United States Patent

[11] 3,548,725

[72] Inventor Eckhard Dirk Lindemann
Raisdorf Near Kiel, Germany
[21] Appl. No. 706,410
[22] Filed Feb. 19, 1968
[45] Patented Dec. 22, 1970
[73] Assignee Dr. Rudolf Hell Kommanditgesellschaft
Kiel-Dietricksdorf, Germany
a Limited Partnership
[32] Priority Feb. 25, 1967
[33] Germany
[31] No. 61,955

[54] **METHOD OF ORGANIZING THE CORE MEMORY IN ELECTRONIC PHOTOTYPE SETTERS OPERATING BY RASTERING**
6 Claims, 3 Drawing Figs.

[52] U.S. Cl. 95/4.5
[51] Int. Cl. B41b 27/20
[50] Field of Search 95/4.5

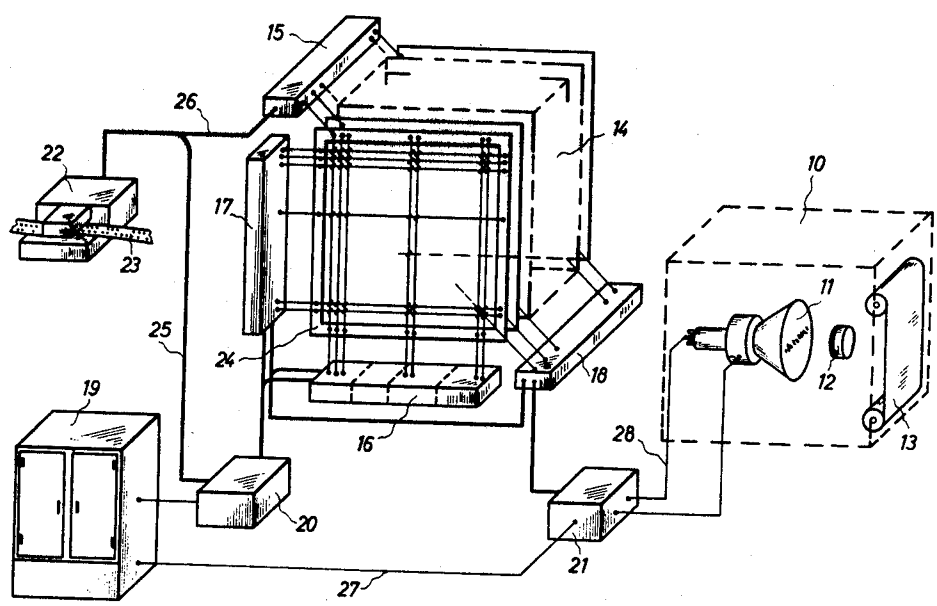
[56] **References Cited**

UNITED STATES PATENTS

3,041,947	7/1962	Mulock	95/4.5
3,174,415	3/1965	Kikuchi	95/4.5
3,278,683	10/1966	Ashby	95/4.5X

Primary Examiner—John M. Horan
Attorney—Hill, Sherman, Meroni, Gross & Simpson

ABSTRACT: A method of organizing the core memory in an electronic phototype setter operating by rastering is disclosed wherein characters to be used in printing are called up under a binary coded number allocated to each character which number is independent of whether the number is upper or lower case or of script type and size and by addressing with this calling up number a storage cell of the core memory from which cell the address of said character in the desired script type and size in which it is to be set as well as the data concerning the width of such character are taken.



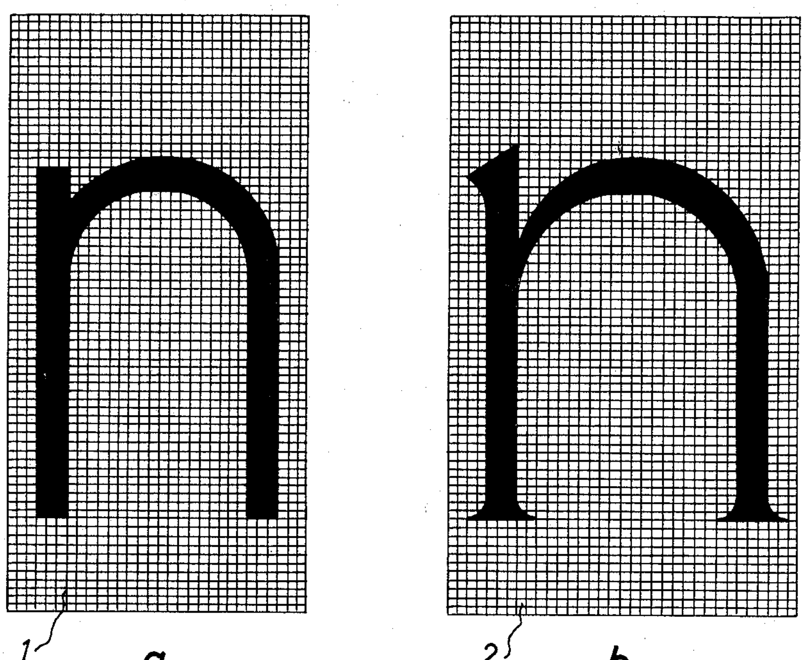


Fig. 1

INVENTOR
Eckhard Dirk Lindemann

BY Hill, Sherman, Meroni, Gross & Simpson ATTYS.

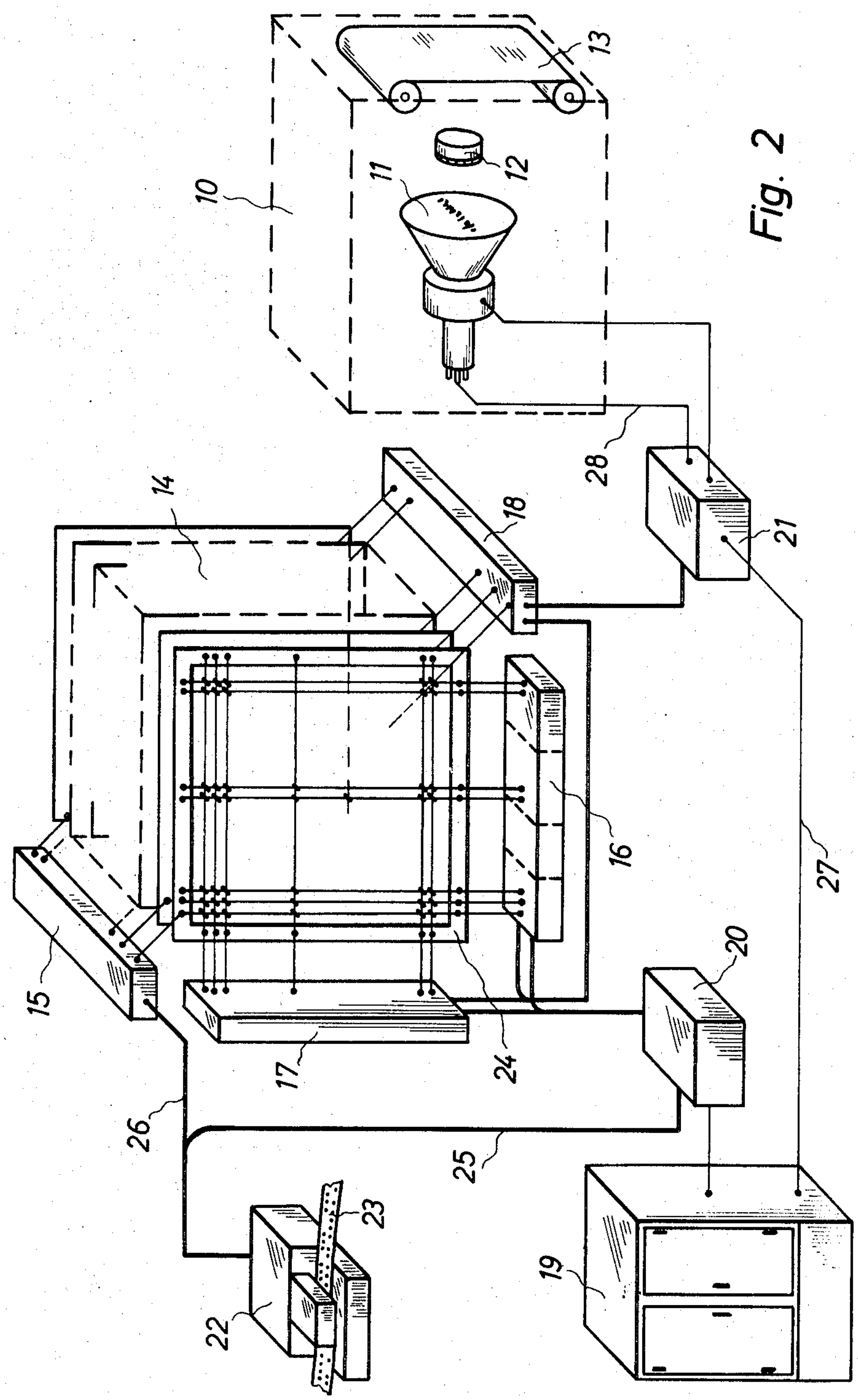


Fig. 2

INVENTOR
Eckhard Dirk Lindemann

Hill, Sherman, Meroni, Gross & Simpson

BY ATTYS.

METHOD OF ORGANIZING THE CORE MEMORY IN ELECTRONIC PHOTOTYPE SETTERS OPERATING BY RASTERING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to the methods of organizing core memories in electronic phototype setters operating by rastering such that characters may be stored and called up in an efficient manner from a core memory under the control of a punch tape or computer and supplied to a cathode ray tube.

2. Description of the Prior Art

Prior storage of characters in core memories for use in electronic phototype setters has required tremendously large capacities of core memories so as to allow a large number of character types (some hundreds) which may be from several character font, to be stored.

BRIEF SUMMARY OF THE INVENTION

The present invention allows a character to be stored in a core memory so that it is assigned a binarily coded number which is independent of the case, type and size in which it is to be set. In order that the desired character can be found at its calling up in the core memory, its address is deposited in the memory when reading in the font, in other words, when filling the core memory. Special memory cells serve this purpose which are addressed with a number when the character is called up from the computer for the setting process. These memory cells constitute the organization part of the core memory. The addresses likewise consist of binarily coded numbers. The addresses of equal characters of different font and sizes might be quite different. In addition, the width of each character is deposited in the respective memory cell of the organization part of the core memory.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show an embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1*a*** and **1*b*** show script originals of the character "n" of two different font.

FIG. **2** shows the block circuit diagram of a complete phototype setter equipment.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method of organizing the core memory in electronic phototype setters operating by rastering.

A high resolution cathode ray tube is used as a display tube in electronic phototype setters. The characters of one line to be set are produced point by point and column by column by the cathode ray, as in television, in the form of luminous characters positioned side by side on the luminous screen of the tube. The characters are photographed line by line by a camera onto a film transported continuously or in steps vertical to the direction of the lines. The film is then developed and subsequently reproduced by means of a printing process, as for example, the offset process.

When using the raster method, each character is formed by a large number of luminous points with the electron beam being uniformly deflected according to a column raster along an area which is occupied by a character field. The deflection is independent of the kind of character. The final shape of the character is obtained by gating the cathode ray tube beam at those points of the raster which correspond to black picture elements of the character to be represented. The cathode ray is blocked at all other places.

The uniform raster deflection of the cathode ray for writing a character is to be distinguished from the main deflection or positioning deflection of the electron ray, which gives the center or corners of the individual character fields the predetermined position on the luminous screen within a line.

The voltages for gating and blocking the video signals which are applied to the grid of the display tube for making the characters visible, are obtained according to the raster method by interrogating a core store which provides binary pulse sequences representing the black and white character elements which compose the character fields point by point and column by column. The cathode ray is periodically vertically deflected synchronously with the interrogation of the core store.

When setting complicated texts requiring a large number (some hundreds) of character types, which may be from several character font, core memories of sufficiently high capacity are used into which all the required characters are read as needed in binary form prior to or during typesetting. The various binary sequences which correspond to the separation of the characters into successive columns are taken from a high capacity electronic memory, as for example, a magnetic drum memory store in which all character types which may ever be used are stored in the form of binary sequences. When a new setting order arises, the alphabets in the core memory that are not required are erased, and the new alphabets required are taken from the high capacity memory and read into the core memory. In this case, the core memory serves as temporary storage with a very short access time, and not more than is required each time for a setting order is stored in this temporary memory. This memory corresponds to the magazine of a conventional setting machine.

The selection and the placing of the characters is controlled by setting instructions which can be in the form of punched tapes or punched cards which are punched according to a multidigit binary code. The setting instructions have to contain in very detailed manner all data required for setting the characters such as kind of character (phonetic value), shape of character (type of alphabet, font) size and width of character, spaces, bold face types, italics, length of lines, indents, omissions, paragraphs, line spacings, justification, hyphenation and change of magazine.

Instead of punched tapes or punched cards, a computer may be used which is programmed with the text to be set and with the setting instructions in binary coded form and which computes justification and hyphenation. Furthermore, the alphabetic sorting of words and names as in dictionaries and telephone directories, may be achieved by the computer.

In order to satisfactorily fulfill the requirements which are assigned to an electronic phototype setter of this type, a special type of organization of the core memory is necessary. According to this invention, the core memory is organized to call up the character to be set independent of upper or lower case and of script type and size, under a binary coded number allocated to said character, and by addressing with this coded number a storage cell of the core memory, from which the address of the character in the desired script type and size in which it is to be set and the data concerning the width of the character are taken.

A character to be set is characterized by its phonetic value or meaning content and by the technical specifications regarding its form. If characters such as letters, figures, punctuation marks and other symbols are to be set, particulars are necessary which determine whether the respective letters are to be set in capitals or lower case letters and in which particular script type and size. When organizing the core memory, the difference between the phonetic value or the meaning content of the character and its technical design must be maintained.

First of all, each character, corresponding to its phonetic value or meaning content independent of case, type, and size in which it is to be set, is assigned a binarily coded number. In this way, letters are numbered in their alphabetic order. The letter *a* may be indicated by the number **1**, *b* by the number **2**, *n* the number **14**, etc. Thereafter, figures, punctuation marks, and other symbols are numbered successively.

In order that the desired character can be located at its position in the core memory, its address must be deposited in the memory when filling the core memory. Special memory cells serve this purpose which are addressed with the number under which the character is called up from the computer for the setting process. These memory cells constitute the organization part of the core memory. The addresses also consist of binary coded numbers. The addresses of the same characters of different font and sizes can be quite different. Thus, the letter *n*, represented by the number 14 in the case of a 6-point Grotesque-Script, may have the address-number 312,while the same letter with a 10-point Garamond-Script may have the address number 786.

Besides the address of a character, its width is deposited in the respective memory cell of the organization part of the core memory. The width of a character is the number of picture columns which constitute the character at its raster-type dissection into picture points and includes a certain number of empty columns to the left and to the right of the character. The widths of the individual characters of a definite font and size vary considerably from each other. If the letter *a*which has an average width, requires 28—30 picture columns, narrow characters such as *i*, 1, comma and full stop need only 8—10 columns, whereas broad letters such as M and W require 50-—60 columns. The width of a character, therefore, determines the amount of space required by the character at its division into image columns in a group of binary magnetized annular cores in the core memory.

When reading-in the font, the core memory addresses of the individual characters together with their widths including the number of empty columns on both sides of the character are placed at the head of the hold combinations which contain the information about the division of the characters into image elements as identifiable signals in binary coded form. When reading-in the punched tape into the core memory, the addresses and widths are first stored under the identification number of the character, independent of script type and size, in the memory cells of the organization part of the core memory.

Then, the address itself is triggered, and the information bits of the character image are stored in the core memory. In this way, it is possible to fill the core memory with different font, and to change the font by erasing them.

There are two ways to store the width of individual character images of an alphabet of a definite script type and size in the core memory. The number of empty columns on both sides of the actual character field (in which the first and last columns contain at least one black point) is characteristic for each character. This number is so selected that, when several successive characters are composed into one word, the spaces of successive characters resulting from the number of empty columns behind a character and in front of the next character present a pleasant view to the eye. When these empty columns in front of and behind a character field are stored, the cathode ray beam is blocked when these empty columns are interrogated in the core memory and the beam is not being used. After the recording of one column, the ray is automatically deflected horizontally one column width to the right in order to record the next column. Therefore, no additional instructions from the computer for horizontal deflection are required. But the storage of the empty columns requires additional space in the core memory.

Instead, only the image columns of the actual character fields need be stored in the core memory without the empty columns on both sides and cores will be saved. Then, however, additional instructions are necessary for recording a character within a word. The instructions specify how many column widths the cathode ray beam must be horizontally deflected to the right without being vertically deflected after the beam has written the last column of a character and before it begins to record the first column of the next character. This number of column widths is equal to one more than the sum of the numbers of empty columns to the right of a character and to the left of the following character.

The means for storing the character information in the core memory are groups of annular cores which correspond to the image columns which make up the characters. The annular cores of these groups are magnetized in either one or the other of the two possible modes corresponding to the presence of white or black image elements in the image columns.

The essential of this storage consists in assigning one annular core to each image element of the rastered character field. As many annular cores are therefore needed as image elements contained in a character field (number of lines times number of columns).

However, still another type of storage is possible by using the known "run-length-coding." The individual image elements are not stored in magnetized annular cores, but the number of successive constant image elements (white or black) in an image column is stored. A number is assigned to the change of color (black to white or white to black). If these numbers are represented in a multidigit binary code, one then needs as many memory cells for storing these numbers as there are digits in the binary code. If the binary code has *n*digits, the largest possible number *z*thereby represented is equal to 2^n. However, $n = \log_{2z}$ much less than *z*. The selection of the number of digits of the binary code depends upon how many image elements can be contained in an image column of the largest characters which may occur; since there are image columns in such as M or T, which consist only of black elements. The average number of image elements of constant color in a column is, of course, considerably smaller. Nevertheless, when using the method of run-length-coding a considerable saving of annular cores is generally achieved.

If the last upper section of an image column of a character field consists only of white image elements, the storage of this white section is not necessary since the cathode ray is blocked during the interrogation of this section. The identification number of the last black section of the image column can then be provided with an additional characteristic number which causes the vertical deflection of the cathode ray beams to be stopped, and the recording of the next image column is begin.

In order to obtain the image content of the characters required for the setting process in binary coded form, a concrete script original of each of these characters for each font must be made at the start.

Each of these script originals is photoelectrically scanned in a sufficient number of columns. However, only the number of usual empty columns on both sides of the character, the leading and trailing width, are registered.

The white and black values obtained during scanning are converted into binary data in the scanning device, either as one bit for each image element, or as a multidigit binary number (one byte) for the length of each image column section which consists of equal (white or black) image elements. The binary data are punched into a tape in the form of hole combinations, the punched tape being then read into either the core memory of the phototype setter equipment or the high capacity memory.

Two script originals prepared for scanning are represented in FIGS. 1*a* and 1*b*. These figures (FIG. the character *n*in Grotesque-Script (FIG. 1*a*) and in Garamond-Script (FIG. 1*b*). It is seen that each character is drawn into a character field **1** or **2** provided with a raster line network. The small rectangles (the network meshes) which need not necessarily be squares formed by the raster lines are the image elements. The small strip limited by two adjacent vertical raster lines, represents an image column.

The character field **1** has leading and trailing widths of three empty columns each, whereas the character field **2** has a leading width of two empty columns and a trailing width of one empty column.

Each of these two characters *n*will be assigned the same number in the organization part of the core memory, while the addresses under which their image contents are stored will be different.

The phototype setter equipment consists of the recording device **10** containing the cathode ray tube **11**, the imaging lens **12**, and the photographic film **13**. Also, the core memory **14** with the input register **15**, the address registers **16** and **17**, the output register **18**, the computer **19**, and two control devices **20** and **21**.

The reading device **22** fills the core memory **14**. The reading device **22** scans the combinations of holes punched in tape **23** and feeds the scanned data to the core memory **14** in the form of electronic pulses.

The core memory **14** consists of a plurality of similar matrix plates **24** arranged one behind the other. Each matrix plate has, as it is conventional, two systems of horizontally and vertically arranged wires with the crossing points having a magnetic annular core which surrounds the two wires. The horizontally arranged wires of the same line of each matrix plate and the vertically arranged wires of the same column of each matrix plate are connected in parallel, respectively. Thus, all annular cores in the same column and line in the matrix plates have a common address, and, therefore, constitute a memory cell. The input (inhibit) lines and the output lines, however, are brought out separately.

The vertical wires are connected with the outputs of the address register **16**, and the horizontal wires with the outputs of the address register **17**.

The wires visible at the outputs of the input register **15** and the wires visible at the inputs of the output register **18** are the reading or output conductors of the memory.

The number of horizontal and vertical wires and annular cores of each matrix plate as well as the number of the required matrix plates depends on the number of the characters to be stored.

An alphabet consisting of upper and lower case letters, punctuation marks, figures, and other symbols, comprises 90—100 different characters. When using the saving run-length-coding, on the average about 40 core memory cells with 16 bits each are required for each character. A complete alphabet, therefore, requires about 4,000 memory cells. Since it may be desired to be able to store four different alphabets for a setting order, each of the required matrix plates must have at least 16,000 annular cores. At least 100 cores per alphabet are also required for the organization part of each matrix plate. The number of the horizontal and vertical wires required in this example are 128 each.

The "reading-in" is accomplished as follows:

The first combination of holes of the punched tape **23** represents the command for beginning the storing process. This command is fed via the conductor **25** to the control device **20** and causes the switching processes required for addressing, so that the next scanned data combination is used as a character number, and the memory cell to which this number is assigned in the organization part is called up via the address registers **17** and **16**. Then the punched tape **23** gives the address that the character has in the memory. This is the address of that memory cell in which the first data combination of the image content is to be stored. The data combination corresponding to this address is fed via the conductor **26** to the input register **15** and from there into the memory cell of the organization part called up under the character number. Immediately thereafter this address is also called up in the memory part after which the storing of the image content of the character may begin. After the storing of an image column has been finished, an electronic counter contained in the control device **20** and having counted the read-in data, causes the addition of 1to the counting result and switches the storing to the next column.

After the last data combination belonging to the image content of a character has been stored, a command is given from the punched tape **23** to the control device **20** to use the next data combination as the address of the following character.

Prior to the storing of the image content, the data concerning the width of the character is read-in into the organization part. Besides the actual width of the character, the number of empty columns on either side of the character is known. These empty columns are necessary so that the varying spaces between successive characters offer a pleasant view to the eye.

The advantage of storing the data concerning the width as a special data combination results in saving as many memory cells as there are empty columns.

A characteristic feature of the memory organization is that only the first 14 digits of the mentioned 16 digits of each memory cell are utilized for the actual image content while the remaining two digits, the 15th and 16th digit, serve for selecting the desired font from the supposed four different fonts. These last two digits may be occupied by commands of the computer **19** or by manually operated switches.

The setting process occurs and is accomplished as follows:

First, the computer **19** controls the deflection of the cathode ray beam of the cathode ray tube **11** so that the beam is deflected to its initial position on the screen which is the starting position of the beam for the recording of the first character of a character line, and, also, the computer gives the command for the beginning of the setting process. Then, via the control device **20**, the computer calls up the number of the character to be set in the organization part of the core memory **14**. The control device **21** causes the output register **18** to read out the memory address of the character from the memory cell assigned to this number, and the output register **18** feeds the memory address to the address registers **16** and **17**. After the memory address has been called up, the image content of the first image column is read out and fed to the control device **21** which is caused to control the brightness of the cathode ray beam according to the image content. The deflection of the cathode ray beam is controlled by commands from the computer.

The memory data read out are counted by the control device **21**, and, as soon as all the data of one image column are read out, the control device **21** calls up the address of the next image column by adding 1to its counting result.

After the last memory data of a character have been read out, the setting of the character has been finished and then the control device **21** feeds back a control pulse via the conductor **27** to the computer **19** and the pulse causes the computer to call up the number of the next character to be read out.

While only the image content is deposited in the core memory **14**, the setting commands such as font, size, length of line, justification, hyphenation, space lines, etc. are given by the computer **19**.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably come within the scope of my contribution to the art.

I claim:

1. The method of organizing the core memory in electronic phototype setters operating by rastering, comprising:
   calling up the character to be set under a binary coded number allocated to said character independent of upper or lower case and of script type and size, and
   addressing a storage cell of the core memory with the call up coded number from which cell the address of said character in the desired script type and size in which it is to be set as well as the data concerning the width of said character are taken.

2. The method of claim 1, wherein the width of said character is determined by the number of columns which constitute said character.

3. The method of claim 1, wherein the data concerning the width of said character comprises the number of empty columns to the left of said character, the number of columns constituting said character, and the number of empty columns to the right of said character.

4. The method of claim 1, wherein the three data determining the width of said character are stored in the organization part of the core memory.

5. The method of claim 1, wherein the numbers of successive image elements of the same color constituting the black and white sections of the individual columns are stored in the core memory.

6. The method of claim 1, wherein the identification number of the last black section of each column is provided with an additional characteristic number which when read initiates the recording of the next picture column.