

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
13 February 2003 (13.02.2003)

PCT

(10) International Publication Number
WO 03/011601 A1(51) International Patent Classification⁷: **B41J 3/407**

(21) International Application Number: PCT/EP02/08549

(22) International Filing Date: 30 July 2002 (30.07.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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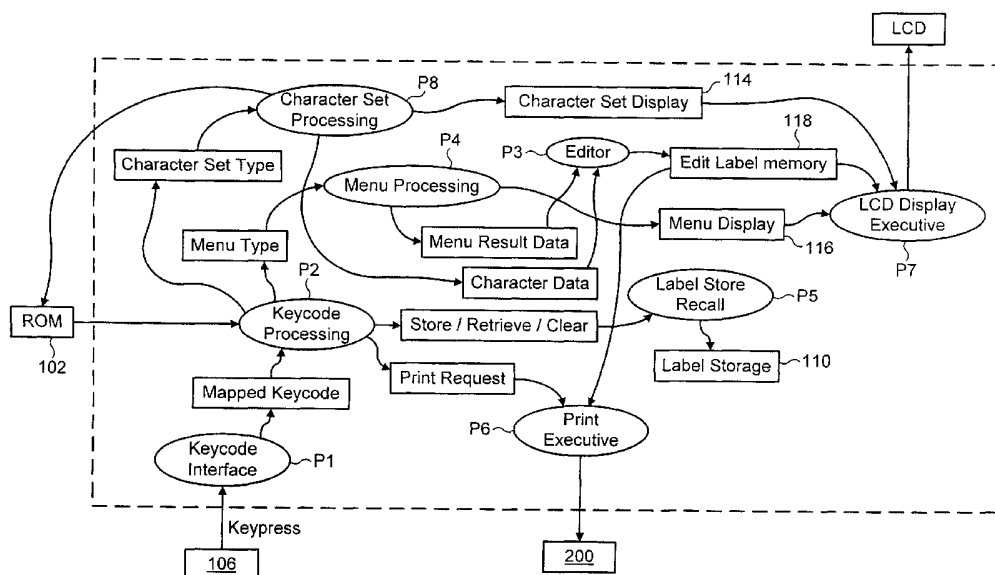
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Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR PRINTING COMPLEX CHARACTERS



(57) **Abstract:** A printing device for printing an image onto an image receiving medium comprises an input means for enabling a user to define an image to be printed by selecting characters and/or symbols, a printing means arranged to print said image as successive columns of pixels on the image receiving medium, and control means for receiving image data from the input means defining said selected character and/or symbols and operable to generate therefrom said successive columns of pixels for printing, wherein the control means comprising a first character development processor connected to receive said image data from the input means and operable to generate therefrom print data defining the image to be printed, and a second print control processor arranged to receive the print data and operable to generate therefrom said successive columns for printing.

METHOD AND APPARATUS FOR PRINTING COMPLEX CHARACTERS

The present invention relates to a method and device for printing text for labels. Particularly but not exclusively the present invention relates to printing text for complex languages comprising a larger number of characters than modern languages.

There are known thermal label printing devices designed to deal with complex languages. Presently these printers are designed to print characters of one type of language, for example printers designed to be used specifically for Chinese will only print Kanji characters. Other character types for other complex languages include Hirangana, Katakana and Romaji.

There are several disadvantages of such currently available printers. One disadvantage occurs during the development of printers designed to print characters of complex languages. During development of the printer, software developed to deal with the generation of character data is constrained by the requirements necessary to effect printing, thereby limiting the options available for enhancement of complex characters. A further disadvantage occurs when manufacturing such printers. During the manufacturing stage it is difficult to adapt a printer designed to print characters for one type of language into a printer that prints characters for a different language. Therefore manufacturers incur greater financial risk when undertaking the production of printers that are capable of only printing characters for one particular type of language.

It is an aim of the present invention to overcome these disadvantages and in particular to print complex language characters in a way which may easily be developed and adapted for use with different languages, thereby reducing development times and cost.

According to one aspect of the present invention there is provided a printing device for printing an image onto an image receiving medium comprising an input

means for enabling a user to define an image to be printed by selecting characters and/or symbols; a printing means arranged to print said image as successive columns of pixels on the image receiving medium and control means for receiving image data from the input means defining said selected character and/or symbols and operable to generate therefrom said successive columns of pixels for printing, wherein the control means comprising a first character development processor connected to receive said image data from the input means and operable to generate therefrom print data defining the image to be printed , and a second print control processor arranged to receive the print data and operable to generate therefrom said successive columns for printing.

In the described in embodiment the first character development processor is arranged to access a font storage means holding font data defining characters of a complex language in order to generate print data.

In the described embodiment the first and second processors are connected in a master/slave configuration such that the second print control processor is organised to execute commands from the first character development processor for controlling printing.

In the described embodiment the print control processor is arranged to supply the printing status information to the character development processor responsive to a request for print status information from the character development processor.

According to a second aspect of the present invention there is provided a method of operating a printing device for printing an image onto an image receiving medium, the method comprising defining an image to be printed by selecting characters and/or symbols at a user interface; supplying image data from the user interface to a character development processor which is operable to generate therefrom print data defining the image to be printed; supplying said print data to a print control processor which is operable to generate therefrom successive

columns for printing and to output said successive columns sequentially to a printing means.

According to a third aspect of the present invention there is provided a method of printing of a complex language onto an image receiving medium comprising developing print data from selected characters to be printed according to a character development program in a first processor; and generating successive columns of pixels defining an image to be printed on the image receiving medium according to a print control program executed on a second processor connected to said first processor and arranged to receive said print data therefrom.

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made by way of example to the accompanying drawings in which:-

Figure 1 is a plan view showing two cassettes inserted in a printing device embodying the present invention;

Figure 2 is a plan view of a printing device embodying the present invention;

Figure 3 is a block diagram of a circuit for controlling a printing device in accordance with the invention.

Figure 4 is a diagram illustrating some of the control components of the printing device in greater detail;

Figure 5 shows some of the elements of Figure 4 in more detail;

Figure 6 shows the general format of a message packet; and

Figures 6a to 6p show the formats of specific message packets and response packets.

Figure 1 shows in plan view two cassettes arranged in a cassette receiving bay 13 of a printing device. The upper cassette 2 contains a supply of the image receiving tape 4 which passes through a print zone 3 of the printer to an outlet 5 of the printer. The image receiving tape 4 comprises an upper layer for receiving a printed image on one of its surfaces and having its other surface coated with an adhesive layer to which it is secured to a releasable backing layer. The cassette 2 has a recess 6 for accommodating a platen 8 of the printer. The platen 8 is mounted for rotation within a cage moulding 10.

The lower cassette 7 contains a thermal transfer ribbon which extends from a supply spool to a take up spool within the cassette 7. The thermal transfer ribbon 12 extends through the print zone 3 in overlap with the image receiving tape 4. The cassette 7 has a recess 14 for receiving a print head 16 of the printer. The print head 16 is movable between an operative position, shown in Figure 1, in which it bears against the platen and holds the thermal transfer ribbon 12 and the image receiving tape 4 in overlap between the print head 16 and the platen 8 and an inoperative position in which it is moved away from the platen to release the thermal transfer ribbon and the image receiving tape. In the operative position the platen 8 is rotated under the action of a DC motor 7 (figure 3) to cause image receiving tape to be driven past the print head and the print head is controlled to print an image onto the image receiving tape by thermal transfer of ink from the ribbon 12. The print head 16 comprises a thermal print head having an array of printing elements connected in parallel, each of which can be thermally activated in accordance with the desired image to be printed. The image is printed by the print head 16 on the image receiving tape 4 on a column by column basis with the columns being adjacent one another in the direction of movement of the tape 4.

The tape printing device may include at cutting location 20 downstream of exit 5, a cutting mechanism 28 which carries a blade 24. The blade 24 cuts the image receiving tape 4 against an anvil 30.

Figure 2 is a view of the printer from above. The cassette receiving bay 13 is covered by a lid 15 which is hinged along the line 17 at the rear of the printer and which can be opened from the front to reveal the cassette in the cassette receiving bay 13. The printer also has a keyboard 106 which has a plurality of character set keys CK designated generally by arrow 111 and a plurality of function keys FK. A character set key on the keyboard may correspond to set of characters defined by the number of strokes in a character, the phonetic sound of a character or similar feature which defines a subset of characters. Various methods for representing a set of characters for complex languages are well known in the art and will not be described further. The printer also has a display 108 which is a liquid crystal graphics display.

A block circuit diagram for controlling the printing device is shown in figure 3. In accordance with the embodiment of the invention, there are two microprocessor chips in the circuit, a master processor chip 100 and a print engine processor chip 200.

The microprocessor 101 of the master processor chip 100 is connected to control operations of the display 108 and to supply print data to the print engine processor chip 200. The master processor chip 100 comprises a read only memory (ROM) 102 provided for storing permanent data, a microprocessor 101 and random access memory capacity for storing short term data, indicated diagrammatically by RAM 104. As shown in Figure 4, the RAM 104 comprises four portions: a character display portion 114; a menu display portion 116; an edit label portion 118 and a label storage portion 120. Font data for defining a set of characters corresponding to a key on the keyboard may be stored in rows of a look up table in the ROM 102. The microprocessor 101 receives inputs from the ROM 102 and the keyboard 106.

The microprocessor 101 runs a number of different programs to control operations of the printer. A keyboard interface program P1 receives key presses from the keyboard 106 and provides mapped key code data to a key code processing

program P2. The key code processing program P2 has a number of different functions. Firstly, it receives the font data from ROM 102. It supplies menu-type data to a menu processing program P4 depending on the menu which is selected by the function keys FK of the printer. It supplies character set type data to a character set processing program P8 which is selected by a character set key of the printer. It also supplies character data to an editor program P3 depending on the characters selected from the character set selection keys 111 of the keyboard 106. It further supplies label store/recall functions to a label store/recall program P5. Finally, the key code processing program P2 supplies print request data to a print executive program P6.

The menu processing program P4 supplies menu result data to the editor program P3. It also supplies menu display data for storage in the menu display portion 116 of the RAM 104. The editor program P3 acts on the menu result data and character data to formulate and edit a label which is stored in the edit label memory portion 118 of the RAM 104. This edit label memory portion 118 of the RAM 104 holds data defining the current label which is being formulated and/or edited.

The label store/recall program P5 is responsive to store/recall functions supplied from the key code processing program P2 to transfer label data between the edit label memory portion 118 of the RAM 104 and the label storage portion 120 of the RAM 104.

The microprocessor 101 also runs an LCD display executive program P7 which manages data to be displayed on the display 108 based on the contents of the menu display portion 116 of the RAM and the working portion 118 of the RAM.

Label data is held in the edit label memory portion 118 of the RAM in different data structures as shown in Figure 5. In particular, a text data structure label type (marked text in Figure 5) holds text data regarding the characters and symbols etc which have been selected for printing. The text data includes new page and new

line information. An attribute data structure page setting type (marked label in Figure 5) holds attributes with which the characters are to be printed, and effectively defines the format of the label. In addition, the working portion 118 of the RAM contains edit data including the position of a cursor as a file cursor type and display control information. At any time, label data and edit data for one label is held in the working portion 118 of the RAM.

Keyboard interface program P1 receives the keyboard presses from keyboard 106 and provides mapped key code data to the key code processing program P2. When a character set key is pressed the key code processing program P2 supplies the character type data to the character set processing program P8. The character set processing program P8 then sends a notification to ROM 102 in the form of a pointer to a particular address within the ROM, the address being dependent on the character key selected.

Figure 5 shows diagrammatically some of the different addresses within the ROM 102. In the embodiment ADDR 0 is for characters comprising 2 strokes, ADDR 1 is for characters comprising 3 strokes and so on.

Each address of the ROM 102 which specifies a character set is associated with a row of a look up table, also stored within the ROM 102. These rows store all the possible text characters for each character set as binary or ASCII data. The character set processing program P8 retrieves the selected character set font data from the ROM and sends it to the character set display portion 114 of the RAM 102.

The display executive program P7 acts on the data held in the character set display portion of the RAM to display the character set. The user can then scroll using the cursor control keys and select a character from the set.

The selected character font data is received from the ROM by the key processing program and sent to the editor program P3. The character size selection

information is supplied from the menu processing program P4 to the editor program P3. The editor program P3 uses the character data and character size information to formulate the label. This formulated text data, including the return key information, is put into the text data structure label type in the working portion 118 of the RAM 104. Executive program P7 acts on the data in working portion 118 and drives display driver 109 to display the data on display 108.

As previously mentioned, a character set key on the keyboard may also correspond to the phonetic representation of a character or similar feature which defines a subset of characters. These alternative methods of characterising subsets of characters may also correspond to the addresses for subsets of character data stored in the ROM.

If no key strokes are detected by the microprocessor 100 during a predetermined time period the microprocessor switches the status of the power supply to standby.

When the user issues a command to print via the keyboard, the processor 100 runs the print executive program P6. The print executive program P6 prepares print data to be sent to the print engine processor 200.

The edit data is not used for printing. The print executive program P6 does not formulate a complete dot pattern image of the label to be printed in RAM prior to printing. Instead, column data is prepared "on the fly". Thus, the print executive program P6 extracts text data from the text data structure and attribute data from the attribute data structure and manipulates this data to generate successive print columns and output to the RAM 204 of the print engine microprocessor 200 in accordance with a communication protocol explained below. The print engine processor chip 200 also comprises a read only memory (ROM) 202 and a microprocessor 201.

The print engine processor 200 is connected to output data to drive the print head 16 via the print head driver 18. The microprocessor chip 200 also controls the speed of the DC motor 7 driving the platen 8. The microprocessor may also control the cutting mechanism 28 to allow lengths of tape to be cut off.

The input register of the print head driver circuitry 18 receives column data serially from the RAM 204 of the print engine microprocessor 200. When the input register is full the data is transferred in parallel to the data register of the print head to be printed. While the print head 16 is printing one column, the next column can be placed in the input register for printing. This technique is described in our earlier European Patent EP513290.

The DC motor 7 which drives the image receiving tape 4 past the print head 16 is provided with a shaft encoder for monitoring the speed of rotation of the motor. Microprocessor 200 monitors the speed of rotation of the motor and sends strobe signals to the print head driver at a rate which is related to the monitored motor speed, thus causing a column of pixel data to be printed by the print head 16 in dependence of the speed of rotation of the motor and hence also in dependence of the speed that the image receiving tape is driven past the print head.

Communication between the master processor 100 and the printing processor 200 shall now be described. Communication between the two processors is facilitated by a communications protocol program which is implemented by the ROM 102 of the master processor 100.

There are two main functions of the protocol:

1. To transmit commands and status information between the PC and the label printer.
2. To efficiently transfer print data from the master processor 100 to the print engine processor 200.

The communication between the master processor 100 and the print engine processor 200 should be considered as a master-slave arrangement, with the master processor 100 as the master. The master processor 100 therefore initiates all exchanges.

In all exchanges (with two exceptions, discussed below), the master processor 100 starts the dialogue by sending a message to the print engine processor 200. The print engine processor 200 responds by providing a response echoing the message, appending any necessary data, together with an acknowledgement to show the message has been received. Each message is identified by a message identifier (taking the form of two characters ?) which indicate the action to be taken by the print engine processor.

All messages fall into one of two categories:

- i) Commands – The master processor 100 issues commands to cause an action to be initiated by the print engine processor, such as cut tape, print column data and advance tape. – The print engine processor 200 responds to a command message by echoing the message identifier and appending an acknowledgement byte to indicate if an error occurred in the transmission of the message. The acknowledgement byte also informs the master processor 100 if the print engine is able to receive another message.
- ii) Requests – The master processor 100 issues requests when it wishes to determine the status of the print engine processor 200. The master processor 100 will need to know information such as tape size, whether a cassette is present, if the battery is low etc. – The print engine processor responds to a request message by echoing the message identifier with an acknowledgement byte together with the additional status information requested.

Occasions will arise when the print engine processor is unable to receive any more messages. This will normally occur when compressed print data is being

transmitted. To inform the master processor 100 that no more messages can be sent, the print engine processor sends a flag (changes a bit) in the acknowledgement byte. When the print engine processor is able to receive more data it will issue a "continue" message. The master processor may then send the next message.

All messages and their responses are encoded into a packet structure, consisting of a maximum of 128 bytes. The generic form of the packet is shown in Figure 6 for which the following table explains the abbreviations.

ESC	A fixed identifier (ASCII character 27)
MID1)	Message identifier bytes. Indicate the
MID2)	type of message. (ASCII characters)
NBytes	The total number of data bytes in the packet including checksum.
DATA1)	Data associated with the command.
DATAn)	
CKS	The checksum for the preceding data bytes.

This encoding allows a flexible and expandable protocol to be defined. The message identifier bytes (MID1,MID2) are encoded as ASCII alphanumeric codes. The meaning of these identifiers and their corresponding actions is detailed below.

The checksum is calculated as a byte-by-byte XOR of the preceding message bytes, including ESC and the message identifiers.

MESSAGE DEFINITIONS

Acknowledge Byte (Ackbyte)

Ackbyte is used in all responses to command and requests. Ackbyte indicates if an error has occurred, or if the microprocessor 100 must wait before sending another message. The Ackbyte is also sent with the ERROR message to indicate the type of error. The format of the Ackbyte is as follows:

Ackbyte:	Bit0	Checksum error
	Bit1	Unknown command
	Bit2	Incorrect data
	Bit3	Timeout error occurred
	Bit4	Wait
	Bit5	Serial communications error
	Bit6	Printer fault

The bits indicate the following errors:

Bit0	Checksum error. Set when an input packet checksum error is detected.
Bit1	Unknown command. The packet "ESC" character is not received when expected. Invalid MID1/MID2 character or character combination.
Bit2	Incorrect data.
Bit3	Timeout error. Input reception timeout occurs within a data packet. Timeout set to 1 second.
Bit4	Wait. Unable to accept any further commands/requests. The "Continue" message is output when inputs may be resumed.
Bit5	Serial communications error. Examples: - framing or overrun reception errors are detected on the serial communications input.
Bit6	Printer fault. Examples: - cutter jammed, no tape/lid opened.

Request – Identify Cartridge Present

IDENT To identify the label printer to the microprocessor 100, with its software revision number and printhead information, the PC sends an IDENT request which is shown in Figure 6a, where R is a message identifier denoting a request and I is a message identifier denoting IDENT. The response of the microprocessor 200 is shown in Figure 6b where:

Unit ID	=	Type of Unit (1 for cartridge)
SWRev	=	Software revision number
Hbytes	=	Number of bytes for head
Res 1,2	=	Printhead resolution (dots/mm*10)

Request - Status

STATUS To inform the microprocessor 100 of the state of battery, cutter mechanism, tape present, etc. the microprocessor 100 sends a STATUS request which is shown in Figure 6c where S is a message Identifier denoting STATUS. The response of the microprocessor 200 is shown in Figure 6d where:

Sbyte:

Bit0	Battery low
Bit1	Cutter jammed
Bit2	No tape/lid open
Bit3	Message still being actioned
Bit4	Scissor cut engaged

Request – Tape Size

TAPE SIZE To identify size of tape, the microprocessor 100 sends a

request to the microprocessor 200 as shown in Figure 6e where T denotes TAPE SIZE. The response of the microprocessor 200 is shown in Figure 6f where:

Tbyte: 0 - 6mm tape
 1 – 12mm tape
 2 – 19mm tape

Command – Advance Tape

ADVANCE To advance the tape by a specified distance, the microprocessor 100 sends a command in the form shown in Figure 6g where A is message identifier denoting ADVANCE, and Len1,2 = length of tape advance (in 1/8th of millimetre).

The response of the microprocessor 200 is merely an acknowledgement echoing the message identifier T as shown in Figure 6h.

Command – Cut Tape

CUT To cut tape at current position, the microprocessor 100 sends a command in the form shown in Figure 6i, where X denotes CUT. The acknowledgement is shown in Figure 6i.

Command – Abort

ABORT To stop all printing immediately, the microprocessor 100 sends a command in the form shown in Figure 6k where Q denotes ABORT. The acknowledgement is shown in Figure 6l.

Command – Reset All

RESET ALL To reset the microprocessor 200 to its initial state and to cause printing to be stopped immediately and the printhead buffers to be flushed, the microprocessor 100 sends a command message as shown in Figure 6m where R denotes RESET. The form of acknowledgement is as shown in Figure 51 but with R replacing Q.

Command – Print Data

PRINT DATA To download bitmapped data from the microprocessor 100 to the microprocessor 200, the microprocessor 100 sends a command message as shown in Figure 6n, where Nbytes = the number of data bytes in the entire packet (Max = 128). The response is as shown in Figure 6l, but with P replacing Q.

The microprocessors 200 can issue two messages which are not subject to the “master/slave” principle and which are issued in a format equivalent to acknowledgement to a command message from the microprocessor 100.

SW Handshake – Continue

CONTINUE To inform the microprocessor 100 that it is okay to send data, after a previously issued “WAIT” (setting a bit in Ackyte), the microprocessor 200 issues a message as shown in Figure 6o.

Error Message

ERROR

To inform the microprocessor 100 that an error has occurred, which is not detailed in Ackbyte, a message can be issued by the microprocessor 200 asynchronously, in the form shown in Figure 6p.

CLAIMS:

1. A printing device for printing an image onto an image receiving medium comprising:
 - an input means for enabling a user to define an image to be printed by selecting characters and/or symbols;
 - a printing means arranged to print said image as successive columns of pixels on the image receiving medium; and
 - control means for receiving image data from the input means defining said selected character and/or symbols and operable to generate therefrom said successive columns of pixels for printing,wherein the control means comprising a first character development processor connected to receive said image data from the input means and operable to generate therefrom print data defining the image to be printed, and a second print control processor arranged to receive the print data and operable to generate therefrom said successive columns for printing.
2. A printing device according to claim 1, which comprises a font storage means accessible by the first character development processor, said font storage means holding font data defining characters of a complex language.
3. A printing device according to claim 1 or 2, wherein the first character development processor is arranged to execute a character development program for generating print data from complex characters.
4. A printing device as claimed in any preceding claim which comprises a display connected to be controlled by the first character development processor and arranged to display said selected characters and/symbols.
5. A printing device according to any preceding claim wherein the first and second processors are connected in a master/slave configuration such that the

second print control processor is organised to execute commands from the first character development processor for controlling printing.

6. A printing device according to any preceding claim wherein the second print control processor comprises a print buffer for holding print data ready for printing.

7. A printing device according to any preceding claim wherein the second print control processor is operable to execute a print control program which controls the speed at which the image receiving medium is moved relative to the printing means.

8. A printing device according to any preceding claim wherein the print control processor is arranged to supply printing status information to the character development processor responsive to a request for print status information from the character development processor.

9. A printing device according to any preceding claim wherein the character development processor is programmed to turn off if it has received no image data from the input means during a predetermined time.

10. A printing device according to any preceding claim wherein the image receiving medium comprises an image receiving tape and wherein the printing device comprises cutting means arranged to cut off a portion of said tape after an image has been printed.

11. A method of operating a printing device for printing an image onto an image receiving medium, the method comprising:

defining an image to be printed by selecting characters and/or symbols at a user interface;

supplying image data from the user interface to a character development processor which is operable to generate therefrom print data defining the image to be printed;

supplying said print data to a print control processor which is operable to generate therefrom successive columns for printing and to output said successive columns sequentially to a printing means.

12. A method according to claim 11 when used to print complex characters.

13. A method of printing characters of a complex language onto an image receiving medium comprising:

developing print data from selected characters to be printed according to a character development program in a first processor; and

generating successive columns of pixels defining an image to be printed on the image receiving medium according to a print control program executed on a second processor connected to said first processor and arranged to receive said print data therefrom.

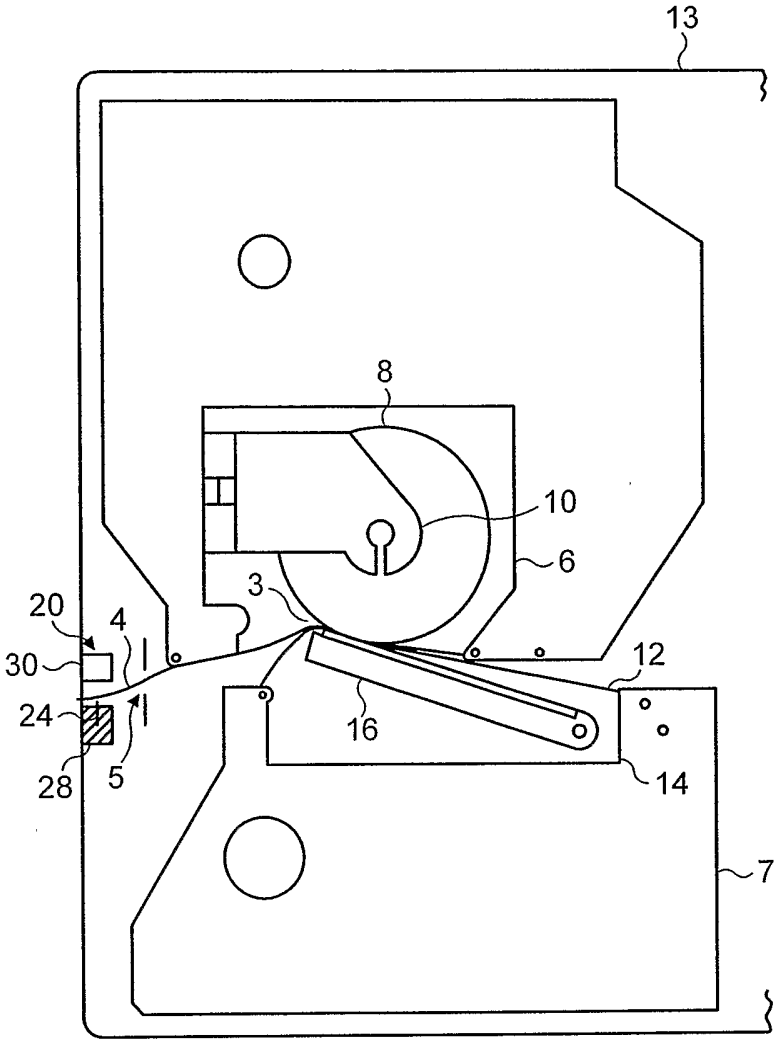


FIG. 1

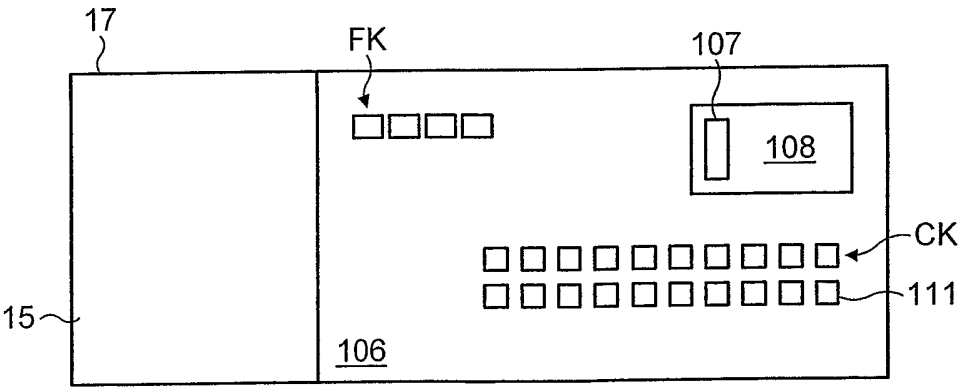


FIG. 2

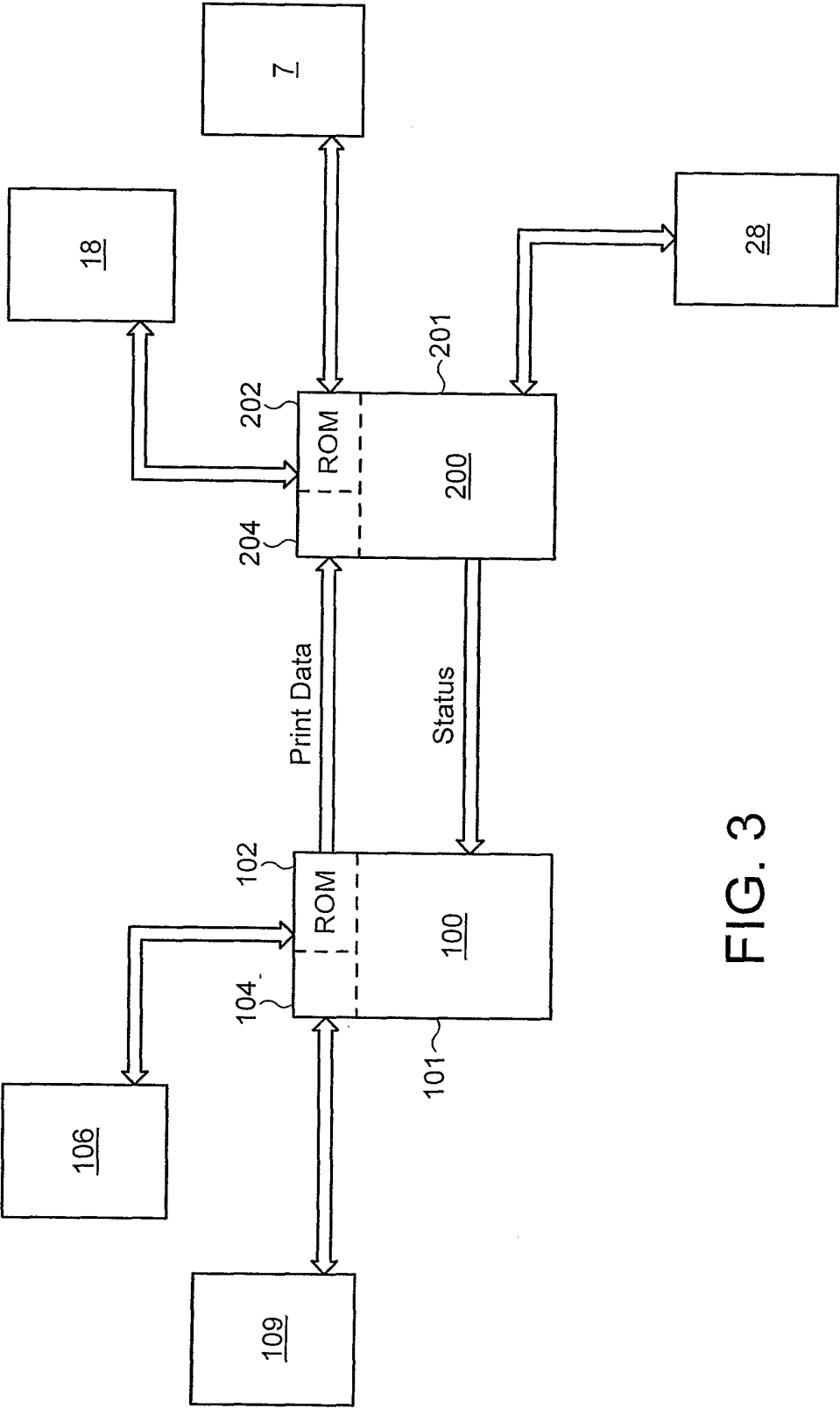


FIG. 3

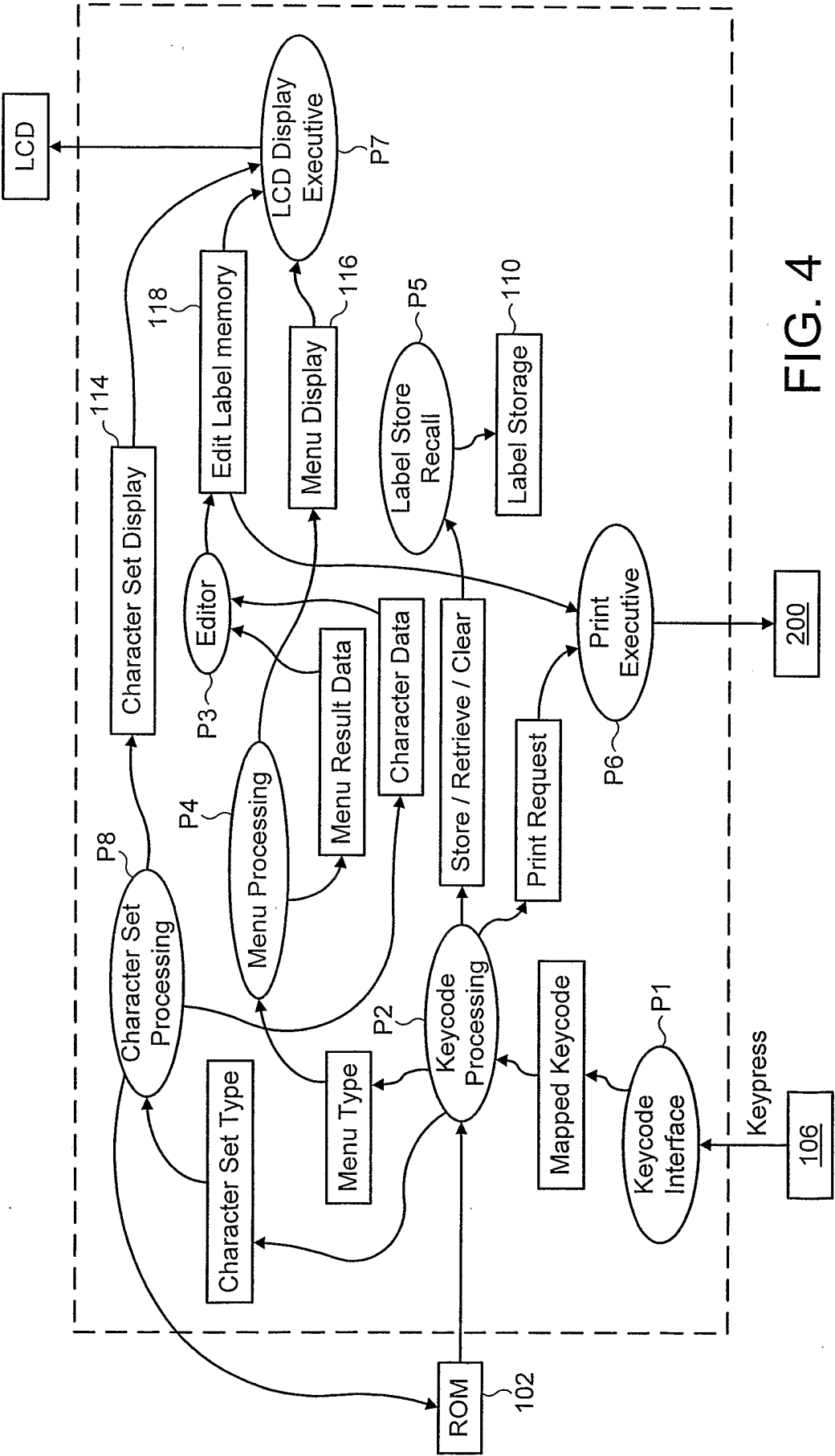


FIG. 4

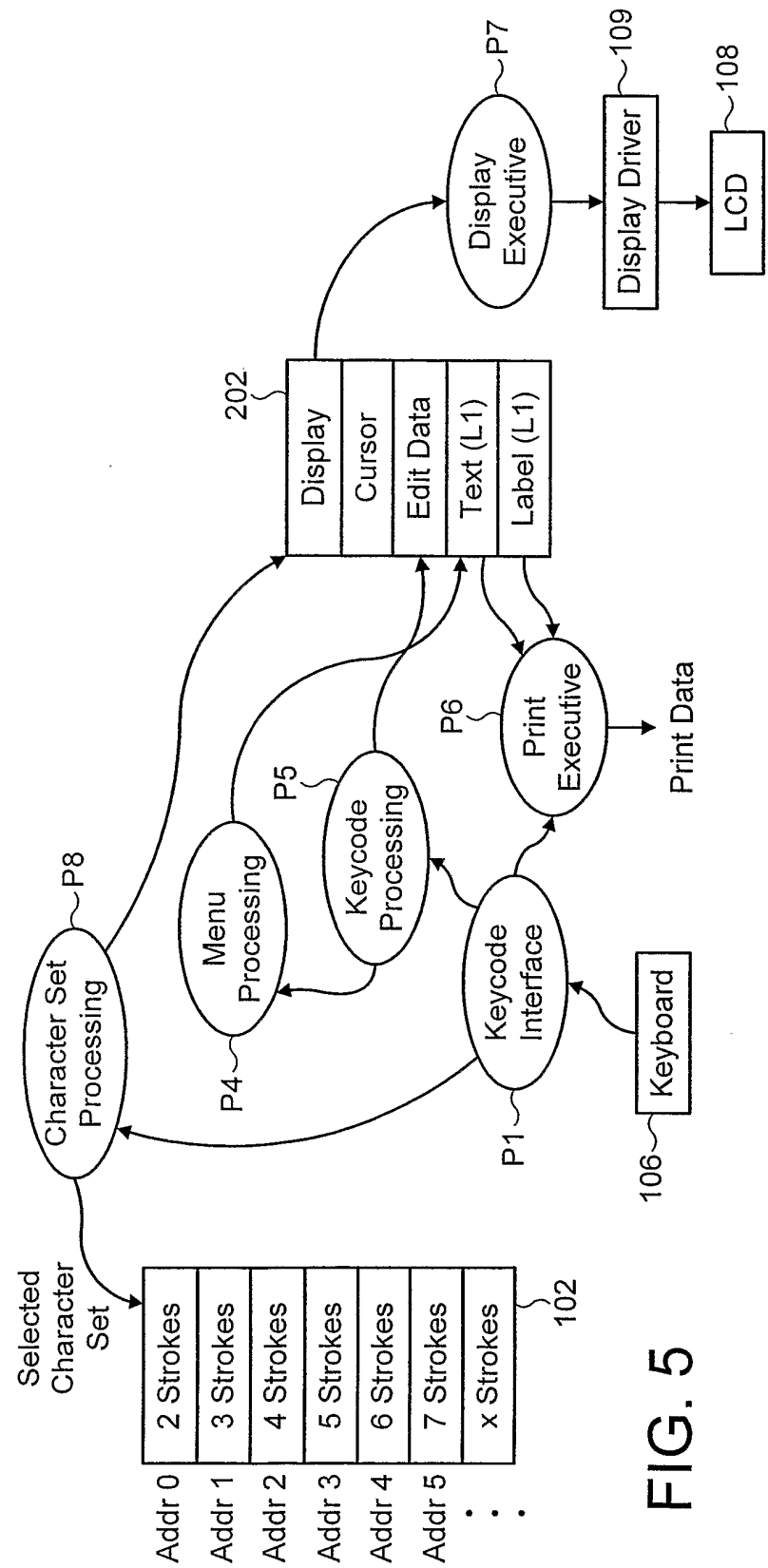


FIG. 5



FIG. 6a



FIG. 6b

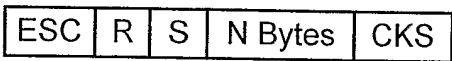


FIG. 6c

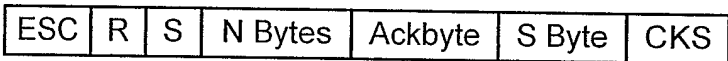


FIG. 6d



FIG. 6e

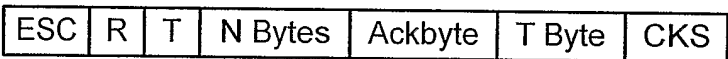


FIG. 6F

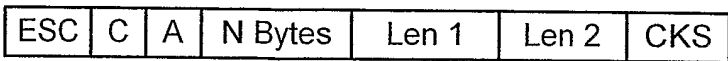


FIG. 6g

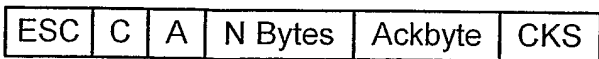


FIG. 6h

6 / 6

ESC	C	X	N Bytes	CKS
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FIG. 6i

ESC	C	X	N Bytes	Ackbyte	CKS
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FIG. 6j

ESC	C	Q	N Bytes	CKS
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FIG. 6k

ESC	C	Q	N Bytes	Ackbyte	CKS
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FIG. 6l

ESC	C	R	N Bytes	CKS
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FIG. 6m

ESC	C	P	N Bytes	Data 1	Data 2	...	Data N	CKS
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FIG. 6n

ESC	C	C	N Bytes	Ackbyte	CKS
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FIG. 6o

ESC	C	E	N Bytes	Ackbyte	CKS
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FIG. 6p

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/08549

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B41J3/407

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

7 October 2002

Date of mailing of the international search report

16/10/2002

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/08549

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