United States Patent [19]

Yeh

[11] **3,820,644**

[45] **June 28, 1974**

[54] **SYSTEM FOR THE ELECTRONIC DATA PROCESSING OF CHINESE CHARACTERS**

[76] Inventor: **Chan-Hue Yeh,** 1501 California Ave., Alto, Calif. 94304

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[21] Appl. No.: **357,703**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 225,048, Feb. 10, 1972.

[52] **U.S. Cl.** ..... **197/1 A,** 101/93 C

[51] **Int. Cl.** **B41j 3/50**

[58] **Field of Search** ..... 197/1, 1 A, 98; 235/145; 101/93 C

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—R. T. Rader
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

Method and apparatus for electronically processing bits of information, particularly Chinese characters where the information is Chinese characters or the like, the steps comprising digitally converting the Chinese character by means of a 480 point matrix and converting the digitalized character to 120 hexadecimal digit code units.

33 Claims, 28 Drawing Figures

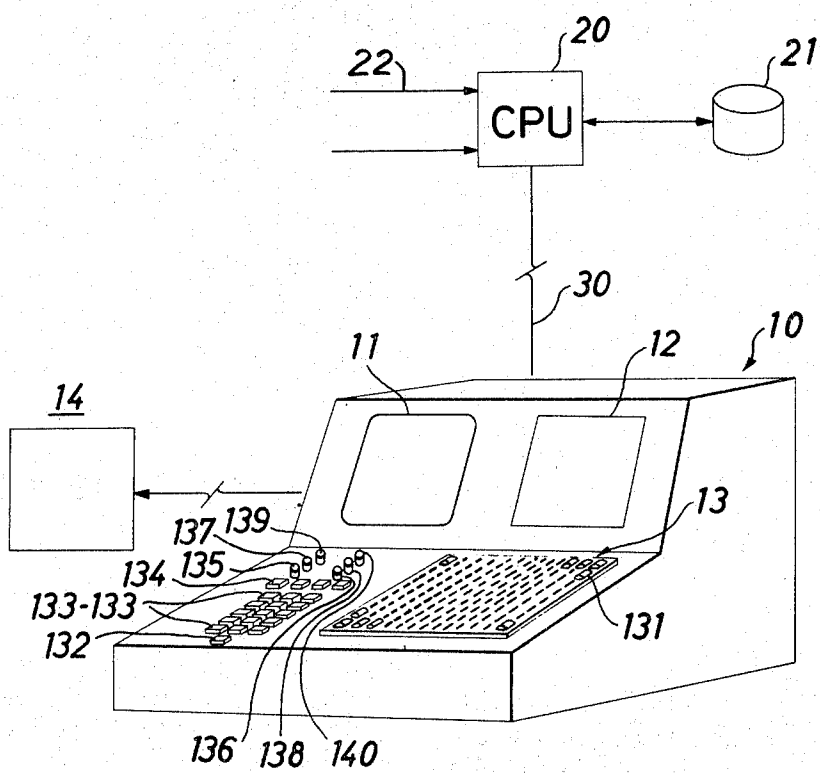


FIG.1A

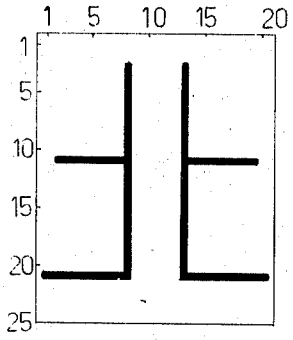


FIG.2A

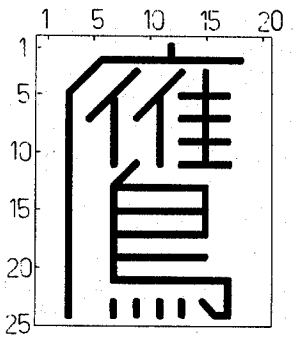


FIG.3A

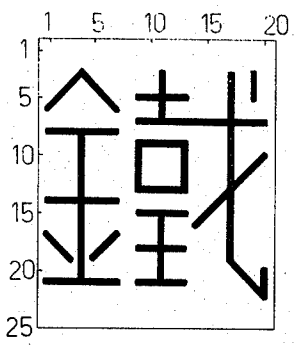


FIG.1B

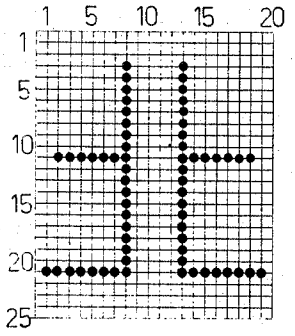


FIG.2B

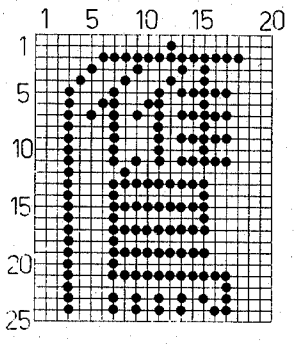


FIG.3B

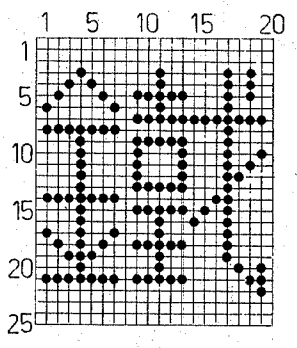


FIG.1C

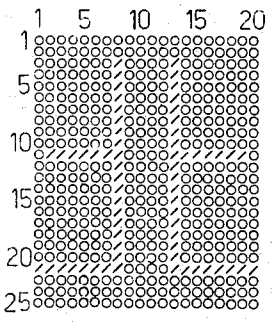


FIG.2C

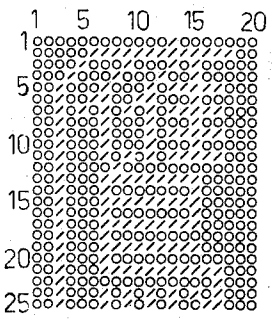


FIG.3C

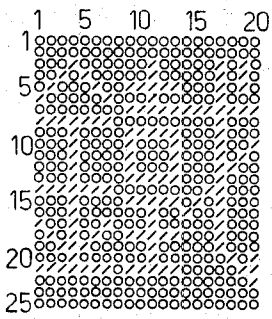


FIG.1D

```
00000
00000
01080
01080
01080
01080
01080
01080
01080
01080
7F0FE
01080
01080
01080
01080
01080
01080
01080
01080
01080
FF0FF
00000
00000
00000
```

FIG.2D

```
00100
07FFC
088A0
11120
222F8
26620
2AAF8
22220
222F8
22220
22AF8
21000
23FE0
22020
23FE0
22020
23FE0
22000
23FE0
22000
23FF8
20008
22AA8
22A98
```

FIG.3D

```
00000
00000
1020A
2820A
44F8A
82208
00FFF
FE008
10F88
10888
10889
1088A
10F8C
FE008
10F98
10228
92208
54F88
38209
10205
FFF83
00001
00000
00000
```

FIG. 4

Digitized Characters Organization

Group	Section	Character Number	Digitized Chinese Character Data Record 120 Hexadecimal Digits	Comments (For Reference Only)				
				Chinese Phonetic Alphabet	Chinese Phonetic Symbol	Romanized Syllable	Chinese Character	meaning
1	001	1	.....					
		2						
		3						
		⋮						
		15	.....					
	002	1	.....					
	⋮	⋮						
		1	.....					
	016	5	00000 00000 01080 01080 01080 01080 01080 01080 01080 01080 7F0FE 01080 01080 01080 01080 01080 01080 01080 01080 01080 FF0FF 00000 00000 00000	ㄅ	ㄆㄟˊ	Pei	北	North

FIG. 5

Master File

Record Number Five-digit	Record (Data) 120 Hexadecimal Digits
10011	.....
	.....
10165	00000 00000 01080 01080 01080 01080 01080 01080 01080 01080 7F0FE 01080 01080 01080 01080 01080 01080 01080 01080 01080 FF0FF 00000 00000 00000
⋮	⋮
⋮	⋮

FIG. 6

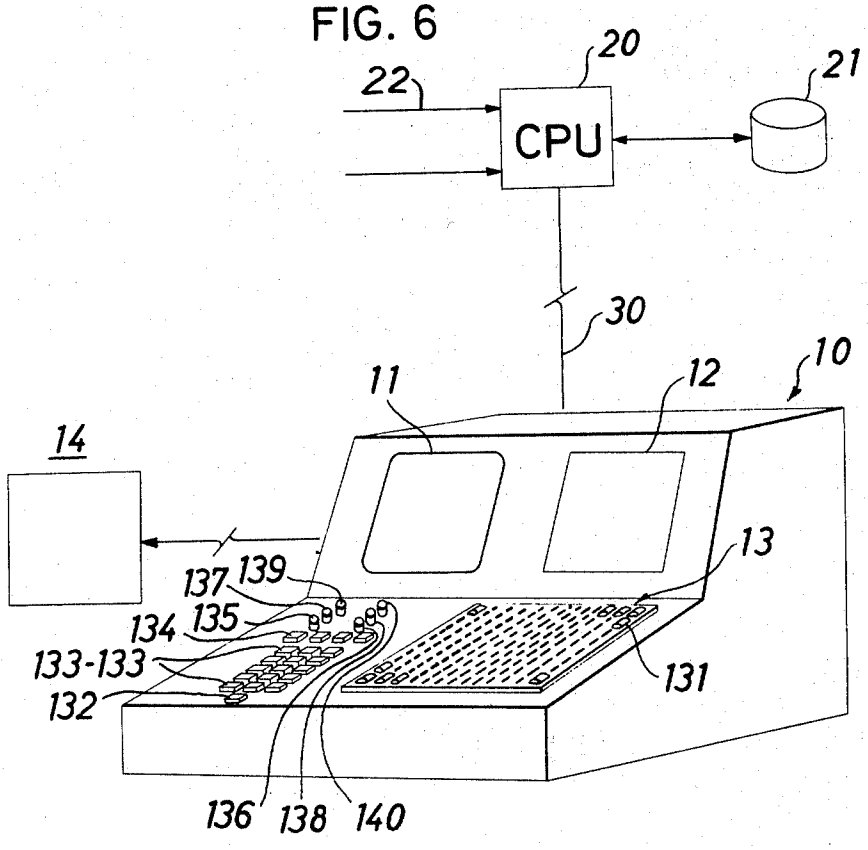


FIG. 7A

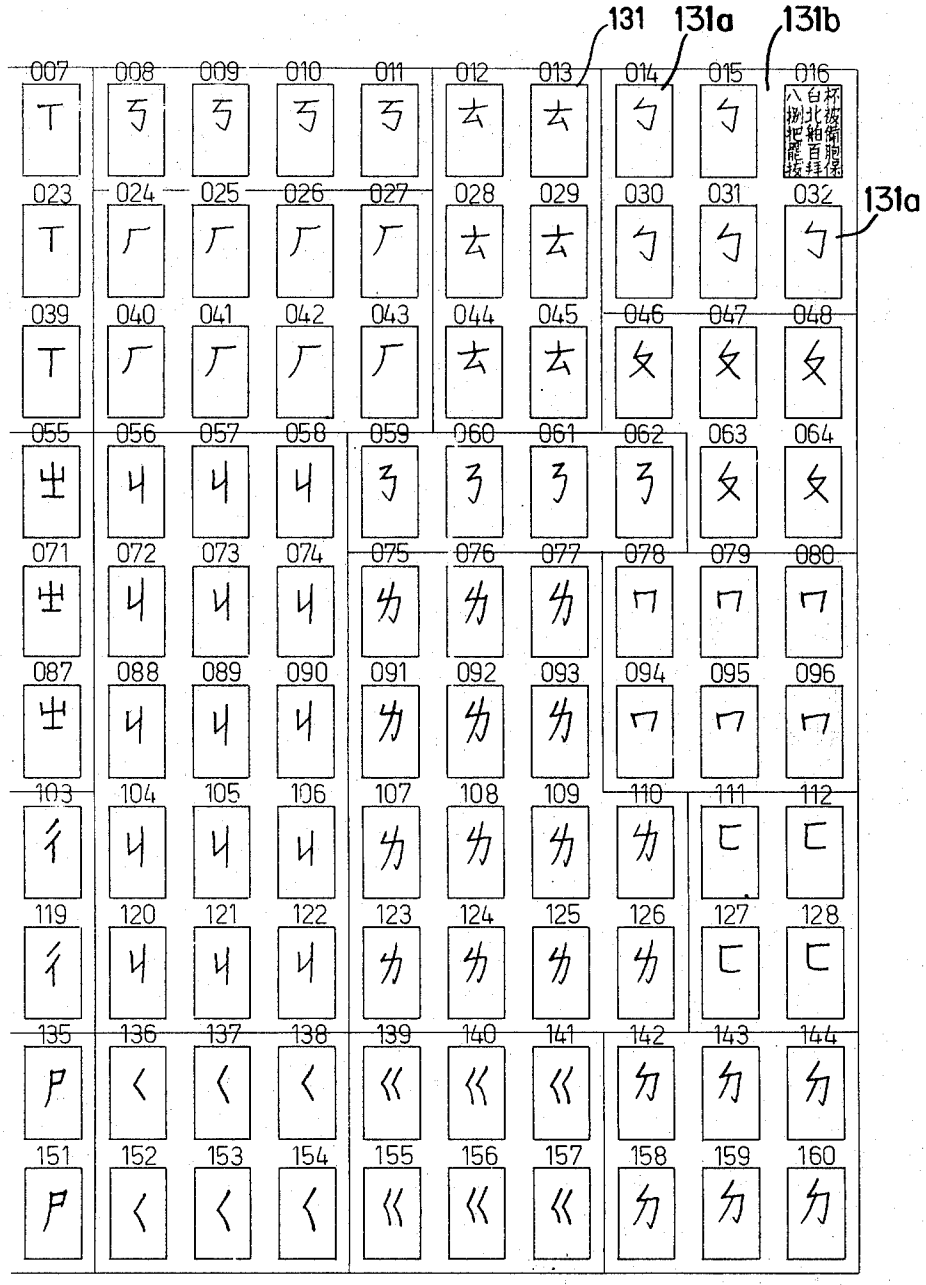
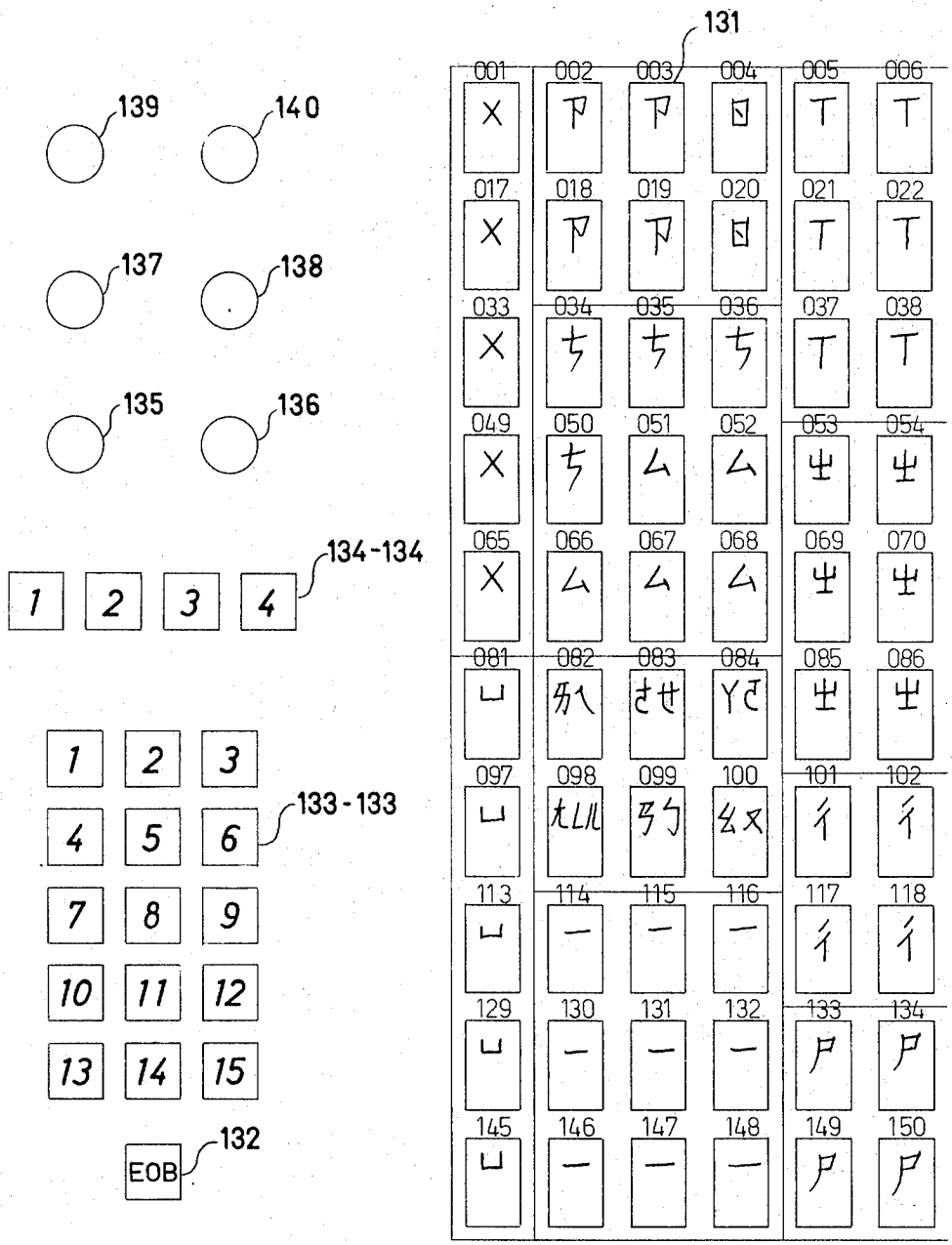


FIG. 7B


131
139
140
137
138
135
136
134-134
1 2 3 4
1 2 3
4 5 6
7 8 9
10 11 12
13 14 15
133-133
EOB
132
001 002 003 004 005 006
017 018 019 020 021 022
033 034 035 036 037 038
049 050 051 052 053 054
065 066 067 068 069 070
081 082 083 084 085 086
097 098 099 100 101 102
113 114 115 116 117 118
129 130 131 132 133 134
145 146 147 148 149 150

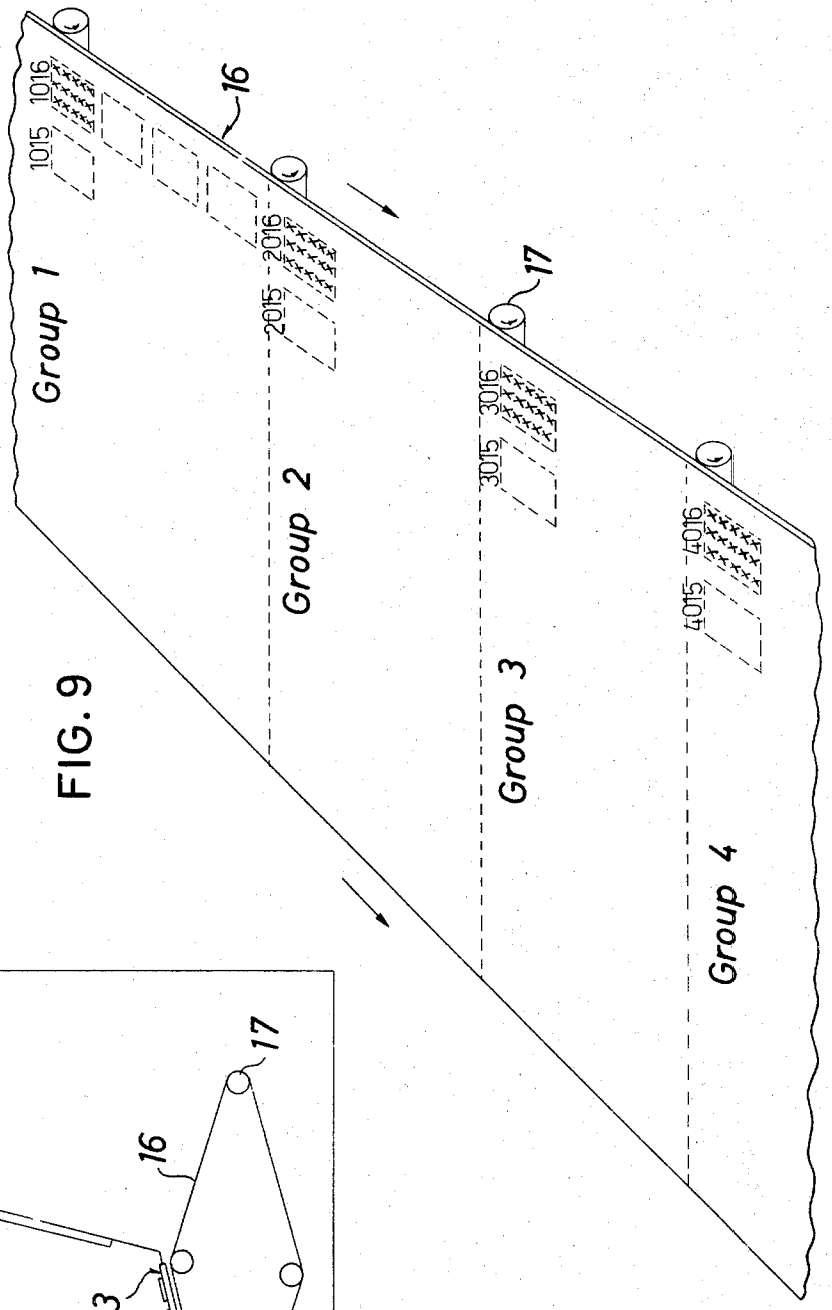

16
17
1015
1016
2015
2016
3015
3016
4015
4016
Group 1
Group 2
Group 3
Group 4

FIG. 9

17
16
13
17
133-133

FIG. 8

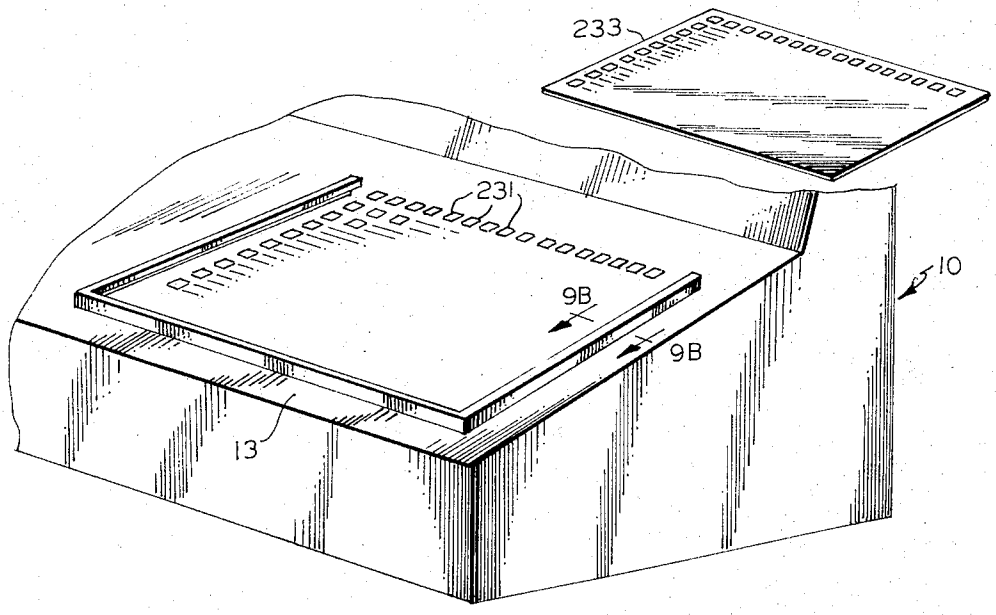


FIG.9A

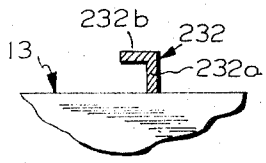


FIG.9B

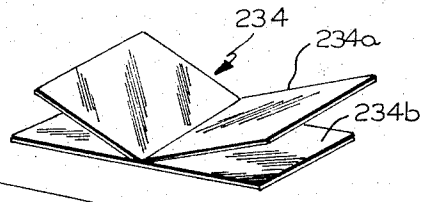


FIG.9C

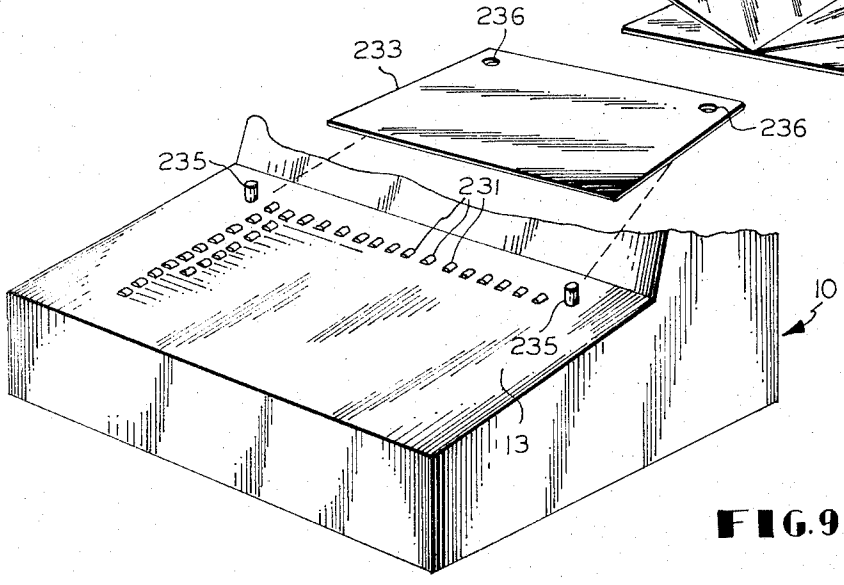


FIG.9D

FIG. 10

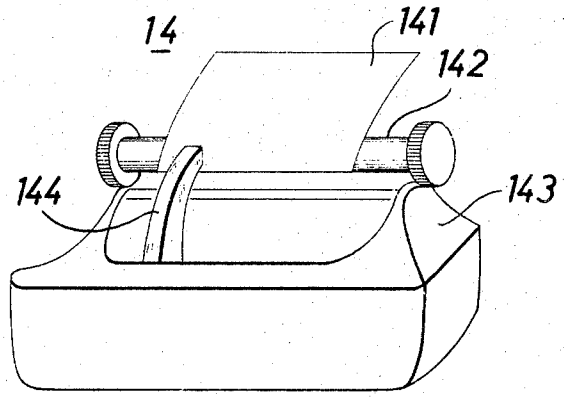


FIG. 12

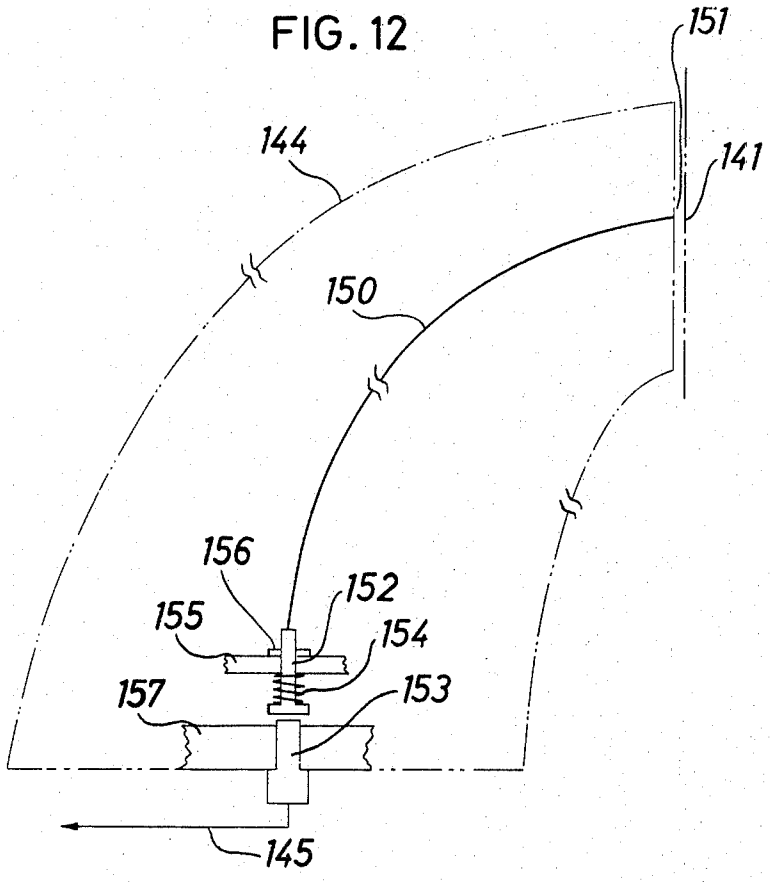


FIG. 11A

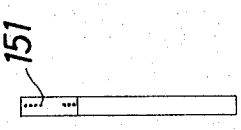
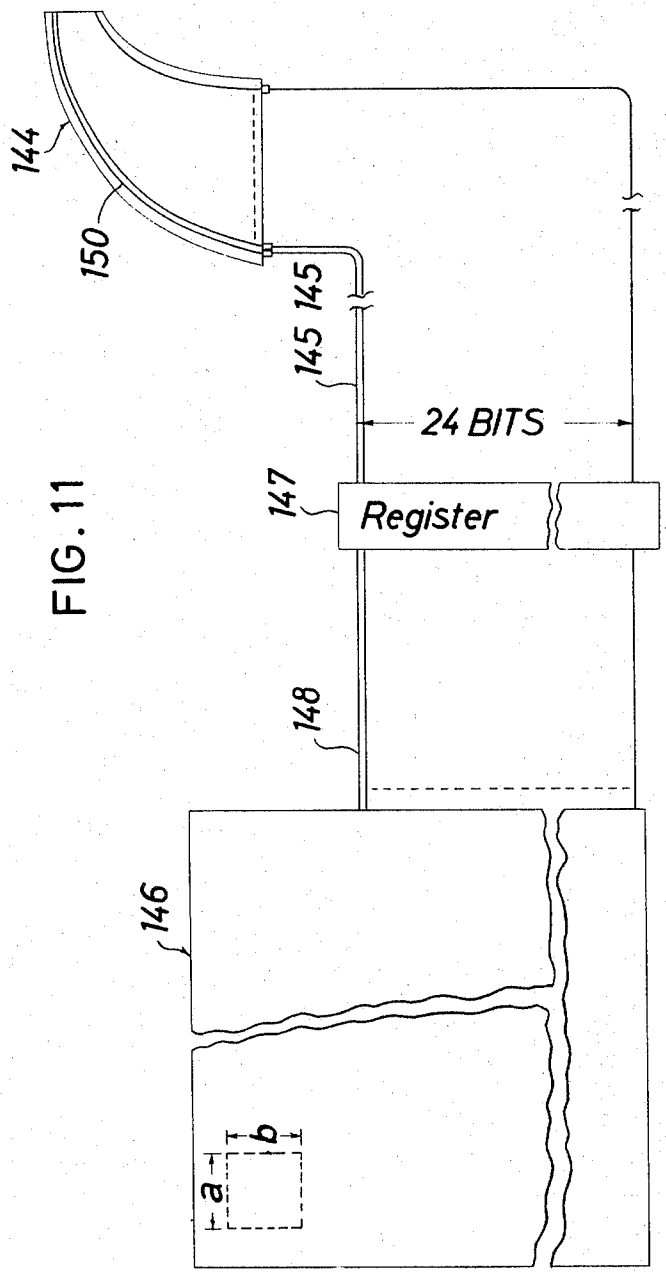


FIG. 11



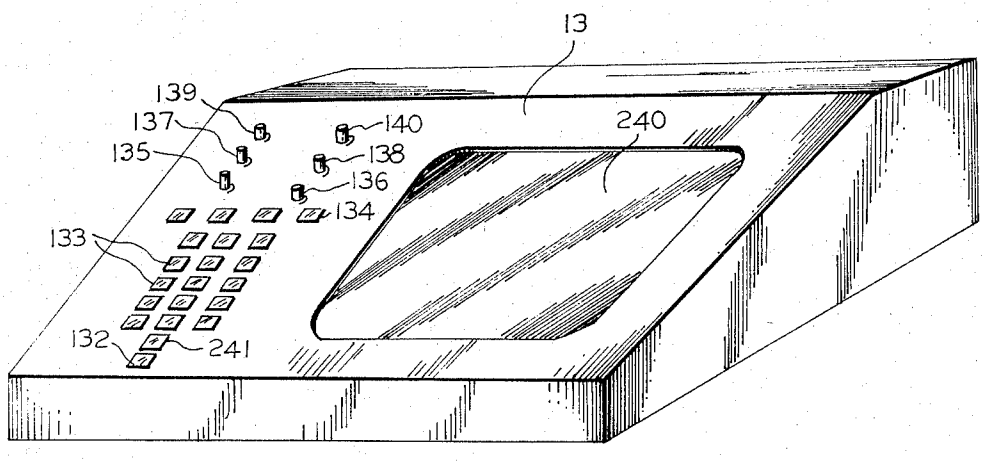


FIG. 13

SYSTEM FOR THE ELECTRONIC DATA PROCESSING OF CHINESE CHARACTERS

This application is a continuation-in-part of my application Ser. No. 225,048 filed Feb. 10, 1972.

BACKGROUND OF THE INVENTION

This invention relates to a novel system for electronic data processing of bits of information, particularly Chinese characters, and more particularly to a Chinese typewriter and a teletype machine for direct Chinese message transmission and switching from one station to another.

In the prior art, a Chinese typewriter comprises a complex mechanism and a galley in which many lead types are attached. The typist must be trained to memorize the location of each character type positioned on the galley. This training takes at least four months or more. In operation, each character is retrieved physically and mechanically from the galley and then stamped on paper one at a time. A well trained typist can only type about 20 to 30 characters per minute.

At the present time, in order to send a telegraph in Chinese, the sender must use a Standard Telegraph Code Book and translate the message into a specified numerical code. Similarly, the receiver also must use the same reverse procedure to decode the message. This procedure is inefficient, costly and highly inconvenient. Accordingly, there is need for a system for electronic data processing of Chinese characters.

Therefore, an electrically operated Chinese typewriter and a computerized Chinese character, in particular, have recently been the subject of extensive research and development. However, due to inherent problems in processing Chinese characters in particular, no digitalized alphabet of Chinese characters being conveniently and simply stored and no arrangement, classification or organization of Chinese characters being provided for quick and easy access, a practical automated or computerized Chinese typewriter is still not commercially available.

SUMMARY OF INVENTION

Accordingly, it is an object of this invention to provide a novel system particularly suitable for electronic data processing of Chinese characters.

It is another object of this invention to provide a novel Chinese character typewriter and a teletype machine for direct Chinese message transmission and switching from one remote station to another.

It is a further object of this invention to provide a system which revolutionizes Chinese character typing and Chinese character telegraph operation, and which eliminates the necessity of coding and decoding operations used in present Chinese telegraph systems.

These and other objects are attained by this invention which, in a preferred form, comprises a system wherein each Chinese character is digitalized by means of a 20x24 matrix (480 grid points) and simplified by being converted into a code unit of 120 hexadecimal digits, and selectively stored in a master file within a direct access storage apparatus. A keyboard is provided for quick access to the master file. Under the keyboard a motor driven reference character sheet is disposed with the characters grouped thereon according to the order of the Chinese phonetic alphabet. By appropriate keying of selected buttons corresponding to certain groups, sections and characters, mechanism within the

apparatus retrieve code units for corresponding characters from the master file. Printing means are provided for printing out the characters which are retrieved. The printing means comprises a twenty four wire printing head which is selectively actuated in accordance with the retrieved code units to print the corresponding characters.

BRIEF DESCRIPTION OF DRAWING

FIG. 1A is a Chinese character "Pei," meaning "North;"

FIG. 1B depicts a digitalized form of the Chinese character "Pei" as shown in FIG. 1A;

FIG. 1C depicts a binary representation of the digitalized character shown in FIG. 1B;

FIG. 1D depicts the hexadecimal equivalent of the binary digits shown in FIG. 1C;

FIG. 2A depicts another Chinese character "Ying" meaning "Eagle," representing a typical long pattern of Chinese characters;

FIG. 2B depicts the digitalized form of the character "Ying", shown in FIG. 2A;

FIG. 2C depicts the binary representation of the digitalized character shown in FIG. 2B;

FIg. 2D depicts the hexadecimal equivalent of the binary digits shown in FIG. 2C;

FIG. 3A depicts another Chinese character "Tieh," meaning "Iron," representing a typical wide pattern of Chinese characters;

FIG. 3B depicts the digitalized form of the Chinese character "Tieh", as shown in FIG. 3A;

FIG. 3C depicts the binary representation of the digitalized character shown in FIG. 3B;

FIG. 3D depicts the hexadecimal equivalent of the binary digits shown in FIG. 3C;

FIG. 4 depicts a chart showing a preferred organization of a portion of digitalized characters organized in accordance with the present invention, wherein the Chinese characters are divided into four groups, each group comprising 160 sections, each section comprising 15 characters, and each character being digitalized in the form of code units of hexadecimal digits;

FIG. 5 depicts a form of a master file for the code units in accordance with this invention;

FIg. 6 is a schematic diagram showing a novel system for electronic data process of Chinese characters according to this invention;

FIGS. 7A and 7B are plan views of the right and left parts of a keyboard panel showing four push-buttons for character group selection, 160 push-buttons for section selection, and 15 push-buttons for character number selection;

FIG. 8 is a schematic side elevation of the combination of the keyboard panel and the character reference sheet with associated parts being omitted for clarity;

FIG. 9 is a partial perspective view of the character reference sheet;

FIG. 9A is a partial perspective view of a modified embodiment of the terminal unit and keyboard according to the present invention;

FIG. 9 is a section on line 9A—9A of FIG. 9A;

FIG. 9C is a perspective view of a character sheet arrangement for use with the embodiment of FIGS. 9A and 9B;

FIG. 9D is a partial perspective view of another modified embodiment of the terminal unit and keyboard according to the present invention.

FIG. 10 is a perspective view of a Chinese matrix printer;

FIG. 11 is a schematic diagram showing the electrical connection between the buffer and matrix pring head;

FIG. 11A is a side view of the matrix print head of FIG. 11;

FIG. 12 is a schematic diagram of the structure inside a print head comprising 24 pieces of fine wire with only one piece of printing wire being shown for clarity; and

FIG. 13 is a perspective view of a terminal unit and keyboard of another modified embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following description, the method and apparatus are disclosed as being for handling of Chinese characters. However, as will be apparent from this description, the method and apparatus can be used to handle other similar information which can be grouped and represented in a similar fashion.

DIGITALIZATION OF CHINESE CHARACTERS

An important aspect of the preferred embodiment of this invention is that the Chinese characters used in the typewriter of the invention are digitalized by means of a 20x24 matrix (480 grid points), and each digitalized character is, in turn, represented by 120 hexadecimal digits.

Referring now to FIGS. 1A–1D, a Chinese character "pei" is shown. The Chinese character is superimposed in discrete form, i.e., in the form of dots, on a matrix of 20x24 grid points as shown in FIG. 1B. Then the character is digitalized, i.e., the points on the grid are represented in binary form as shown in FIG. 1C with the points occupied by dots having one binary form and the unoccupied points having the other binary form. For simplicity, the binary form of the character is, in turn, converted into a hexadecimal form in a conventional manner, as shown in FIG. 1D.

Similarly, FIGS. 2A–2D and FIGS. 3A–3D depict other examples of typical long and wide patterns of Chinese characters, respectively. Character "Ying," shown in FIGS. 2A–2D, requires a mininum of 24 rows for sufficient clarity, although it only takes 16 out of 20 columns in the matrix. The character "Tieh," shown in FIGS. 3A–3D, requires a minimum of 20 columns for sufficient clarity.

A COMPUTERIZED FILE SYSTEM FOR THE DIGITIZED CHINESE CHARACTERS

Having digitalized all Chinese characters and converted them into hexadecimal form, a computerized file system is then established by arranging the digitalized Chinese characters according to the standard 37 Chinese Phonetic Alphabets. The thus converted characters are stored in a direct-access storage device in an electronic data processing system according to the arrangement of the file system, such that they can be retrieved with ease.

According to the present invention, digitalized Chinese characters are arranged in four groups. Each group has a capacity of 2,400 characters. It is to be noted that 7,773 Chinese characters are considered to be currently in use. The most widely used 2,400 characters are organized as the first group. The less used 2,400 characters are organized as the second group, etc. The least used characters are organized as the fourth group. Also, special characters which are not currently in use but are of special interest in a particular field, such as financial, medical, scientific, engineering, etc., can be placed in the fourth group. Up to 2,128 special characters can be placed in the fourth group.

Each group of 2,400 characters is divided into 160 sections. Each section has 15 characters of the same Standard Chinese Phonetic Syllable. The 160 sections are arranged in alphabetical order according to the Standard 37 Chinese Phonetic Alphabets.

Reference is made to FIGS. 7A and 7B which show a Group No. 1 represented schematically. The 160 rectangles 131*a* are for the section within Group No. 1, and, in actual practice, each section has 15 characters therein, as shown in section 016 in the upper right-hand corner of FIG. 7A. It will be seen that section 016 is in a subgroup 131*b*, outlined in solid lines, of six sections, sections 014–016 and 030–032, all of which form one of the 37 phonetic subgroups in the phonetic alphabet. This is indicated in the figure in the individual sections by the Chinese symbol for this part of the phonetic alphabet. Other subgroups are outlined and in the drawing the sections contain the Chinese symbols for the other parts of the phonetic alphabet. In actual practice, each section will contain 15 Chinese characters, just as does section 016 in the drawing.

The character "pei" in FIG. 1 appears at position 5 in Group 1, Section 016 in FIG. 7A. Thus, for example, the character "pei" in FIGS. 1 and 7A would appear in the file system in Group No. 1, Section 016, Character No. 5, with a five digit file system number 10165, where the first digit 1 is the Group Number, the second, third and fourth digits together are the Section Number 016, and the fifth digit is the Character Number 5 within the particular section. In FIG. 4, the fifth digit, which can be a single digit number or a two digit number, is handled as a hexadecimal digit. Thus, the fifth character will require only one digit space. The master file, as shown in FIG. 5, is created by entering the data for the digitized character in the storage device of an EDP system in the form of input data cards or other similarly known means. In order to provide quick and easy access to the master file, such that the digitalized character can be retrieved, the following techniques and apparatus or devices have been developed.

The reason that four is the number of groups into which the characters are divided is that the decimal numbers from 1 to 4 can be represented by four bits in a binary system. The reason that 15 is the number of characters per section 131 is that the decimal numbers from 1 to 15 can be represented by four bits in the binary system. The numbers of the sections within a group can be represented by eight bits in the binary system. Although only 160 sections have been provided in the disclosed embodiment, it will be clear to those skilled in the art that with eight bits, up to 256 decimal numbers can be represented. Therefore, the number of sections within any group can be increased up to 256. The total number of bits by which the file system number can be represented is thus seen to be 14, so that any file system number in binary form can be divided into two seven-bit groups. These groups are in conformity with the American Standard Code for Information Interchange (ASCII), in which information in binary

form is transmitted and received in seven-bit groups. The system of the present invention is therefore fully compatable with current information interchange systems.

A SYSTEM FOR PERFORMING CHINESE TYPEWRITER OPERATIONS

The system for retrieving and utilizing characters according to the present invention is shown in FIG. **6**, and compriese a terminal unit **10** connected to a CPU (central processing unit) **20** which in turn is connected to a direct access storage device **21**, such as a disk in which the master file system is stored. It is to be understood that the CPU **20** is preferably a conventional computer which is programmed to (a) search switches on a keyboard, to be described hereinafter, to detect which switches are closed and to derive the file system number from the closed switches; (b) retrieve the data for the digitalized data for the character corresponding to a file system number from the storage device; (c) convert the hexidecimal digit data to binary form; (d) feed the converted data to a buffer storage means and control the buffer storage means for driving a matrix printer and a character display unit, both to be described hereinafter; and (e) to convert the file system number to the ASCII code and transmit and receive such code and reconvert received coded file system numbers for use in retrieval from the storage device. The CPU can thus have transmission lines **22** connected thereto which can be connected to a like system, and the CPU can transmit and receive ASCII coded file system numbers to and from said lines. It is thus seen that the system has communications capability. The terminal unit **10** is a means for supplying a signal representing a file system number and is connected to CPU **20** through communications lines **30.** It will be appreciated that more than one terminal unit **10** can share the same CPU **20,** if desired.

The terminal unit includes character display unit **11,** keyboard **13** and Chinese character printer **14.** Item **12** can be another display unit.

CHARACTER DISPLAY UNIT

The character display unit **11** may be either a conventional cathode ray tube (CRT) type of device or a conventional display matrix utilizing light emitting diodes. In the use of a CRT device, the minimum resolution is preferably 4,096 points per square inch. In the case of a display matrix using light emitting diodes, the matrix should be 20×24 matrix grid points per character corresponding to the digitalized Chinese character matrix. In either case, there is preferably a buffer storage means in the display unit **11** which may have a capacity of 450 characters for display data and 50 characters for system use. The initial position of the character to be displayed can be selected and adjusted with respect to the vertical and horizontal position by conventional cursor buttons among the operational push-buttons **136–140** on the keyboard **13.**

KEYBOARD

The keyboard **13,** shown in FIGS. **6, 7A, 7B** and **8,** comprises a switch means such as push-buttons **134—134** for character Group selection, 160 switch means such as push-buttons **131—131** for Section selection, 15 switch means such as push-buttons **133—133** for character number selection, and switch means such as push-buttons **132, 134, 135, 136, 137, 138, 139** and **140** for operational use. The respective switch means are connected to the CPU **20** for supplying thereto a signal representing a part of the file system number corresponding to the push-button. For example, to supply a signal for "pei" of FIG. **1,** push-button **1** of buttons **134** is pressed and sends a signal representing the first or "group" digit of the file system number. Then push-button **131** for section **016** is pushed and then push-button **5** of push-buttons **133** is pushed to send signals representing the second through the fifth digit and the sixth digit of the file system number, respectively.

In FIGS. **8** and **9,** a character reference sheet **16** is provided for each group of sections, there being four reference sheets **16.** The sheets are positioned relative to the push-buttons **131** so that there is one section corresponding to each push-button. Preferably, the reference sheets are joined to each other in a continuous endless belt and are placed around a set of motor driven rollers **17—17** (the motor not being shown) controlled by group push-buttons **134** and located under keyboard **13.** Push-buttons **131** are transparent and display the sections on the respective sheets therethrough. In this manner, the sheet for any one of the four character groups can be caused to move into position under pushbuttons **131** by pressing the corresponding push button group buttons **134—134** (see FIGS. **6,** 7A and 7B). Preferably indicating lights positioned in group buttons **134—134** will be turned on when the buttons are pressed to indicate that certain groups are being used.

By searching through the **160** section push-buttons **131—131,** any one of the 2,400 characters for a given group can be read from the character reference sheet **16** positioned under the keyboard panel **13.** As can be seen from FIG. **6,** all of the **160** section push-buttons **131—131** are in the form of a magnifying lens to enable clear reading of the characters.

When a Section button **131** is pressed, a three digit number is generated to indicate which section is selected. The three digit number for a given section then becomes the middle three digits of the five digit file system number.

Having selected a Section, any particular character within the section can be selected by pressing the Character Number button **133—133** located on the keyboard according to the position of the character in that section (see FIGS. 7A and 7B).

When a particular Character Number button **133** is pressed, a digit is generated to indicate which number is pressed, and if desired, a push-button **132** can be provided which is pushed after pushing any one of push-buttons **133** to produce an EOB (End of Block) **132** code signal. Note that on the keyboard the Character Number push-buttons **133—133** are designated as **1, 2, . . . , 14, 15.** Internally, however, a signal representing a single hexadecimal digit **1, 2, . . . 9,** A, B, C, D, E or F is generated. This Character Number digit then becomes the last digit of the five-digit file system number identifying the desired character in the storage device.

Thus, for a given character in the Character Reference Sheet **16,** there is a one-to-one correspondence for signal representing the five digit file system number sent from the keyboard **13** and the five-digit file system

number for the code unit in the storage device 21 for that particular character.

All push-buttons on the keyboard may be constructed utilizing printed circuit technology so that there is no obstacle under the keyboard panel to prevent movement of character reference sheets 16.

In addition, in accordance with the invention, the quick direct operation by the operator to look up all sections of characters sharing the same part of the Chinese phoentic alphabet is facilitated by coloring the panel with various colors for various parts of the alphabet. All sections under the same part of the phonetic alphabet would have the same color. For example, in FIGS. 7A and 7B, on the top right corner there are six sections which are designated as sections 014, 015, 016, 030, 031, and 032 and have characters having the same initial sound " ㄎ " and these can have the same color, e.g., red. Note that other light colors such as ivory and beige may be used.

An alternative arrangement is shown in FIGS. 9A and 9B in which the keyboard 13 on the terminal unit 10 is comprised of a plurality of simple pressure sensitive switches 231, which preferably have lights incorporated therein which are turned on when the switch is actuated. A U-shaped channel frame 232 is provided around the sides and bottom of the area occupied by the switches 231, the individual members of the frame having a cross-section in which a vertical portion 232*a* extends upwardly from the surface of the keyboard and a horizontal portion 232*b* extends horizontally from the upper end thereof. A character sheet 233 is provided which has printed thereon sections having the characters within the sections in the same manner as illustrated in FIGS. 7A and 7B. The character sheet 233 fits removably into the U-shaped channel frame 232 and the printed sections overlie corresponding switches 231, so that simple finger pressure on the sheet on a desired section actuates the switch therebeneath, and the section of the sheet is illuminated from beneath by the light in the switch. The remainder of the keyboard 13 is the same as in the embodiment of FIG. 6.

The character sheet 233 is at least opaque, and can be printed with one group on one side, or can have one group on one side and a second group on the other side. In order to have four groups available, it will be necessary to have a minimum of two sheets.

In order to have the two sheets in convenient form so that the operator can shift from one group to another quickly, a combined character sheet 234 can be provided, as shown in FIG. 9C. The sheet has two sheet portions 234*a* and 234*b* secured at the transverse centerlines to form what is essentially a four page booklet. It will be appreciated that by properly printing the sections on the various pages, by opening the booklet to the centerfold one group can be displayed, by opening the booklet to between the first and second pages, a second group can be displayed, by opening the booklet to between the third and fourth pages a third group can be displayed, and by turning the booklet over a fourth group can be displayed on the outside faces of pages 1 and 4. All four groups of sections can thus be combined in one handy character sheet which can be slipped into the U-shaped frame 232 very easily.

Another alternative arrangement is shown in FIG. 9D in which the keyboard has the same pressure sensitive switches 231 thereon, but instead of the frame 232 it has a plurality of fastening means around the periphery of the area occupied by the switches. The fastening means are shown here as simple posts 235 for insertion through corresponding apertures 236 in the corners of sheet 233. However, the fastening means could also be simple spring clips or the like, under which the upper edge of the sheet could be held, or could be magnets for attracting magnet means on the sheet.

CHINESE CHARACTER MATRIX PRINTER

Referring to FIG. 10, there is shown a perspective view of a Chinese matrix printer according to the invention, in which a paper 141 which is to have characters printed thereon is inserted around a roller 142 rotated in response to printing head 144 reaching the end of each row and contained in body 143 of the printer. It is appreciated that the matrix print head 144 is an essential part of the system.

As shown in FIG. 11, matrix print head 144 comprises 24 pieces of fine wire 150 (only two of which are shown), such as stainless steel wire, with a diameter of 0.010 inch, each having a wire pin 152 and wire drive 153 (see also FIG. 12). Each wire 150 is operatively connected to its associated wire pin 152 which is actuated by wire driver 153 which is, in turn, electrically connected to buffer storage means in display unit 11, the buffer storage means here being designated 146, through register 147 by conductors 148—148 and 145—145. They are operated in response to signals from buffer storage means 146 (see FIG. 11), wherein *a* and *b* represent 20 points on a row and 24 points in a column of the matrix grid, respectively.

In this way, each of the print wires can be actuated electromechanically and electronically. 24 pieces of wire are arranged in a line corresponding to one column of each digitized Chinese character (see FIG. 11A). In particular, the ends 151 of wires 150 (as viewed in FIG. 11A from the ends of wires 150) represent a column of 24 grid points of a digitized character. In other words, all of the wires are actuated simultaneously and one column of dots forming part of a character is printed simultaneously. When less than all the wires are actuated, only parts of the column are printed. Thus, matrix print head 144 will print the digitalized Chinese character one column at a time from left to right. The data for the dots in the column, which together form the pattern of a character and number of characters to be printed per line, is obtained from display buffer storage means 146.

FIG. 12 shows a schematic diagram of a single printer wire 150 within print head 144, one end of which is free and normally held in the surface of the printing head out of contact with the surface of paper 141 by the force of spring 154 between retainer 155 a flonge on a wire pin 152. A stop 156 on wire pin 152 limits movement of wire pin 152, and thus wire 150, away from the paper 141. A wire driver 153 is mounted on a support member 157. When wire driver 153 is actuated for example by solenoid or fluidic means, wire pin 152 and wire 150 are pushed, and end 151 of wire 150 projects out of surface of print head 144 and into contact with the surface of paper 141 to form a dot as part of the pattern in accordance with the data obtained from display buffer storage means 146.

It should be pointed out that the scale of the print head shown in FIG. 12 is considerably enlarged for the purpose of clarity. In practice, each wire is about 0.010 inch in diameter and the total length of the line of 24

pieces of wire would be about 0.24 inch. In a length of 1/4 inch for the line of wires there is some clearance for the lubrication of the wires.

There are two conventional styles of writing Chinese documents. One is horizontally from left to right and then from top to bottom. The other is vertically from top to bottom and from right to left. The CPU is programmed for supplying data for the character to the buffer storage means **146** in either style, and the proper program is selected by pressing the "vertical" or the "horizontal" buttons **139** or **137** on keyboard **13.**

If the vertical style is selected, the matrix printer will print the document as if it is for horizontal style except one character from each vertical line is printed and then from left to right. As far as the printer is concerned, it is not aware of which style is to be or being printed, for it simply follows the bit pattern in the display buffer storage means **146.** The pattern in which the data is placed in the buffer storage means **146** determines the style.

TYPING PROCEDURE AND DATA FLOW

Style Selection

Enter either horizontal style or vertical style through the buttons **137** or **139** located on keyboard **13.** A button light can be provided which will be turned on to indicate which style is being typed.

Display Position Adjustment

The vertical and horizontal "Display" buttons **140** and **138** on the keyboard **13** are coupled to the display device **11** to adjust the location of the character to be displayed on the display device **11** to the desired position by conventional control means.

Character Group Selection

The operator quickly determines which one of the four groups to which the desired character belongs and then presses the proper button **134** on the keyboard. The button light will be turned on to indicate which group of characters is selected for typing. At the same time, the motor driven rollers **17—17** will move the Character Reference Sheet **16** under the keyboard **13** to a pre-determined position such that the entire group of characters can be read through the transparent push buttons **131—131.** And simultaneously, a signal representing digit **1, 2, 3** or **4,** depending upon which group is selected, is generated and sent to the buffer storage means **146** to become the first digit of a five-digit file system number.

Section Selection

The operator quickly determines the Chinese Phonetic Symbol for the desired character and then goes to the subgroup of sections which share the same part of the Chinese phonetic alphabet and then scans through the windows **131—131** in the subgroup for the desired character. Once the desired character is located in a section of the Character Reference Sheet **16,** the Section button **131** is pressed. A three-digit number corresponding to the section number is generated and sent to the buffer storage means **146** to become the middle three-digits of a five digit file system number.

Character Number Selection

The operator presses one of the 15 Character number push buttons **133** to select the desired character in the section. The Character NUmber push buttons **133—133** are arranged on the keyboard **13** in physical positions corresponding to the positions of the characters within the sections on character reference sheet **16.** At the same time, a hexadecimal digit number is generated and sent to the buffer storage means **146** to become the fifth digit of the five digit record number. In a practical embodiment, the buffer storage means **146** then generates a signal to inform the CPU **20** that a desired character with the file system number in the buffer storage means **146** is wanted. The CPU control program then causes the CPU to take the file system number from the buffer storage means and retrieve from the storage device **21** the 120 hexadecimal digits for the desired character and send them to the buffer storage means **146** in the display device **11** and the digitalized Chinese character is displayed. The process continues until either a page of document is completed or the 450 character buffer storage means is filled, whichever occurs first.

Print

The operator presses the "Print" button **135** on the keyboard and all characters on the display device **11** are printed on the matrix printer **14** and a hard copy is obtained.

Typing Example 1

Chinese Character	Standard Chinese Phonetic Symbol	Romanized Phonetic Symbol	Meaning
北	ㄅㄟˇ	Pei	North

Suppose the character "Pei"or "North" shown above is the desired character to be typed. Since this is a widely used character, the operator quickly determines it to be in Character Group **1.** Hence, the operator presses "1" button **134** under "Character Group". The operator then quickly determines the Standard Chinese Phonetic Symbol for this character which is ㄅㄟˇ. The operator then scans through Sections **131***a* in the subgroup **131***b* in the top right hand corner of the keyboard **13,** as seen in FIG. 7A, and finds the desired character in section **016** in the second row, second line, corresponding to character number button **133,** which is in position **5,** in FIG. 7B.

The operator then presses the Section button **131** which is for section **016** and then presses Character Number Button **133,** corresponding to position "**5.**" Since the desired character is in the No. **5** position, a five digit file system number **10165** is generated from the keyboard which is the file system number for the desired character "Pei" stored in the form of **120** hexadecimal digits. The data is then retrieved from storage and placed in display buffer storage means **146** for printing by the matrix printer **14.**

CHINESE TELETYPE SYSTEM FOR MESSAGE TRANSMISSION AND SWITCHING

As shown in FIG. **6,** the terminal unit **10** which is connected to CPU **20** via communications lines **30** is for a Chinese Typing System according to the present invention. Several terminal units **10** can be connected to the CPU **20** via communications lines **30.**

If the transmission and switching of a Chinese character message is desired, the operator simply types the message as if it is a regular typing operation except after the entire message is finished and displayed on the display device **11,** the operator presses a transmission button **136** on the keyboard **13,** causing it to generate

a signal which causes the program in the CPU **20** to carry out transmission of the file system numbers. The first thing the transmission program does is to send a message to the sending terminal "Enter Receiving Terminal Number", which is displayed on the display device or buffer storage means **146** (see FIG. **11**). The operator on the sending terminal then enters the receiving terminal number through the Character Number buttons **133—133** on the keyboard **13** and then presses EOB key. The message handling control program in the CPU **20** then reads in the message from the display buffer storage means **146** of the sending terminal **10** and checks whether the receiving terminal is busy. If not, the message is transmitted to the buffer storage means **146** of the receiving terminal. Thus, transmission and switching of a Chinese character message from one terminal to another is completed.

Alternate Typing System

An alternate typing system can be provided in which the **160** section push buttons **131—131** on the keyboard **13** and the display device **11** are eliminated, as shown in FIG. **13.** The capacity of the buffer storage means for the terminal is reduced to **50** characters. The Character Reference Sheet **16** is displayed directly in front of the operator, for example through a window **240.** An additional push button **241** for the digit zero "0" is added to the 15 character push-buttons **133—133.** Otherwise, the buttons are the same as in FIG. **6.** In operation, the operator selects the Group Number, and then enters the Section Numbers, as well as the Character Number through the 16 numeric buttons **133, 241** (0, 1, 2, . . . 15), in accordance with this embodiment of the ivnention. Thus, instead of pressing the Section button **131** to generate the three digit section number, the section number is now entered manually through the numeric buttons **133** and **241.** The alternate typing system is to enter the file system Number for the desired character one character at a time and is printed on the matrix printer **14** on a one to one basis.

Alternate Message Switching System

As in the alternate typing system, the character is entered as well as transmitted and switched one character at a time in the alternate message switching system. The section push buttons and display device are eliminated in the alternate system. The section number is entered manually through the numeric buttons.

It should be noted that the master file can be stored in a Read-Only-Storage (ROS) memory device as a stand alone typing system.

The foregoing is intended to be only illustrative of the principles of the invention. Numerous modifications and variations thereof would be evident to the worker skilled in the art. All such modifications and variations are to be considered to be within the spirit and scope of the invention.

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As in the alternate typing system, the character is entered as well as transmitted and switched one character at a time in the alternate message switching system. The section push buttons and display device are eliminated in the alternate system. The section number is entered manually through the numeric buttons.

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The foregoing is intended to be only illustrative of the principles of the invention. Numerous modifications and variations thereof would be evident to the worker skilled in the art. All such modifications and variations are to be considered to be within the spirit and scope of the invention.

What is claimed is:

1. A means for storing, retrieving and reproducing individual characters in a large number of characters, comprising a plurality of sheets equal to a number of relatively large groups of the characters in which groups the characters are according to the frequency with which the characters are used, each sheet having a plurality of sections arranged thereon and each section having a relatively small number of characters therein each having a common characteristic, a keyboard having thereon a first plurality of switches equal in number to the number of sheets, a second plurality of switches equal in number to the number of sections and arranged on said keyboard in the same arrangement as said sections are arranged on said sheets, and a third plurality of switches equal in number to the number of characters in a section and arranged on said keyboard in the same arrangement as said characters are arranged in said sections on said sheets, means for placing said sheets in juxtaposition with said second plurality of switches with the sections on the sheets in positions corresponding to the positions of said switches, means connected to the respective switches for generating a signal when the respective switches are actuated, whereby a signal representative of a file system number including the group, the section and the position of the character in each section for the characters on the sheets is generated when switches for the respective group, section and position for each character are actuated, a storage means for storing code units representative of the characters according to a file system in which each code unit is assigned the corresponding file system number, access and retrieval means coupled between said signal generating means for said switches and storage means for gaining access to said storage means and retrieving the code units for characters corresponding to the file system numbers from said signal generating means, and character representing means coupled to said access and retrieval means for receiving therefrom the code units for the retrieved characters and representing the characters in visible form.

2. Means as claimed in claim **1** in which there are four sheets and four switches in said first plurality of switches, and 15 characters in each section and 15 switches in said third plurality of switches.

3. Means as claimed in claim **1** in which the characters are Chinese characters, and there are four groups of characters and four switches in said first plurality of switches, there are 160 sections and 160 switches in said second plurality of switches, and there are 15 characters in each section and 15 switches in said third plurality of switches.

4. Means as claimed in claim **3** in which the sections on said sheets are arranged in subgroups according to the Chinese phonetic alphabet.

5. Means as claimed in claim **4** in which the areas of the sheets occupied by the subgroups of sections are different colors.

6. Means as claimed in claim **1** in which said sheets are connected together in a continuous length, and

means beneath said keyboard for moving said continuous length beneath said keyboard for positioning sheets beneath the keyboard, said switches in said first plurality being coupled to said moving means for controlling said moving means for moving the length to position the sheet corresponding to the respective switches beneath the keyboard according to which switch is actuated, said keyboard having transparent portions corresponding to each switch for viewing the sections on the respective sheets through the keyboard.

7. Means as claimed in claim 6 in which said switches have transparent actuators as a part thereof, and said sheets have the sections thereon positioned immediately beneath the transparent actuators when they are placed in juxtaposition with said switches.

8. Means as claimed in claim 7 in which said actuators are magnifying lenses.

9. Means as claimed in claim 1 in which said switches are pressure sensitive switches, and said keyboard has means thereon for positioning said sheets one at a time over said switches, whereby finger pressure by an operator on the sheet over the switches is sufficient to actuate switches corresponding to the sections on the sheets.

10. Means as claimed in claim 9 in which said switches have lights therein and said sheets are opaque, whereby light from the switches can shine through the sheet when a switch is actuated by pressure on the sheet.

11. Means as claimed in claim 9 in which said positioning means on said keyboard comprises a U-shaped channel frame around the sides and bottom of the keyboard for receiving the sheets.

12. Means as claimed in claim 9 in which said sheets are individual sheets which are held by said positioning means one at a time.

13. Means as claimed in claim 9 in which said sheets are attached to each other in the form of a booklet.

14. Means as claimed in claim 1 in which said storage means stores code units which are representations of the characters in discrete form on a matrix of grid points.

15. Means as claimed in claim 14 in which the code units are hexidecimal forms of binary digitalized discrete characters, and said access and retrieval means comprises means for converting the code units from the hexidecimal form to the binary form.

16. Means as claimed in claim 14 in which the character representing means is a matrix printer.

17. Means as claimed in claim 16 in which said matrix printer comprises means for printing dots on a matrix grid of twenty by twenty-four grid points, and said code units received from said access and retrieval means are binary digitalized discrete characters on a matrix of twenty by twenty-four grid points which can be printed by said matrix printer.

18. Means as claimed in claim 1 further comprising a buffer storage means coupled between said access and retrieval means and said character representing means for storing code units and control means on said keyboard coupled to said buffer storage means for feeding stored code units to said character representing means under control of said control means.

19. Means as claimed in claim 1 in which said character representing means comprises a cathode ray type display device.

20. Means as claimed in claim 1 in which said character representing means comprises a cathode ray type display device, coupled to said access and retrieval means, a matrix printer, a buffer storage means coupled between said access and retrieval means and said matrix printer, and control means on said keyboard coupled to said buffer storage means for controlling the buffer storage means to feed stored code units to said matrix printer.

21. A means for generating signals corresponding to file system numbers for character in a large number of characters, comprising a plurality of sheets equal to a number of relatively large groups of the characters in which groups the characters are according to the frequency with which the characters are used, each sheet having a plurality of sections arranged thereon and each section having a relatively small number of characters therein each having a common characteristic, a keyboard having thereon a first plurality of switches equal to the number of sheets, a second plurality of switches equal to the number of sections and arranged on said keyboard in the same arrangement as said sections are arranged on said sheets, and a third plurality of switches equal in number to the number of characters in a section and arranged on said keyboard in the same arrangement as said characters are arranged in said sections on said sheets, means for placing said sheets in juxtaposition with said second plurality of switches with the sections on the sheets in positions corresponding to the positions of said switches, and means connected to the respective switches for generating a signal when the respective switches are actuated, whereby a signal representative of a file system number including the group, the section and the position of the character in each section for the characters on the sheets is generated when switches for the respective group, section and position for each character are actuated.

22. Means as claimed in claim 21 in which there are four sheets and four switches in said first plurality of switches, and fifteen characters in each section and fifteen switches in said third plurality of switches.

23. Means as claimed in claim 21 in which the characters are Chinese characters, and there are four groups of characters and four switches in said first plurality of switches, there are 160 sections and 160 switches in said second plurality of switches, and there are 15 characters in each section and 15 switches in said third plurality of switches.

24. Means as claimed in claim 23 in which the sections on said sheets are arranged in subgroups according to the Chinese phonetic alphabet.

25. Means as claimed in claim 24 in which the areas of the sheets occupied by the subgroups of sections are different colors.

26. Means as claimed in claim 21 in which said sheets are connected together in a continuous length, and means beneath said keyboard for moving said continuous length beneath said keyboard for positioning sheets beneath the keyboard, said switches in said first plurality being coupled to said moving means for controlling said moving means for moving the length to position the sheet corresponding to the respective switches beneath the keyboard according to which switch is actuated, said keyboard having transparent portions corresponding to each switch for viewing the sections on the respective sheets through the keyboard.

27. Means as claimed in claim 26 in which said switches have transparent actuators as a part thereof, and said sheets have the sections thereon positioned immediately beneath the transparent actuators when they are placed in juxtaposition with said switches.

28. Means as claimed in claim 27 in which said actuators are magnifying lenses.

29. Means as claimed in claim 21 in which said switches are pressure sensitive switches, and said keyboard has means thereon for positioning said sheets one at a time over said switches, whereby finger pressure by an operator on the sheet over the switches is sufficient to actuate switches corresponding to the sections on the sheets.

30. Means as claimed in claim 29 in which said switches have lights therein and said sheets are opaque, whereby light from the switches can shine through the sheet when a switch is actuated by pressure on the sheet.

31. Means as claimed in claim 29 in which said positioning means on said keyboard comprises a U-shaped channel frame around the sides and bottom of the keyboard for receiving the sheets.

32. Means as claimed in claim 29 in which said sheets are individual sheets which are held by said positioning means one at a time.

33. Means as claimed in claim 29 in which said sheets are attached to each other in the form of a booklet.

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