(12) UK Patent Application (19) GB (11) 2 188 179 (13) A

(43) Application published 23 Sep 1987

(21) Application No **8706268**

(22) Date of filing **17 Mar 1987**

(30) Priority data

(31) **841141** (32) **19 Mar 1986** (33) **US**

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(51) INT CL^4
H03M 11/00

(52) Domestic classification (Edition I)
G4H 13D KJ
H4T 109 121 141 150 DCX
U1S 2090 G4H H4T

(56) Documents cited
None

(58) Field of search
G4H
Selected US specifications from IPC sub-classes H03M H03K

(54) Processing system and phonetic-based method of selecting and reproducing picture language characters

(57) A system and method for selecting and reproducing characters in the picture languages, as for example Chinese, from phonetic symbols; wherein a Roman character is chosen representing the initial sound of the picture character to cause display of the sounds having that initial sound, then one of these is selected to cause display of all characters having the selected sound (grouped by intonation), then one of these is selected for reproduction. The system includes a computer processing unit (CPU) and memory, a video controller coupled to the CPU and to a cathode ray tube (CRT) display, with a touch screen overlay on the face of the CRT display. The CRT is controlled by addressing a four-page (frame) memory holding character codes each consisting of high and low address portions (for addressing a character generator ROM) and attribute bits. The high and low address portions are applied to the character generator ROM via a register and a counter respectively.

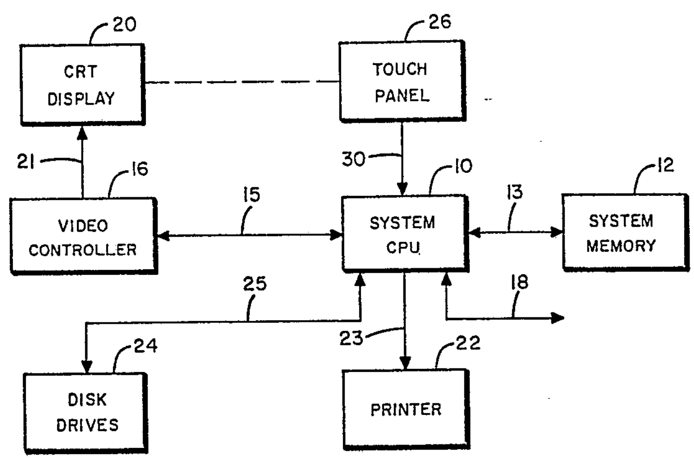


Fig. 1

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 188 179 A

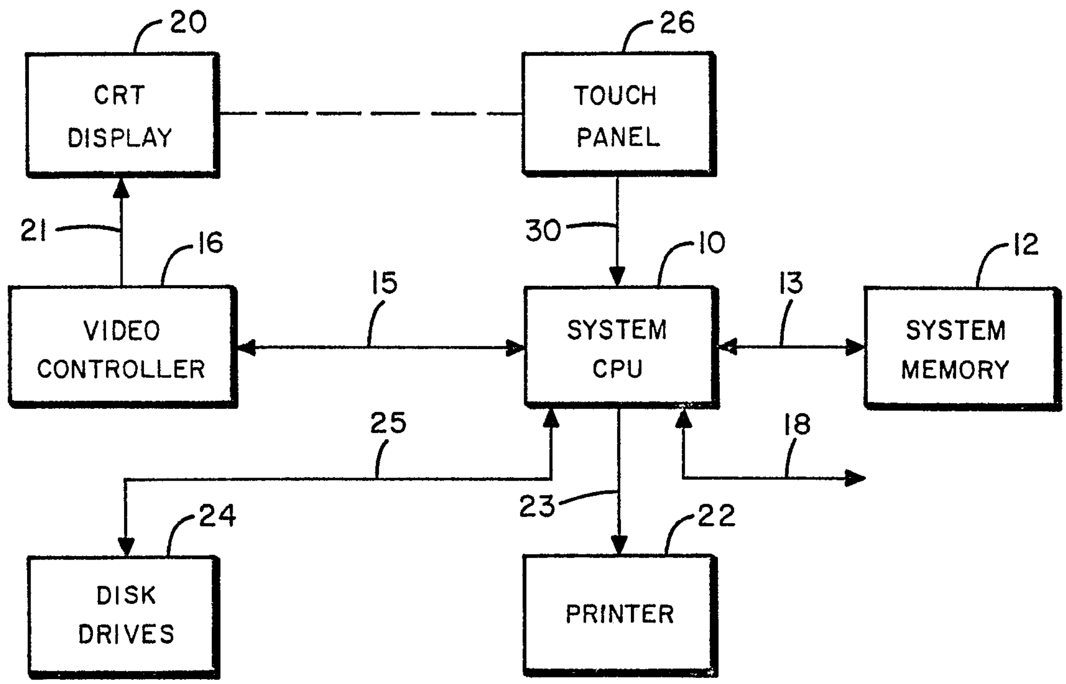

20
CRT DISPLAY
26
TOUCH PANEL
21
30
16
10
12
VIDEO CONTROLLER
15
SYSTEM CPU
13
SYSTEM MEMORY
25
18
23
24
22
DISK DRIVES
PRINTER

Fig. 1

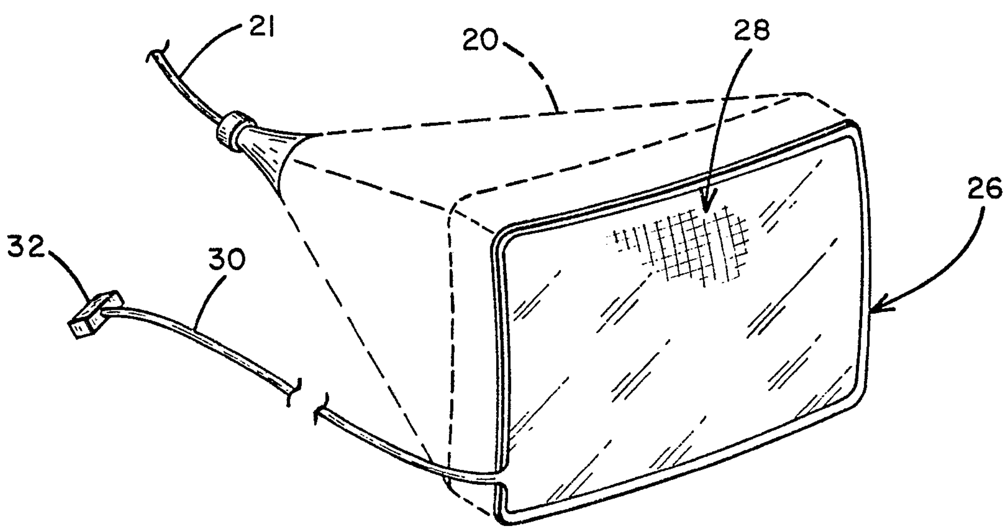

21
20
28
26
32
30

Fig. 2

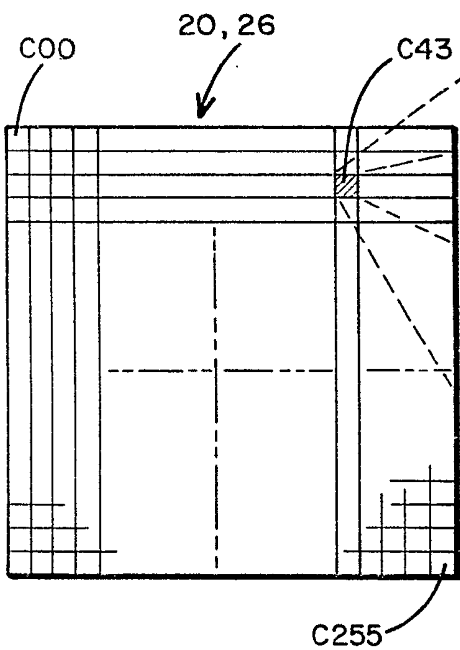
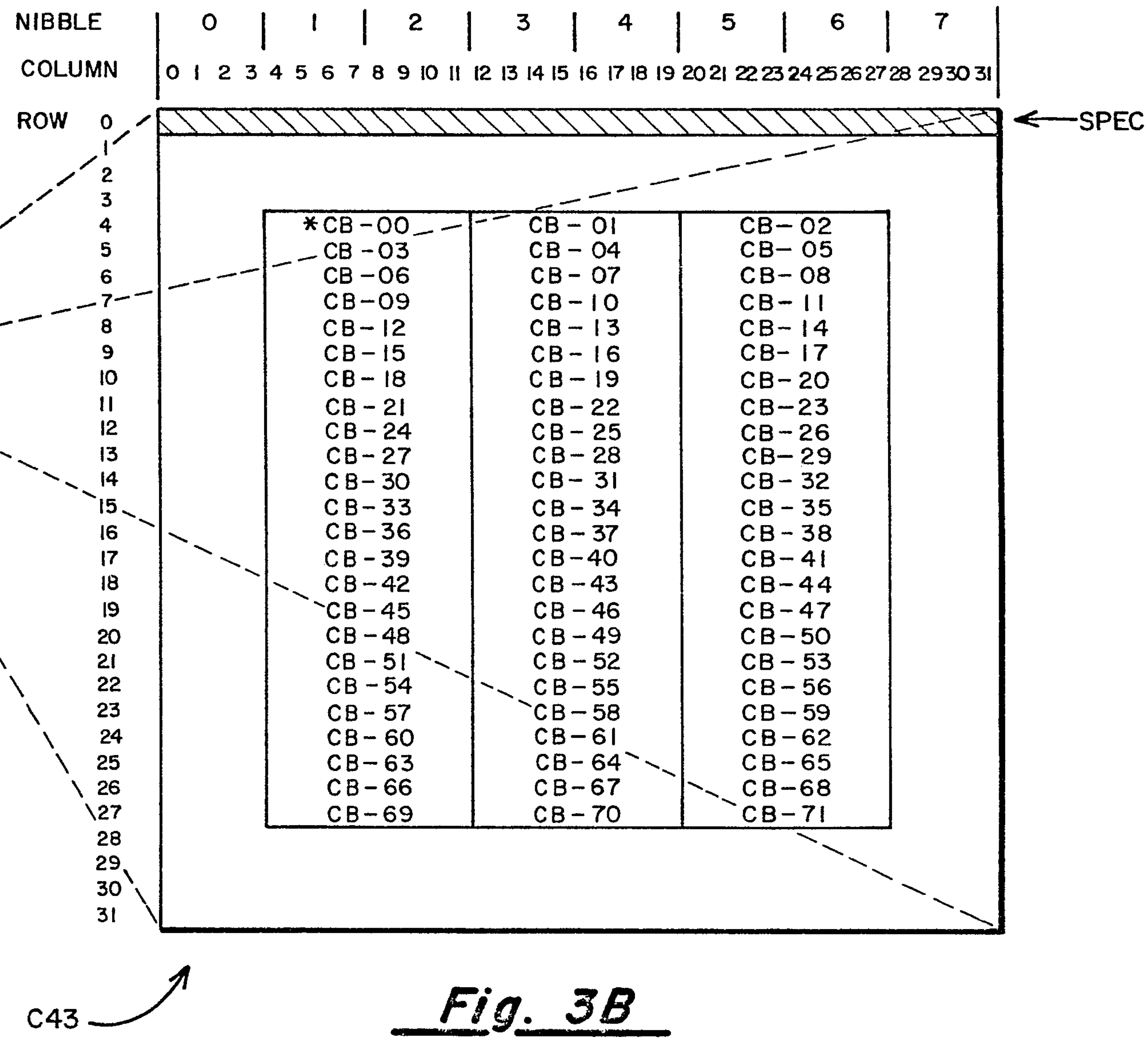

C00
20,26
C43
C255

Fig. 3A


NIBBLE 0 1 2 3 4 5 6 7
COLUMN 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
ROW 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
SPEC
*CB-00
CB-01
CB-02
CB-03
CB-04
CB-05
CB-06
CB-07
CB-08
CB-09
CB-10
CB-11
CB-12
CB-13
CB-14
CB-15
CB-16
CB-17
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CB-51
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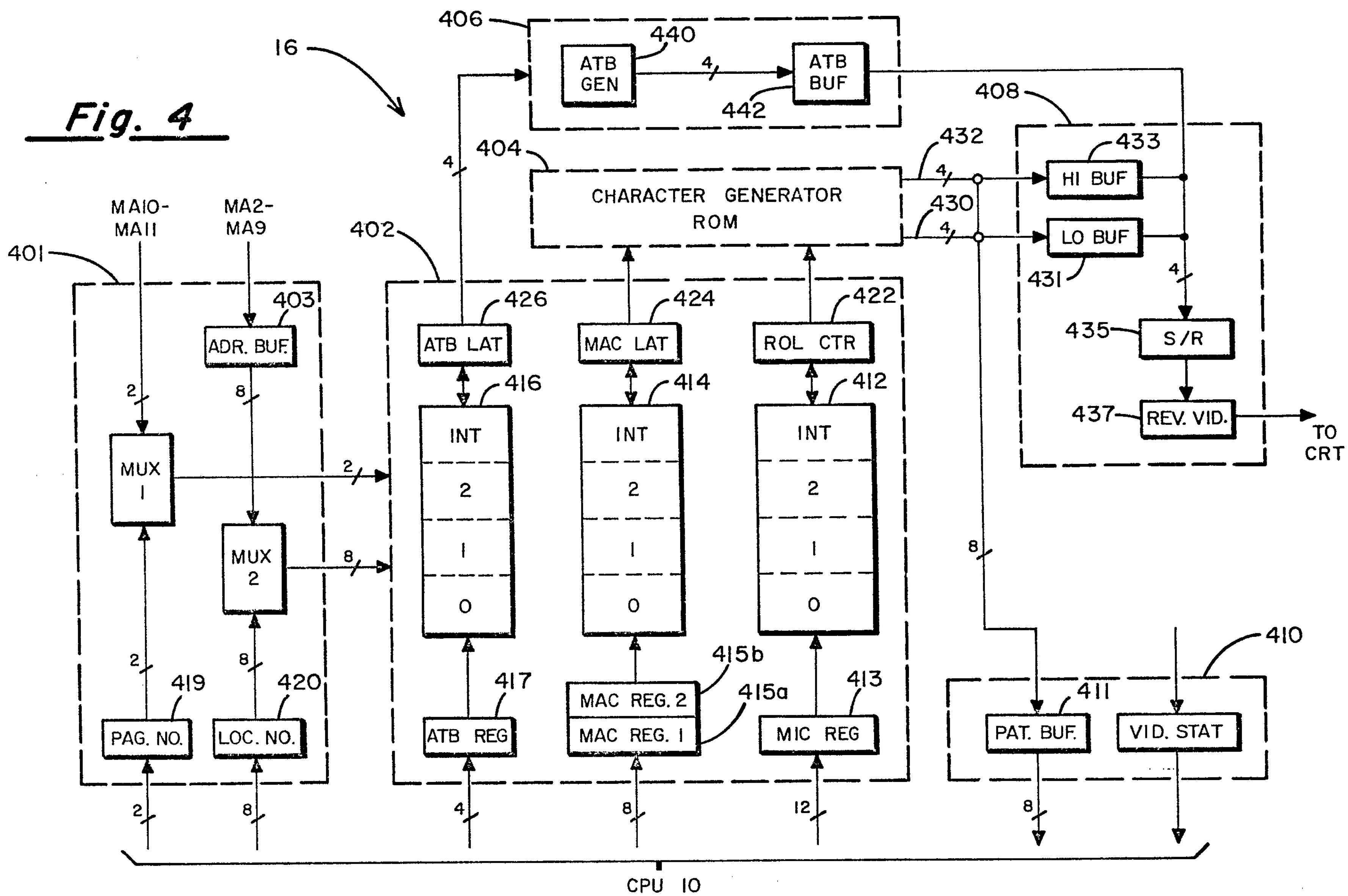
CB-59
CB-60
CB-61
CB-62
CB-63
CB-64
CB-65
CB-66
CB-67
CB-68
CB-69
CB-70
CB-71
C43

Fig. 3B

Fig. 4


16
401
MA10-MA11
MA2-MA9
ADR. BUF.
MUX 1
MUX 2
PAG. NO.
LOC. NO.
403
419
420
402
ATB LAT
MAC LAT
ROL CTR
INT
2
1
0
ATB REG
MAC REG. 2
MAC REG. 1
MIC REG
426
424
422
416
414
412
417
415b
415a
413
406
ATB GEN
ATB BUF
440
442
404
CHARACTER GENERATOR ROM
432
430
408
HI BUF
LO BUF
S/R
REV. VID.
433
431
435
437
TO CRT
410
PAT. BUF.
VID. STAT
411
CPU 10

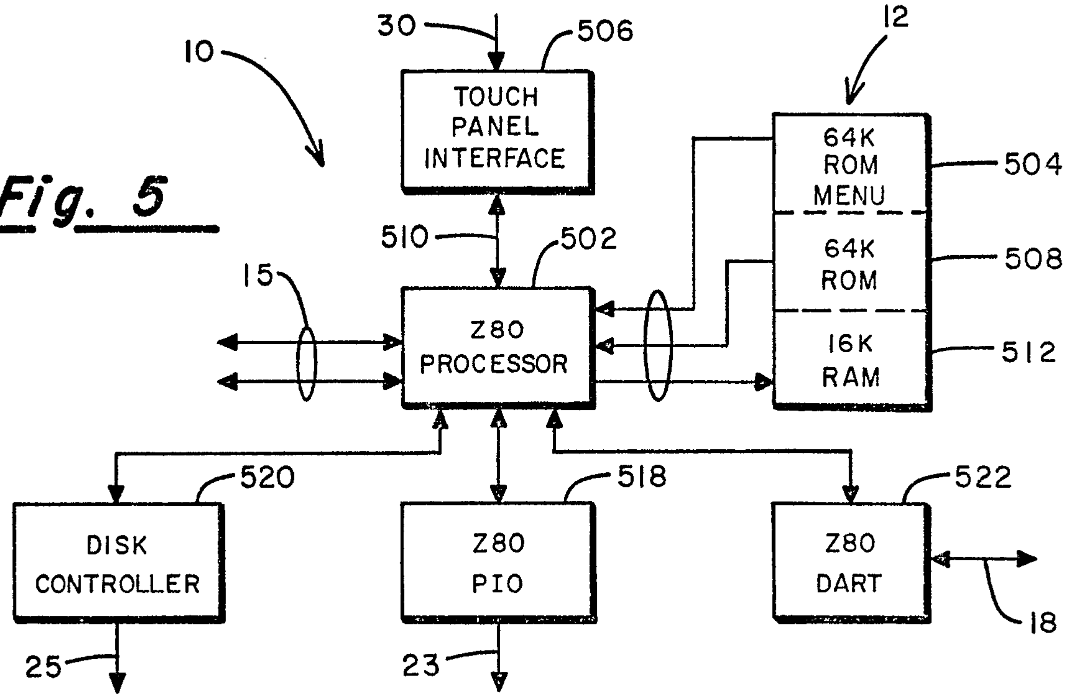

10
30
506
TOUCH PANEL INTERFACE
12
64K ROM MENU
504
64K ROM
508
16K RAM
512
510
502
15
Z80 PROCESSOR
520
518
522
DISK CONTROLLER
Z80 PIO
Z80 DART
18
25
23

Fig. 5

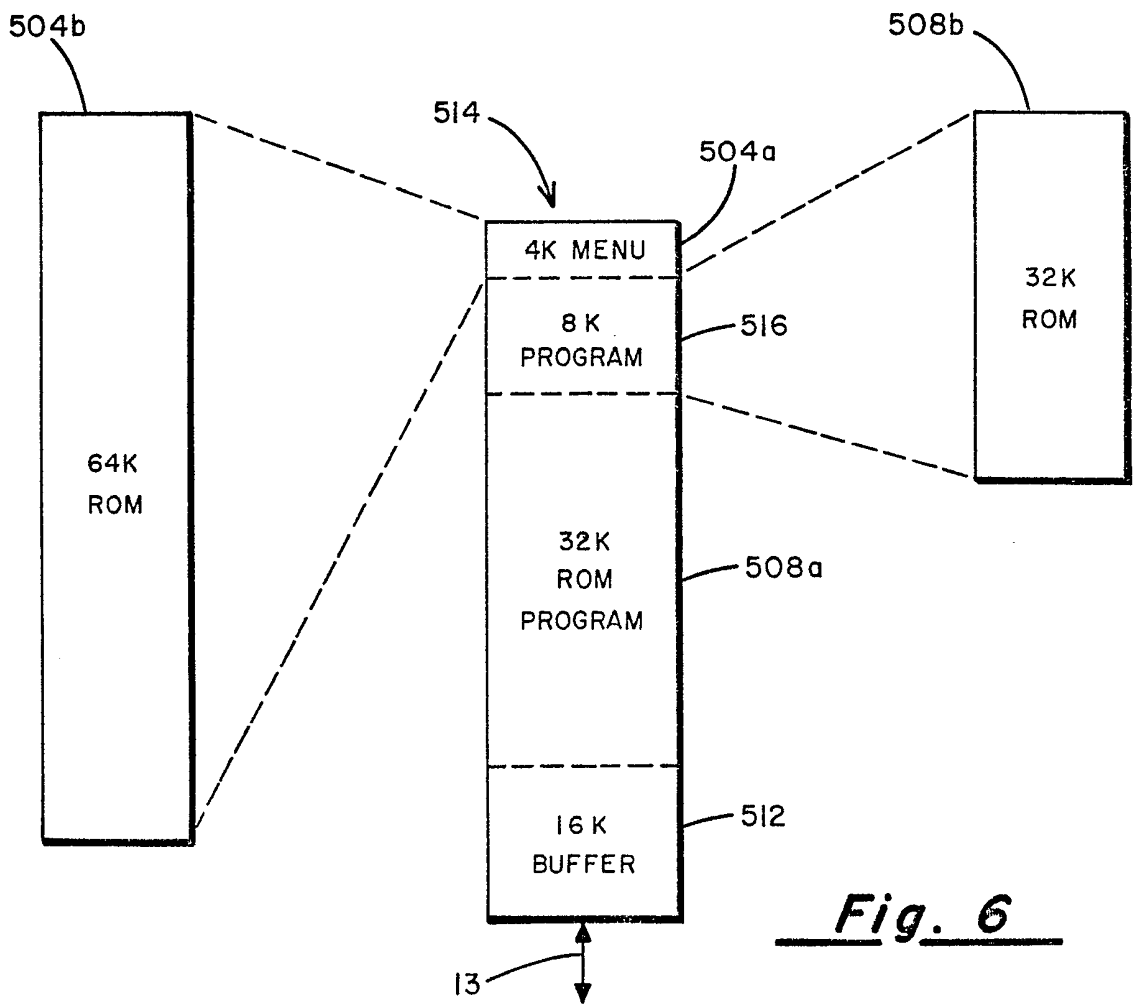
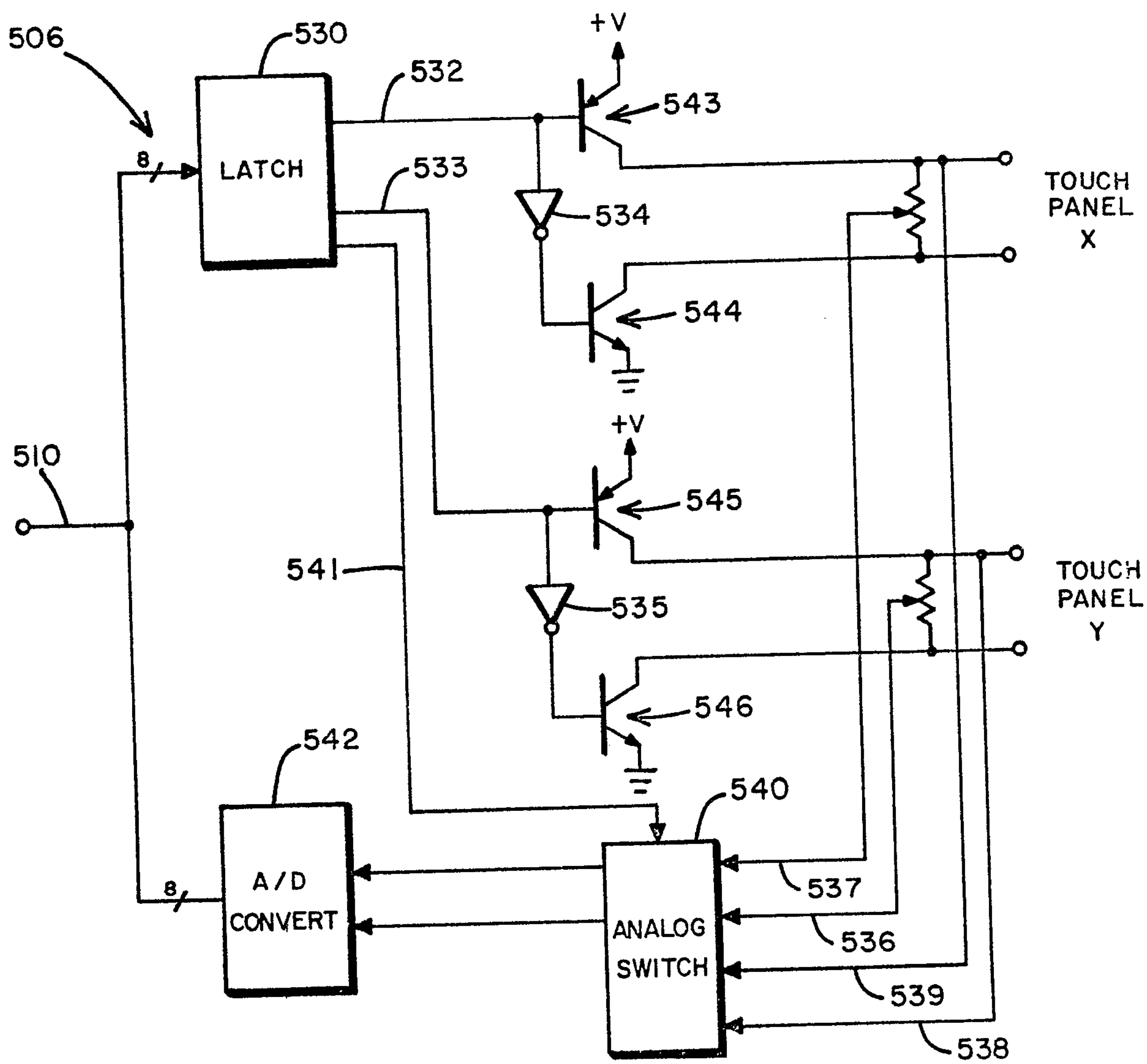

504b
508b
514
504a
64K ROM
4K MENU
8 K PROGRAM
516
32K ROM
32K ROM PROGRAM
508a
16 K BUFFER
512
13

Fig. 6



506
530
LATCH
8
532
533
+V
543
534
544
TOUCH
PANEL
X
510
+V
545
541
535
TOUCH
PANEL
Y
546
542
540
A/D
CONVERT
8
ANALOG
SWITCH
537
536
539
538

Fig. 7

a	阿
ai	愛
an	安
ang	昂
ao	凹

Fig. 8A

ba	八	bi	比
bai	白	bian	編
ban	板	biao	表
bang	邦	bie	別
bao	包	bin	彬
bei	北	bing	丙
ben	本	bo	波
beng	崩	bu	不

Fig. 8B

ca	擦	chai	拆	chou	抽		
cai	才	chan	産	chu	出	ci	刺
can	參	cha-ng	昌	chua	欻	cong	匆
cang	倉	chao	抄	chu-ai	揣	cou	湊
cao	草	che	撤	chu-an	川	cu	粗
ce	冊	chen	沉	chu-ang	床	cuan	竄
cen	岑	che-ng	成	chui	吹	cui	崔
ceng	層	chi	吃	chun	唇	cun	村
cha	叉	cho-ng	沖	chuo	綽	cuo	挫

Fig. 8C

		den	扽		
da	大	deng	燈	dong	冬
dai	代	di	地	dou	豆
dan	單	dian	店	du	毒
dang	當	diao	吊	duan	短
dao	刀	die	跌	dui	堆
de	的	ding	丁	dun	敦
dei	得	diu	丟	duo	多

Fig. 8D

e	俄
ê	欸
en	恩
er	而

Fig. 8E

fa	法		
fan	凡	feng	風
fang	方	fo	佛
fei	肥	foy	否
fen	分	fu	夫

Fig. 8F

ga	嘎	gai	改	gan	甘
gang	港	gao	高	ge	革
gei	給	gen	根	geng	更
gong	工	gou	狗	gu	古
gua	瓜	guai	怪	guan	關
guang	光	gui	規	gun	棍
guo	國				

Fig. 8G

ha	哈	hai	海	han	汗
hang	航	hao	好	he	合
hei	黑	hen	很	heng	横
hng	哼	hong	紅	hou	后
hu	呼	hua	化	huai	懷
huan	歡	huang	黃	hui	灰
hun	昏	hue	火		

Fig. 8H

ji	機	ji	加	jian	堅
jiang	江	jiao	交	jie	接
jin	金	jing	京	jiung	窘
jiu	九	ju	局	juan	卷
jue	決	jun	君		

Fig. 8J

ka	卡	kai	開	kan	看
kang	康	kao	考	ke	科
kei	剋	ken	肯	keng	坑
kong	空	kou	口	ku	苦
kua	跨	kuai	快	kuan	寬
kuang	狂	kui	虧	kun	困
kuo	擴				

Fig. 8K

		li	力		
la	拉	lia	倆	lo	咯
lai	來	lian	連	long	隆
lan	藍	liang	良	lou	樓
lang	浪	liao	料	lu	路
lao	勞	lie	列	lü	律
le	樂	lin	林	luan	亂
lei	累	ling	領	lue	略
leng	冷	liu	流	lun	論
				luo	落

Fig. 8L

m	呣	mi	迷
ma	媽	mian	面
mia	埋	miao	苗
man	滿	mie	滅
mang	忙	min	民
mao	毛	ming	明
me	么	miu	謬
mei	沒	mo	磨
men	門	mou	謀
meng	蒙	mu	母

Fig. 8M

na	拿	neng	能	ning	寧
nai	耐	ng	嗯	niu	牛
nan	男	ni	你	nong	弄
nang	囊	nian	年	nou	耨
nao	鬧	nia-ng	娘	nu	奴
ne	呢	niao	鳥	nü	女
nei	内	nie	捏	nuan	暖
nen	嫩	nin	您	nue	虐
				nuo	諾

Fig. 8N

o	喔
ou	歐

Fig. 8O

pa	爬		
pai	拍	pian	片
pan	判	piao	票
pang	旁	pie	瞥
pao	拋	pin	品
pei	培	ping	平
pen	盆	po	迫
peng	朋	pou	剖
pi	皮	pu	普

Fig. 8P

qi	七	qing	青
qia	恰	qio-ng	穹
qian	千	qiu	求
qia-ng	強	qu	區
qiao	巧	quan	全
qie	切	que	缺
qin	侵	qun	群

Fig. 8Q

ran	然	rong	容
rang	壤	rou	肉
rao	繞	ru	如
re	熱	ruan	軟
ren	人	rui	瑞
reng	仍	run	潤
ri	日	ruo	弱

Fig. 8R

wa	瓦		
wai	外	wen	文
wan	完	weng	翁
wang	王	wo	我
wei	危	wu	五

Fig. 8W

sa	灑	shai	晒	shou	手	si	四
sai	塞	shan	山	shu	殊	song	松
san	三	sha-ng	上	shua	刷	sou	搜
sang	桑	shao	少	shu-ai	率	su	俗
sao	嫂	she	舍	shu-an	栓	suan	算
se	色	shei	誰	shu-ang	雙	sui	隨
sen	森	shen	身	shui	水	sun	損
seng	僧	she-ng	生	shun	順	suo	所
sha	沙	shi	十	shuo	說		

Fig. 8S

ta	他	tiao	挑
tai	台	tie	帖
tan	探	ting	艇
tang	唐	tong	通
tao	桃	tou	偷
te	特	tu	突
tei	忒	tuan	團
teng	疼	tui	推
ti	體	tun	吞
tian	天	tuo	脫

Fig. 8T

xi	西	xing	星
xia	下	xio-ng	兄
xian	先	xiu	休
xia-ng	香	xu	須
xiao	消	xuan	玄
xie	些	xue	雪
xin	心	xun	汛

Fig. 8X

ya	壓		
yan	言	yo	喲
yang	揚	yong	永
yao	要	you	由
ye	夜	yu	余
yi	依	yuan	元
yin	因	yue	月
ying	迎	yun	勻

Fig. 8Y

						zhun	准
za	扎	zha	炸	zhi	知	zhuo	卓
zai	再	zhai	宅	zho-ng	中	zi	子
zan	暫	zhan	占	zhou	州	zong	宗
zang	髒	zha-ng	張	zhu	朱	zou	走
zao	早	zhao	找	zhua	爪	zu	租
ze	責	zhe	折	zhu-ai	拽	zuan	鑽
zei	賊	zhei	這	zhu-an	專	zui	罪
zen	怎	zhen	珍	zhu-ang	莊	zun	尊
zeng	增	zhe-ng	正	zhui	追	zuo	左

Fig. 8Z

— 戈疙咯哥胳鴿割擱歌

/ 革閣格葛擱隔膈鎘骼

閤部鬲蛤

✓ 個合鉻蓋

\ 個各鉻箇

Fig. 9

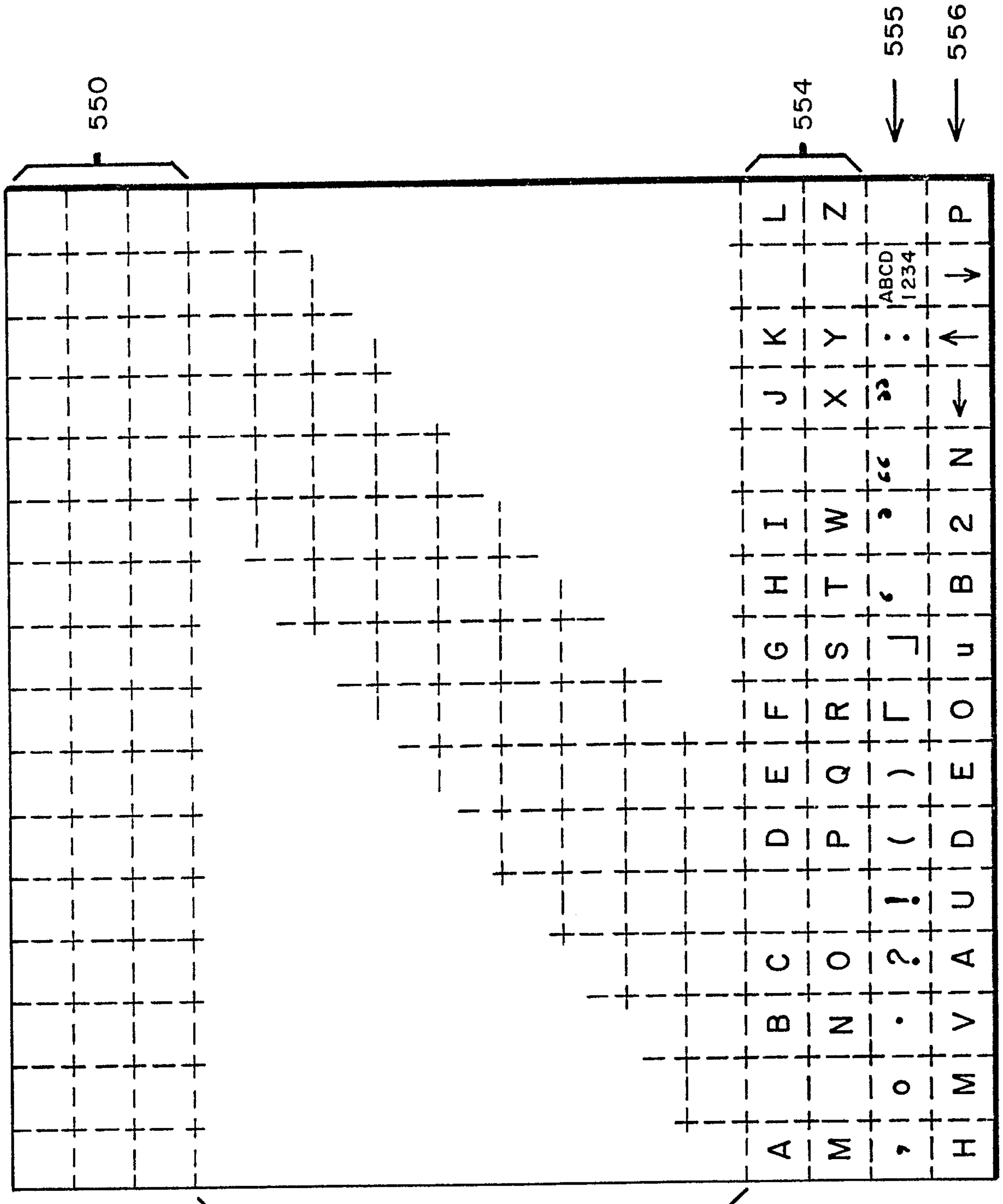


Fig. 10

SPECIFICATION

Processing system and phonetic-based method of selecting and reproducing picture language characters

Background of the invention

The present invention relates to a system for and method of selecting and reproducing language characters. More particularly, the method relates to a phonetic-based method for selecting a desired character in one of the picture languages from a group consisting of thousands of character possibilities. The term "picture languages" refers generally to languages in which character reproduction is not based upon a simple alphabet, but which is based upon characters which have been derived from pictorial representations over a long period of time, i.e., Chinese, Japanese, etc. Such languages will be referred to generally herein as oriental languages. The system for performing the method utilizes a particular combination of digital computer logic and memory elements, and a cathode ray tube (CRT) display with a transparent touch screen overlay for operator input commands to the logic elements.

Oriental languages are generally characterized in that they include an exceedingly large number of written characters, and that the character representations are generally derived from or are pictorial representations representing entire words or phrases. For example, the Chinese language contains more than 40,000 distinct characters, of which approximately 10,000 characters are in common everyday usage in language, and the remaining characters are less frequently used. Languages of this nature have been characteristically reproduced by hand manipulation of a pen or brush, although mechanical reproduction is possible.

To the extent that oriental languages have been machanically reproduced in printed form, the machinery for achieving this reproduction has historically consisted of large mechanical machines which can print individual characters in columns and rows using fonts which are accessible in a large selection matrix. Oriental language printing machines have required considerable operator skill for efficient use, for the machines usually require a close interaction with an operator in order to function.

With the advent of computer technology a variety of techniques have been developed for electronically processing characters in the oriental languages. In general, these techniques have involved the use of more or less "standard" keyboards normally associated with computers. One technique involves assigning several identities to a number of different keys, and specific characters are accessed from the computer memory by depressing individual keyboard keys in predetermined sequences. This provides coded instructions to the program logic of the computer identifying the specific character to be reproduced. Another technique utilizes Romanized characters as a selection input to the programmed computer logic, and yet another technique employs coding by numbers. These techniques are typified by the so-called cang jie method, the method of first/last stroke plus phonetic discriminator, the romaji conversion method, and the telegraphic code method.

Using the cang jie method, the operator must memorize the keyboard of the computer processor, including the cang jie representations of character fragments and must learn which keys each of the representations are on. Each key typically serves more than one cang jie symbol. When using the machine the operator mentally separates characters to be processed into their component fragments, and then obtains the desired character by pressing keys for cang jie equivalents of character fragments in the proper sequence, as though he were constructing the character by hand. The machine uses programmed logic to interpret the input key strokes and converts them to the desired characters. Selection by the machine of the proper character is facilitated by programmed grammar, and the operator reverts to use of a numerical code table if the cang jie form is unknown or is nonexistent.

The first/last stroke plus phonetic discriminator method requires that the operator memorize the computer processor keyboard, and in particular which strokes are available and which keys represent the strokes. Also, the operator must learn which phonetic symbols are available and which keys the phonetic symbols are associated with. When using the machine, the operator examines the characters to be processed, and identifies the first and last stroke making up each character. He then must know which characters can be distinguished on the basis of first and last stroke only, and which ones need a phonetic discriminator. The operator enters a character by pressing appropriate keys for the first and last stroke and the phonetic discriminator, if required, in the proper sequence. The computer processor uses programmed logic to interpret the input key strokes and converts them into a complete character. Selection of the proper character is facilitated by programmed grammer rules, and the operator reverts to use of the numerical code table if the strokes and phonetic symbols are insufficient for extracting the proper character from memory.

The romaji conversion method requires that the operator memorize both the romaji keyboard and the Romanized spelling for all the sounds of the oriental language. For example, the Chinese language has 409 or 410 Romanized phonetic sounds. The People's Republic of China utilizes four hundred nine sounds in conversation, whereas the traditional Chinese language form used in Taiwan and elsewhere employs four hundred and ten sounds. When using a machine based on romaji conversion, the operator must examine the Chinese language document to be processed, mentally convert the written characters into sounds, convert those sounds into the romaji form, and then enter the romaji letters in proper sequence using an alphabetic or similar type of keyboard. The machine uses programmed logic to interpret the romaji letter sequences and convert them to the desired characters. Selection of the proper character is facilitated by programmed grammar rules, which is an essential part of romaji conversion using a keyboard input. The operator has no need for numerical code tables, since all characters can be expressed in romaji.

The numerical code method has been used for many years in the field of telegraphy. The operator must memorize code numbers for specific characters in order to achieve proficiency in the use of the technique, and those characters that are not memorized by the operator must be found using numerically coded tables. An input into a computer processor is made via numerical keys, and the processor uses programmed logic to interpret the input key strokes and convert them to characters.

In the transition from mechanical "typewriters" to electronic character processors, some use has been made of what is generally called the tablet/stylus technique. This consists of a tablet with a fixed display of commonly used characters on its surface, and a stylus for identifying the location of desire characters. It has the advantage over the old Chinese mechanical typewriter in that it is smaller in size, but the number of characters displayed is limited by the physical size of the tablet, and the physical size of the tablet in turn is limited by how many characters can be usefully displayed without completely confusing the operator. An electronic stylus is used in place of a mechanical positioning device, and it provides an electrical signal that identifies X-Y coordinates on the tablet to the computer.

Several of the methods described above employ programmed grammar rules, either as an essential element or as an important aid for facilitating character selection. This is a major shortcoming of keyboard operated processors for the Chinese, Japanese or Korean languages, because programmed grammar rules cannot accommodate jargon unless specifically programmed. Jargon is defined as the body of colloquial expressions which have come into practice as languages have evolved and which may vary in meaning from one segment of society to another. Machines will obey rigid rules of grammar, but people generally do not. Jargon is widely used in every field from computers to medicine, and varies from one region to another even within a single country. A machine which is dependent upon use of proper grammar for efficient operation can be nearly paralyzed by jargon. Stated another way, the preparation of documents in any specialized field where jargon is essential to communications will significantly reduce operator efficiency.

The romaji conversion method described above depends upon programmed grammar rules, and so is intolerant of jargon. Even more important, however, is the fact that message distortion will usually result from typographical errors caused when the romaji conversion method is used. A machine operator working in the English language can and will make typographical errors, but this does not usually destroy the sense of what is being communicated. With romaji conversion processing of the Chinese language however, a typographical error can change the meaning of a word dramatically. For example, an operator intending to type the romaji form "hezi" could easily strike the wrong one of two adjacent keys producing the Chinese character form of "gezi" and changing the intended meaning while still retaining grammatical continuity. The word "hezi" has reference to a nuclear device, whereas "gezi" relates to a dove, the symbol of peace.

From the above summary of existing language processing methods it is evident that computer processing can and has been used to enhance the practice of these methods. Because of the unique speed capabilities of computers, they are a valuable tool in facilitating the selection and reproduction process of constructing oriental characters because they can very rapidly apply a large number of known and predetemined rules to this process, and can store a large volume of character-related information. Through the use of modern matrix type printers and CRT display screens, the outputs of these devices can be used to reproduce a hard copy of pictorial symbols, or the output can be used as a character generator for word processors or computers. A conventional input device to a computer processing system is a keyboard, which is a severe handicap when dealing in a language having thousands of characters because the number of characters greatly exceeds the practical limit for keyboard size. To address this problem the present invention contemplates a method which most effectively works with a dynamic "keyboard" wherein the identity of the respective "keys" is a dynamic function of the respective method steps being performed at the moment.

Whereas the steps of the method can be performed utilizing a wide variety of machine and/or non-machine constructions, they are most efficiently performed in combination with a machine having a cathode ray tube (CRT) utilizing a touch panel overlay construction for interfacing with a computer processor. The advantage of a touch panel device for use in performing the method is that the user/machine interface is achieved by touching the various X-Y coordinate positions physically fixed on the touch panel, whereas the visual display shown on the CRT display screen may be selectively manipulated to place different character options at the various X-Y intersections. Therefore, depending upon which of the method steps is being performed at any instance, the CRT display screen may indicate a plurality of character choices and the operator may touch the X-Y coordinate corresponding to one of these choices to initiate the next step of the language processing method. In this manner, the finite area of a touch panel may take on many different meanings in the course of performing a multi-step method but each display associated with any particular step may contain only a finite and readily understandable body of character information of consideration by the operator. When used in conjunction with a phonetic approach to language construction all of the character options for sounds being processed may be displayed, thus accommodating even the most specialized topic, jargon or slang. Further, the use of a phonetic approach to the generation of language characters also enables the use of voice recognition techniques for processing phonetic sounds, which can greatly speed up the computerized practice of the method.

A particular problem exists in connection with the display of oriental language characters on a CRT display screen in conjunction with a touch panel. In such a system the touch panel becomes a dynamic "keyboard" wherein the function and interpretation of the various key "pads" is interdependent with the display information presented at the same physical location of each key pad. Operator selection of any key pad inherently causes an entirely new display pattern of characters and/or symbols to appear, and the new pattern defines a new function and/or interpretation of the various key pads, which leads to yet a further set of operator selection choices. For the system to operate efficiently the entire CRT display screen must be capable of rapidly changing from one display pattern to another, and the operator must not perceive any troublesome delay in time from his selection of a key pad to the display of a pattern resulting from his selection.

It has been found in experimental use that an operator can become exceedingly skilled in constructing language characters according to the teachings of the invention, and the operator's speed of operation can approach the maximum speed which human hand-eye coordination will permit. Under these conditions the presentation of each new display pattern on the CRT display screen must be perceived by the operator to be instantaneous, for any slower display change will be perceived by the operator as an excessive system delay.

The time required for changing a display pattern on a CRT display screen is inherently limited by two factors: the horizontal and vertical sweep signal timing, and the capability of the system to deliver the necessary blanking and/or unblanking signals in synchronism with the sweep signals in order to present the display pattern. The time-density of blanking/unblanking signals is a function of the display pixel resolution required for a particular application, i.e. the number of discrete display spots required to adequately discern the differences between the various characters displayed, under conditions of maximum character display density on the CRT display screen. It has been empirically determined that the maximum effective character display density is approximately 256 oriental characters across the entire face of a CRT display screen; further, it has been determined that each character requires a 24X24 matrix of pixel cells in order that an optimal degree of resolution is obtained to enable an operator to discern one oriental character from all others.

In a practical CRT display system the number of viewable horizontal trace lines is 512, and therefore a 24X24 matrix of pixel cells will require 26 horizontal lines per character row. A reasonable spacing between adjacent rows of characters will add in additional 8 horizontal lines per character row, leading to the conclusion that 16 character rows of optimal resolution may be displayed on the face of a CRT display screen. Since oriental characters must generally be accommodated within a square geometric perimeter, the CRT display screen is generally limited to 16 character columns as well, leading to a character display matrix of 16X16, or a total of 256 characters, across the face of a CRT display screen.

A character matrix of 16X16 characters requires a pixel matrix of 512X512 pixels (24 character pixels plus 8 spaces per character), which requires a total of 262,144 pixels which must be presented to the CRT display each time the screen is changed or refreshed. If the CRT display screen is refreshed at the rate of 50 Hertz (Hz), the pixel data rate exceeds 13 Megahertz (Mhz). Further, if the pixel information is stored in a digital memory of the type commonly associated with computer technology wherein each memory location is capable of storing 8-bits of binary information, the memory size must be 32,768 (32K) addresses, and the memory data retrieval rate must be of the order of 2 Mhz. While such memory sizes and data retrieval rates are within the state of the art in computer technology, they present particular problems in constructing a language processing system wherein a great many additional computing functions are required in addition to the function of presenting CRT display patterns to a display screen, and more or less continuously changing these display patterns.

The present invention addresses these problems by providing a novel construction for character addressing the desired field of information to be displayed on a CRT display screen, rather than by utilizing a bit-plane concept wherein a pixel map is constructed within a bit-plane memory for feeding to the CRT display.

Further, the present invention utilizes the novel construction disclosed herein advantageously utilizes the novel construction disclosed herein advantageously in conjunction with a method of operating a language processing system in a fast and efficient manner.

The preferred embodiment of the present invention will be described with reference to the Chinese language, it being understood that the method can be readily adapted to other oriental languages. The Chinese language has been extensively studied, and a number of different approaches have been devised for simplifying the problem of selecting and accessing only a single desired Chinese character from the many thousands of character options which are available. Each of these approaches use different phonetic representations as a basis for making the desired character selections, and the present method is adaptable for use in connection with any of them. Among the different techniques previously devised for this purpose are the Pinyin Romanization technique, the Chinese National Phonetic Alphabet (CNPA) technique, the Yale Romanization technique, and the Wade-Giles Romanization technique. The Pinyin Romanization technique utilizes simplified Chinese characters which have been developed and used in the People's Republic of China. The other techniques utilize traditional Chinese characters.

Summary of the invention

The processing system of the present invention includes a digital computer processing unit (CPU) with inherent high-speed memory storage elements, a cathode ray tube)CRT) display unit connected to a video controller which is coupled to the CPU. The video controller is adapted for receiving data and commands from the CPU to cause the visual display of graphics information on the face of the CRT screen. The system also includes a transparent touch panel overlay on the face of the CRT display, which overlay is subdivided into a plurality of X-Y coordinate touch-responsive switch positions selectable by an operator, and suitable output devices such as printers and/or communications channels and/or memory devices for receiving output data and commands from the CPU. The method of the present invention includes the steps of displaying on the CRT screen an alphabet or phonetic assembled character set, selecting one of the displayed characters, displaying on the screen of the CRT a further character set which includes all phonetic sounds relating to the selected character, selecting one of the characters in the further character set, displaying on the screen of the CRT the picture language characters which are representative of the selected character, selecting the desired picture language character, and reproducing the selected desired picture language character.

It is a principal object and advantage of the present invention to provide a computer-based system for developing meaningful sentence structure and messages in any of the picture languages by repetitive implementation of a simple character selection and processing method.

It is a further object and advantage of the present invention to provide a system for reproducing any of the characters of the picture languages, and for selecting such characters through a phonetic-based method of selection.

It is another object and advantage of the present invention to provide a language processor for developing reproducible characters in any of the picture languages according to a simple and expedient method.

It is another object and advantage of the present invention to provide an efficient man-machine interface for selecting and constructing a picture language message from the character set of the picture language.

Brief description of the drawings

The foregoing and other objects and advantages of the invention will become apparent from the following specification and claims, and with reference to the appended drawings, in which:

Figure 1 shows a block diagram of the system of the present invention;

Figure 2 shows a pictorial view of the touch panel;

Figure 3A shows a diagram of a CRT/touch screen character cell matrix;

Figure 3B shows a diagram of a character pixel cell matrix;

Figure 4 shows a block diagram of the video controller;

Figure 5 shows a block diagram of the CPU;

Figure 6 shows a functional block diagram of the system memory;

Figure 7 shows a diagram of the touch panel interface;

Figures 8A-8Z show respective alphabetic/phonetic character representations;

Figure 9 shows a representative display of character intonations; and

Figure 10 shows a further representative diagram of the CRT/screen display areas.

Description of the preferred embodiment

Referring first to Figure 1, a computer processing system for implementing the method described herein as shown in block diagram form. The system of Figure 1 is configured with commercially available components, and interconnection between the respective components are all known with well-known and commercially available techniques.

In the preferred embodiment the system computer processing unit (CPU) 10 utilizes a commercially available computer processor semiconductor identified as a Z80 processor, together with a number of commercially available semiconductor register elements. For convenience herein, when referring to commercially available semiconductor components, reference will be made to the commercial type designation, together with a descriptive word or phrase which is indicative of the function of the semiconductor element. Thus, the "Z80 processor" is recognized to be a semiconductor element which is commercially available under the type designation "Z80" from Zilog, Inc., a U.S. semiconductor manufacturer, and its principal function is to operate as a computer processor.

System CPU 10 will be described in more detail hereinafter, with respect to its internal functional arrangement. System CPU 10 is connected to receive signals from tough panel 26 via cable 30, in the form of binary representations of the X-Y coordinate positions of a panel location wherein pressure has been applied to the face of touch panel 26, as by depressing touch panel 26 with a finger. System CPU 10 is capable of receiving and transmitting data to a system memory 12 via lines 13, and is also capable of receiving and transmitting data to a video controller 16 via lines 15. These data transmissions are accomplished according to well-known techniques associated with data transmission in the computer industry.

Video controller 16 is connected to CRT display 20 via lines 21, and generates the timing and control signals necessary for displaying visual images on the face of the CRT display 20. Video controller 16 contains the circuitry which is necessary for continually refreshing the display images on the face of CRT display 20, as well as the circuitry required for changing any of these visual images.

CRT display 20 may be a commercially available CRT unit which generates visual information by a plurality of horizontal line sweeps across the face of the screen, coupled with a vertical sweep which selectively shifts the horizontal sweep traces consecutively downwardly across the face of the screen. An electron gun is activated in CRT display 20 in timed relationship to the horizontal and vertical sweep signals to produce a lighted spot at every location wherein a display image is desired. In the preferred embodiment the face of CRT display 20 has been geometrically subdivided into 256 character positions, arrange in a 16X16 matrix of character display positions. Each of these positions is capable of displaying an independent character or symbol, and will be referred to herein as a "character cell". Each character cell is further subdivided into 1,024 pixel cells, arrange in a 32X32 pixel cell matrix. A pixel cell is the smallest unit capable of physical measurement and description on the face of CRT display 20, and each pixel cell represents a spot where light illumination may occur, or may not occur, as a result of control signals developed by video controller 16.

System CPU 10 is operatively connected to a printer 22 via lines 23, which preferably is a "matrix" type printer or equivalent, capable of printing characters of sufficiently high resolution so as to enable a reader to discriminate between the many different, but similar, characters which might be selected. It is preferable that printer 22 has the capability of printing character symbols in 24X24 dot matrix patterns, for it has been found that this pattern provides sufficient and optimal resolution for the most complex pictorial characters likely to be encountered in performing the method.

Figure 2 shows a diagrammatic view of touch panel 26, in association with CRT display 20, illustrating that touch panel 26 is formed for closely fitting against the outside of the CRT display screen. Touch panel 26 is constructed of transparent material across its face having conductive surfaces connected to a cable 30 which terminates in a plug 32, and plug 32 may be directly connected to system CPU 10. Touch panel 26 operates to generate a unique electrical signal whenever any intersecting coordinate of a row or column conductor 28 is touched by an operator. Touch panel 26 may have an intersecting matrix of interconnecting points for resolving X-Y coordinate positions on the screen, or may employ a voltage divider arrangement operating through an analog-to-digital converter to provide 50,000 or more discrete X-Y coordinate positions.

In the preferred embodiment touch panel 26 is configures to provided touch-responsive positions corresponding to the matrix of 16X16 character cell positions on the face of CRT display 20. This provides a matrix of 16X16 touch-responsive positions on touch panel 26, which are physically aligned over the character cell positions identified with respect to CRT display 20. Therefore, any character or symbol which is displayed on the face of CRT display 20 may be physically selected by a touch movement, depressing touch panel 26 at the physical location of the character display, and this touch response will be transmitted to system CPU 10 as a binary signal indicative of the location which has been depressed, and therefor indicative of the location which has been depressed, and therefore indicative of the character display which has been selected by an operator.

The system therefore provides for interactive operation between an operator and a CRT display screen, according to functions and programs which have been prestored in memory, and which are controllable by system CPU 10. The system software associated with the operation of the system therefore defines the interactive combinations which are possible, as well as the sequencing of the interactive operations. The system software incorporates a menu scheme of operation, wherein the CRT display provides a tabulation of interactive options available for selection by the operator. In addition, a predetermined number of character cell positions are reserved on the face of CRT display 20 for displaying certain control symbols which are known to the operator, and which may be selected to initiate predetermined commands to control the operation of the system. In one sense, the display of images on CRT display 20 may be thought of as a dynamic and infinitely variable "keyboard", wherein the meaning and interpretation of the respective character cell locations are a dynamic function of the information displayed at any particular moment, thus providing an unlimited range of selection possibilities, which possibilities are controlled by the operation of the system software.

System CPU 10 may optionally be connected to one or more disk drives 24 via lines 25, for storage and retrieval of information and data useful in the operation of the invention. System CPU 10 may also transmit and receive information and data over telecommunications lines 18, to communicate with remote terminals and computers.

CRT Display/Touch Panel Geometry

Figure 3A shows the geometric subdivisions, referred to herein as character cells, which are distributed over the face of the CRT 20 display screen, and have corresponding physical coincidence with positions over the touch panel 26. For illustrative purposes these character cells are shown in Figure 3A as rows and columns of rectangular boxes, whereas in actual practice they are merely relative physical positions on the face of the respective CRT display 20 screen and touch panel 26. Each physical position is uniquely addressable as a character cell location, running from character cell C0 in the upper lefthand corner, to character cell C255 in the lower righthand corner. In each of these character cell positions a unique character or symbol may be displayed by the CRT display 20, and the physical location may be selected by depressing the touch panel 26 at the corresponding position.

Figure 3B shows an exploded diagram representation of one character cell, as for example character cell number C43, which is found in the third row and twelfth column of the character cell matrix of Figure 3A. Figure 3B illustrates that each character cell may be further subdivided into a matrix of 32X32 pixel cells, and each pixel cell represents a discrete point on CRT display 20 which may be selectively illuminated for displaying an image pixel. There are therefore 1,024 image pixels or pixel cells in each character cell, and when these pixel cells are selectively illuminated there is formed a unique character or symbol on the face of the CRT display 20 screen at the corresponding character cell position.

Figure 3B illustrates the technique for identifying the pixel cells within any given character cell, by designating pixel cells in terms of column position (0-31) and row position (0-31). A pixel cell may then be designated as the intersection of any row or column, and is the smallest uniquely identifiable location on the face of the CRT display 20 screen. The pixel cells within any character cell are further arranged and designated in terms of display functions which will hereinafter be described. For example, an outer spacer band, called the "attribute band", comprising the four outermost pixel cells around the perimeter of each character cell, are functionally different from the inner matrix of pixel cells which they surround. The inner matrix comprises 24X24 pixel cells, and is reserved for the display of any actual character or symbol. The "attribute band" of pixel cells is reserved for displaying various functional attributes which have been defined for the system. Examples of these functional attributes are underlining, overlining, or bordering a character or symbol which is displayed. For convenience herein the attribute band of pixels will be identified as attribute pixels, and the inner 24X24 matrix of pixels will be identified as character pixels. The first row of attribute pixels (0-31) in each character cell has a unique functional identity which will be hereinafter described.

The character pixels of Figure 3B are further identified and subdivided into 72 character bytes, which represent the binary information required for transmission by the video controller 16 to uniquely identify the illuminated or non-illuminated state of groups of eight character pixels. Since the processor of the preferred embodiment utilizes logic organized into 8-bit bytes, it is convenient to identify the character bytes comprising the character pixels correspondingly. Therefore, 72 character bytes, each byte consisting of 8-bits of binary information, are required to completely define the illumination state of all character pixels of each character cell. In Figure 3B these character bytes are identified by the designations CB00-CB71, each row of character pixels requiring 3 character bytes, numbering from the upper left corner of the character pixels (character byte 00) down to the lower right corner of character pixels (character byte 71). The binary character byte information is selectively transferred from the video controller 16 to the CRT display 20 in a sequential manner which will be hereinafter described. One half a character byte will be referred to herein as a "nibble", which will also be conveniently referred to in the description which follows.

Video Controller

Figure 4 shows a block diagram of certain logic and circuit elements comprising video controller 16. Video controller 16 incorporates an MC6845 CRT controller, and reference should be made to the product description of the MC6845 in conjunction with the description herein. One manufacturer of the MC6845 is Motorola, Inc. of Austin, Texas. Logic signals and identifiers consistent with the product description of the MC6845 will be used herein where applicable. For example, Figure 4 shows page/location address logic 401, having as inputs thereto signals designated MA10-MA11, and MA2-MA9, which signal designations are consistent with product description of the MC6845 CRT controller. In this case, these signal designations identify particular output bits of the "start address" register as described in the MC6845 product description.

Page/location address logic 401 receives data signals from the CPU 10, as well as internal data and control signals from the MC6845, for selecting a page number address in ROM address memory 402 and for selecting a location number address within the selected page. The address selection information is output from Page 1 location address logic 401 to ROM address memory 402.

ROM address memory 402 contains the memory cells for storing address data for identifying and selecting any of the addresses in character generator ROM 404. In the preferred embodiment character generator ROM 404 is a collection of 24 EPROM memory semiconductors, Type 27512, available from semiconductor manufacturers having the capacity of storing more than 1.5 million 8-bit bytes of data. Therefore each memory location in one EPROM is capable of storing a character byte as has been described with reference to Figure 3B, and the entire character generator ROM 404 is capable of storing over 21,000 characters. Each EPROM memory semiconductor in character generator ROM 404 is organized into 8 blocks, each block having 4096 addresses. Since each displayed character requires 72 character bytes, each EPROM semiconductor block has the capability of storing 56 complete characters. The addresses for locating these character bytes in character generator ROM 404 are retained in ROM address memory 402. ROM address memory 402 is formed of a plurality of Type 2148 RAM memory chips available from semiconductor manufacturers, each of which has a capacity of storing 1,024 4-bit words. ROM address memory 402 is organized into convenient subdivisions for fast access to character generator ROM 404, and for convenient storage of the addressing information necessary for identifying all character cells and all pixel cells associated with CRT display 20. For example, ROM address memory 402 is organized into four "pages" of address selection memory, each page having 256 storage locations, corresponding to the 256 character cells identifiable on the face of CRT display 20. Further, each of the pages of ROM address memory 402 is segmented into three sections, comprising a 4-bit "attribute" section associated with the generation of attribute information, an 8-bit section associated with the generation of a "macro" address portion, and a 12-bit section for generation of a "micro" portion of the address selection of character generator ROM 404. The "micro" and "macro" address selection incorporates a total of 20 address bits, which is sufficient for selecting any address in character generator ROM 404, up to a total of approximately 1 million addresses. The operation of ROM address memory 402 will be more fully described hereinafter.

The output of character generator ROM 404 is transferable either to CPU 10 or to CRT display 20. If the output of character generator ROM 404 is to be transmitted to CPU 10 it is first transferred to CPU output logic 410, where it is retained in 8-bit bytes in a pattern buffer 411, and subsequently transferred to CPU 10 under control of the CPU 10 data channel logic. If the output of character generator ROM 404 is to be transferred to CRT display 20 it is first transferred in 4-bit bytes, or "nibbles" to character byte output logic 408. The 4-bit nibbles are transferred to an internal shift register in character byte output logic 408, and serially shifted to the CRT display 20 as video information.

The attribute logic 406 receives attribute addressing information from ROM address memory 402, and generates the appropriate attribute signals for subsequently feeding to the CRT display 20 via character byte output logic 408. The operation of attribute logic 406 will be more fully described hereinafter.

Character generator ROM 404 retains the binary representations of all possible characters and symbols which may be displayed on the face of CRT display 20, and these binary representations are organized in sequential address groupings within character generator ROM 404 for easy access by the addressing information retained within ROM address memory 402. Each address in character generator ROM 404 is capable of storing an 8-bit byte of binary information, as described with reference to Figure 3B. Each displayed character requires a grouping of 72 consecutive bytes within character generator ROM 404. The binary information stored within these 72 consecutive addresses is sufficient to selectively illuminate any of the 24X24 matrix of pixels associated with any particular character cell. During any single display sweep on the face of CRT display 20 it is therefore necessary to access 256 groups of these locations within character generator ROM 404, and the starting address locations of each of these 256 groups define the identity of the particular character which is to be displayed on the face of CRT display 20. In other words, any particular character selection may be identified by its starting address within character generator ROM 404, and its image will be displayed by sequentially accessing 72 consecutive memory locations beginning at that starting address. Thus, the identity and selection of any particular character may be governed by simply accessing the starting address of that character in character generator ROM 404. Since approximately 21,000 characters may be stored within character generator ROM 404 in this fashion, it is necessary that CPU 10 retain a library of approximately 21,000 character codes, each of which may be converted into a starting address referenced to character generator ROM 404, in order for CPU 10 to control the selection and display of any of these characters on the face of CRT display 20.

In addition, CPU 10 must be capable of signaling to video controller 16 the identity of the physical character location on the face of CRT display 20 where any particular character is to be displayed. Since character positions are identified numerically as positions 0-255, CPU 10 must convey to video controller 16 the character position information which will enable video controller 16 to display the proper character at the proper character position on the face of CRT display 20. This selection and control process is accomplished within ROM address memory 402, wherein CPU 10 transmits the starting position address of each selected character to ROM address memory 402, consecutively arranged to correspond with the 256 character positions identifiable on the face of CRT display 20. In other words, by using 256 consecutive locations within ROM address memory 402, CPU 10 can identify the character position and the character selected for display the character position and the character selected for display at that position, sufficient to completely designate all possible characters to be displayed on the face of CRT display 20 during any single sweep of the vertical trace across CRT display 20. This amount of memory in ROM address memory 402 is designated as a "page" of memory.

ROM address memory 402 has the capacity of storing four "pages" of display information, and three of these pages (pages 0-2) may be directly accessed by CPU 10 for prestoring three different image display fields for CRT display 20. The fourth page is identified as an "internal" page, and is utilized by video controller 16 to control the pixel images displayed during the horizontal sweep while the face of CRT display 20 is being refreshed. Therefore, the internal page controls the dynamic display of pixel information during each horizontal signal trace across CRT display 20, and is synchronized to the horizontal and vertical retrace signals associated with CRT display 20, which signals are developed by the MC6845 CRT controller.

The "pages" of ROM address memory 402 are symbolically illustrated in Figure 4A by the numerals 0, 1, 2 and INT (internal). ROM address memory 402 is further subdivided into a micro address memory section 412, a macro address memory section 414, and an attribute address memory section 416. Micro address memory 412 has a capacity of 1,024 12-bit memory cells, macro address 414 has a capacity of 1,024 8-bit memory cells, and attribute address memory 416 has a capacity of 1,024 4-bit memory cells. As has been hereinbefore stated, the 1,024 12-bit memory locations of micro address memory 412 are grouped into four 256-word pages, and the same is true for the micro address memory 414 and the attribute address memory 416.

Micro address memory 412 has an input 12-bit register which is designated as micro register 413. Micro register 413 receives 12 data bits of information from CPU 10, which data bits originate in the Z80 processor 502 (see Figure 5) as bits A0-A11.

Macro address memory 414 has a two-stage input register designated as 415A (macro register 1) and 415B (macro register 2). Register 415A receives an

8-bit data signal which originates at the Z80 processor 502 register stages D0-D7.

Attribute address memory 416 has an input attribute register 417, which receives 4 data bits originating in the Z80 processor 502 in register stages A8-A11. Each of the registers 413, 415A, and 417 receive address data over the respective input lines, which is then stored in selected locations in the respective sections of ROM address memory 402.

The addresses within ROM address memory 402 in which the input register information is stored is selected by page/location address logic 401. Page/location address 401 receives input information from CPU 10 via input register 419, which is designated as a "page number" register. This register receives 2-bits of information from CPU 10, which is sufficient to uniquely identify any of the four pages within ROM address memory 402. A second input register, designated location number register 420, receives 8-bits of information from CPU 10, which is sufficient to uniquely identify any of the 256 addresses within ROM address memory 402 associated with the selected page. The input lines to register 419 originate in the Z80 processor 502 A register, and the input lines to register 420 originate in the Z80 processor 502 D register, specifically stages D0-D7.

Page/location address logic 401 is capable of receiving address information from both CPU 10 and internally from video controller 16, specifically from the MC6845 CRT controller. Therefore, page/location address logic 401 functionally incorporates two multiplexers for the purpose of selecting which of the two address sources is to be utilized during any accessing operation into ROM address memory 402.

ROM address memory 402 has two output registers for transferring information retrieved from the micro address memory 412 and the macro address memory 414 into the character generator ROM 404, for purposes of selecting memory addresses of binary character representations which have been prestored in character generator ROM 404. A rolling counter 422 is coupled to micro address memory 412, for two-way data transmission, and is coupled to character generator ROM 404. A macro latch register 424 is coupled to macro address memory 414 for two-way data transmission, and is coupled to character generator ROM 404. Together, registers 422 and 424 retain 20-bits of address selection information, which is sufficient for uniquely identifying any of the more than 1 million address locations within character generator ROM 404. Macro latch register 424 contains the high order 8 address bits, and rolling counter register 422 contains the low order 12 address selection bits. An attribute latch register 426 is coupled to attribute address memory 416 for two-way data transmission, and is coupled to attribute logic 406 for selecting the attribute information, which will be described hereinafter.

Each time an address has been selected in character generator ROM 404, an 8-bit byte will be output from character generator ROM 404 over output lines 430 and 432. Output lines 430 and 432 may be gated either into CPU output logic 410, as a parallel 8-bit byte, or into character byte output 408, as two parallel 4-bit byte segments. CPU output logic 410 is utilized to transfer this information back to CPU 10, and specifically to Z80 Processor 502 register stages D0-D7. When retrieved in this form, CPU 10 may utilize the output information internally, or may collect it for later transmission to a printer for a printing operation. When the output data from character generator ROM 404 is gated into character byte output 408, it is for the purpose of displaying the information on the CRT display 20. Lines 430 are gated into low buffer register 431, and lines 432 are gated into high buffer register 433. The contents of register 431 (referred to as a nibble) are gated into shift register 435, and are serially shifted out of shift register 435 into video transmitter 437. Video transmitter 437 serially shifts the information to the CRT display 20 as video information. Next, the nibble contents of high buffer register 433 are gated into shift register 435 and serially shifted into video transmitter 437, for subsequent transmission to the CRT display as video information. The serial shifting of information to the CRT display 20 as video information is coordinated with the horizontal and vertical synchronizing lines which drive the trace signals for CRT display 20, so as to assure that the video information corresponds properly with the horizontal and vertical positional requirements of the sweep signals. The serial stream of video information transmitted by video transmitter 437 is received by the CRT display 20 as a serial stream of blanking and unblanking signals, which control the CRT electron gun to designate the illuminated and non-illuminated pixels on the face of CRT display 20.

The attribute band which borders every character cell on the face of CRT display 20 is treated somewhat differently from the inner 24X24 matrix of pixels within each character cell. The visual images which may be displayed within the attribute band in the preferred embodiment are extremely limited in quantity, being restricted to essentially three choices:

1) a line for underlining the character within the character cell;

2) a line for overlining the character within the character cell; and

3) an illuminated border surrounding the character within the character cell.

Since the above three attribute selections involve only a limited and predetermined variety of pixel illumination within the attribute band for any character, it is possible to create this limited variety of choices without the need for an extensive memory for storing a wide variety of pixel illumination information. At any given row in the attribute band of a character cell the attribute pixels are either all illuminated or all non-illuminated, and there is therefore a need to retain in attribute memory 416 only an identity of the type of attribute selected and the character position for that attribute. The attribute type description is retained in each 4-bit memory cell in attribute address memory 416, and the relative position of each memory cell determines the character position on the face of CRT display 20 wherein the attribute information will be displayed.

For any particular character position the contents of the address associated with that position in memory 416 is transferred to attribute latch register 426, and from there into attribute logic 406. Attribute logic 406 comprises an attribute generator 440 and an attribute buffer register 442. Attribute generator 440 is a preprogrammed semiconductor chip, commonly known as a programmable array logic chip, which provides a predetermined 4-bit output signal in response to a predetermined 4-bit input signal. The 4-bit output signal is transferred into attribute buffer register 442, wherein it is held until it is transferred into character byte output logic 408, and specifically to shift register 435. Shift register 435 converts the information into a serial bit stream for transferring to the CRT screen for display purposes.

Display Screen Refresh Operation

The image displayed on CRT display 20 is continually refreshed at the rate of twenty-five times per second, and this refresh is controlled by video controller 16. The refresh operation simply provides a fresh electron beam scan across the face of the CRT tube to reilluminate those pixels which have been selected as image display pixels so as to maintain what appears to be a constant image on the face of the CRT display 20. The refresh operation requires a completely new generation of the binary character information within the character generator ROM 404, corresponding to the characters which have been identified for display by the contents of ROM address memory 402 at all of the 256 character positions controlled by ROM address memory 402. The refresh operation occurs repetitively, independently of whether video controller 16 is interacting with CPU 10 for the transmission of new character data. The refresh operation is controlled entirely within video controller 16, by signals generated by the MC6845 CRT controller. The refresh operation will display the character pattern identified in any one of the pages 0, 1, 2 of ROM address memory 402, although the character data of the selected page will have been duplicated into the internal memory INT page for dynamic interaction with the character generator ROM 404 as the refresh operation proceeds. During refresh the address selection for ROM address memory 402 is controlled by the MC6845 CRT controller, which inputs page selection identifiers into page/location address logic 401 over its address lines MA10-MA11, and which inputs the location address within the page into page/location address 401 via its address lines MA2-MA9.

For purposes of explanation we will assume that CRT display 20 is at the beginning of a refresh cycle, and will refresh the CRT display 20 by displaying the characters identified in page 0 of ROM address memory 402. It is assumed that the characters in page 0 have been prestored into page 0 by operation between the video controller 16 and CPU 10. In this context, the MC6845 CRT controller generates a page 0 address identifier on its output lines MA10-MA11, and a 0 character location address on its output lines MA2-MA9. This causes an access to be made in page 0, address 0 of ROM address memory 402. The contents of this address location are transferred respectively into rolling counter 422, macro latch register 424, and attribute latch register 426. This transfer is coordinated with the horizontal sweep frequency, also controlled with the horizontal sweep frequency, also controlled by the MC6845 CRT controller, so as to occur during the first horizontal line trace across the top of the CRT display screen 20. This corresponds to row 0 of the first row of characters, for which there is never any pixel information transmitted to the CRT display. After the contents of the first address location in page 0 have been transferred to the respective registers 422, 424 and 426, the contents of these registers are transferred into the same relative address of the internal page of memory. At the beginning of the second horizontal trace line the contents of attribute latch register 426 are transmitted into attribute logic 406, and the attribute generator 440 therein generates a pattern based upon the attribute identified and the first four pixels of row 1 (column 0, 1, 2, 3). This attribute generator pattern is transferred out through attribute buffer 442 into shift register 435, and from there through the video transmitter 437 to the CRT display. The attribute generator pattern is repeated for consecutive 4-bit segments throughout the entire 32 pixels of row 1 of the first character. This sequencing is controlled by program array logic within video controller 16, which is capable of recognizing when the video controller is operating within the attribute band of any particular character. The contents of register 422 and 424 are disabled during the time that the video controller is operating within the attribute band of any particular character.

After the first 32 pixels of row 1 have been updated the character count in the address buffer register 403 is incremented to select the next character position in ROM address memory 402. The operation proceeds as before with respect to row 1 of character position 2, and the sequence continues consecutively for row 1 or characters 0-15, to the end of the second horizontal trace line. During the horizontal retrace interval the address buffer register 403 is reset to character position 0 to initiate the sequence for the next horizontal trace line (row 2). The sequence continues through 2 and row 3, and begins again with row 4. At row 4, which is the first row where character information will be displayed, a new cycle of events occurs which permits the activation of registers 422 and 424. The first 4-bits of character row 4 contain attribute information, which is processed as has been described previously. The next 8-bits of row 4 will initiate the address of character byte 00, which address has been contained within rolling counter 422, as well as the upper eight address bits of character byte 00, which has been retained in macro latch register 424. This address information is coupled into character generator ROM 404, resulting in the retrieval over lines 430 and 432 of character byte 00. Character byte 00 is transferred into registers 431 and 433, and from there to shift register 435, and sequentially shifted through shift register 435 to video transmitter 437, and from there to CRT display 20, resulting in the illumination of the proper pixels representative of character byte 00. In the meantime, rolling counter 422 has been incremented by one count and used as address selection information for character generator ROM 404 to select the character byte 01. After character byte 01 has been transmitted to visual display 20 rolling counter 422 is again incremented and used as address selection information for character byte 02; this process is repeated one more time for character byte 03 before restoring it into internal memory at the address location representative of character position 0. The final 4-bits of row 4 of character position 0 are attribute bits, and these are generated as has been described previously with respect to attribute generator 440.

Next, address buffer 403 is incremented and the cycle described above is repeated with respect to the character bytes identified in character position 1 in ROM address memory 402.

The refresh sequence continues throughout all the character bytes associated with characters 0-15, as well as with respect to the attribute band associated with characters 0-15, and then the address buffer register 403 is incremented to the count 16. The various sequences described above repeat themselves until all of the 256 characters displayed on CRT display 20 have been refreshed on the face of the CRT display screen. At this time, the refresh memory sequence begins anew at character position 0 and continues indefinitely at 20 millisecond intervals for so long as the equipment is operational.

Character Printing Operation

The only place in the entire system wherein a character pattern representation exists is in character generator ROM 404. Therefore, whenever a character is to be retrieved for display, either on a CRT screen or is to be displayed by printing via a printer, the character must be retrieved from character generator ROM 404. In the case of character printing, the retrieval of the character bytes from character generator ROM 404 must be accomplished during time intervals when character generator ROM 404 is not being utilized for feeding character bytes to the CRT display 20. Therefore, the only time available for retrieving information from character generator ROM 404 is during the vertical retrace interval associated with CRT display 20.

The control of the data transfer required for character retrieval from character generator ROM 404 is maintained by CPU 10, consistent with the timing restrictions imposed upon these data transfers by video controller 16. Thus, CPU 10 may identify a character for retrieval from character generator ROM 404 at any time, but video controller 16 will permit such a transfer only during the vertical retrace interval. If all of the 72 character bytes required for the transfer of a complete character representation cannot be accomplished during a single vertical retrace interval, CPU 10 must maintain its own internal record of that portion of the character which has been transmitted, and must continue the transmittal process during the next vertical retrace interval. In that respect, CPU 10 must maintain its own internal record of the character byte number which has been retrieved from character generator ROM 404, and it must update that internal record each time a new character byte is transmitted, until all 72 characters bytes associated with a particular character have been retrieved. The following description illustrates the operation for retrieval of a character.

CPU 10 generates the character identifier in the form of a macro address which is transmitted to macro register 2, designated 415B, and in the form of a micro address which is transferred to micro address register 413. The micro address generated corresponds to the address of the character byte 0 from the desired character in character generator ROM 404. During the vertical retrace interval register 415b and register 413 are directly coupled into character generator ROM 404, thereby permitting direct access to the address identified. The contents of that address appear at output lines 430 and 432, and are transmitted to pattern buffer 411 in CPU output logic 410. Internal handshake logic signals the CPU 10 that the desired information is ready and the CPU 10 that the desired information is ready and the CPU 10 receives the contents of pattern buffer 411. The CPU 10 then generates an incremented address for transmission to micro register 413 and the process becomes repeated. After 72 character bytes have been transferred according to this procedure, CPU 10 has received the complete binary representation of the selected character. The CPU 10 may then output this information in a form suitable for printing to the printer associated with the system.

System CPU and Memory

Figure 5 shows a block diagram of the system CPU 10 and system memory 12. The heart of system CPU 10 is Z80 processor 502, which, in the preferred embodiment, is a semiconductor element manufactured by Zilog, Inc. The term "Z80" is a registered trademark of Zilog, Inc., which identifies a family of semiconductor products designed for interconnection and interaction. Z80 processor 502 is more particularly known by the product number Z8400, which is an 8-bit microprocessor having an instruction set of 158 instructions, two sets of six general purpose registers which may be used individually as either 8-bit registers or as 16-bit registers pairs, two sets of accumulator and flag registers, a program counter, two index registers, and an interrupt register. Reference should be made to the manufacturer's product description for a complete understanding of the internal logic construction and operation of the Z80 processor 502.

Z80 processor 502 communicates with system memory 12, and more particularly with three functionally different sections of system memory 12. Memory section 504 comprises a 64K read only memory (ROM) which is used to store binary information representative of all of the preformatted displays which are desired for interaction with an operator via CRT display 20. Included in these preformatted displays are a plurality of menus, each of which display for operator consideration a number of selectable options for guiding and directing the operator of the system. The various menus are presented to the screen of CRT display 20 as a result of operator input commands and selections via touch panel 26. For example, when the system is initially turned on the operator is presented with a menu which provides a number of options for his selection, to control the subsequent mode of operation of the system. Depending upon the operator selection, which is received by the Z80 processor 502 via touch panel 26 and touch panel interface 506, the Z80 processor 502 will execute certain operating and application programs which are stored in memory section 508. Memory section 508 comprises a 64K ROM memory for storage of all operating and application programs. In addition thereto memory section 512 comprises a 16K random access memory (RAM) which is designated a buffer memory section, for storage of various program variables, printer and disk access data, communications information, and various other storage requirements. All of the sections of system memory 12 are directly accessible by Z80 processor 502 via memory access lines 13.

Because of design limitations associated with the Z80 processor 502, its memory accessing capability is limited to a memory size of 64K. Therefore, system memory 12 is functionally organized to permit a memory capacity in excess of 64K to be accessible by Z80 processor 502, as is shown in Figure 6. Figure 6 is a functional block diagram illustrating the functional organization of memory sections 504, 508 and 512. Block 514 represents the directly accessible memory to Z80 processor 502, through its normal memory addressing operations. Accessible memory 514 is therefore comprised of accessible blocks of data from memory sections 504 and 508, and the entire contents of memory section 512. As has been hereinafter described, memory section 504 is capable of retaining 64K of data relating to menus for display on CRT display 20. However, only a 4K block 504a of memory section 504 is directly accessible by Z80 processor 502 at any given time, as is illustrated in the accessible memory block 514. Any 4K portion of memory section 504b may be functionally designated as accessible memory, but at any instant of time the system is limited to a 4K menu storage access. Likewise, memory section 508 has been previously described as containing a capacity of storing 64K of operating and application programs. However, a 32K portion of memory section 508, designated 508a in Figure 6, is directly accessible by Z80 processor 502 at any given instant of time, and the remaining portion of memory section 508, designated 508b in Figure 6, is directly accessible in 8K blocks. This access is obtained through an 8K program window 516, which forms a portion of accessible memory 514. The entire contents of memory section 512 are directly addressable by Z80 processor 502 in any given instant of time.

Z80 processor 502 communicates with a printer 22 via a parallel input/output section which is designated Z80 PIO section 518 in Figure 5. Z80 PIO section 518 is available from Zilog, Inc. under product designation Z8420, and consists of a Z80 bus interface, internal control logic, two input/output data paths with associated control and interrupt logic. Reference should be made to the manufacturer's specification for an understanding of this component.

Z80 processor 502 may communicate with one or more disk drives 24 through a disk controller 520. Disk controller 520 is a commercially available product, as for example product designation WD1772, which is available from semiconductor manufacturers and suppliers of disk drive equipment.

Z80 processor 502 may communicate via telecommunications lines 18, through Z80 DART 522. Z80 DART 522 is available from Zilog, Inc., under product designation Z8470, and is identified as a dual asynchronous receiver/transmitter, which contains two independent full-duplex channels with separate modem controls.

Figure 7 shows a diagram of touch panel interface 506. Touch panel interface 506 receives signals which originate in the Z80 processor 502 data bus, and which may temporarily be stored in a latch register (not shown) prior to being transmitted to touch panel interface 506. Likewise, signals are transmitted from touch panel interface 506 to Z80 processor 502 via lines 510. Z80 processor 502 activates touch panel interface 506 by sending an 8-bit code over lines 510, causing latch register 530 to generate signals 532 and 533 to sequentially activate the touch panel 26 X-axis and Y-axis signal conductors. An analog response signal is coupled back into touch panel interface 506 via lines 538 and 539, which response signals are representative of the X and Y coordinate positions on the touch panel screen which have been depressed by the operator. These signals are received by analog switch 540, and are transmitted to A/D converter 542. A/D converter 542 converts the analog voltage signals into an 8-bit binary quantity which is then transmitted back to Z80 processor 502 via lines 510.

Touch panel 26 utilizes a resistive conductor grid which provides a sensitivity of more the 65,000 physical positions on the face of CRT display 20 screen. Touch panel interface 506 develops the analog drive signals for connecting to the touch screen resistive grid, and receives the analog return signals for enabling a determination of the physical position which has been touched by the operator, to the exclusion of all other physical locations on the face of CRT display 20.

In operation, Z80 processor 502 transmits a first 8-bit code over lines 510, which are received at latch 530. This code activates line 532, which turns on semiconductor switches 543 and 544. These switches permit a voltage +V to be conducted to the touch panel X-axis conductors, which comprise an array of parallel resistive lines across the face of touch panel 26. An orthogonal array of Y-axis resistive conductors is also positioned across the face of touch panel 26, in spaced-apart relationship to the X-axis conductor array. If an operator has depressed the face of touch panel 26 at any particular location, the voltage signal on one of the X-axis conductors will be conducted to the intersecting Y-axis conductor, and a voltage will be coupled to analog switch 540 via line 538. A reference voltage is also coupled to analog switch 540 via lines 536, representative of 1/2 the full scale voltage across the Y-axis conductor. A gating signal on line 541 causes the voltage signals on lines 536 and 538 to become conducted to A/D converter 542. A/D converter 542 converts the voltage signal to an 8-bit binary signal which is transmitted back to Z80 processor 502 via lines 510.

At another time, Z80 processor 502 transmits an 8-bit binary code over lines 510 to be received by latch 530. This code causes activation of line 533, which turns on semiconductor switches 545 and 546 thereby applying a voltage +V to the Y-axis resistive conductor array across touch panel 26. Similarly, if an operator has depressed a touch panel at a particular physical location, a voltage will be coupled to the intersecting X-axis conductor and will be transmitted via line 538 back to analog switch 540. This voltage signal, together with a reference voltage signal on line 537, are gated to A/D converter 542 by a gating signal on line 541. A/D converter 542 converts the analog voltage value into an 8-bit primary value which is transmitted back to Z80 processor 502 via lines 510.

According to the foreging operation, Z80 processor 502 receives two sequential binary values representative of the respective X-axis position and the Y-axis position wherein an operator has depressed the face of touch panel 26. Since Z80 processor 502 has previously controlled the instructions for placing a predetermined display pattern on CRT display 20, Z80 processor 502 has the ability to interpret the X-axis and Y-axis position signals in relationship to the display patterns. This interaction enables the system to control and implement the method steps described herein.

Method of Operation

The system described herein is capable of operating in conjunction with a wide range of language characters and language dialects. In addition, with respect to the Chinese language in particular, the system is capable of reproducing either simplified or traditional characters, utilizing a number of different but related selection techniques. For example, the Wade-Giles technique utilizes an initial set of Romanized characters to ultimately develop traditional Chinese characters; the Yale technique utilizes an initial set of Romanized characters to develop a traditional Chinese character set; the Chinese National Phonetic Alphabet (CNPA) technique utilizes a set of special characters initially, to develop a traditional Chinese character set; and the Pinyin technique utilizes a Romanized alphabet to develop a simplified Chinese character set. For purposes of describing the operation of the system and the method of operating the system the Pinyin technique will be utilized, it being understood than any of the other techniques can equally well be utilized by the system.

The method may be briefly described as a series of three steps or iterations which can enable the operator to construct an unlimited transcript of Chinese characters to produce a hard copy document via the printer, or to transmit to other locations via telecommunications lines. The three steps may be simply stated as:

1) selecting a Romanized character representative of the initial character sound; this produces a display of all Chinese sounds in Romanized form associated with the selected character, together with commonly recognized Chinese characters having these sounds;

2) selecting the desired character sound from those displayed as a result of step 1); this produces a display of all Chinese characters having the selected sound, grouped according to Chinese language intonations;

3) selecting the desired Chinese character from the display as a result of step 2) above; this produces a further display and retention of the selected character.

The method is best understood in reference to Figures 8A-8Z, which shows respective Chinese sound character representations in Romanized form and grouped according to letters of the Roman alphabet, and with reference to Figure 9, which shows a representative display of language character intonations, and with reference to Figure 10, which shows a representative diagram of the CRT/touch screen display areas. Referring first to Figure 10, the format of a typical display is illustrated. As has been discussed hereinbefore, the face of the CRT screen (and corresponding touch panel) is functionally subdivided into a matrix of 16X16 display characters. For purposes of performing the method this matrix is functionally organized in a particular format. The first three character rows are designated the selected character display field 550; the next nine character rows are designated the character field 552; the next two character rows are designated the alphabetic display field, 554; and the next character row is designated the punctuation and common character display field 555; the bottom character row is designated the function display field 556. The alphabet display field 554, the punctuation display field 555, and the function display field 556 together comprise one of the plurality of menus which are prestored in the system memory 12 ROM memory section 504. These display fields are therefore initially presented to an operator on the face of CRT display 20, in order that the method may be implemented.

In order to begin constructing a Chinese character message, the operator locates the alphabetic letter in alphabet display field 554 which is associated with the first letter of the Romanized phonetic sound of that character. The operator depresses touch panel 26 at the position of the desired displayed alphabetic character, which causes the system to retrieve a further menu associated with that character, and to display that menu in the character display field 552. For example, if the operator had determined that the phonetic sound of the desired Chinese character was "ge", he would initially depress the "G" character in the alphabetic display field 554. This causes the system to retrieve from ROM menu memory the characters shown in Figure 8G, and to display these characters in character display field 552.

Next, the operator observes the character display field and locates the phonetic "ge", which has associated with it a commonly known Chinese character of the same phonetic sound. He depresses either the "ge" position or its associated Chinese phonetic character, which commands the system to retrieve a further menu from the ROM menu memory. The further menu will present in character display field 552 all Chinese characters associated with the phonetic sound "ge", for the operator's examination, grouped in rows associated with different Chinese intonations. An example of this display, relating to the phonetic sound "ge" is shown in Figure 9. The intonations are c escribed by the symbols on the left, adjacent each row of characters. The symbol adjacent the first row (—) indicates a flat intonation, which is neither rising nor falling as the character is pronounced. All characters shown in the first row are "ge" characters having such a flat intonation. The symbol adjacent the second row (/) indicates a rising intonation when the character is spoken, and all characters shown in the second row (and continued for convenience into a third row) are "ge" characters having such a rising intonation. The symbol adjacent the fourth row (V) indicates an intonation which falls and rises when the character is spoken, and all characters shown in the fourth row are "ge" characters having such a falling and rising intonation. The symbol adjacent the fifth row (\) indicates a falling intonation as the character is spoken, and all characters shown in the fifth row are "ge" characters having such a falling intonation when they are spoken.

The operator then locates the desired Chinese character and depresses the face of touch panel 26 at that character display position, which commands the system to display that character in the selected character display field 550. The operator repeats the steps for the next subsequent character. After all of the desired characters have been selected and displayed in the selected character display field 550, the operator may print the selected character set, transmit the selected character set to a remote location via telecommunications lines, or store the selected character set in memory.

The function display field 556 contains a number of special character identifiers which are usable by the operator for assistance, or for commanding the system to conduct various operations. These character functions are described below:

H this causes a "help" display to appear in character display field 552, which identifies and explains all of the other function pads contained in function display field 556.

M this causes the system to return to the main menu, i.e., the initial menu which is displayed at the time of the system is turned on.

V this causes the system to display the entire message which has been constructed according to the foregoing steps described above; if the message is longer than the available number of lines for displaying, the message is scrolled upwardly to enable the operator to view the entire message.

A this causes the system to revert to the "abacus" mode of operation, which is unrelated to the present invention.

U this causes the system to undo the last steps performed in constructing a message, and is equivalent to an "erase" function.

D this causes the system to delete a character that has been selected, and is implemented by first touching the character in question on the display screen, and then touching the D position.

E this is an "exit" function which enables the operator to resume writing after performing editing operations.

O this is an "overwrite" function, causing the system to write over a character which appears on the screen. It is implemented by first touching the character which is to be replaced, touching the "O" position, and selecting a character to replace the original character.

u this causes the system to underline a character, and is implemented by first touching the character where the underlining is desired, and then touching the small "u" character position.

B this causes the system to produce bold characters, and is implemented in conjunction with touching the desired character.

2 this causes the system to print a character twice its normal size on the face of the display screen.

N this causes the system to insert a command into the message to begin a new page.

← this is a carriage return symbol, which enables the operator to start a new paragraph or a new line at any point where this symbol is depressed.

↑ this causes the system to scroll the character display field upwardly.

↓ this causes the system to scroll the character display field downwardly.

T this causes the system to scroll the entire selected character display field 550 up or down three lines at a time.

The punctuation display field 555 is utilized to insert the identified punctuation marks into a message at any desired location.

It may be appreciated that the function display field 556 may be organized according to a wide variety of function formats, wherein special symbols and/or characters are utilized at various positions to specify functions of interest. Further, the function display field 556 may be modified during the course of operation of the system to accommodate different sets of function descriptors, according to the implementation steps of the particular operations being performed by the system. Likewise, the punctuation display field 555 may be similarly modified to contain a wide variety of symbols, designs, and unique marks which may be of use in performing the system operation.

The character display fields shown in Figures 8A-8Z are representative display fields for each of the Romanized sounds, organized according to the Roman alphabet. It may be appreciated that these character display fields are representative, and other character display fields may equally well be provided for use in connection with the system. For example, character display fields associated with other and further languages, and other and further dialects of the same language may be utilized in substitution of those illustrated herein. Whereas the invention is particularly adapted for use in connection with languages having a large number of characters and character symbols, it is also usable conveniently with a wide variety of languages having lesser numbers of character choices.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

CLAIMS

1. A language processor for assembling and reproducing characters of an oriental language from a phonetic alphabet using a three-step technique, comprising

a) a visual display screen for selectively displaying character sets for operator examination;

b) a touch-sensitive panel overlaying said visual display screen and having a plurality of touch-sensitive locations overlaying said displayed character set, each location having means for generating an electrical signal representative of said location;

c) a first memory library having binary coded representations of a phonetic alphabet stored therein;

d) a second memory library having a plurality of first groups of binary coded representations of oriental and romanized characters stored therein, each such first group having relation to a character of said phonetic alphabet;

e) a third memory library having a plurality of second groups of binary coded representations of oriental characters stored therein, each such second group having relation to a character in one of said first groups;

f) means for selectively retrieving from a memory library and transmitting to said visual display screen, in response to electrical signals generated from said touch-sensitive panel, either said phonetic alphabet or one of said plurality of first groups or one of said plurality of second groups; and

g) means for selecting and reproducing a single oriental character from a displayed second group.

2. The apparatus of claim 1, wherein said second memory library further comprises a plurality of first groups of binary coded representations of oriental and phonetic characters, each one of said first groups including a plurality of representations of phonetic sounds associated with respective different ones of said representations of said phonetic alphabet.

3. The apparatus of claim 2, wherein said third memory library further comprises a plurality of second groups of binary coded representations of oriental characters, each one of said second groups including a plurality of representations of sound intonations associated with respective different ones of said representations of phonetic sounds.

4. The apparatus of claim 3, wherein said means for selectively retrieving and transmitting further comprises a digital computer processor system having means for transforming said electrical signals generated by said touch-sensitive panel into binary coded words, and having means for selectively accessing said first, second and third libraries in response to said binary coded words.

5. The apparatus of claim 4, wherein said means for selectively accessing further comprises means for assembling a character set for display on said visual display screen, and means for selectively accessing said second and third memory libraries to retrieve selected character representations for inclusion into said character set or display.

6. The apparatus of claim 5, wherein said means for assembling a character set further comprises an address memory having respective address locations associated with each of said plurality of touch-sensitive locations.

7. The apparatus of claim 6, wherein said means for selectively accessing said third memory library further comprises means for storing binary coded representations of respective third memory address locations into said address locations.

8. The apparatus of claim 7, wherein said means for transmitting to said visual display screen further comprises means for transforming said selected character representations retrieved from said first, second and third memory libraries into serially transmitted binary codes, and transmitting said binary codes to said visual display screen.

9. The apparatus of claim 8, wherein said binary codes associated with each selected character representation further comprise 576 binary bits of information assembled into a 24X24 matrix on said visual display screen.

10. The apparatus of claim 9, further comprising an attribute band of binary coded information associated with each selected character representation, said attribute band comprising an array of 4 binary bits of information surrounding said 24X24 matrix on said visual display screen.

11. A language processor for presenting sensible language character options to an operator, and for iteratively responding to operator selections to present a desired sensible language character, and for reproducing said desired character, comprising

a) a visual display screen for presenting sensible character options to an operator;

b) a transparent touch panel fitted over said display screen, said touch panel having a plurality of touch-sensitive positions arrayed over the screen, each position having a unique electrical signal identity;

c) a computer processor connected to said touch panel, said processor having means for converting said position identity electrical signal into a representative binary signal;

d) a library of binary coded words accessible by said processor, said library including a plurality of sensible character options corresponding to a plurality of touch-sensitive positions, and means for selecting one of said plurality of character options responsive to said commands from said computer processor;

e) means for transferring said selected one of said character options to said visual display screen for representation thereon; and

f) means for reproducing said selected character options in a printed media.

12. The apparatus of claim 11, wherein said library further comprises a character memory having a plurality of accessible addresses, groups of said addresses being associated with respective different characters, and each address group defining a fixed number of respective sequential character memory storage locations, and wherein the contents of said sequential character memory storage locations are prestored with binary coded words, each word representing a portion of a character display pattern.

13. The apparatus of claim 12, wherein said library further comprises a character address memory having a plurality of accessible addresses, each of said addresses being associated with respective different touch-sensitive positions arranged over said visual display screen, and wherein the contents of each of the memory storage locations associated with said addresses define a character memory address which is the first address of a group of character memory addresses associated with a character.

14. The apparatus of claim of 13, wherein said library further comprises an address output register coupled to said character address memory, and means for transferring the contents of said character address memory storage locations to said address output register, and means for utilizing the contents of said address output register for selecting a character memory address.

15. The apparatus of claim 14, further comprising a counter coupled to said address output register, said counter having means for incrementing the contents of said address output register a predetermined number of times equal to said fixed number of character memory locations defined by an address group; and further comprising means for transferring the incremented contents of said address output register back to the same character address memory storage location from which the contents originated.

16. The apparatus of claim 15, further comprising means for sequentially selecting said character address memory addresses.

17. The apparatus of claim 12, wherein said means for transferring further comprises a character output register and means for transferring binary coded words from said character memory storage locations to said character output register; a parallel-to-serial register coupled to said character output register; and means for transferring the serial output of said parallel-to-serial register to said visual display screen.

18. The apparatus of claim 17, wherein said visual display screen further comprises a cathode ray tube having a horizontal sweep signal driven at a first frequency and a vertical sweep signal driven at a second frequency; and means for developing said first and second frequencies and said horizontal and vertical sweep signals.

19. The apparatus of claim 18, wherein said means for developing said first frequency is coupled to said parallel-to-serial register and to said means for transferring the serial output of said register.

20. The apparatus of claim 19, wherein said means for developing said first frequency is coupled to said means for transferring the contents of said character address memory storage locations to said address output register, and to said counter coupled to said address output register, and to said means for sequentially selecting said character address memory addresses.

21. A system for retrieving and reproducing language characters from a character memory wherein a plurality of such characters memory wherein a plurality of such characters are prestored in binary representations, the binary representations of each such character comprising a fixed and predetermined group of character memory addresses arranged sequentially from an initial character memory address, comprising

a) a character memory address register operatively connected to said character memory for accessing said memory addresses to retrieve said binary representations to a character output register, said character memory address register incorporating a counter means for incrementing its contents after each access to said character memory, and means for incrementing said counter means to a count equal to the number of character memory addresses in each said group;

b) an address memory having a plurality of memory cells for storing character memory addresses, one memory cell for each such group of character memory addresses, including means for retrieving the contents of each memory cell and transferring the contents to said character memory address register, and means for receiving the contents of said character memory address register and restoring said contents into each of said memory cells;

c) register means for receiving character memory addresses from an external source and for transferring said character memory addresses into said address memory;

d) means for receiving the contents of said character output register and for reproducing said contents in a form of visible manifestation.

22. The apparatus of claim 21, wherein said means for receiving and reproducing further comprises a parallel-to-serial register coupled to said character output register, a cathode ray tube coupled to said parallel-to-serial register to serially receive the output from said register, and means for generating a horizontal and vertical sweep signal in said cathode ray tube and means for generating a sweep blanking signal coupled to receive the serial output from said parallel-to-serial register.

23. The apparatus of claim 22, further comprising means for receiving said horizontal sweep signal, and for generating timing signals therefrom; having output timing signals coupled to said character memory address register, said address memory and said character output register.

24. The apparatus of claim 23, wherein said external source further comprises a digital computer

processor.

25. The apparatus of claim 24, further comprising a touch panel closely fitted to said cathode ray tube, said touch panel having a pressure sensitive surface and an electrical output signal representative of the physical location on said surface where pressure is applied.

26. The apparatus of claim 25 further comprising means for receiving said electrical output signal and for transforming said signal into a binary coded signal, and for transferring said binary coded signal to said digital computer processor.

27. The apparatus of claim 26, further comprising means in said digital computer processor, for developing a unique character memory address in response to a received binary coded signal from said means for transferring.

28. The apparatus of claim 24, further comprising means for transferring the contents of said character output register to said digital computer processor.

29. The apparatus of claim 28, further comprising a printer coupled to said digital computer processor.

30. The apparatus of claim 28, further comprising a telecommunication line coupled to said digital computer processor.

31. A method of selecting a unique oriental language character from a set of oriental characters wherein the set is organized into groups according to romanized phonetic sounds and into subgroups according to intonations of phonetic sounds, comprising the steps of:

a) selecting the romanized alphabetic character corresponding to the first letter of the desired romanized phonetic sound;

b) selecting all romanized phonetic sounds beginning with the selected alphabetic character;

c) selecting the oriental character group corresponding to the desired romanized phonetic sound;

d) selecting the oriental character subgroup which has the desired intonation from within the selected oriental character group; and

e) selecting the desired oriental character from within the subgroup having the desired intonation.

32. The method of claim 31, further comprising the step of reproducing the desired and selected character.

33. The method of claim 32, wherein the step of selecting all romanized phonetic sounds alternatively comprises selecting all romanized phonetic sounds and oriental characters representative of said phonetic sounds beginning with the selected alphabetic character.

34. The method of claim 31, further comprising repeating steps a) through e) to assemble a message consisting of the selected oriental characters.

35. A method of constructing an oriental character message from a plurality of oriental character subgroups organized by intonation, within a plurality of oriental character groups organized by phonetic sound, within a plurality of phonetic sounds organized alphabetically, comprising the steps of

a) selecting from among the plurality of phonetic sounds, the desired phonetic sound;

b) selecting from the plurality of phonetic sound groups organized within the desired phonetic sound, the desired phonetic sound group; and

c) selecting from within the plurality of subgroups organized by intonation within the desired phonetic sound group, the desired oriental character.

36. The method of claim 35, wherein the steps of selecting further comprise selecting by depressing a touch panel overlay on a cathode ray tube on which the selection group is displayed.

37. The method of claim 36, further comprising reproducing the selected desired oriental character.

38. A method of selecting a unique oriental language character from a set of oriental language characters wherein the set is organized into a plurality of subgroups, each subgroup having a common phonetic identifier and at least two intonation variables, and wherein the plurality of common phonetic identifiers are organized into a plurality of groups of identifiers, each group having a common initial phonetic sound identifier, and wherein the common initial phonetic sound identifiers are organized into a single group, comprising the steps of:

a) selecting from the single group one of the initial phonetic sound identifiers, and thereby retrieving from the plurality of groups of identifiers the group having said selected initial phonetic sound identifier;

b) selecting from the group retrieved according to step a), a single identifier, and thereby retrieving from the plurality of subgroups the subgroup having said selected identifier; and

c) selecting from the subgroup retrieved according to step b), a single intonation variable, said single intonation variable comprising a unique oriental language character.

39. The method of claim 38, further comprising the step of reproducing the selected single intonation variable.

40. The method of claim 39, further comprising repeating the recited steps to construct a sensible collection of unique oriental language characters to form a message.

41. The method of claim 40, further comprising the step of printing the message.

42. The method of claim 38, wherein the steps of selecting each further comprise selecting by depressing a touch panel overlay on a display surface on which the selection group is displayed.

43. The method of claim 42, wherein the display surface further comprises the face of a cathode ray tube.

44. The method of claim 43, further comprising the step of reproducing the selected intonation variable by separately displaying said variable on said cathode ray tube.

45. The method of claim 44, further comprising repeating the recited steps to assemble a sensible collection of unique oriental language characters and to display said collection to form a message.

46. The method of claim 45, further comprising the step of printing said message.

47. A language processor for assembling and reproducing characters of an oriental language substantially as hereinbefore described with

reference to the accompanying drawings.

48. A system for retrieving and reproducing language characters from a character memory substantially as hereinbefore described with reference to the accompanying drawings.

49. Any novel integer or step or combination of integers or steps, hereinbefore described, irrespective of whether the particular claim is within the scope of, or relates to the same or a different invention from that of, the preceding claims.

Printed for Her Majesty's Stationery Office by
Croydon Printing Company (UK) Ltd, 8/87, D8991685.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.