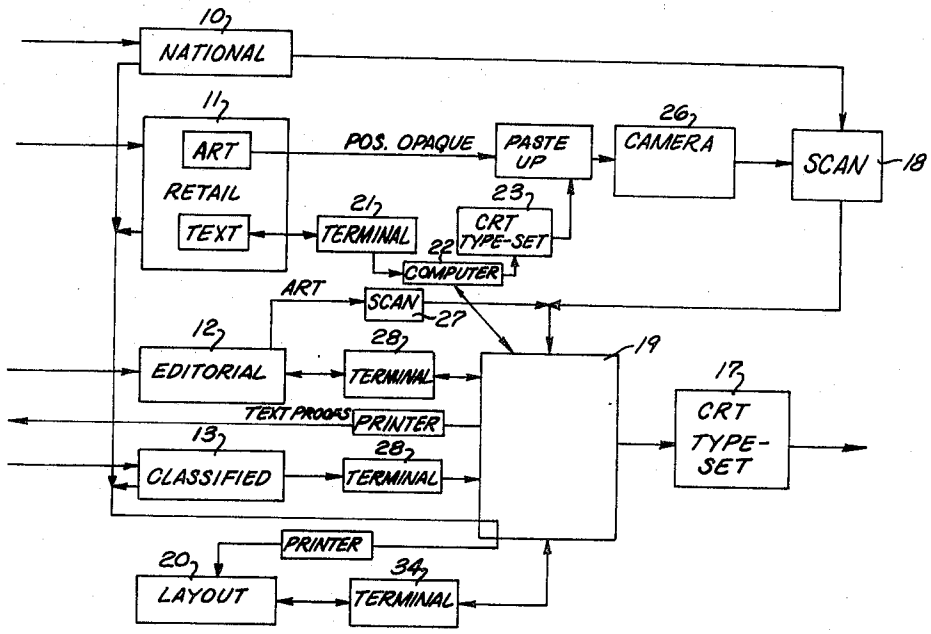
Assistant Examiner—M. L. Gellner
Attorney—Yount and Tarolli

ABSTRACT: Composing method and apparatus for publications such as newspapers in which copy from various sources is entered into a computer in coded form for use in controlling a phototypesetter to prepare a page copy. Certain copy including artwork which may be halftone or continuous tone is scanned to provide the numerical data necessary for controlling the phototypesetter while text material is first edited on an editing terminal and then stored with or without phototypesetting instructions in the computer. Each item to be included in the publication is identified by a heading and a layout department instructs the computer as to where the items are to appear. For this purpose the layout department has a layout terminal for displaying page areas with previously assigned sections outlined and identified and for entering coordinates of newly assigned sections into the computer. The terminal can display magnified portions of the page area. In reproducing continuous-tone copy, dot characters are stored in a character memory and used to provide different halftone screen sizes.



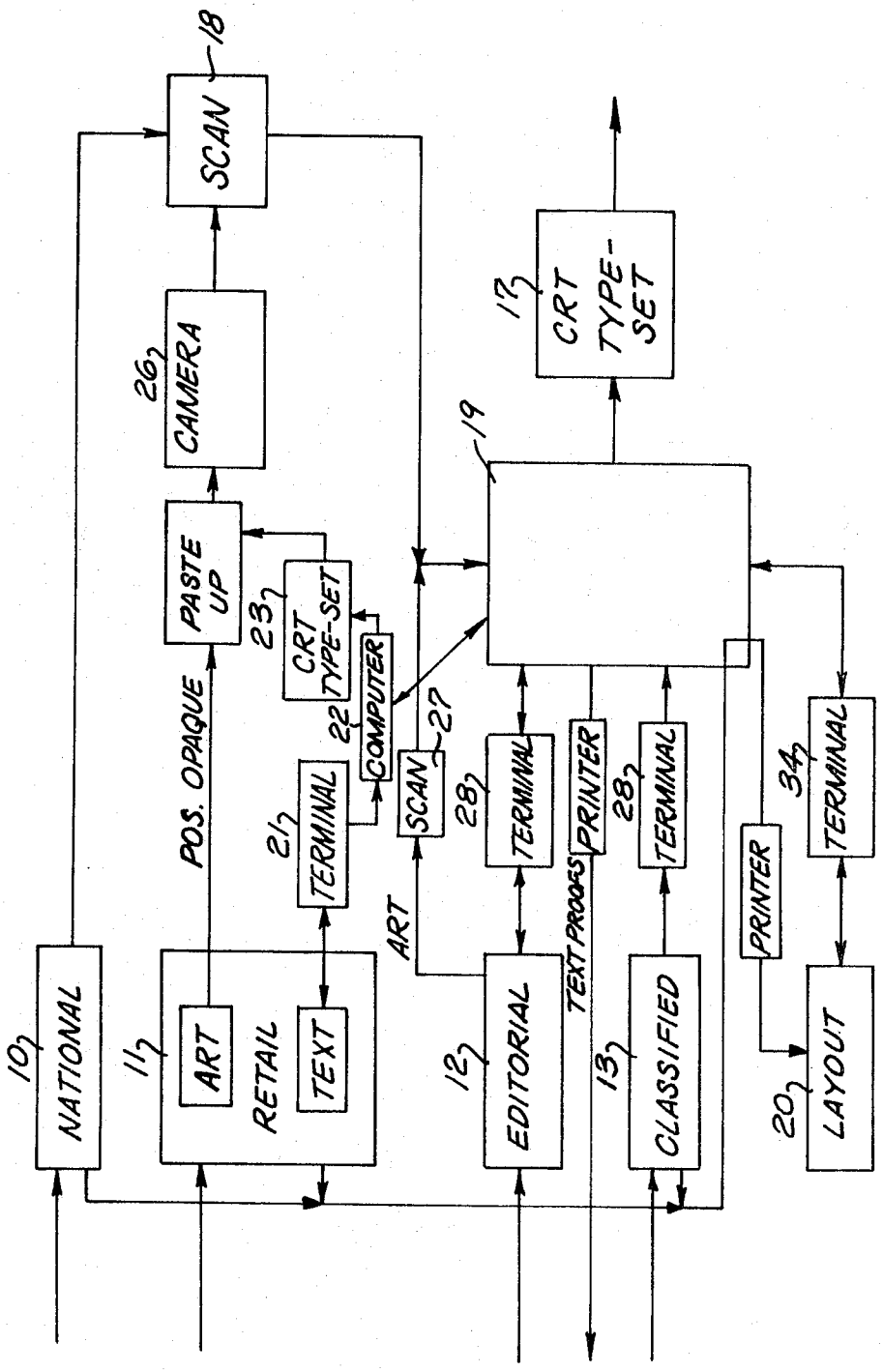

SCAN
18
CAMERA
26
PASTE UP
CRT TYPE-SET
23
COMPUTER
22
SCAN
27
TERMINAL
21
POS. OPAQUE
ART
TEXT
RETAIL
11
NATIONAL
10
19
CRT TYPE-SET
17
TERMINAL
28
PRINTER
TEXT PROOFS
EDITORIAL
12
CLASSIFIED
13
TERMINAL
28
PRINTER
TERMINAL
34
LAYOUT
20

FIG. 1

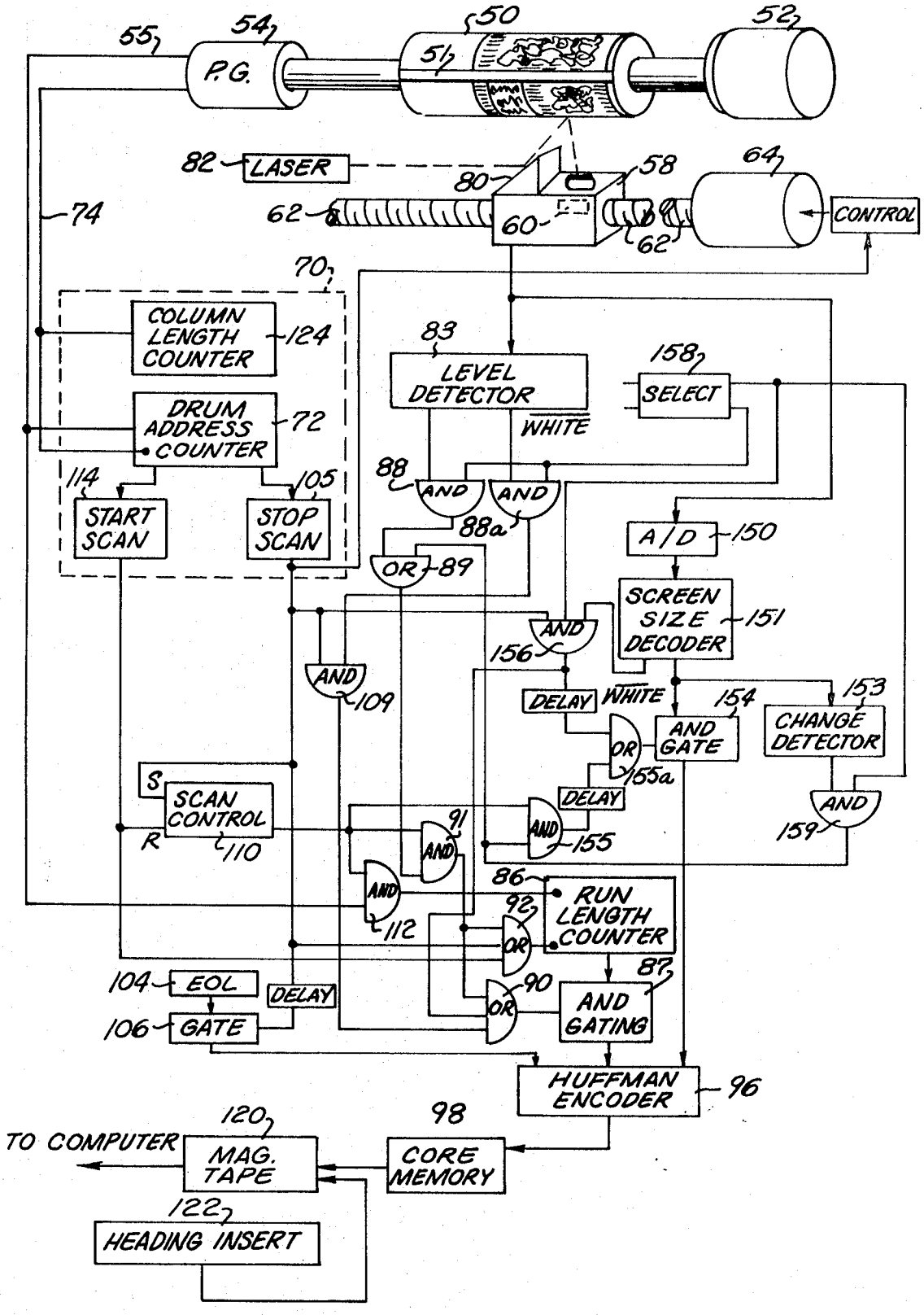

55
54
P.G.
50
51
52
82
LASER
80
58
64
74
62
60
62
CONTROL
70
COLUMN LENGTH COUNTER
124
83
LEVEL DETECTOR
158
SELECT
DRUM ADDRESS COUNTER
72
WHITE
88
AND
AND
88a
114
START SCAN
105
STOP SCAN
A/D
150
OR
89
SCREEN SIZE DECODER
151
AND
156
AND
109
DELAY
WHITE
154
153
AND GATE
CHANGE DETECTOR
OR
155a
S
SCAN CONTROL
R
110
DELAY
AND
159
91
AND
AND
155
AND
86
RUN LENGTH COUNTER
92
OR
112
87
104
EOL
DELAY
90
OR
AND GATING
106
GATE
HUFFMAN ENCODER
96
120
98
TO COMPUTER
MAG. TAPE
CORE MEMORY
122
HEADING INSERT

FIG. 2

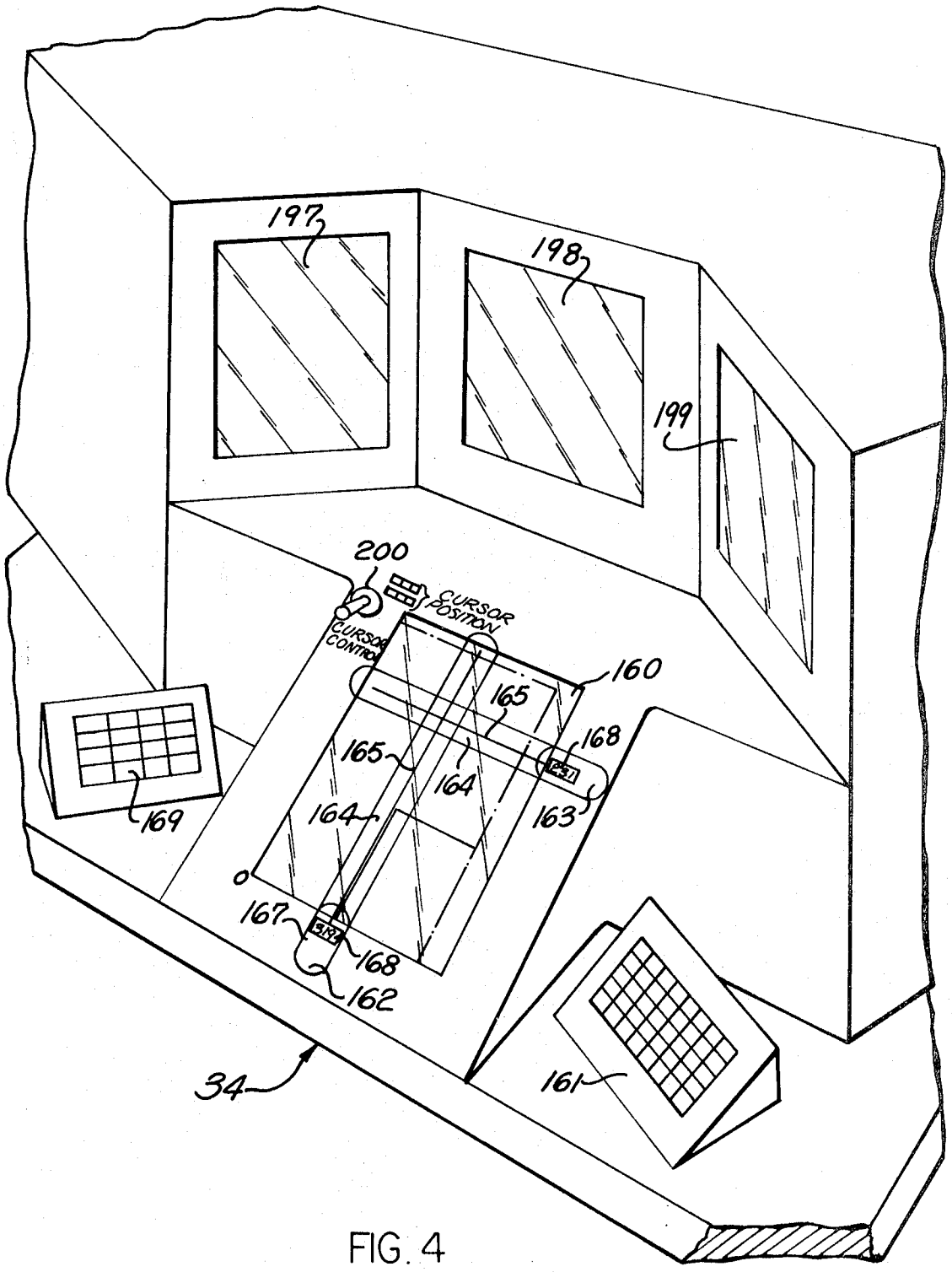

197
198
199
200
CURSOR POSITION
CURSOR CONTROL
160
165
165
164
164
168
163
169
167
168
162
34
161

FIG. 4

FIG. 3

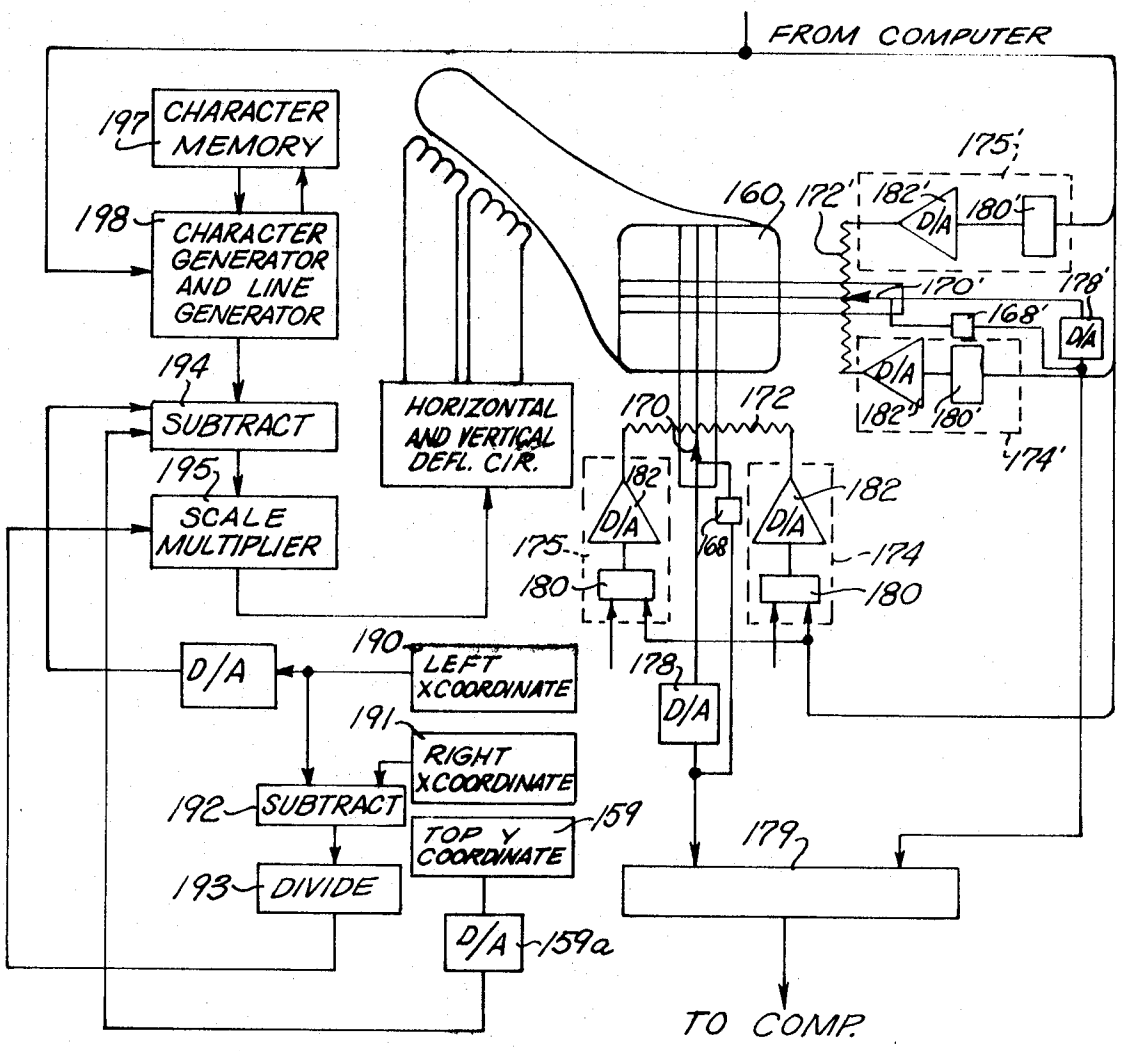

FROM COMPUTER
197
CHARACTER MEMORY
198
CHARACTER GENERATOR AND LINE GENERATOR
194
SUBTRACT
195
SCALE MULTIPLIER
HORIZONTAL AND VERTICAL DEFL. CIR.
160
172'
175'
182'
D/A
180'
170'
178'
168'
D/A
D/A
182'
180'
174'
170
172
182
D/A
175
180
168
182
D/A
174
180
178
D/A
190
LEFT XCOORDINATE
D/A
191
RIGHT XCOORDINATE
192
SUBTRACT
TOP Y COORDINATE
159
193
DIVIDE
D/A
159a
179
TO COMP.

FIG. 5

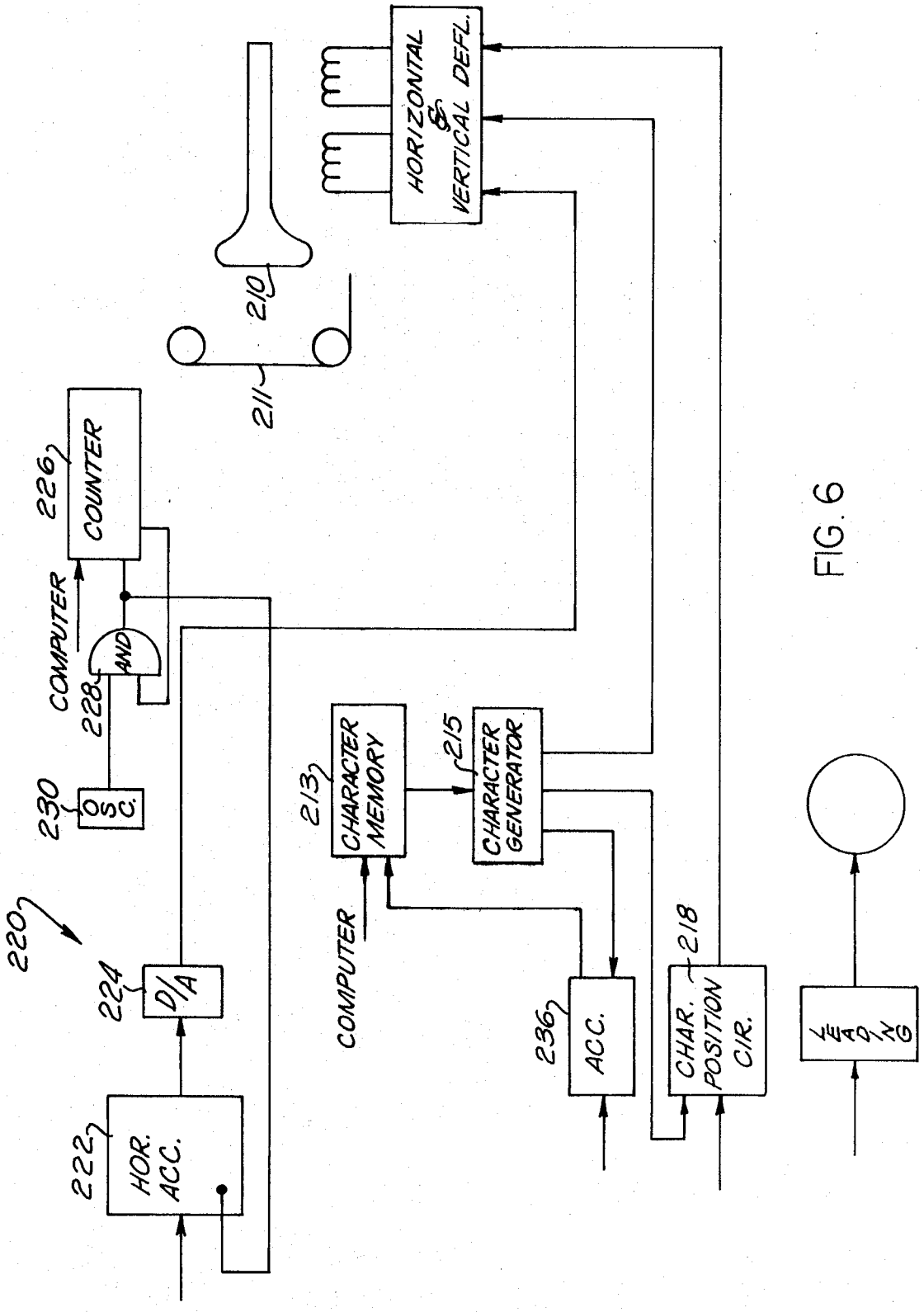

HORIZONTAL & VERTICAL DEFL.
210
211
226
COUNTER
COMPUTER
228
AND
230
OSC.
220
224
D/A
222
HOR. ACC.
213
CHARACTER MEMORY
215
CHARACTER GENERATOR
COMPUTER
236
ACC.
218
CHAR. POSITION C/R.
HEADING

FIG. 6

COMPOSING METHOD AND APPARATUS

The present invention relates to a method and apparatus for composing pages of printed material and, particularly, to such a method and apparatus suitable for composing newspapers, books and magazines.

In composing pages of various publications, it is common for items on a various page to be prepared by different sources at different times. This material must be assembled and arranged as it will appear in the publication, prior to preparing printing plates.

In the newspaper industry, a page is commonly composed by pasting up separate items of prepared copy. The pasted-up page is then used as the starting point for making a corresponding printing plate by photographic and photoetching techniques.

Newspapers and other publications have what is termed a layout department whose function is to allocate particular space in the publication to particular items or departments.

In the case of newspapers, some of the advertisements are commonly received in the form of prepared copy from a national source. Conventionally, this prepared copy is, during composing, pasted onto an allocated section of a particular page in the newspaper as specified by the layout department of the newspaper. Local advertisements, which may include copy prepared outside of the newspaper as well as internally, are also sent to the composing room to be pasted into the space allotted to the particular advertisement by the layout department. Both national and local advertisements are often primarily artwork. Similarly, the layout department also allots space to the classified advertisement department and to the editorial staffs. In the newspaper industry, the term editorial space is used to generically describe space in the newspaper other than the advertisements and the classified sections. The space allotted for editorial will include those pictures associated with the editorial text. Some of the editorial material, such as daily columnists, will require a fixed amount of space daily and have a fixed location in the newspaper. Other editorial material is supplied by the various reporting staffs of the newspaper so as to fill the space as it is allocated to the particular reporting staff by the layout department.

In accordance with the present invention, a computer is utilized to store layout information for a publication and the layout department is provided with a computer terminal which is adapted to display requested page areas with the sections of the page area which have been previously allocated to a particular item indicated as assigned space, preferably by outlining the space. In the preferred practice of the invention, the layout terminal has visual means which may be utilized to indicate on the display of the page, a section on the displayed page area to be assigned to a particular item and the layout terminal on command will enter the coordinate data concerning the space indicated into the storage of the computer so that when the page area is again requested from the computer, the selected space will be outlined or otherwise visually blocked off. In addition to the coordinate data in the preferred practice of this invention, item-identifying information is also entered into the computer so that the display will visually indicate the item which is to be placed into the allocated areas.

After the space in the newspaper or publication has been allocated by the layout department by storing the layout information in the computer, the computer is then operated to either prepare a page copy with the areas for the various items outlined and the identification of the item displayed in the page areas or to operate a cathode-ray tube phototypesetting apparatus to compose the pages including editorial material with the areas for the artwork and the prepared copy otherwise blocked off. In a specific form of the preferred embodiment, the prepared copy from various sources is scanned and stored as a run length code in the computer and the computer operates to control cathode-ray tube photocomposing apparatus to produce the entire composed page including text and artwork.

In the practice of the invention a prepared copy, such as artwork is scanned to provide digital information to be entered into the computer for reconstructing the copy. The scanning is such that the copy may be black and white line copy or halftone copy or a continuous-tone copy, e.g. a conventional photograph. The scanning in the preferred practice produces a code which indicates the length of the segments of a scan of different light levels and in the case of the continuous-tone photograph, the light levels are utilized to determine the dot size to be used in making a halftone reconstruction of the photograph. For such copy the character memory of the phototypesetting apparatus preferably includes instructions for forming a character comprised of a dot pattern which when repeated along a scan line provides halftone copy of proper dot size. Each dot pattern is identified by a character code and during scanning the light level from the copy is converted to a digital number which is decoded to specify the proper dot character for producing the halftone copy. The invention further contemplates reproduction of halftone copy for color purposes by the use of color filters during scanning.

A better understanding of the invention and its advantages will be derived from the following detailed description of a specific form of the preferred embodiment thereof made with reference to the accompanying drawings forming a part of the present specification for all subject matter disclosed therein and wherein:

FIG. **1** is a schematic diagram of the present invention as applied to newspaper composing;

FIG. **2** is a block diagram illustrating a scanner which may be used in practice of the present invention;

FIG. **3** illustrates a dot character for preparing halftone copy;

FIG. **4** is a view showing a layout terminal for use with the present invention;

FIG. **5** is an electrical diagram showing circuitry used with the layout terminal of FIG. **4**; and

FIG. **6** is a portion of the phototypesetter which may be used in practice of the present invention.

Referring to FIG. **1** which is a flow diagram indicating the handling or composing of a newspaper page in accordance with the present invention, material to be composed may be received from a national advertisement department **10**, a retail advertisement department **11** which is primarily local advertisements, an editorial department **12**, and a classified department **13**. The material received by the national advertisement department **10** is usually prepared copy which is suitable for photographing for the purpose of preparing a printing plate. The prepared copy may include text as well as artwork. In accordance with the disclosed embodiment of the invention, the national advertisement is given an identification and is scanned by a scanner **18** which digitizes the prepared copy and the digitized information and the identification heading is entered into the memory bank of a computer **19**. The information which is derived from scanning the copy is such as to enable the computer to provide the necessary commands for causing a cathode-ray tube phototypesetting apparatus **17** to reproduce the copy as part of a page of the publication. Information related to the ad is also delivered to a layout department **20**. The function of the layout department is to assign newspaper space to the ad.

The retail advertisement department which handles local advertisements commonly prepares the ad for publication. These ads will generally include both artwork and text material. In the illustrated embodiment, the retail advertisement department has a computer terminal **21** for a computer **22** which enables the retail department to code the text of the ad so that it may be printed by a cathode-ray tube phototypesetter **23**. The terminal **21** has a cathode-ray tube for displaying the text material stored in the computer **22** and is preferably of the type shown in U.S. Pat. No. 3,165,045 which enables the operator to edit and change the material. The edited material may then be printed out in the phototypesetting apparatus **23** and sent to a pasteup table **24** to be combined with the art

copy. The artwork and the text material are pasted up together to form the desired retail ad and this ad is photographed by a camera department **26** to provide copy for scanning by the scanner **18**. The material from the retail ad department is scanned and entered into the computer together with the identification of the copy. Information related to the ad is sent to the layout department. The computer **22** is linked to the computer **19** so that the insertion of the type-justifying or typesetter-setting instructions may be done by the computer **19** if desired.

The newspaper industry generally assigns the term editorial to generically describe material in the newspaper which is not sponsored and so does not fall into the classifications of national advertisement, retail advertisement or classified advertisement. Accordingly, editorial includes what is commonly referred to as to the sports pages, the women's pages, the financial pages, the editorial pages and general news pages including both local and international news. The editorial department **12** has a computer terminal **28** where the editorial department can code text material and send the text material into the computer **19**. The terminal **28** is an editing terminal which enables the editorial department to view the text material and to edit the text material before insertion into the computer. The terminal **28** may include a computer which justifies the text and inserts the necessary code instructions for the typesetter or this may be done by the computer **19**. Also, the editorial department will have a scanner **27** corresponding to the scanner **18** for scanning artwork to digitize the latter and convert it to a form for storing into the computer and for use in controlling a phototypesetter to reconstruct the copy.

The classified ad also has a computer terminal **28** of the same type as the computer terminal for the editorial department.

As noted above, the layout department **20** has the responsibility for laying out the newspaper and assigning space to various departments and to the ads to appear in the newspaper. The layout department has a computer terminal **34** which enables the layout department to insert coded data into the computer **19** identifying the space where the various ads and articles are to appear. The computer terminal **34** preferably includes a cathode-ray tube display adapted to display page areas of a newspaper and if certain of the page areas have been allocated or assigned by the layout department, these areas will be blocked off, i.e. outlined, and an identification of the article or text material to appear therein will be associated with the area.

As noted above, the editing terminals **21**, **28** maybe of a known type such as the type disclosed in U.S. Pat. No. 3,248,705 issued Apr. 26, 1966 to J.E. Dammann et al. The text copy is entered into a storage associated with the terminal by use of a keyboard. The copy is divided into pages, paragraphs, lines, words and finally characters (including blank characters). Signals representing the characters in any known code are stored in the storage to form the copy. The keyboard of the terminal is such that these proper codes are entered when the proper key for the letter or instruction is struck on the keyboard. The terminal also includes other codes necessary such as space, paragraph, etc. for storing instruction to be used to form the characters into words, lines and paragraphs. In addition, the terminal is such that the stored text material can be displayed on the face of the cathode-ray tube and corrections made in the displayed material, such as insertions and deletions, and then when the copy is as desired, the terminal may prepare a justified of unjustified tape or in some other known manner effect the reading out of the storage for storage into the memory of a computer which will ultimately compose the entire paper. Associated with each text material entered into the computer **19** through the terminals **28** is an identification of the item so that when the layout department assigns the item to a particular location in the newspaper, the computer can locate and compose the item into that location. Each terminal has the necessary codes for entering the identifying headings into the computer **19**.

A scanner which may be utilized in the practice of the present invention is illustrated in FIG. **2**. Referring to FIG. **2**, the copy to be scanned is clamped by a clamp **51** onto a drum **50** which is rotated by a motor **52**. The motor is a synchronous motor which rotates the drum **50** at a constant speed. A pulse generator **54** is operated by the drum and provides one pulse for a predetermined increment of drum rotation on line **55**.

As the copy on the drum **50** is rotated, it is scanned by a scanning head **58** including a photodiode **60**. The scanning head **58** is mounted on a lead screw **62** which is rotated by a stepping motor **64** to index the scanning head lengthwise of the drum **50**. The stepping motor **64** is stepped one increment for each revolution of the drum **50** so that the scanning head **58** is in a fixed scanning position for one revolution of the drum and then is stepped to an immediately adjacent position for its next scan. Accordingly, the scanning head **58** makes successive scans of the copy with each scan lying in a radial plane of the drum **50**. Preferably, the scanning lines are variable between 180 and 720 lines per inch.

The scanning head **58** is stepped by a drum-addressing circuit **70** which supplies a pulse to the stepping motor for each revolution of the drum **50**. As illustrated in FIG. **2**, the drum-addressing circuit **70** may include a counter **72** for counting the pulses from the pulse generator **54** to provide coded indicia which indicates the address of the angular position of the drum. Preferably, the pulse generator **54** provides a pulse at the start or end of each revolution over a line **74**. The signal on line **74** is separate from the increment pulses, and resets the address counter to make sure that any pulse errors do not accumulate.

The scanning head **58** for scanning the copy includes a mirror **80** for directing a scanning beam of light from a laser **82** onto the copy. The light reflected from the copy is detected by the photodiode **60** and the photodiode provides an essentially two-level signal when scanning black and while copies which indicates either black, i.e. a line or mark, or white, i.e. background. At the start of a scan, the copy is assumed to be white and a level detector **83** will detect a white level at the output of the photodiode **60**. As the white background is scanned, pulses from the pulse generator **54** are applied through an AND-gate **112** to a run length counter **86** which counts the pulses from the pulse generator **54** to determine the length of a segment of a scan. When the beam strikes a black line or other black portion of the copy, the level from the photodiode to the level detector changes to a black level and the level detector detects this change and provides a gating signal to a gate **87** to gate out the number in the counter and a reset signal to the counter **86**. The counter may be the type which is read out by resetting the stages. The signal from the level detector is applied to gating **87** through an AND-gate **88**, OR-gate **89**, AND-gate **91**, and OR-gate **90** and to the reset terminal of the counter **86** from the output of AND-gate **91** through an OR-gate **92**. When the readout gate **87** is activated, the number in the counter **86** is gated to a Huffman encoder **96**. The Huffman encoder converts the number from the counter **86** to a Huffman code and stores it in a core memory **98**.

As the scanning continues, the counter **86** will again count pulses from the pulse generator **54**, until the signal changes to a white signal. At this time, the pulse gate **87** will again be activated by the level detector **83** to read the count in the counter **86** and to reset the counter **86**. From the foregoing it can be seen that the level detector must give a gating reset signal each time the output level changes from white to black or vice versa. Level-detecting circuits for this purpose are within the ability of those skilled in the art and may comprise a multivibrator circuit which is switched to one state at a first level which corresponds to the white level and which resets at a lower level which corresponds to the level slightly higher than that from the black copy.

Each time the drum **50** makes a complete revolution, the scanning of the copy is to occur on a new line and it must be indicated that a scan path has been completed and a new one

is to begin. The drum addressing circuit **70** stores an end-of-line (EOL) code in a storage register **104** and a stop scan register and comparator **105** provides a signal when the count in the counter **72** corresponds to the setting of the stop scan circuit **105**. This setting is preferably settable by the operator.

The signal from the stop scan register and comparator **105** is applied through OR-gate **92** to effect a resetting of the counter **86** and also is applied to OR-gate **92** to activate the readout gating **87** to gate the setting of the run length counter **86** to the Huffman encoder **96**. The stop scan signal is also applied with a delay to an AND-gate **106** to gate the EOL code to the Huffman encoder.

Since it is not necessary to code a white background run length at the end of a line scan, the stop scan signal activating the readout gate **87** is applied to one input of an AND-gate **109** which has its output connected to activate the gating **87** through the OR-gate **90**. The second input for AND-gate **109** is conditioned by a NOT white level output signal from the level detector **83**. Consequently, if the signal from the level detector indicates a white signal, no gating to the Huffman encoder occurs in response to the stop scan signal.

The stop scan signal also sets a control bistable multivibrator **110** to stop pulses to the counter **86** and to prevent a gating of the reading of the run length counter to the Huffman encoder by the level detector. The control multivibrator **110** has a reset or NOT output which normally conditions AND-gate **112** through which pulses are supplied to the counter **86** as well as AND-gate **91** through which the change of level signal from the level detector **83** is normally supplied to the readout-gating circuit **87** for the run length counter **86**.

As noted above, the address counter **72** is reset by the signal on line **74** from the pulse generator **54** at the time clamp **51** starts to move under the scanning head. When clamp **51** clears the scanning head and a new scan is to start, a start scan circuit **114** is activated by the count in the address counter to reset the control multivibrator **110**. During the period that the control multivibrator is set, changes in the output level from the level detector will not effect the gating of the zero count in the run length counter **86** to the encoder and when the scan is again started, the first gating to the encoder will be the run length number for the background at the start of the next scan. The start and stop scan registers and comparators **105**, **114**, may be set to provide the start and stop signals at selected address for the copy drum.

From the foregoing it can now be seen that the scanner provides a run length code which is stored in the core memory **98**. The run length code indicates the length of scan of the material which is white beginning at a certain point and then the length of the first black encountered and thereafter the numbers alternatively represent white and black segments. When an end of a circumferential scan is reached, the EOL code is inserted to indicate that a new scan is starting. This information is utilized to operate the beam of a cathode-ray tube to reproduce the scanned material. It can be readily understood that if the beam is initially positioned where the scanned copy is to begin along the X or horizontal coordinate and then advanced along a scan line, a number of units corresponding to the segment length of the first white portion of the line without the beam on, i.e. with the beam blanked, and then the beam is turned on while it is moved in a controlled manner a distance represented by the code indicating the length of the black segment and that this is done alternately during each scan as the beam moves across corresponding scan lines, the picture will be reproduced. The end-of-line code after each line scan is used in the reconstruction to reposition the cathode-ray tube beam at the original start coordinate in the direction of scanning but with an incremental step corresponding to the step of the scanning head **58** along the orthogonal coordinate.

The core memory **98** for storing the codes is a conventional core memory and serves as a buffer to store the information from the Huffman encoder **96** while the information in the core memory is being put on to magnetic tape by a readout device **120**. Associated with the scanning system is also a heading insertion logic device **122** for inserting onto the tape the identification of the copy including the scanning resolution, i.e. the distance increment between circumferential scans, the column length and the column width. The column width will be a standard width and can be inserted by the operator directly from the copy while the column length may be obtained directly from the copy or from the drum-addressing circuit. If it is to be obtained directly from the drum-addressing circuit, the circuitry will include a column length counter **124** which is activated each time there is an output on line **74** from pulse generator **54**. If desired, the column length counter **124** can be utilized to determine the length of scan and in such a case can be preset to a number and when the output of the counter is stepped to zero it will provide a signal to stop the scan.

The Huffman encoder is a conventional encoder which is utilized to reduce the memory capacity necessary for storing the information. In a Huffman encoding circuitry, a code comprised of binary bits is assigned to the run length in accordance with their frequency of appearance so that the run length which appear most frequently require the lesser number of bits for storage.

The information on the magnetic tape prepared by the readout device **120** is entered into the computer memory along with the heading. Alternately, the data may be transferred on a time-sharing basis directly from the core memory **98** into the computer **19**.

It is desirable, that the level detector be able to scan continous-tone copy. The system thus far described is adapted to scan black and white line copy or pictures formed of halftone dots. In the case of the continuous-tone copy as distinguished from a halftone copy, it is necessary to obtain halftone information in order to be able to prepare a printing plate. When scanning continuous-tone copy, the signal from the scanning head is applied to an analog-to-digital converter **150** which has a digital output that indicates the level of the signal rather than to the level detector **83**. The numerical output of the A/D circuit **150** is converted to a halftone screen dot code by a decoder **151**. Each screen dot may cover a range of levels in the output from the A/D circuit **150** or the A/D circuit **150** may be such that each change in digital output represents a new screen size. When scanning continuous photographs, the number in the run length counter **86** is printed each time there is a level change resulting in a change in the output of the screen size decoder **151**. In operation, when the change occurs in the output of the screen dot decoder **151**, a change in output circuit **153** provides a signal for activating readout gate **87** through OR-gate **89**, AND-gate **91** and OR-gate **90** to gate the run length reading to the Huffman encoder **96** and to also gate the new screen dot to the encoder by activating with a delay a readout gating circuit **154**. The output from the change detector **153** is applied to one input of an AND-gate **155** whose output is applied through a delay circuit and an OR-gate **155*a*** to activate the gating **154**. The other input of AND-gate **155** is conditioned by the reset output of the scan control circuit **110** so that when the scan control circuit is set at the end of an individual scan the change detector **153** will not activate gate **154** until the stop scan control circuit **110** is reset.

Instead of delaying the activation of gating **154**, the readouts from the counter **86** and from the decoder **151** may be simultaneously gated to buffer storages in the encoder **96** which are read in sequence, so that the number stored in the run length counter is read first into the core storage and then the number representing the new screen dot. The address of the run length counter at the time of the change of the A/D output of circuit **150** will indicate the length of the scan segment for the preceding screen dot. In reproduction, dot characters will be placed along the scan segment a predetermined distance from each other along the scan line as determined by the information in the character storage. In continuous tone scanning, a NOT white signal is supplied from the decoder **151** to AND-gate **156** to gate the stop scan signal to

activate the readout gate **154** to read out the screen dot for the last run length of a scan only if the copy is NOT white during the last segment scanned. The AND-gate **156** has an output which is applied with a delay to OR gate **155***a* for activating gate **154** as well as being applied to the OR-gate **90** to activate the readout gating **154** for the run length counter **86**.

When the continuous-tone circuitry is to be utilized, a select bistable control circuit **158** is set to condition AND-gate **159** to pass the signal from change detector **153** and to condition an input of AND-gate **156**. When operating in a black and white mode, the select circuit is in a reset state to condition AND-gates **88**, **88***a* to render the level detector **83** effective.

In reproducing the continuous-tone photograph, each screen dot is represented by a "character." A character buffer storage or disc has the instructions for forming each dot character. The dot characters are formed by making the character from a series of closely spaced dots with the spacing and arrangement of the dots or spots varying depending upon the screen size. FIG. **3** shows enlarged dot characters for a given screen size spaced along a line with each character being comprised of a plurality of spots. It will be recognized that if the individual character dots are considered as a character, the dot character can be formed with the same technique as is utilized for forming an alpha character by turning a cathode-ray beam on and off at spots which when integrated form the alpha character. Phototypesetting systems which function in this manner are well known in the art.

It will also be seen that the present system is adapted for the use in reproducing color photographs if a color filter is used and the continuous tone copy is scanned for color. In scanning for color, the light from the scanning may be directed along separate paths each containing a particular color filter to obtain the "grey tone" level for each color. Also, the computer may be utilized to produce angularly displaced dot patterns for the different colors corresponding to screens angularly disposed with respect to each other in order to avoid moire patterns.

As noted above, the layout department allocates space for the national and local ads and also allocates space to the editorial department. The layout department uses the terminal **34** to develop information relating to the spaces allocated to the ad departments and to the editorial departments and store it in the computer. Referring to FIG. **4**, a layout terminal is illustrated which includes a layout cathode-ray tube **160**. The cathode-ray tube **160** is part of a readout display for reading out page layout information stored in the computer. The layout information stored in the computer includes the data necessary to display a page with assigned sections on the page outlined and preferably with a readout of the particular item assigned to the page. Thus, when a section is assigned, data is stored in the computer relating to the page in which the item appears, the identity of the item, and coordinate data which will enable conventional graphic circuitry to outline the assigned sections when a display of the page is requested by the layout department.

The outlining of assigned areas is accomplished by lines which extend parallel to X- and Y-coordinates for the page. Cathode-ray tube terminals for producing graphics and printed legends in response to information stored in the computer are known to those skilled in the art. The layout department in allocating space of sections of a page area, codes the coordinates of the allocated section with respect to a page origin and supplies heading information by operating a conventional alphanumeric keyboard **161** which includes a key for each character and when the key is struck, a character code is provided so that the character can be called from a character memory and reproduced on the face of the cathode-ray tube in a conventional manner. The layout terminal **160** has visual indicating means for deriving the coordinates of a section to be assigned. The visual indicating means comprises an X-coordinate marker **162**, and a Y-coordinate marker **163**. The X-coordinate marker and the Y-coordinate marker comprise transparent bodies **164** extending parallel to the X- and Y-coordinates respectively, with each body having a sight line **165** thereon which extends perpendicular to the respective coordinate. The X-coordinate marker and the Y-coordinate marker are movable along the X- and Y-coordinates, respectively, and each includes a handgrip portion **167** with the handgrip portion carrying a digital display device **168** which indicates the value of the coordinate with respect to the zero origin of the page. It is assumed in the present illustration that the top left-hand corner of the CRT is the zero origin for the X- and Y-coordinates when a full page is displayed. By moving the marking devices **162**, **163**, the signt lines **165** can be located to lie along the lines outlining the section to be assigned and to determine the coordinates for the end points of the lines which outline the section to be assigned. Known computer terminals with a cathode-ray tube display are adapted to draw lines if given the coordinates of the end points of the lines. As will be recognized by those skilled in the art, the lower right-hand sections and the upper right-hand sections, etc. can be outlined by establishing the coordinates of the corner which is closest to the center of the page. This is true since the other coordinates are the outside edges of the page and a code key on a keyboard **169** can readily provide a code which instructs that the line be drawn from the coordinates of the corner which define the inside corner to the outside edges of the page. Special code keys may be provided for this instruction such as upper right, lower right, upper left and lower left. Also, if the lower right-hand corner, for example, has been assigned, the space immediately above the lower right-hand corner can also be allocated by striking the lower right corner key after establishing the coordinates of the inside top corner of the space provided the left-hand coordinate for the new section is the same as that for the assigned lower right-hand corner. While the instruction for outlining the space immediately above the lower right-hand corner will effect the drawing of a line to the lower edge of the page along the left-hand X-coordinate it will be immaterial since it will coincide with the left-hand side of the outline for the lower right-hand corner section. In the absence of such special code keys, the section may be outlined in a conventional display by establishing the coordinates of the corners of the section.

The layout cathode-ray tube **163** and part of the circuitry for deriving the X- and Y-coordinates for a section is illustrated in FIG. **5**. Referring to FIG. **5**, the movement of the X-coordinate marker along the X-coordinate moves a tap **170** on a potentiometer **172**. The potentiometer **172** is connected between a voltage source **174** and a voltage sink **175**. The voltage of the sink and the source determine the magnitude of the voltage at the different points along the potentiometer **172** at the ends of the potentiometer. For a full-page display on the cathode-ray tube, the voltage of the sink will be zero representing zero deflection from the origin along the X-axis and the voltage of the source voltage will be that necessary to effect full deflection of the beam to the right-hand side of the page, for example, 10 volts. As the X-coordinate marker **162** is moved, the potential of the sliding tap **170** will change from a minimum of zero where the arm is positioned at the zero coordinate position for the X-axis to a maximum of 10 volts depending upon the position of the arm along the X-coordinate This voltage is converted to a number by a digital-analog circuit **178** to provide the X-coordinate position. The digital output of the circuit **178** is supplied to an interface circuit **179** and on command may be stored in the computer to indicate a selected X-coordinate value for a line or point. The output of the A/D circuit **178** is also connected to the digital display device **168** on the X-coordinate marker **162** so that the operator may have a direct reading of the coordinate magnitude.

Similar control circuitry is provided for the Y-coordinate marker **163** which is movable along the Y-coordinate and the components in the Y-circuitry have been given the same number as the component at the X-circuitry with prime mark appended thereto. Thus, by positioning the X-coordinate marker along one vertical side of the section to be assigned

and the Y-coordinate marker along the horizontal side of the coordinates of the corner formed by the intersecting sides can be readily ascertained.

In accordance with one feature of the present invention, the operator may select a portion only of the newspaper page to appear on the face of the cathode-ray tube and this portion magnified on the face of the tube. For this purpose, the voltage source **174** and the voltage sink **175** are adjustable so that the operator may read the coordinates of the magnified portion with respect to the original page origin and not to the zero origin on the cathode-ray tube. If, for example, the lower right-hand quarter of the page is to be displayed on the face of the tube, the X-coordinate of the left side of the page, assuming the voltage from zero to full scale on the X-coordinate is 10 volts, is actually going to appear on the cathode-ray tube at the zero-volt position but in terms of the absolute coordinate of the page it will be the 5-volt position. In this instance, the sink voltage is adjusted to 5 volts and the source voltage is maintained at 10 volts so now the full-scale deflection for the cathode-ray tube is represented by a 5-volt difference across the potentiometer **172**. It will be noted, that this 5-volt difference corresponds to the 5-volt difference which occurs or exists along the X-coordinate scale when the full page is displayed. Accordingly, the potential at the tap **170** is in actuality the deflection voltage measured with respect to the origin of the page. Consequently, as the coordinate markers are moved along the coordinates, the coordinate indication by the digital display devices **168** will be with respect to the page zero and any information supplied to the computer will also be in accordance with page zero.

In order to enable the operator to magnify a selected portion of the page, the source **174** and the sink **175** each include a register **180** and a digital-analog converter **182** for converting the setting of the register to an analog voltage. The registers are set to numbers which indicate the value of the X-coordinate which corresponds to that for the left- and right-hand side of the section to be displayed. The digital-to-analog converter converts this to a corresponding voltage so that the voltage at the left-hand end of the potentiometer corresponds to the X-coordinate value for the left-hand side of the section and so that the voltage at the right-hand end of the potentiometer corresponds to the X-coordinate value for the right-hand side of the section to be displayed.

The circuitry for expanding the scale for the Y-coordinate marker **163** is a duplicate of that for the X-coordinate marker **162** and has been given the same reference numbers as the corresponding X-coordinate components with a prime affixed thereto.

It will also be appreciated that the registers **180, 180'** may be set to expand the page which would normally take less than the full size of the cathode-ray tube to that size which is a maximum for the tube.

If the operator is working on an expanded portion of the page, it is necessary for the graphic information being supplied to the cathode-ray tube to be modified so that the tube will properly display any allocated sections in the particular area which has been selected. This may be readily accomplished by the operator establishing the right-hand and left-hand X-coordinate values in registers **190, 191**. The terminal **34** includes a subtracting circuit **192** for subtracting the X-coordinate values and a dividing circuit **193** for dividing the full-scale voltage for the page display by the difference to obtain the scale factor. The deflection signals to the cathode-ray tube from the line and character generator in response to the page readout from the computer may then be altered by subtracting in a circuit **194** the voltage of the lower coordinate X-voltage from the X-deflection signal called for by the character generator and the top Y-coordinate registered in a register **189** and converted to an analog in a D/A circuit **159*a*** from the Y-deflection voltage and then multiplying the resultant voltages by the scale factor in a circuit **195**. This will then cause the readout onto the cathode-ray tube to correspond with the selected area and to be magnified.

Preferably, the layout terminal also includes a plurality of cathode-ray tube displays which enable the layout man to see the information which appears on the facing page and a backside of the requested page and also, in systems which are provided with the magnification feature, a full-page display of the page being worked on by the layout operator. Such cathode-ray tube displays are indicated by the reference numerals **197, 198, 199**. The cathode-ray tube for the full-page display will not have the magnifying circuitry for modifying the output of the character and line generator associated with the display. The cathode-ray tubes **197, 198, 199** will have character memory and generating circuitry and a line generator controlled as in the case of cathode-ray tube **160** from the computer on a time-sharing basis.

Also, in accordance with the invention, the layout terminal **34** may include a spot-type cursor formed by a beam from a cathode-ray gun in the display and controlled by a joystick **200**. Displays with such cursors are known to those skilled in the art and are such that when the cursor is in a position on the face of the cathode-ray tube, the coordinates of the cursor may be entered into the computer on command. It will be appreciated that when a magnified portion of the page is being utilized, the coordinates of the spot will have to be converted to absolute coordinates with respect to the page origin rather than with respect to the deflection origin on the cathode-ray tube.

In the case of the X-coordinate, the X-coordinate value of the cursor may be multiplied by a scale factor, one half in the case where one half of the page along the X-coordinate is to be displayed on the face of the tube, and by adding the magnitude of the X-coordinate for the left-hand side of the section when a full page is displayed. This will convert the X-coordinate magnitude of the cursor relative to the cathode-ray tube screen when an expanded section is displayed to a magnitude for displaying the full page on the face of the tube. The Y-coordinate may be similarly converted.

It will be understood from the foregoing that the terminal **34** includes circuitry and controls for entering the coordinates of points on the cathode-ray tube into the computer **19** to assign space to an item or a copy. Also, the computer includes those controls necessary to request a display of a page or page section on the cathode-ray tubes of the terminals. In addition, the terminal **34** includes a character memory **197**, for storing alphanumeric character generating instructions for causing a character and line generator circuit **198** to provide the necessary deflection signals for the cathode-ray tube to generate the character at the position indicated by the computer. The coordinates of the top left-hand corner of the assigned section may be utilized by the circuit **198** as the starting coordinates for reproducing the alphanumeric legend for the item assigned to the section. The character-generating circuit **198** will operate to supply deflection signals to initially position the beam in accordance with these coordinates and the character instructions in the memory or from the computer will update the basic positioning signal in a known manner after each character is generated to position the beam for the next character.

The editorial department also has a layout terminal **34** so that the editorial department may subdivide the space allocated to it by the layout department. When the editorial department allocates space, the department will supply alphanumeric information which indicates the nature of the item so that when the item is stored in the computer, the item can be located and printed out when the page is composed.

After the entire newspaper has been stored in the computer memory, the computer may be operated to read out the items page by page and to include the necessary instructions for the phototypesetter. It will be understood that the items on the page may be read out at random and need not be selected in a given order. Consequently, the computer may be programmed to search its memory bank for those items appearing on the page and when an item is located, the computer may operate to prepare a punch tape or magnetic tape or can directly

operate the phototypesetter in accordance with the stored information to produce a page copy.

The phototypesetter used with the present invention may be a known typesetter and the computer may be programmed to supply the necessary instructions for operating the typesetter. The manner of programming a computer to provide the necessary instructions for a typesetter to reproduce the copy which has been stored as described in the computer is within the ability of those skilled in the art. The manner of utilizing a computer to provide justification for unjustified text and instructions for interword spaces as well as for leading purposes is well known.

The phototypesetter controlled by the computer **19** is preferably one in which the character is formed by turning the beam on and off to form dots which define the character. In such a typesetter, the beam may be turned on and off at predetermined locations in accordance with instructions from the character memory as the beam is moved in a raster scan pattern. Such an apparatus is disclosed and described in application Ser. No. 591,734, filed Nov. 3, 1966 and assigned to the same assignee as the present invention. The beam may also be incrementally stepped from position to position where it is to be turned on in response to incremental instructions from the character memory as fully disclosed and described in copending application Ser. No. 710,349, filed Mar. 4, 1968 by Edwin R. Kolb and assigned to the same assignee as the present invention.

Either type of phototypesetter generally comprises a cathode-ray tube **210** for writing the copy onto a film **211**. Conventionally, the vertical leading of the copy is obtained by moving the film vertically in response to leading instructions and a leading circuit **212** for this purpose and controlled from the computer has been shown in FIG. **6**.

The phototypesetter includes a character memory **213** which stores a font of character instructions to be utilized to control a character generator **215** when the computer requests that a particular character be formed. The character generator provides vertical and horizontal deflection signals for the cathode-ray tube **210** to be added to character-positioning signals provided by the character-positioning circuit **216**. The character positioning will receive codes such as interword codes from the computer and as well as data for initially positioning the writing beam. The positioning circuit may receive updating information from the character generator after each character within a word is written by the cathode-ray tube to position the beam for the next character in the word.

It is entirely within the skills of those in the art to program the computer **19** to justify the coded text stored therein and to insert codes and instructions necessary to write the text material with the cathode-ray tube **210** and the film **211**.

For scanned copy the computer provides instructions to the positioning circuit **218** and the leading circuit to properly locate the copy on the page. The phototypesetter preferably includes a scanned copy generator **220** for the reconstruction of the scanned copy. The illustrated scanned copy generator comprises a horizontal accumulator **222** in which the run length number is set to establish an increment of horizontal deflection along the X-coordinate. At the start of a scan, the computer enters the first white run length into the accumulator and this is converted to a deflection voltage by a D/A converter **224** to deflect the beam a corresponding number of increments. The computer then enters the next run length number, which is for a black signal, into a counter **226**. When a number is set into the counter **226**, a gate **228** is activated to supply pulses from an oscillator **230** to the horizontal accumulator **222** and to pulse the counter toward zero. This steps the cathode-ray beam incrementally the length of the black segment and the beam is turned on at each step to generate the black segment and expose the film. When the counter reaches zero, the gate **228** is deactivated and the computer enters the run length number of the next white segment in the accumulator etc. until the scan is completed. At that time, the EOL instruction in the computer effects the resetting of the accumulator **222** to zero and the necessary leading in accordance with the resolution data.

When the phototypesetter is being operated to reproduce copy which was continuous-tone copy, the computer will address the character memory to provide the necessary instructions for forming the dot character corresponding to the proper screen dot. The run length will be entered into an accumulator **236** and each time a dot character is generated, a specified width stored with the dot character is subtracted from the accumulator. The accumulator will cause the character memory to repeat the character until the accumulator is reduced to zero at which time the computer supplies new instructions. White run lengths are added to the position circuit as an interword space. The end-of-line instruction will cause the computer to return the character-positioning circuit to the start scan position.

As noted above, it is entirely within the ability of those skilled in the art to program the computer to operate as described above to reproduce text material and scanned material stored therein in the manner described.

After the film has been exposed to provide a page of copy, it is developed and used as the copy from which a printing plate is prepared.

While a complete highly automatic system has been disclosed, it will be recognized that features of the system and of the invention may be used independently of each other but to advantage in a more simplified system.

From the foregoing it can be seen that the various departments code text material by striking a conventional character code key for each character to provide a character code which is used to address the character memory. Each item which is stored in this manner and each scanned item which is stored is stored with an identification code which enables the item to be located when the layout information indicates that the item is to be reproduced on a page being prepared and the item is then read from storage to operate the phototypesetter and to reproduce the item at the page location specified by the code layout data. The coded layout data includes the top left and coordinates of the section in which the item is to be displayed and this data may be used in a conventional manner known to those skilled in the art to lead the film to properly locate the item.

What is claimed is:

1. An apparatus for composing and preparing page copy for a publication comprising a phototypesetter for writing text material on a film in accordance with coded instructions supplied to the phototypesetter, first means including storage means for storing character codes for characters to be reproduced by said phototypesetter to reproduce the characters, said first means comprising a character memory for storing a font of characters each of which has an address code for selecting the character for reproduction by said typesetter on said film, computer means for selecting characters from said memory and operating said phototypesetter including storage means for storing text material to be printed in the form of a binary character code for specifying the character to be selected from the character memory, first computer terminal means connected to said computer means for converting the characters of text material of items to be printed into said character codes and for storing said character codes and a binary identification of each item of text material in said storage means, second memory means for storing location data including coded information concerning page number and location of the page for items to be printed, and second terminal means for entering into said second memory means a coded identification of the page of a publication on which the item is to appear and coded coordinate data indicating the location of the item on the page responsive to the stored data in said second memory means and including means controlled by said computer means for visually displaying page areas of said publication with the sections of the page which have been assigned to an item indicated on the display.

2. An apparatus for composing and preparing page copy as defined in claim 1 wherein said second terminal means includes means associated with said display for visually indicating new sections to be assigned and for storing coordinates of said new section in said memory means and said first means being operable to read out said items of said first memory means to operate said phototypesetter and to position the items on a page and in the location called for by the data stored in said second memory means.

3. In an apparatus as defined in claim 1, wherein said apparatus comprises scanning apparatus for scanning copy and for providing coded data for operating said phototypesetter to reproduce the scanned copy and for storing said coded data in said computer means.

4. In an apparatus as defined in claim 3, wherein said scanning means comprises means for scanning said copy along line scans and for indicating by coded data the length of segments of each scan of a predetermined tone characteristics, said phototypesetter including means for reproducing said tone characteristic for a predetermined line segment in response to coded data indicating the length of a line segment to be reproduced.

5. In a phototypesetting apparatus, a phototypesetter for writing text material in graphics on a recording medium in response to coded data, said apparatus including a character memory having instructions for forming the characters of a font of characters stored therein and operable in response to coded data to effect operation of said phototypesetter in response to coded data, each of said characters in said memory having an address code, said phototypesetting apparatus being operable in response to coded data indicating the length of line segments to be printed to effect the writing of a line segment, storage means for storing data for controlling said phototypesetter including means for storing coded data for providing said address codes for characters to be written and means for storing coded data indicating the length of segments to be formed by said typesetting apparatus to reproduce copy, terminal means for supplying coded characters for storage in said storage means in accordance with text to be printed and scanning means for supplying coded data representing length of scans for reproducing copy which has been scanned by said scanning means.

6. A method for composing a page of printed material comprising entering coded layout data into a computer to allocate a page section to a particular item by visually displaying a page area on which the material is to appear with any previously allocated sections of the displayed page area blocked out, visually indicating on the display a section to be allocated to an item, converting the visual indication into coordinate data for the section to be allocated which coordinate data may be used by the computer to locate the sections on the page and to outline the page on request, entering the said coordinate data and data identifying the item to appear in the allocated area into the computer, coding items to appear on the page by establishing code signals for each letter of the text material to provide coded character data, storing the coded character data in the computer with an address identification for each item so stored, and operating the computer in accordance with the layout information to control the phototypesetter in accordance with said coded character data to reproduce said items on said page at the locations specified by said coordinate data, and utilizing the computer to control a phototypesetting apparatus to generate a page having the allocated items displayed thereon.

7. A method as defined in claim 6, wherein the aforesaid steps include the steps of scanning artwork to derive digital data which is entered into the computer with the digital data being such that the computer may operate a cathode-ray tube composing machine to produce the scanned material including artwork and operating the computer in accordance with the layout information to reproduce pages which are composed with both text and artwork in the photocomposing apparatus.

8. In a method as defined in claim 7, wherein the prepared copy is scanned by a scanner to provide bit signals for line and halftone copy and to provide length of scan data indicating the length of a scan across a continuous-tone artwork and the length of segments with the scan of predetermined tone densities and a tone measurement indicating the density of the continuous tone while it is being scanned, converting the continuous tone signal to a digital data and entering the digital data together with the coordinate data indicating the points in each scan where the continuous-tone artwork starts and stops into the computer and utilizing the digital tone data to control the effective halftone screen size of a halftone reproduction of the artwork on a cathode-ray tube of the photocomposing machine and the length data to control the extent of the halftone reproduction.

9. A method for composing a copy page of a publication comprising allocating portions of the page to particular items by entering coded layout data into a computer programmed to control a cathode-ray tube display of page areas with assigned sections outlined when coordinate data specifying the sections is stored in the computer, deriving said coded data by calling the computer to display a selected page area on the cathode-ray tube display and operating visual indicating means separate from the computer to indicate on the visual display the sections to be assigned, establishing electrical signal representative of coordinate data in response to a positioning of said visual indicating means and applying the electrical signal to the computer to enter coordinate data defining the location of the visual indicating means to define the assigned section together with an identification of the item for the section and preparing a copy page in accordance with the stored layout information.

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