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(71) Applicant
OKI Electric Industry Co Ltd

(Incorporated in Japan)

7-12 Toranomon 1-chome, Minato-ku, Tokyo 105, Japan

(72) Inventors
Eisho Sudoh
Seiji Asano

(74) Agent and/or Address for Service
Venner Shipley & Co
368 City Road, London, EC1V 2QA

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B41J 3/02

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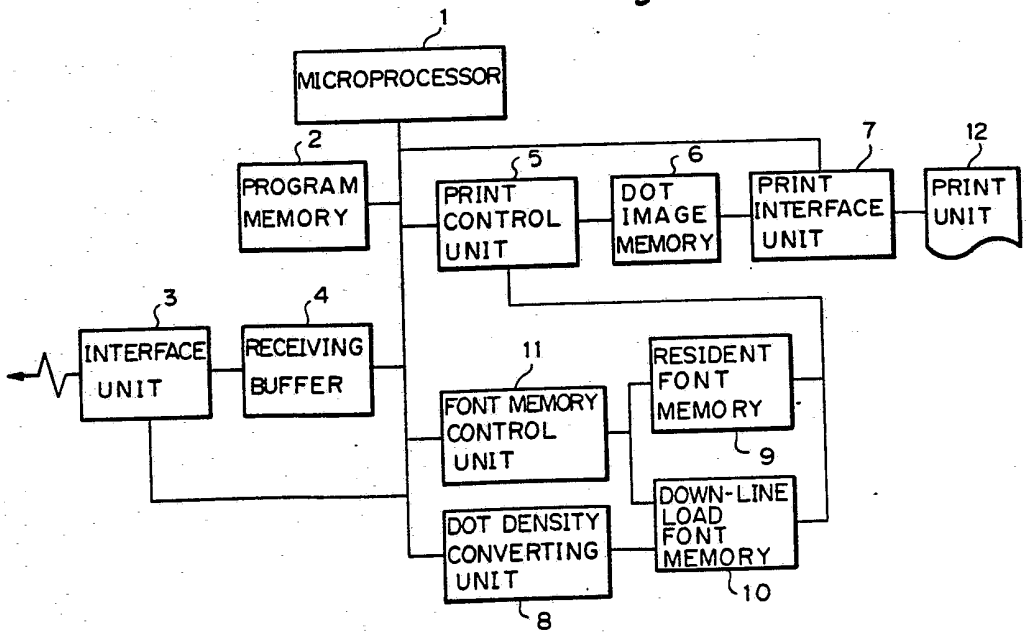
(56) Documents cited
None

(58) Field of search
G4H
Selected US specifications from IPC sub-class
B41J G06K G06F

(54) Printing mode control system

(57) A font converting means (8) converts (dot density conversion) a down-line loaded font received through interface means (3) into a font represented by a dot matrix of the same size as that of a resident font stored in first memory means (9) and stores it in second memory means (10). Control means (5, 11) selectively reads from one of the first and second memory means (9, 10) in conformity to a font code included in print data, edits dot image data, and then feeds the same to a printing unit (12). Only the rarely used down-line load font is subjected to dot density conversion so that the print dot density of the converted down-line load font coincides with that of the print dot density of the printer to be controlled, while a frequently used font of a print dot density coinciding with that of the printer is stored as resident font. Thus, a plurality of printers differing from each other in print dot density can be connected to the host unit of a system in the same interface conditions without entailing variation of character pattern and size of print area.

Fig. 3



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Fig. 1(a)

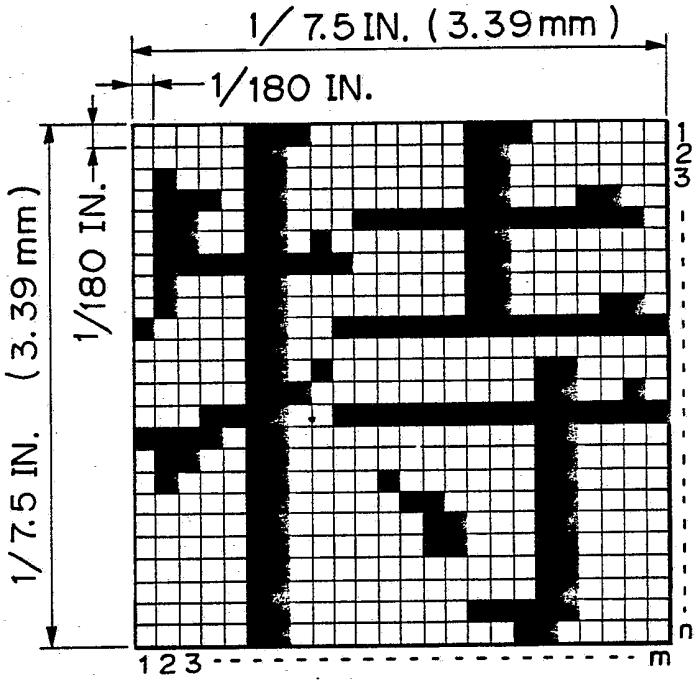
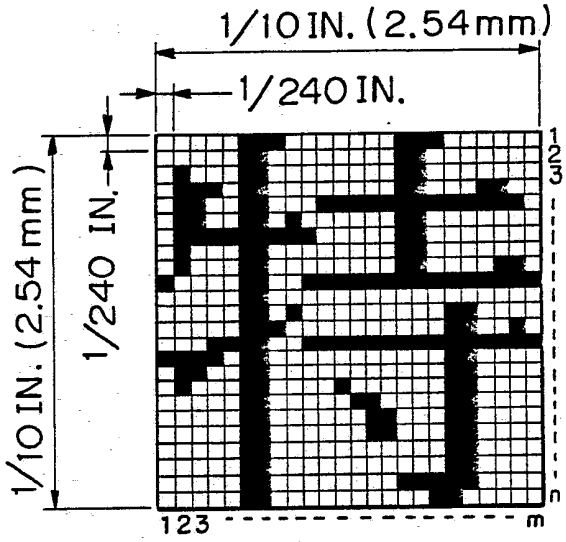

1/7.5 IN. (3.39mm)
1/180 IN.
1/180 IN.
1/7.5 IN. (3.39 mm)
1 2 3
1 2 3
n
m

Fig. 1(b)


1/10 IN. (2.54mm)
1/240 IN.
1/240 IN.
1/10 IN. (2.54 mm)
1 2 3
1 2 3
n
m

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Fig. 2(a)

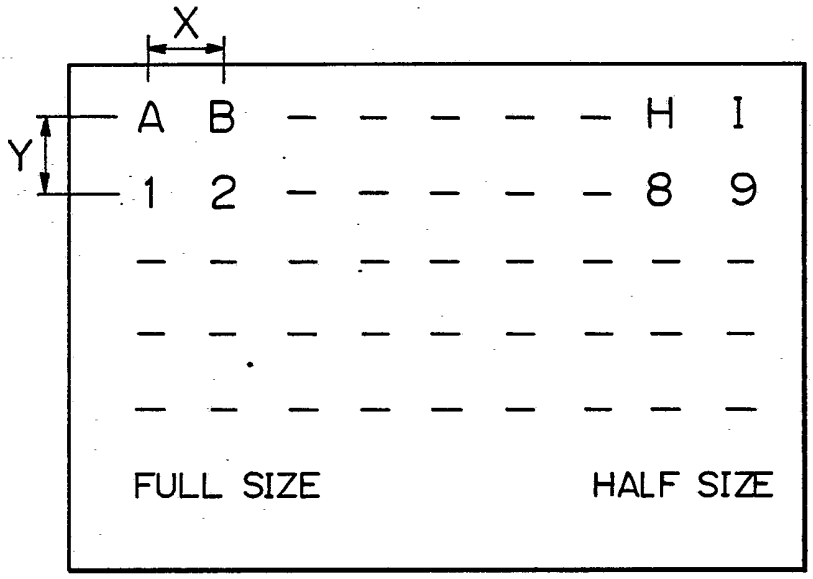


Fig. 2(b)

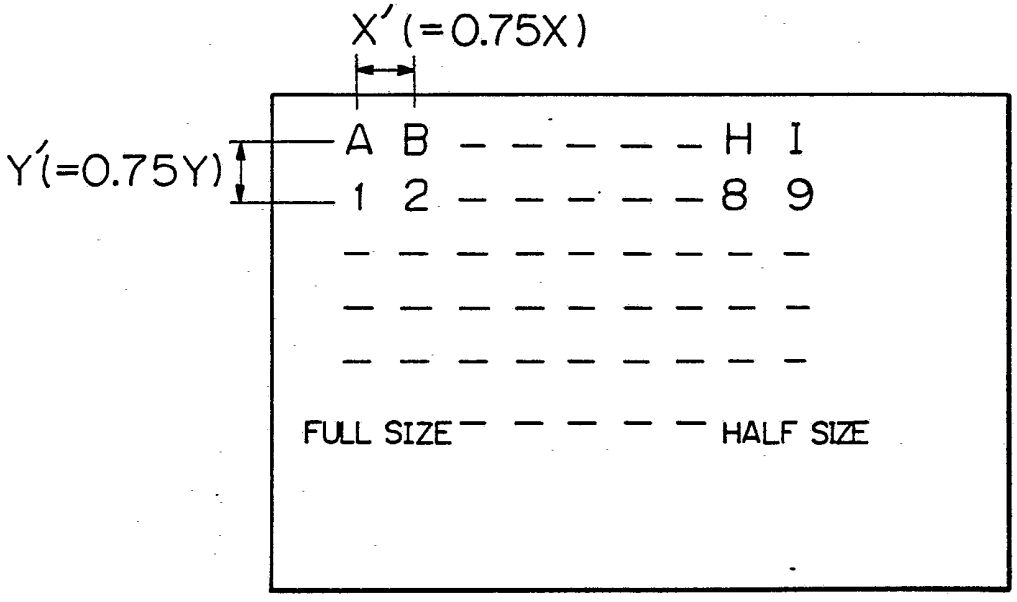


Fig. 3

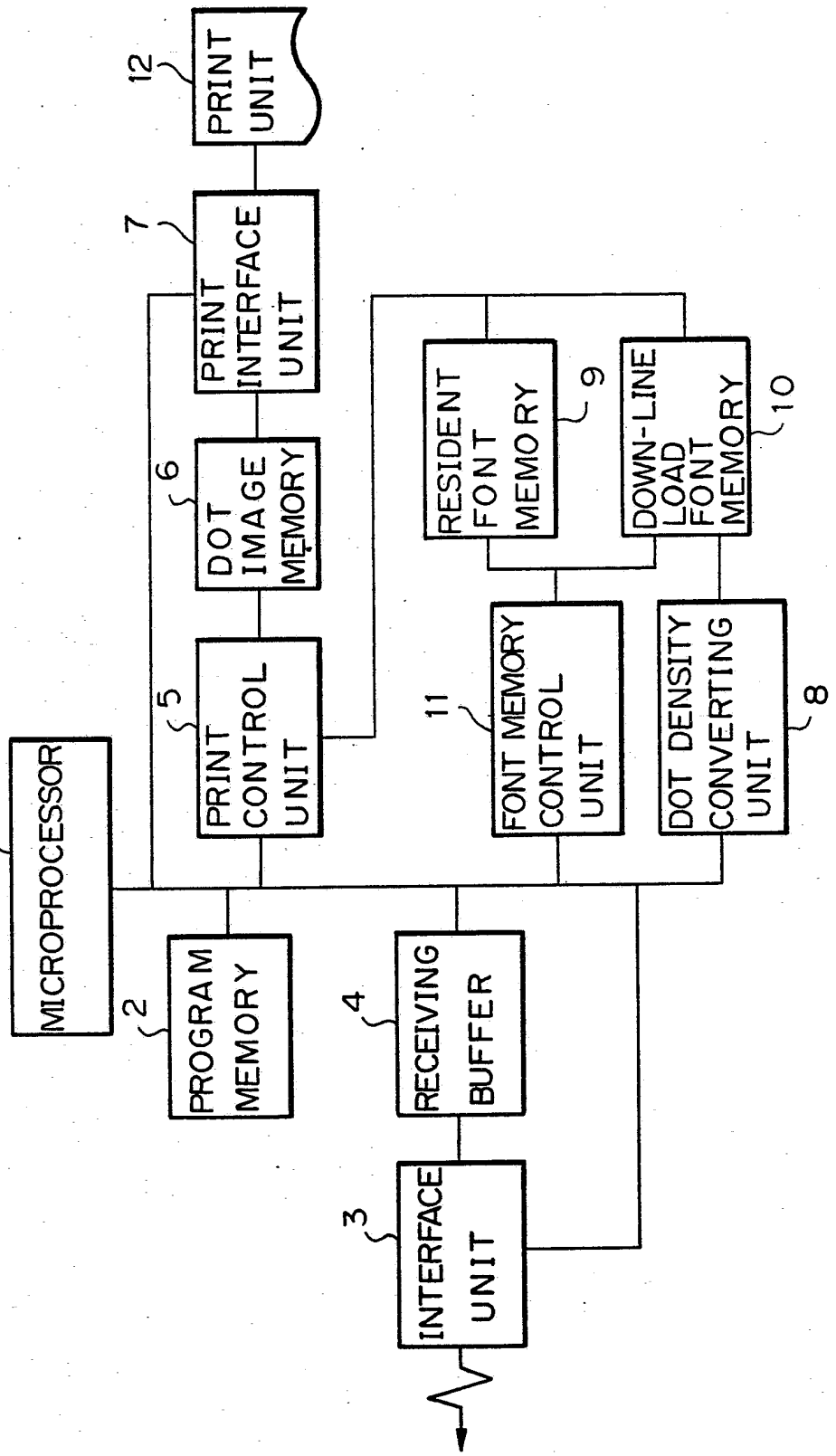

MICROPROCESSOR
1
PROGRAM MEMORY
2
INTERFACE UNIT
3
RECEIVING BUFFER
4
PRINT CONTROL UNIT
5
DOT IMAGE MEMORY
6
PRINT INTERFACE UNIT
7
DOT DENSITY CONVERTING UNIT
8
RESIDENT FONT MEMORY
9
DOWN-LINE LOAD FONT MEMORY
10
FONT MEMORY CONTROL UNIT
11
PRINT UNIT
12

Fig. 4

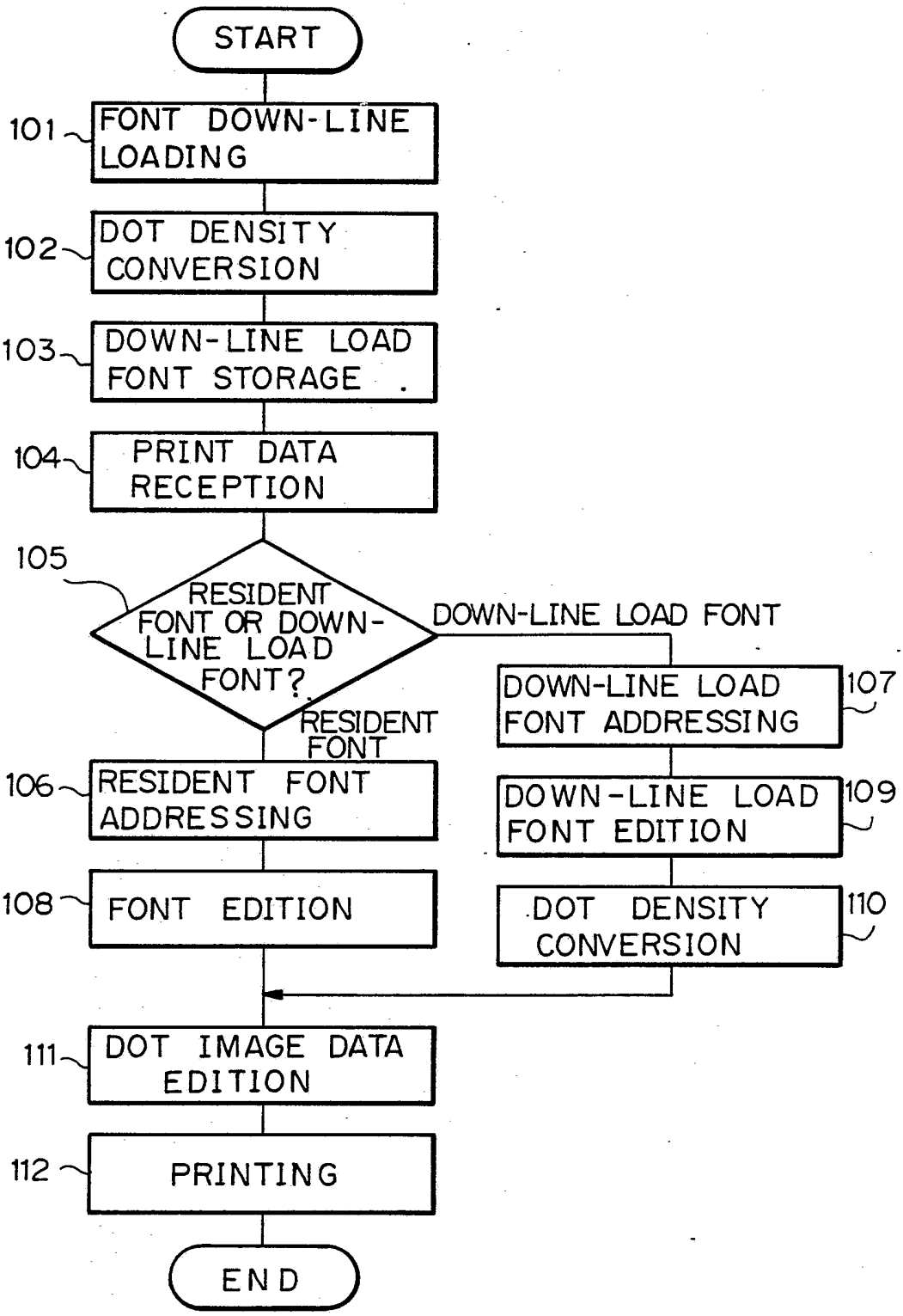

START
101
FONT DOWN-LINE LOADING
102
DOT DENSITY CONVERSION
103
DOWN-LINE LOAD FONT STORAGE
104
PRINT DATA RECEPTION
105
RESIDENT FONT OR DOWN-LINE LOAD FONT?
DOWN-LINE LOAD FONT
RESIDENT FONT
107
DOWN-LINE LOAD FONT ADDRESSING
106
RESIDENT FONT ADDRESSING
109
DOWN-LINE LOAD FONT EDITION
108
FONT EDITION
110
DOT DENSITY CONVERSION
111
DOT IMAGE DATA EDITION
112
PRINTING
END

Fig. 5

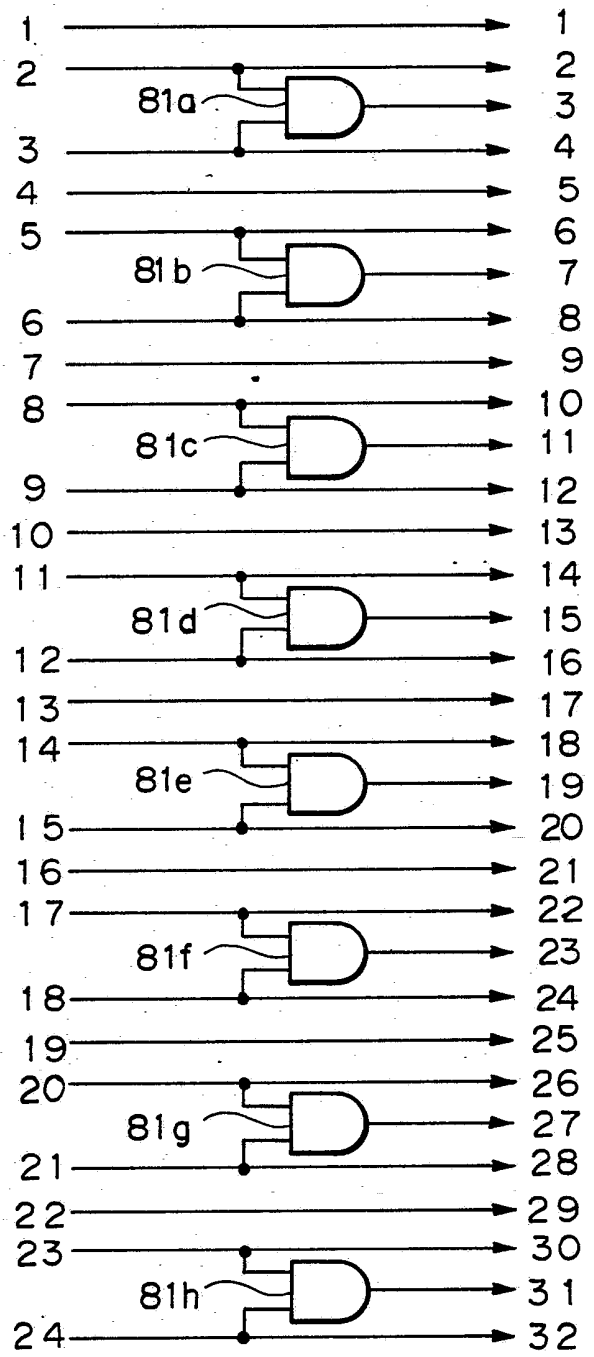

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81g
81h
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Fig. 6 (a)

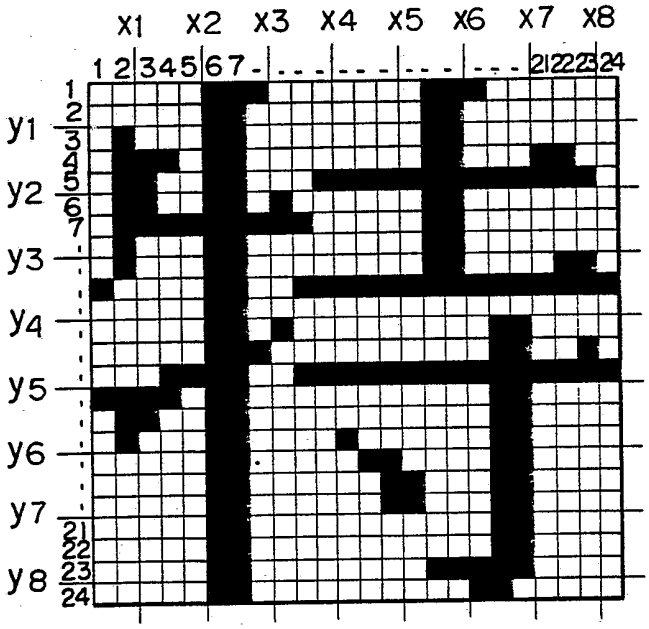

x1 x2 x3 x4 x5 x6 x7 x8
1 2 3 4 5 6 7 - - - - - - - - - - - - 21 22 23 24
y1
y2
y3
y4
y5
y6
y7
y8

Fig. 6 (b)

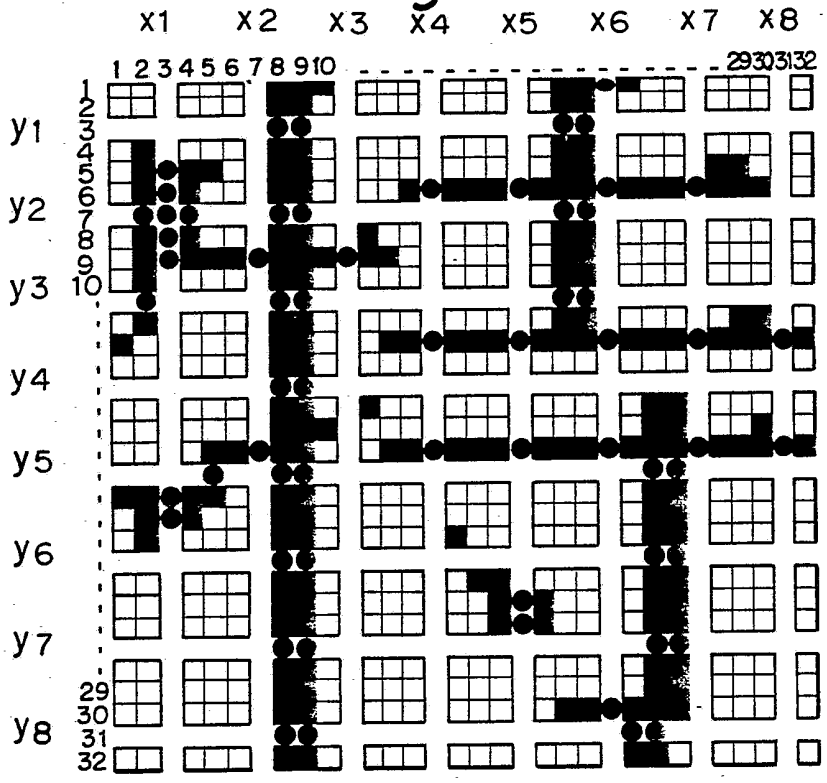
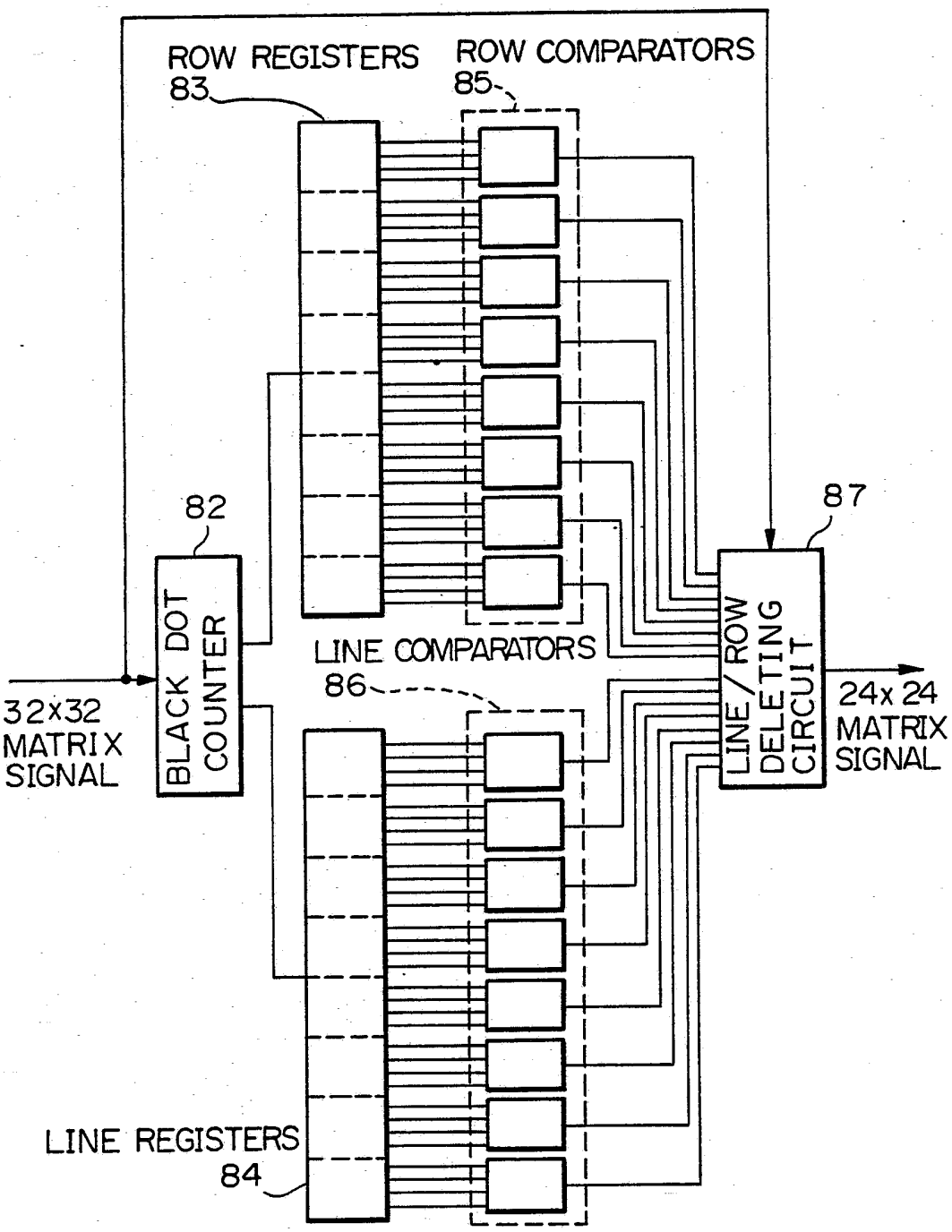

x1 x2 x3 x4 x5 x6 x7 x8
1 2 3 4 5 6 7 8 9 10 - - - - - - - - - - - - - - - - 29 30 31 32
y1
y2
y3
y4
y5
y6
y7
y8

Fig. 7


ROW REGISTERS
83
ROW COMPARATORS
85
82
87
BLACK DOT COUNTER
LINE/ROW DELETING CIRCUIT
LINE COMPARATORS
86
32x32 MATRIX SIGNAL
24x24 MATRIX SIGNAL
LINE REGISTERS
84

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Fig. 8 (a)

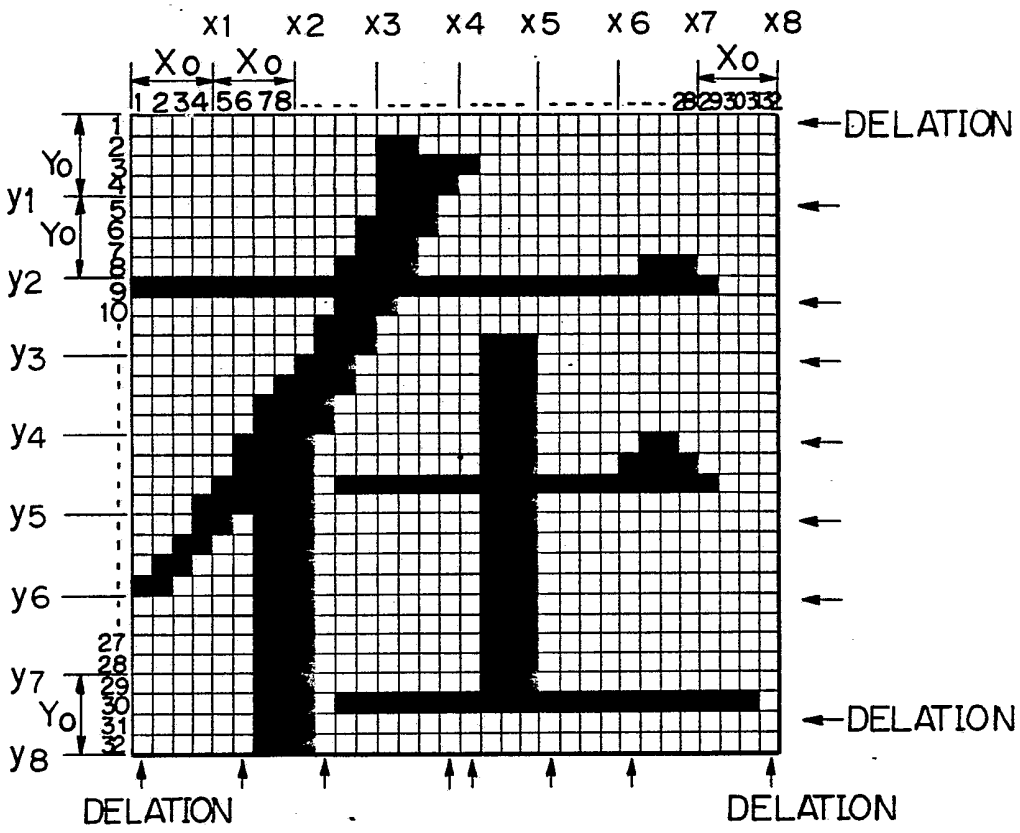
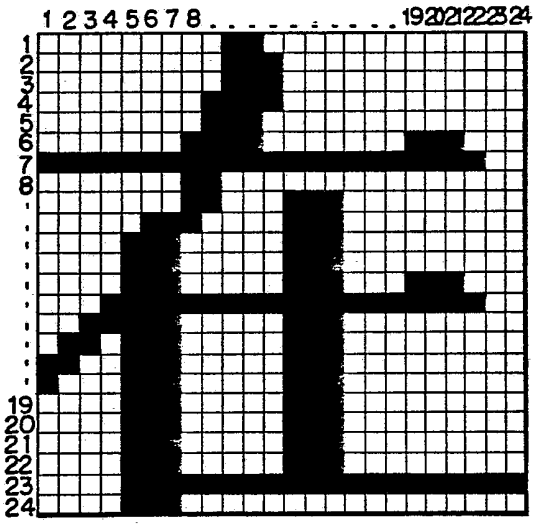


Fig. 8 (b)



PRINTING MODE CONTROL SYSTEM

DESCRIPTION

The present invention relates to a printing mode control system for controlling a system including a plurality of printers differing from each other in print dot density connected thereto.

In most cases, an impact wire dot printer and a non-impact page printer are connected to a system capable of being connected to a plurality of printers differing from each other in print dot density. Generally, the print dot density of the wire dot printer is low, for example, 1/180 in. in dot pitch, owing to its structural characteristics, while the print dot density of the non-impact page printer is as very high as, for example, 1/240 in. in dot pitch. Accordingly, when the page printer for fine dot matrix print is connected additionally to the system which has been connected to the wire dot printer for coarse dot matrix print or when the wire dot printer is disconnected from the system and the page printer is connected to the system, there arise problems that the print size of characters is reduced accordinhg to the increase of print dot density and that the printing area is reduced according to the increase of print dot density.

The foregoing problems in the conventional system will be explained more concretely with reference to Figs.

1(a) and 1(b) showing an exemplary mode of reduction of a character, and Figs. 2(a) and 2(b) showing an exemplary mode of reduction of a printing area.

The most preferable size of letters, from the viewpoint of readability, is in the range of 9 to 10 point (1 point = 0.3514 mm, JIS Z 8305). Generally, a character (font) comprises a dot matrix of 22x22 (approximately 3.1 mm x 3.1 mm = 8.8 point) or a dot matrix of 24x24 (approximately 3.4 mm x 3.4 mm = 9.6 point) when the print dot pitch is 1/180 in.. When a 9.6-point character of the dot matrix of 24x24 for the wire dot printer of 1/180 in. in dot pitch as shown in Fig. 1(a) is printed by the page printer of 1/240 in. in dot pitch, the 9.6-point character is reduced to a 7.2-point character (approximately 2.54 mm x 2.54 mm), which makes reading the character very difficult. Furthermore, suppose that the wire dot printer of a 1/180 in. in dot pitch prints characters of a dot matrix of mxn on a sheet in a print layout as shown in Fig. 2(a), in which character pitch X and line pitch Y are expressed by

$$X = 1/180 \text{ (in.)} \times m \text{ (dot)} \times a$$

$$Y = 1/180 \text{ (in.)} \times n \text{ (dot)} \times b$$

where a and b are integral multiples of character size, then the page printer of 1/240 in. in dot pitch prints the same characters in an unsatisfactory print layout as shown in Fig. 2(b) deteriorating the layout of print area. In Fig. 2(b), character pitch X' and line pitch Y' are

expressed by

$$X' = 1/240 \text{ (in.)} \times m \text{ (dot)} \times a = 0.75X$$

$$Y' = 1/240 \text{ (in.)} \times n \text{ (dot)} \times b = 0.75Y$$

where m, n, a and b are the same mentioned above.

In a printing mode control system compensating for such drawbacks, the application program or the like stored in a host unit is provided with an individual print data for a printer using a coarse dot matrix, an individual print data for a printer using a fine dot matrix, and control programs respectively for controlling those printers. For example, the application program of the host unit is provided with a down-line load font using a dot matrix of 24x24 for the wire dot printer of 1/180 in. in dot pitch, and a down-line load font using a dot matrix of 32x32 for the page printer of 1/240 in. in dot pitch, and registers the down-line load font conforming to the mode of operation of the printer to be controlled among those down-line load fonts.

However, such a printing mode control system, in which the application program in the host unit includes an individual print data for the printer using a coarse dot matrix, an individual print data for the printer using a fine dot matrix, and control programs respectively for controlling those printers, requires a complex application program, and inevitably requires a new application program or reconstruction of the existing application program in connecting an additional printer using a different dot

matrix to the system which has been in operation in a previously constructed printing mode control system with a printer using a dot matrix.

Accordingly, it is an object of the present invention to provide a printing mode control system capable of converting the print dot density of a host unit so that the print dot density of the host unit matches the pinting mode i.e. the print dot density of the printer additionally connected to the host unit to secure satisfactory print quality.

It is another object of the present invention to provide a printing mode control system capable of reducing or enlarging the font of a host unit to make the font of the host unit match the printing mode of a printer so that characters are printed in a highly readable font.

It is a further object of the present invention to provide a printing mode control system capable of decreasing or increasing the character pitch and line pitch of a host unit to make the character pitch and line pitch of the host unit match the character pitch and line pitch of a printer, respectively, so that characters are printed in a satisfactory layout.

It is still a further object of the present invention to provide a printing mode control system capable of converting the print dot density of a font provided by a host unit so that the print dot density of the font

provided by the host unit matches that of a printer, and capable of storing a font of a converted print dot density as down-line load font.

It is an even further object of the present invention to provide a printing mode control system capable of editing an image data by reading either a converted down-line load font having the same size as that of a resident font, or the resident font according to a print data provided by a host unit to edit an image data, and controlling a printer for printing the edited image data.

To achieve the foregoing objects of the invention, the present invention provides a printing mode control system for controlling a system including a plurality of printers differing from each other in print dot density and connected to a host unit, comprising first memory means for storing a resident font, font converting means for converting a down-line load font into a converted down-line load font matching the print dot density of the resident font, and second memory means for storing the converted down-line load font provided by the font converting means.

According to the present invention, only a down-line load font is subjected to print dot density conversion to produce a converted down-line load font meeting the print dot density of a printer to be used and print data is printed in the converted down-line load font as well as in the resident font, whereby the deterioration of print

quality is obviated, and a plurality of printers differing from each other in print dot density can be connected to a host unit under the same interface conditions.

The above and other objects, features and advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings.

Figs. 1(a) and 1(b) are illustrations, by way of example, of assistance in explaining a procedure for reducing a character;

Figs. 2(a) and 2(b) are illustrations, by way of example, of assistance in explaining a procedure for reducing print area;

Fig. 3 is a block diagram of a printing mode control system, in a preferred embodiment, according to the present invention;

Fig. 4 is a flow chart of assistance in explaining the operation of the printing mode control system of Fig. 3;

Fig. 5 is an enlarged circuit diagram of the print dot density converting unit of the printing mode control system of Fig. 3;

Figs. 6(a) and 6(b) are illustrations of assistance in explaining a procedure for enlarging a character;

Fig. 7 is a block diagram of a reducing circuit included in the print dot density converting unit; and

Figs. 8(a) and 8(b) are illustrations of assistance in explaining a character reducing procedure.

Referring to Fig. 3, connected to a microprocessor 1 are a program memory 2, an interface unit 3 which communicates with a host unit (not shown) for data transmission, a receiving buffer 4 for temporarily storing received data including print data, a print control unit 5 which edits a received print data in a dot image data of a format in which a print unit 12 prints, a dot image memory 6 for storing the dot image data edited by the print control unit 5, a print interface unit 7 which controls operation for reading the dot image data from the dot image memory 6 and operation for transferring the dot image data to the print unit 12, a dot density converting unit 8 which converts a down-line load font received through the interface unit 3 and the receiving buffer 4 from the host unit so as to conform to the print dot density of the print unit 12, a resident font memory 9 storing a frequently used font conforming to the print dot density of the print unit 12 as a resident font, a down-line load font memory 10 for storing the converted down-line load font converted by the print dot density converting unit 8, a font memory control unit 11 which controls addressing operation for storing the converted down-line load font converted by the print dot density converting unit 8 at a predetermined address in the down-

line load font memory 10 and addressing operation for reading the font from the resident font memory 9 or from the down-line load font memory 10 according to a resident font specifying code or a down-line load font specifying code included in the received print data, and the print unit 12 which prints characters and the like on a recording sheet on the basis of dot image data given thereto from the print interface unit 7. Fig. 3 shows only one of a plurality of printers connected to a system. In this embodiment, a device including the components 1 through 12 is designated as a printer. However, the printer may be only the print unit 12 and the components 1 through 11 may be included in an external controller.

In practical application, the printing mode control system may comprise, by way of example, i 80186 (INTEL) as the microprocessor 1, HN27512 (HITACHI) as the program memory 2, i 8051 (INTEL) as the interface unit 3, HM50464 (HITACHI) as the receiveing buffer 4, MSM 76V002 and MSM76V007 (OKI) as the print control unit 5, HM514258 (HITACHI) as the dot image memory 6, MSM 79V001 (OKI) as the print interface unit 7, MSM 78H015 (OKI) as the print dot density converting unit 8, PD 23C4000C (NEC) as the resident font memory 9, HM50464 (HITACHI) as the down-line load memory 10, and MSM 76V001 (OKI) as the font memory control unit 11.

In this embodiment, rarely used fonts are used commonly in the system as down-line load fonts resident in

the host unit.

Referring to Fig. 4, before receiveing print data, a down-line load font of a print dot density different from that of the print unit 12 is given through the interface unit 3 and the receiveing buffer 4 to the print dot density converting unit 8 in step 101. Then, the print dot converting unit 8 converts down-line load font into a converted down-line load font of a print dot density conforming to the print dot density of the print unit 12 in step 102, and then the converted down-line load font is stored in the down-line load font memory 10 in step 103.

Then, print data is received through the interface unit 3 from the host unit by the receiveing buffer 4 in step 104. Then, the microprocessor 1 executes the following steps. In step 105, the microprocessor 1 decides whether the print data stored in the receiving buffer 4 includes a code specifying the resident font or whether the same includes a code specifying the down-line load font. When the print data includes the code specifying the resident font, the microprocessor 1 gives a signal specifying the address of the corresponding resident font to the font memory control unit 11 in step 106. When the print data includes the code specifying the down-line load font, the microprocessor 1 gives a signal specifying the address of the down-line load font to the font memory control unit 11 in step 107.

In steps 108 and 109, the microprocessor 1 gives

instruction, according to codes included in the print data to specify character pitch and line pitch, to the print control unit 5 to edit the font read from the resident font memory 9 or from the down-line load font memory 10 by the font memory control unit 11. When the character pitch and the line pitch are indicated in dots, the character pitch and the line pitch are converted so as to match the print dot density of the print unit 12 in step 110. In step 111, the print control unit 5 edits dot image data according to instructions given thereto from the microprocessor 1, and then stores the edited dot image data in the dot image memory 6. Then, upon the reception of instructions from the microprocessor 1, the print interface unit 7 reads the dot image data from the dot image memory 6 and gives the dot image data to the print unit 12 in step 112.

Functions of the print dot density converting unit 8 will be described hereinafter. The print dot density converting unit 8 has an enlarging circuit for enlarging a dot matrix, and a reducing circuit for reducing a dot matrix.

The enlarging circuit is such as disclosed in Japanese Patent Publication No. 56-15555. Fig. 5 shows an exemplary enlarging circuit. Fig. 6(a) shows an original 24x24 dot matrix, and Fig. 6 (b) shows an enlarged 32x32 dot matrix prepared by enlarging the original 24x24 dot matrix. In preparing the 32x32 dot matrix by enlarging

the 24x24 dot matrix, the 24x24 dot matrix is divided by lines y_1 to y_8 and rows x_1 to x_8. Then, portions of the lines y_1 to y_8 and rows x_1 to x_8 lying between black dots in Fig. 6(a) are converted into black dots as shown in Fig. 6(b), and the rest of the portions of the same are converted into blank dots as shown in Fig. 6(b) to form a pattern in the 32x32 dot matrix as shown in Fig. 6(b). The enlarging circuit shown in Fig. 5 has AND circuits 81a to 81h provided at the respective dividing positions of the rows x_1 to x_8 (the lines y_1 to y_8) to convert an original pattern represented by the 24x24 dot matrix into a pattern represented by the 32x32 dot matrix.

The reducing circuit is such as disclosed in Japanese Patent Publication No. 55-31953. Fig. 7 shows an exemplary reducing circuit. Fig. 8(a) shows an original pattern represented by the 32x32 dot matrix and Fig. 8(b) shows a reduced pattern represented by the 24x24 dot matrix prepared by reducing the original pattern. Referring to Fig. 7 the reducing circuit comprises a black dot counter 82, row registers 83, line registers 84, row comparators 85, line comparators 86, and line/row deleting circuit 87. In reducing a pattern represented by the 32x32 dot matrix to a pattern represented by the 24x24 dot matrix, the 32x32 dot matrix is divided by lines y_1 to y_8 and rows x_1 to x_8. Then, one line having the least black dots among the lines in each division Y_0, and one row having the least black dots among the lines in each

division X_0 are deleted to convert the pattern represented by the 32x32 dot matrix (Fig. 8(a)) into the pattern represented by the 24x24 dot matrix (Fig. 8(b)). The black dot counter 82 counts the number of black dots in the lines and rows, the registers 83 and 84 registers the number of black dots, each row comparator 85 compares the number of black dots in a group of four rows and gives a signal indicating a row having the least black dots to the line-row deleting circuit 87, each line comparator 86 compares the number of black dots in a group of four lines and gives a signal indicating a line having the least black dots to the line-row deleting circuit 87, and then the line-row deleting circuit 87 deletes the lines having the least black dots among those of the corresponding groups to reduce the pattern represented by the 32x32 dot matrix into the pattern represented by the 24x24 dot matrix.

Although the invention has been described with reference to a printer, by way of example, among a plurality of different printers connected to a system, the present invention is not limited to such an application, but may be applied to controlling printing operation in which printers differing in print dot density are connected selectively to the system.

Althugh the invention has been described in its preferred form with a certain degree of particularity, many changes and variations are possible therein. It is

therefore to be understood that the invention may be practiced otherwise than specifically described herein without departing from the scope and spirit thereof.

CLAIMS

1. A printing mode control system for controlling the printing operation of a system including a plurality of printers differing from each other in print dot density and connected to a host unit, and having down-line load fonts provided by the host unit in addition to resident fonts for the printers, comprising:

first memory means for storing the resident fonts;

converting means for converting each down-line load font into a font of a print dot density conforming to that of a resident font for a relevant printer; and

second memory means for storing converted down-line load font converted by said converting means.

2. A printing mode control system according to Claim 1, wherein the resident font is represented by a 24x24 dot matrix or a 32x32 dot matrix, and the down-line load font is represented by a 32x32 dot matrix or a 24x24 dot matrix respectively.

3. A printing mode control system for controlling the printing operation of a system including a plurality of printers differing from each other in print dot density and connected to a host unit, having rarely used fonts commonly in the host unit as down-line load fonts, and frequently used fonts respectively in the printers as resident fonts, comprising:

first memory means for storing the resident fonts;

interface means for receiving the down-line load font and for receiving print data including a code specifying the resident font or the down-line load font;

converting means for converting the size of the down-line load font received through the interface means into the same size as that of the resident font;

second memory means for storing the converted down-line load font converted by the converting means; and

control means for reading the fonts of either the first memory means or the second memory means on the basis of the print data, which edits dot image data and gives the edited dot image data to the printer.

4. A printing control system substantially as herein-before described with reference to the accompanying drawings.

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