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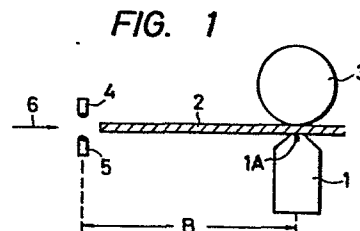
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54 Printer control system.

57 A printer control system which can print characters or symbols on a recording sheet having a predetermined size and in which the height of said characters or symbols may be changed. The control system includes a sensor for obtaining an indication of the effective recording length remaining in said recording sheet. A comparison is made of the effective recording length with a width of a printing line to be printed or the sum of this width and a width of an interline. A determination according to a result of the comparison is made as to whether or not printing the printing line subjected to the comparison should be effected on the space remaining or, on the next recording sheet. Hence, the number of lines for any characters or symbols to be printed on the recording sheet is limited.



This invention relates to a control system in a printer that prints characters or symbols on a recording sheet having a predetermined size in which the height of the characters or symbols may be changed. In particular, this invention relates to a printer control system to prevent incorrect printing where characters or symbols jut out from the bottom edge of a recording sheet, or do not have a proper bottom margin.

A non-impact printer such as a heat-sensitive printer produces an output in hard copy form of characters or symbols (hereinafter referred to merely as "characters") corresponding to electrical input signals. The printer of this type effects a picture element type of printing operation. Accordingly, the printer exhibits excellent recording flexibility, that is, it can print characters of various sizes as desired. Specifically, the height of a character to be printed can be changed as desired by the following method. The video signal of each scanning line is generated by a character generating device and is used for printing a plurality of scanning lines or video signals for one line. The output from the character generating device is thinned out to control the height.

Since the height of characters in printing lines can be set to desired values as described above, the number of lines which can be included in one page of a recording sheet are also changed. Accordingly, if the number of lines in such a printer is maintained unchanged, sometimes an inadequate or no blank area is left on the recording sheet while a line is being scanned. Hence, it becomes impossible to discriminate the contents of printing of that line. Therefore, in

practice sometimes an operator is forced to perform a format calculation before recording so that the printing contents are all included on the respective page. Furthermore, sometimes the number of lines for characters to be recorded on one page is limited using a large character as a reference. If, in this case, small (small in height) characters are printed, an unbalanced blank area may be formed on the marginal bottom portion of the recording sheet.

An object of this invention is to provide a printer control system which can correctly determine the number of lines for characters to be printed on each recording sheet according to the heights of characters to be printed.

According to this invention there is provided a system in a printer for controlling the printing of characters on a recording sheet wherein the height of the characters may be varied including: means for determining the effective remaining length of said recording sheet available for printing; means for determining the width of a line to be printed; means for comparing the effective remaining length with the width of said line to be printed and generating control output; and control means responsive to said control output for determining whether printing of said line to be printed should be effected on said recording sheet or a subsequent one whereby the number of lines to be printed on said recording sheet is regulated.

The accompanying drawing is a description of one embodiment of this invention. More specifically,

FIG. 1 is a side view showing a recording sheet bottom edge detecting section in a printer;

FIG. 2 is a block diagram showing the essential components of a control section in the printer;

FIG. 3 is an explanatory diagram describing the contents of recording sheet feeding data E; and

FIG. 4 is an explanatory diagram showing the maximum and minimum heights of a character to be recorded.

One preferred embodiment of this invention will be described in detail.

FIG. 1 shows a recording sheet bottom edge detecting section in a printer. In the printer, data are recorded thermally on a heat-sensitive recording sheet 2 by using a thermal head 1. In a recording operation, the heat-sensitive recording sheet 2 is subjected to auxiliary scanning so that it passes between the thermal head 1 and a pressing roller 3 which confronts the thermal head 1. In this operation, the thermal head 1 applies thermal pulses to the heat-sensitive recording sheet 2, so that characters are recorded by selective coloring of the recording sheet.

An LED (light emitting diode) 4 and a photo-sensor 5 are located at a distance B, about 30 mm upstream of the heat generating element array 1A of the thermal head 1. These elements are arranged in such a manner that they are positioned on both sides of the path of the recording

sheet 2. The recording sheet 2 is conveyed stepwise in the direction of the arrow 6 (or the auxiliary scanning direction) by a step motor (not shown), and the photo-sensor 5 detects light from the LED 4 when the length of a blank portion of the recording sheet where no recording has yet been effectuated is 30 mm. It is understood that this predetermined distance can be set depending on system or equipment requirements.

FIG. 2 shows the essential components of a control section for carrying out the printing control operation of the printer. Upon detection of light from the LED 4, the photo-sensor 5 applies a preset signal 9 to a subtraction counter 3. At the same time, the subtraction counter 8 presets a predetermined value which is stored in a first buffer register 11.

If the distance between the heat generating element array 1A of the thermal head and the photo-sensor 5 is represented by B, the predetermined value A is:

$$A = B - e$$

where, e is the margin on the bottom of the page which is provided by taking the oblique feed of the recording sheet 2 into consideration. Accordingly, when the margin e is 2 mm and the distance B is 30 mm, the preset value A is 28.

A timing clock signal 12 is applied to the subtraction counter 8. The timing clock signal is synchronous with the drive pulse which is applied to the step motor for moving, that is advancing the recording sheet. Whenever the timing clock signal 12 is applied to the subtraction counter 8, the contents of the subtraction counter 8 are subtracted by the amount of conveyance C of the heat-sensitive recording 2

which is achieved by one drive pulse. Accordingly, the subtraction result (or the effective recording length) D which is outputted by the subtraction counter 8 is:

$$D = A - \sum_{i=1}^n C_i$$

where, n is the integer representative of the number of timing clock signals 12 which are produced after the subtraction counter 8 has been preset. Hence, the effective recording length D which is decreased with the advancement of the recording sheet is successively applied to an arithmetic circuit 13. A second buffer register 14 applies recording sheet feeding data E to the arithmetic circuit 13. As shown in Fig. 3, the recording sheet feeding data E is the sum of the width F of a printing line 16 which is next to the printing line 15 on which data is being printed and the width G of an interline 17 between the printing lines 15 and 16. A controller 19 forms character size data H according to a control code 21 which is transmitted together with a character code from a host system (not shown). According to the character size data H which is representative of the magnification, in the sheet feed direction, of a character, the normal height J of a standard character pattern and the width G of the interline, the second buffer 14 selects and outputs the recording sheet feeding data E. That is, the recording sheet feeding data E outputted by the second buffer 14 can be represented by the following expression:

$$E = H \times J + G \quad (\text{where } H \times J = F)$$

Whenever one line has been printed, the controller 19 outputs a line printing finish signal 23. Upon reception of signal 23, the arithmetic circuit 13 subtracts the recording sheet feeding data E from the effective recording length D.

The output or the subtraction result signal 24 of the arithmetic circuit 13 is supplied to the controller 19.

The controller 19 determines the start of printing the next printing line 16 when the signal 24 is zero or positive; i.e., the effective recording data D is equal to or larger than the recording sheet feeding data E. When, conversely the signal 24 is negative, i.e., the data D is smaller than the data E, the controller 19 operates to end the printing operation of the line when printing the printing line 15 is completed. At the same time, the controller 19 supplies a new page starting instruction signal on line 25 to the host system, so that codes necessary for printing on the first line of the next page the data which were to be printed on the printing line 16 are suitably transmitted.

As is apparent from the above description, according to the invention, before a line is printed, the effective recording length remaining on the recording sheet and the width of the line to be printed are determined from the height of a character to be printed. The data is subjected to comparison in the printer or its peripheral unit, to determine whether or not it is possible to continue the printing operation on that page. This contributes to a reduction of the responsibility placed on the operator of the printer and results in an improvement of clerical work efficiency.

In the above-described embodiment, processing for the new line starting operation is effected by the program in the host systems. However, it is within the scope of this invention that the printer itself may perform the new line starting operation to continue the printing operation.

Furthermore, in the preferred embodiment described herein, the arithmetic operation is started when the photo-sensor detects the rear edge of the recording sheet. However, the arithmetic operation may be omitted in the following case. It is assumed that, as shown in FIG. 4, a character to be recorded is within a range of from the maximum height M to the minimum height N . When the sum $(M + G)$ of the maximum height M of the character and the width G of the corresponding interline is subtracted continuously from the preset value A , if the result of subtraction becomes negative, the arithmetic operation may be omitted. Reduction of the arithmetic processing circuit as described above is effective in decreasing the burden which is given to internal or external arithmetic circuits of the printer or arithmetic devices.

Furthermore, in the preferred embodiment, the LED and the photo-sensor are used to detect the bottom edge of the recording sheet. However, this method may be replaced by a method in which the presence or absence of reflected light is detected by a photo-coupler or the bottom edge is mechanically detected with a microswitch. In the preferred embodiment, the sum of the width of a printing line which is next to the printing line which is being printed and the width of the interline between these two printing lines is compared with the effective recording length, to control the printer. However, the printer may be controlled by utilizing the width of a printing line which occurs much later than the next printing line. Furthermore, in the case where the comparison with the effective recording length is carried out immediately before the next printing line, it is unnecessary to examine the width of the interline.

C L A I M S

1. A system in a printer for controlling the printing of characters on a recording sheet wherein the height of the characters may be varied including: means for determining the effective remaining length of said recording sheet available for printing; means for determining the width of a line to be printed; means for comparing the effective remaining length with the width of said line to be printed and generating control output; and control means responsive to said control output for determining whether printing of said line to be printed should be effected on said recording sheet or a subsequent one whereby the number of lines to be printed on said recording sheet is regulated.

2. A system as claimed in Claim 1, wherein said means for determining the effective remaining length of said recording sheet includes sensor means for determining the passage of an edge of said recording sheet and for generating a sensor output, said sensor means positioned a predetermined distance from a printing head forming part of said system.

3. A system as claimed in Claim 2, wherein said sensor means comprises a source of light positioned on one side of said recording sheet and a photo-detector placed on an opposite side of said recording sheet.

4. A system as claimed in Claim 2, wherein said means for determining the effective remaining length of said recording sheet further including a subtraction counter actuated by said sensor output to receive a first preset input and a second preset input indicative of the incremental conveyance of said recording sheet to be subtracted from said first preset input and delivering an output indicative of the effective length.

5. A system as claimed in any one of the preceding claims wherein said comparing means comprises an arithmetic subtraction circuit receiving a first input representative of the effective remaining length and a second input representing the width of the next line to be printed, said subtraction circuit subtracting said second input from said first input and producing said control output to said control means.

6. A system as claimed in Claim 5, wherein said second input includes the width of an interline between printing lines.

7. A system as claimed in any one of the preceding claims wherein said means for determining the width of a line to be printed comprises a buffer for receiving character magnification data and using said magnification data and representing normal character height and the width of an interline to produce a signal representing the width of the next line to be printed.

8. A system as claimed in Claim 1, wherein said means for determining the effective remaining length of said recording sheet comprises a subtraction counter receiving a first preset input and second input indicative of the sum of the maximum character height and interline width, and wherein said means for comparing is disabled when subtraction of said second input from said first input becomes negative.

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FIG. 1

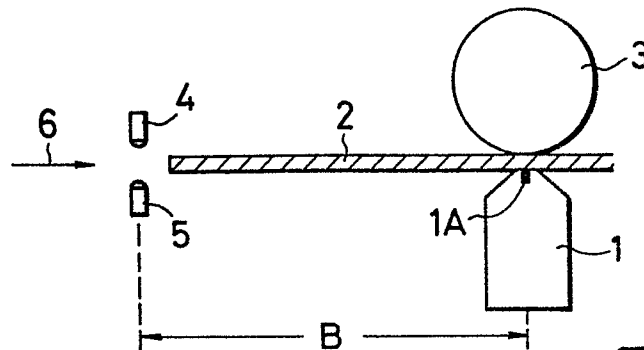


FIG. 2

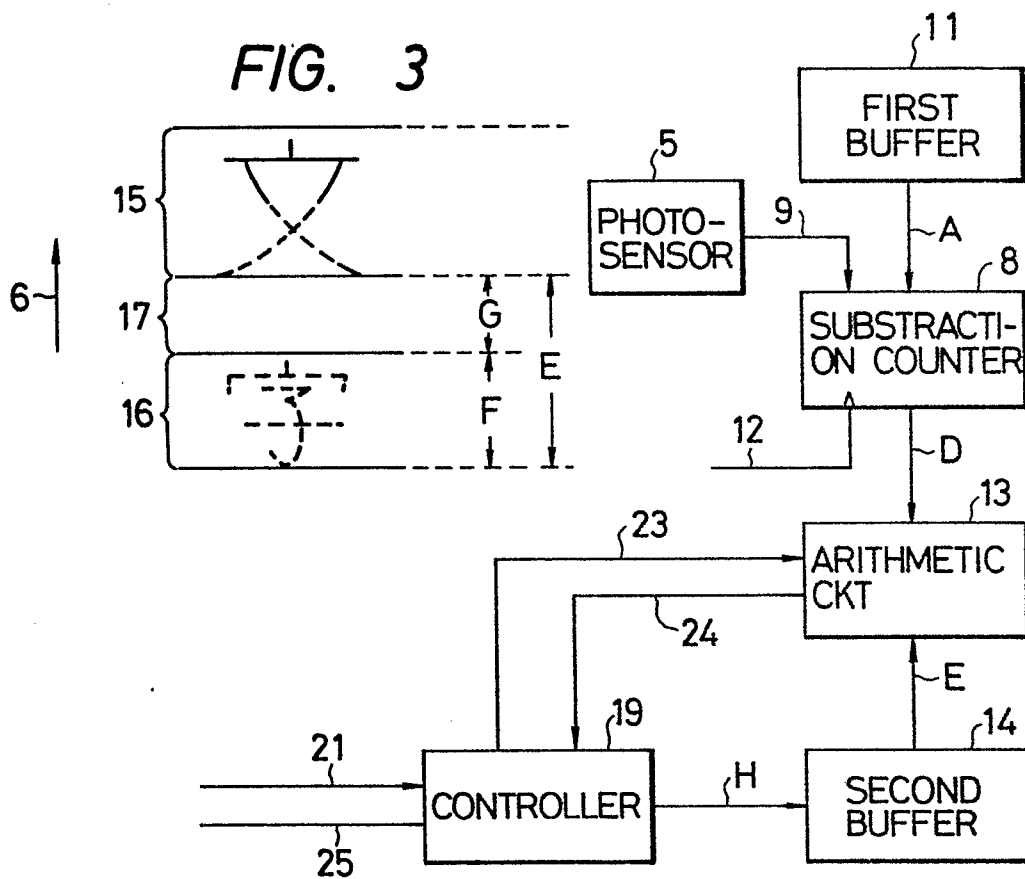


FIG. 4

