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(54) **Bar code printer**

(57) In a bar code printer, the type of bar code and widths of bar code elements are input into an input unit (4, 5, 12). A control circuit (1) selects one of ROM pattern generators (2A-2D) according to the bar code type input, and develops the bar code patterns by adjusting the widths of all the bar code elements included in each bar code pattern according to the element widths input. The results are buffered (3C), then printed (7).

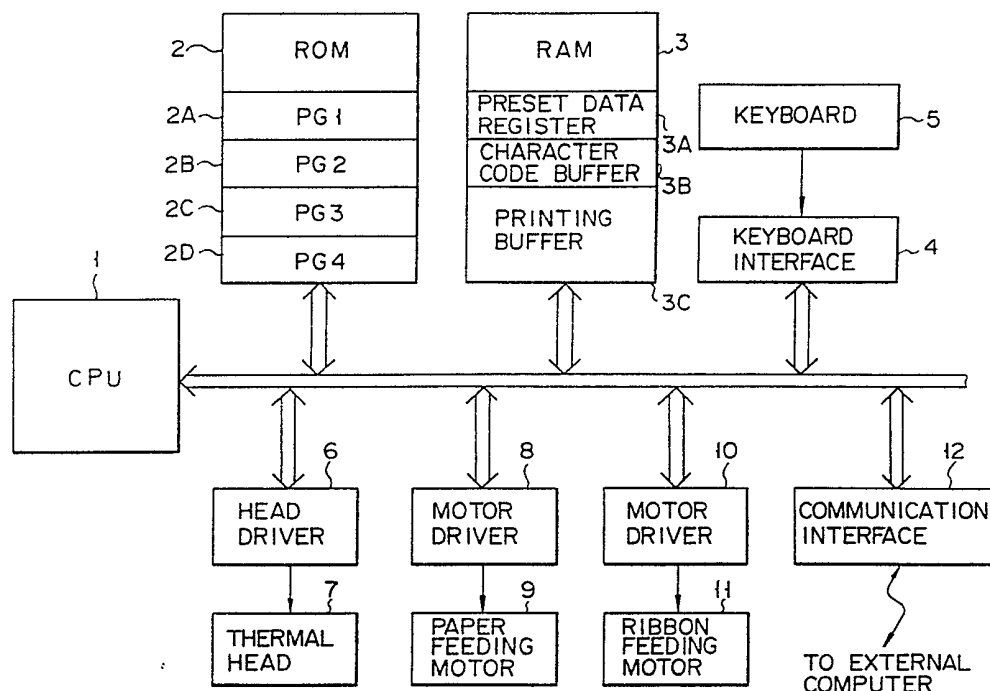


FIG. 3

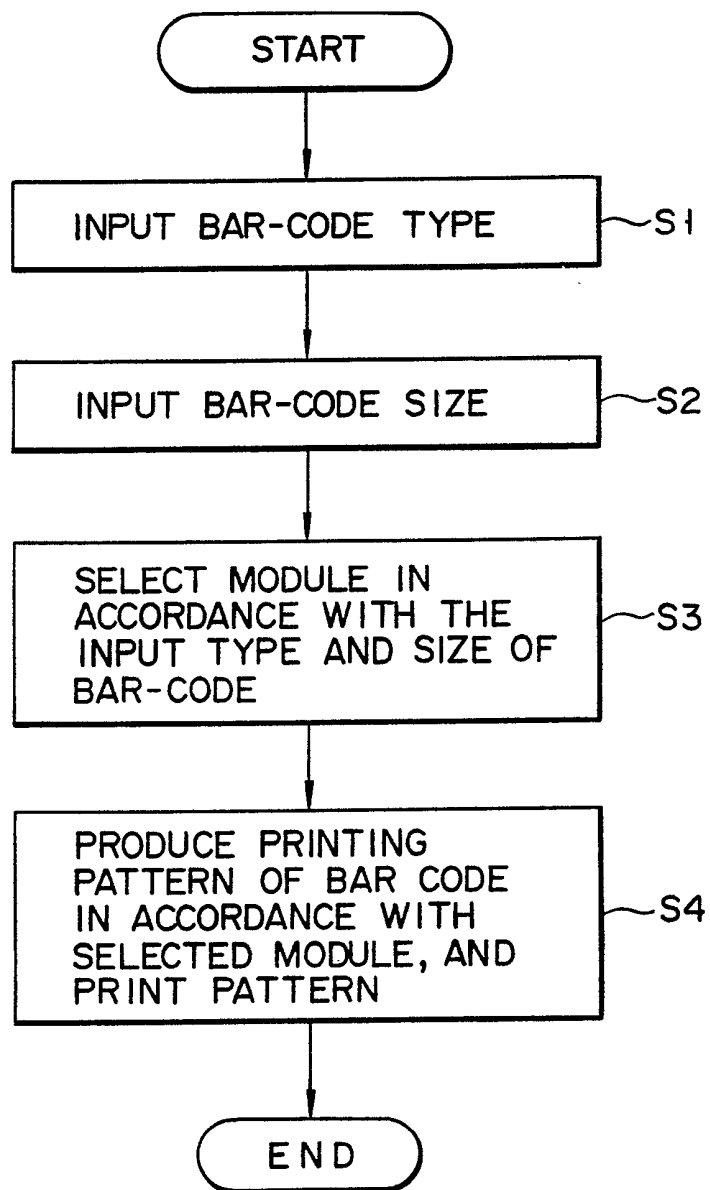


FIG. 1

SIZE TYPE	(1)	(2)	(3)	(4)
A	JAN MODULE 1 (NARROW BAR: 3 DOTS WIDE BAR: 9 DOTS)	JAN MODULE 2 (NARROW BAR: 4 DOTS WIDE BAR: 12 DOTS)	JAN MODULE 3 (NARROW BAR: 5 DOTS WIDE BAR: 15 DOTS)	JAN MODULE 4 (NARROW BAR: 6 DOTS WIDE BAR: 18 DOTS)
B	NW-7 MODULE 1 (NARROW BAR: 2 DOTS WIDE BAR: 6 DOTS)	NW-7 MODULE 2 (NARROW BAR: 3 DOTS WIDE BAR: 9 DOTS)	NW-7 MODULE 3 (NARROW BAR: 4 DOTS WIDE BAR: 12 DOTS)	NW-7 MODULE 4 (NARROW BAR: 5 DOTS WIDE BAR: 15 DOTS)
C	ITF MODULE 1 (NARROW BAR: 3 DOTS WIDE BAR: 9 DOTS)	ITF MODULE 2 (NARROW BAR: 4 DOTS WIDE BAR: 12 DOTS)	ITF MODULE 3 (NARROW BAR: 5 DOTS WIDE BAR: 15 DOTS)	ITF MODULE 4 (NARROW BAR: 6 DOTS WIDE BAR: 18 DOTS)
D	CODE 39 MODULE 1 (NARROW BAR: 3 DOTS WIDE BAR: 9 DOTS)	CODE 39 MODULE 2 (NARROW BAR: 4 DOTS WIDE BAR: 12 DOTS)	CODE 39 MODULE 3 (NARROW BAR: 5 DOTS WIDE BAR: 15 DOTS)	CODE 39 MODULE 4 (NARROW BAR: 6 DOTS WIDE BAR: 18 DOTS)

1 DOT = 1/11.4 (mm)

FIG. 2

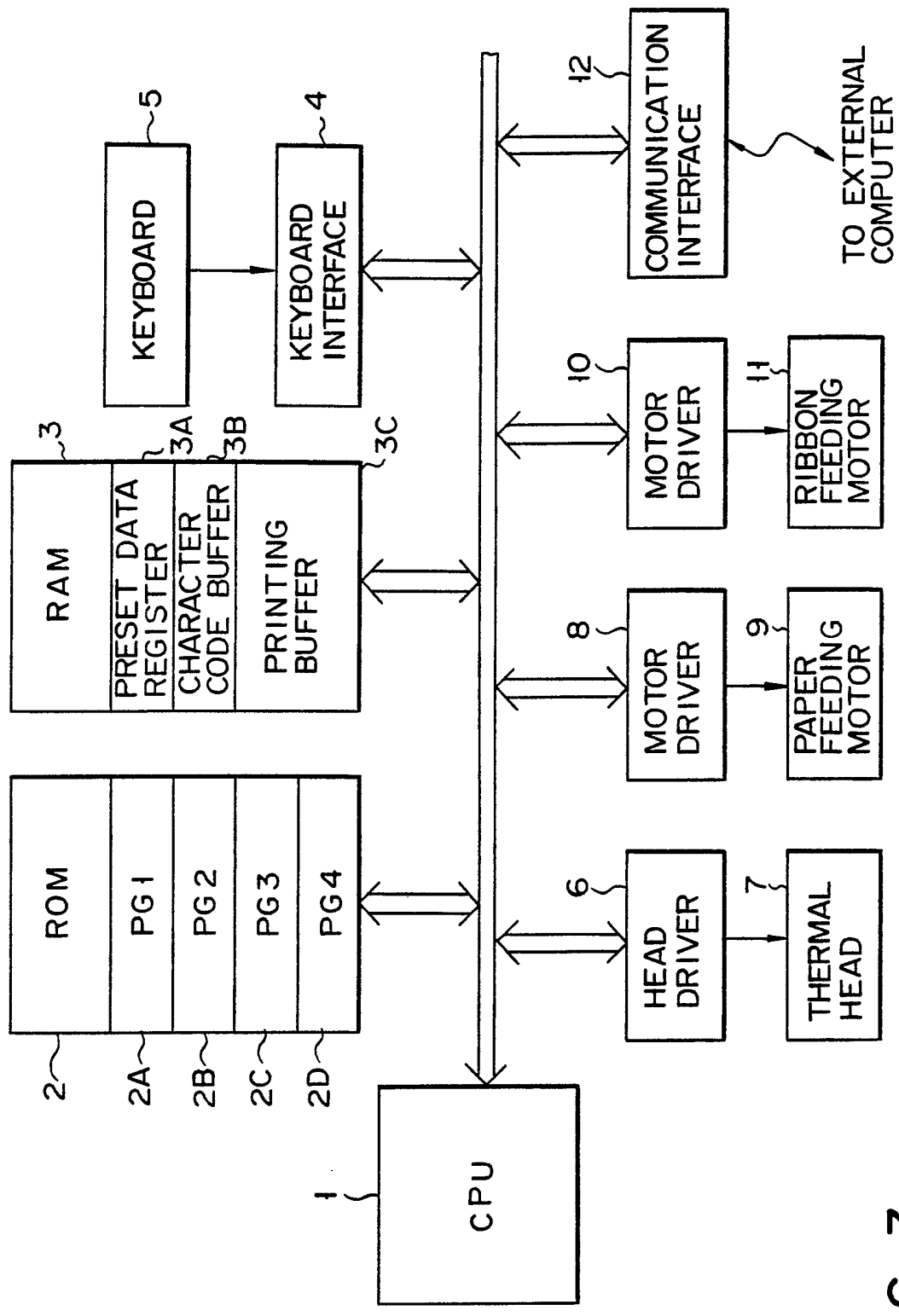


FIG. 3

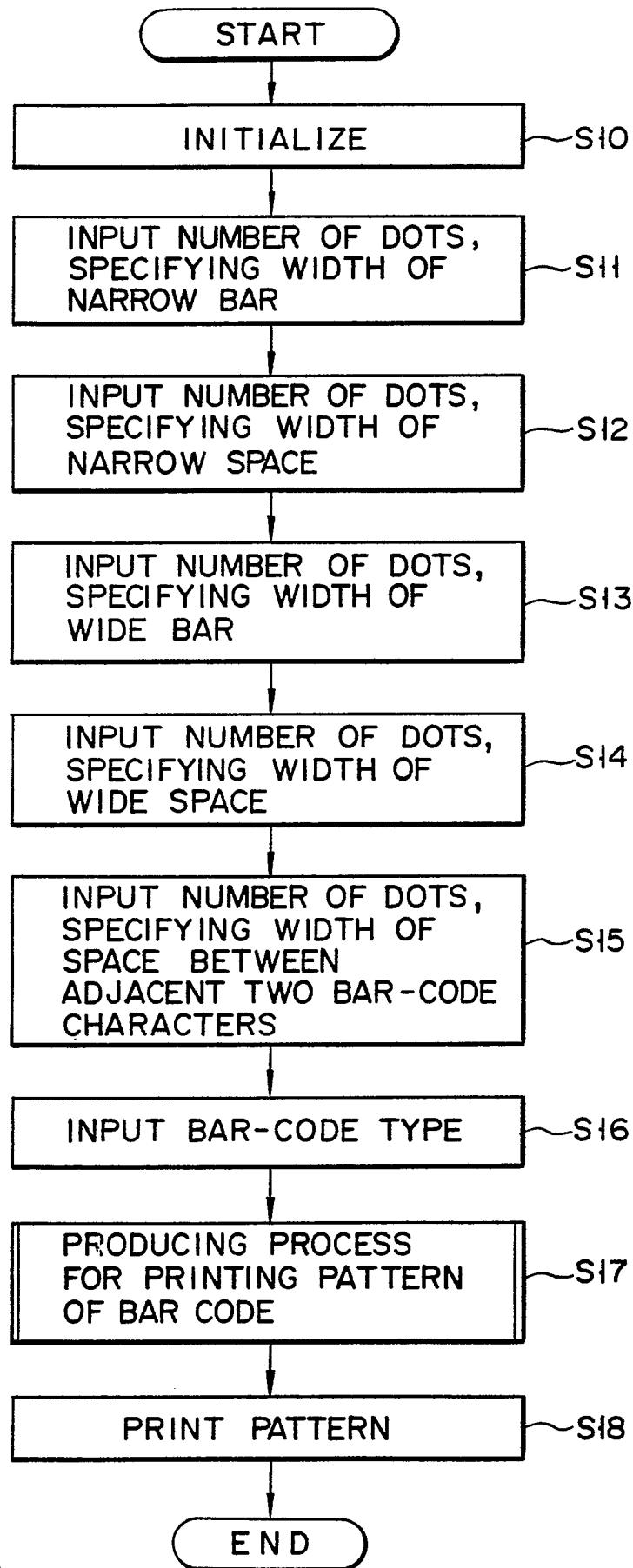


FIG. 4

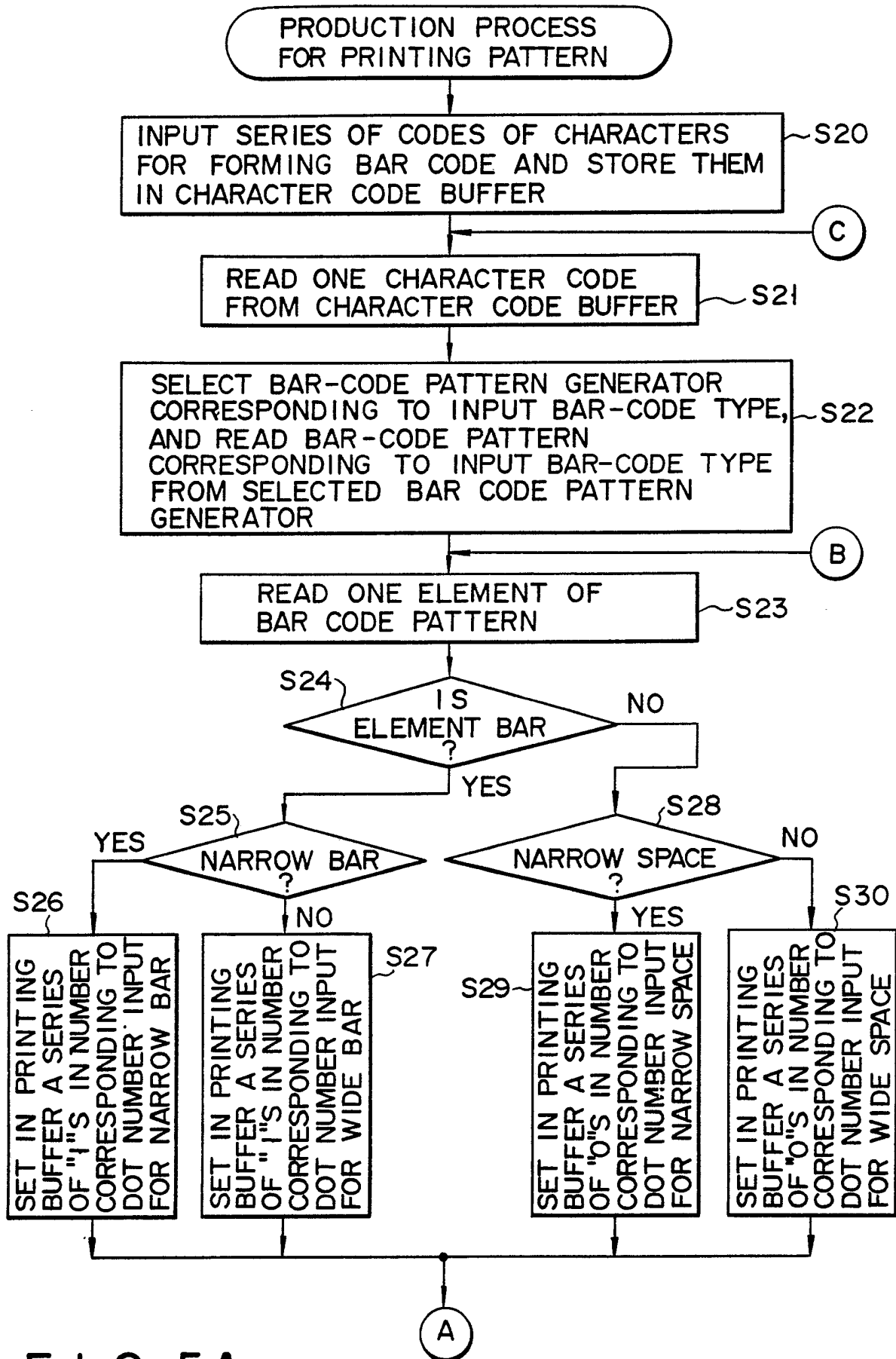


FIG. 5A

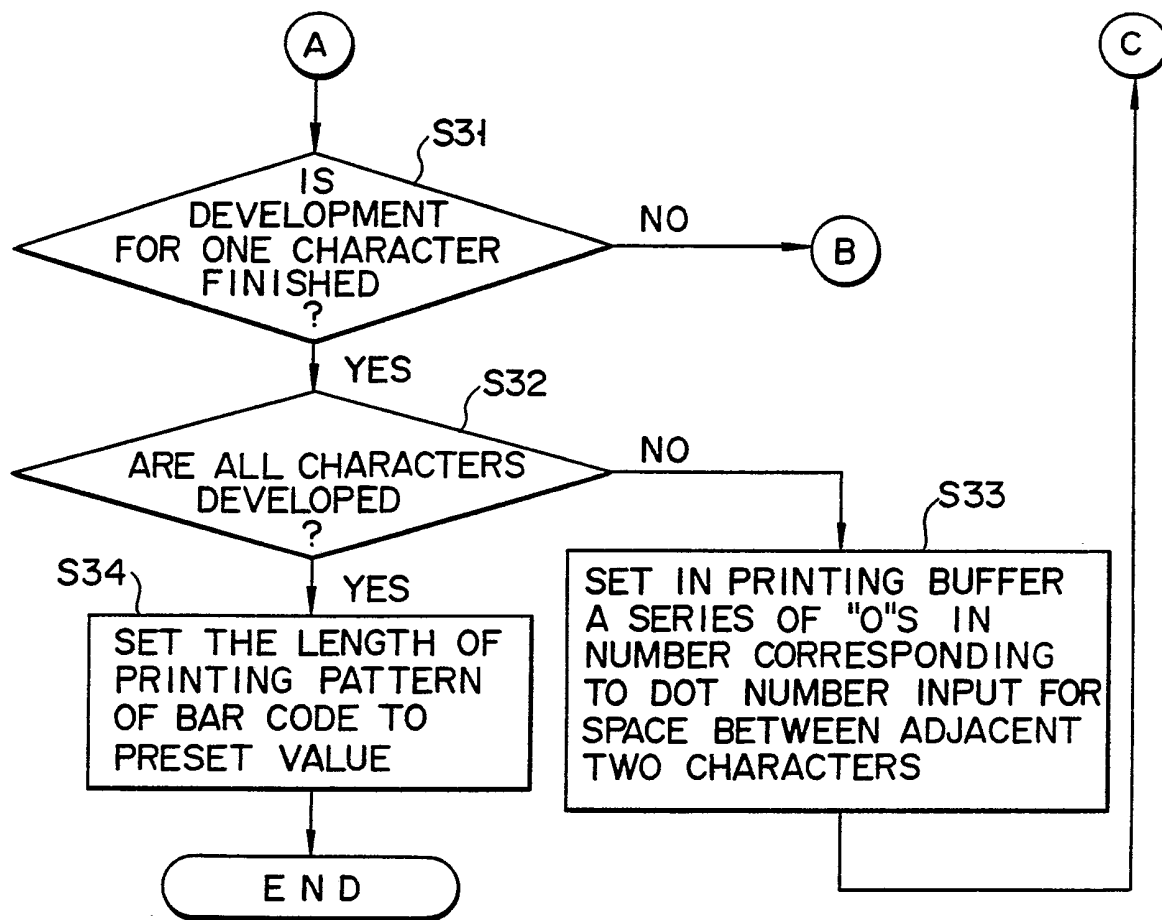


FIG. 5B

"BAR CODE PRINTER"

This invention relates to a bar code printer capable of printing various bar codes.

Recently, bar codes have widely spread all over the
5 world. The bar code is printed on the label paper of
articles such as foodstuffs and miscellaneous goods and
is used to reduce the labor of sales registration operation by automatically reading article information from
the bar code. JAN, NW-7, ITF, CODE39, UPC, EAN are conventionally known as such a bar code, for example. In a
10 case where these bar codes are printed as source markings in the manufacturing stage, for example, various
item data such as a production country name code, article maker code, article item code and check digit are
15 included in the bar codes. However, the bar codes are
different from one another in the type and digit number
of the bar code pattern used for constituting the item
data.

In general, the conventional bar code printer
20 includes a plurality of pattern generators, a printing
buffer, a printing head and a module table so as to
selectively print various bar codes. Each of the pattern generators sequentially converts a line of character
codes into bar code patterns, the printing buffer
25 stores printing patterns of bar codes obtained by
developing the bar code patterns to have a desired size,
the printing head prints the printing pattern of the bar

code stored in the printing buffer, and the module table stores a plurality of modules for specifying the number of dots for the widths of bar code elements or the widths of narrow or wide bars (or spaces) necessary for
5 developing each bar code pattern.

Fig. 1 schematically shows the operation of the bar code printer. In this operation, the type and size of the bar code are input in the steps S1 and S2. Then, a module stored in the module table is selected according
10 to the type and size of the bar code in the step S3, and the printing pattern of the bar code is created and printed in the step S4. In the step of creating the printing pattern, a line of character codes are sequentially converted into bar code patterns by means of the
15 pattern generator corresponding to the input bar code type and the bar code patterns are developed based on the module selected according to the input bar code type and bar code size and stored into the printing buffer as printing patterns. In the printing process, the printing
20 pattern is read out from the printing buffer and supplied to the printing head.

The number of types of the bar codes tends to increase as the bar code has been widely used. The printing density of the printing head is made high so as
25 to print various bar codes with good printing quality. Specifically, if the printing density of the printing head is low, the minimum value of the width of the bar

code element will be limited and there is a possibility that the ratio of the width of the narrow bar to the width of the wide bar which satisfies the standards of various bar codes cannot be freely set. Now, the printing head having the printing densities of 10.5 dots/mm, 11.4 dots/mm and 15.2 dots/mm is used, for example.

Fig. 2 shows an example of a module table provided when the printing head is formed to have the printing density of 11.4 dots/mm. If the printing density of the printing head increases in future, the number of types of the bar codes further increases. Therefore, it becomes necessary to set more modules into the module table and increase in the memory capacity caused by this may not be neglected.

An object of this invention is to provide a bar code printer capable of suppressing increase in the memory capacity due to increase in the number of types of bar codes or increase in the printing density.

The above object can be attained by a bar code printer comprising a printing section; a memory unit having memory areas serving as a plurality of pattern generators for generating various bar code patterns and a memory area serving as a printing buffer; an input unit for inputting the type of bar code and the width of at least one bar code element; and a control circuit for selecting one of the pattern generators according to the

bar code type input via the input unit, causing the selected pattern generator to sequentially generate bar code patterns of desired characters, developing the bar code pattern generated from the pattern generator in the printing buffer so that the elements may have widths the input via the input unit, and causing the printing section to print the printing pattern of the bar code constituted by the bar code patterns developed in the printing buffer.

10 With the above bar code printer, the control circuit selects one of the pattern generators according to the bar code type input via the input unit, causes the selected pattern generator to sequentially generate bar codes of desired characters, and develops the bar code patterns generated from the pattern generator in the printing buffer so that the elements may have the widths input via the input unit. That is, since the bar code printer creates the printing pattern of the bar code without using the conventional module table, increase in 15 the memory capacity due to increase in the number of types of bar codes and increase in the printing density can be suppressed.

25 Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and

obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

5 This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate a presently preferred embodiment of the invention, and together with the general description given above and the detailed description of the preferred embodiment given below, serve to explain the principles of the invention.

Fig. 1 is a flow chart schematically illustrating the operation of the conventional bar code printer;

Fig. 2 shows an example of a module table provided in the bar code printer shown in Fig. 1;

Fig. 3 is a block diagram showing the circuit construction of a bar code printer according to one embodiment of this invention; and

Figs. 4, 5A and 5B are flow charts illustrating the operation of the bar code printer shown in Fig. 3.

There will now be described a bar code printer according to one embodiment of this invention with reference to Fig. 3.

Fig. 3 shows the circuit construction of the bar code printer. The bar code printer includes a CPU 1,

ROM 2, RAM 3, keyboard interface 44, keyboard 5, head driver 6, thermal head 7, motor driver 8, paper feeding motor 9, motor driver 10, ribbon feeding motor 11 and communication interface 12. The CPU 1, ROM 2, RAM3,
5 keyboard interface 4, head driver 6, thermal head 7, motor driver 10 and communication interface 12 are connected to one another via bus lines, and the keyboard 5, thermal head 7, paper feeding motor 9 and ribbon feeding motor 11 are respectively connected to the keyboard
10 interface 4, head driver 6, motor driver 8 and motor driver 10.

The CPU 1 is used to create printing patterns of bar codes and control the operation of the circuit elements and data processing necessary for the printing
15 operation. The ROM 2 is used to previously store the control program of the CPU 1 and other fixed data. The ROM 2 includes memory areas which are provided in correspondence with bar code types such as JAN, NW-7, ITF and CODE39 to store various bar code patterns and serve as
20 bar code pattern generators 2A to 2D each generating a bar code pattern specified by a character code. The RAM 3 is used to temporarily store data processed by the CPU 1 and data to be processed by the CPU 1. The RAM 3 includes a memory area which serves as a preset data
25 register 3A for storing various preset data used for creating the printing pattern of a bar code. The preset data includes data for specifying the widths of elements

(that is, narrow bar, narrow space, wide bar and wide space) of the bar code pattern, data for specifying the width of a space between the bar code patterns of adjacent two characters in the printing pattern, and data
5 for specifying the type of a bar code to be printed. In the preset data, the widths of the narrow bar and wide bar are represented by the number of dots to be marked by the thermal head 7 and the widths of the narrow space and wide space are represented by the number of dots
10 which are not marked by the thermal head 7. The RAM 3 further includes a memory area serving as a character code buffer 3B for storing a plurality of character codes and a memory area serving as a printing buffer 3C for storing the printing patterns of bar codes obtained
15 by developing a plurality of bar code patterns. In the printing buffer 3C, the bar code printing pattern is represented by a matrix of dot data ("1" and "0"). Preset data, character codes and various instructions are supplied to the CPU 1 from the keyboard 5 via the
20 keyboard interface 4 or from an external computer via the communication interface 12. The head driver 6 and motor drivers 8 and 10 are controlled by the CPU 1 to respectively drive the thermal head 7, paper feeding motor 9 and ribbon feeding motor 10 so as to print the
25 bar code printing pattern stored in the printing buffer 3C on paper. The thermal head 7 has a plurality of heat generating elements as printing elements arranged in

a row and the printing elements are selectively activated according to dot data of one line read out from the printing buffer 3C for each row. Each printing element marks a dot when corresponding dot data is "1" and
5 does not mark a dot when corresponding dot data is "0". The paper feeding motor 9 and ribbon feeding motor 10 are each constructed by a stepping motor and are used to feed paper against which the thermal head 7 is pressed and a thermally fusible-ink ribbon set between the
10 printing head and paper in a direction perpendicular to the line of arrangement of the printing elements. The paper and thermally fusible-ink ribbon are fed by a preset distance in each printing operation for one line. The paper feeding distance is determined according to
15 the size and the heat generation amount of the heat generating elements so as to form a line without interruption (or a bar) by successively marked dots.

Now, the operation of the bar code printer is explained with reference to Figs. 4, 5A and 5B.

20 When the power switch of the bar code printer is turned on, the CPU 1 executes the control program stored in the ROM 2 to operate the bar code printer.

Fig. 4 shows the operation of the bar code printer effected when a bar code label issuing operation is
25 instructed by operation of the keyboard 5, for example. When the operation is started, the circuit elements such as the RAM 2 are initialized in the step S10. At this

time, the contents of the printing buffer 3C are all cleared to "0". After this, various preset data is input in the steps S11 to S16 by means of the keyboard 5 or the external computer and set into the preset data register 3A. In the steps S11 to S14, the dot number for specifying the narrow bar width, that for specifying the narrow space width, that for specifying the wide bar width and that for specifying the wide space width are input. In the step S15, the dot number for specifying the width of a space provided between the bar code patterns (or characters) is input. When the above items of preset data are set into the preset data register 3A, the printing pattern creating process is effected in the step S17 and the created printing pattern is printed by means of the thermal head 7 in the step S18.

Figs. 5A and 5B show the printing pattern creating process of the step S17 shown in Fig. 4 in detail. When the printing pattern creating process is started, one line of character codes are input by means of the keyboard 5 or the external computer in the step S20 and sequentially set into the character code buffer. The character codes are sequentially read out according to the arrangement thereof by repeatedly effecting the step S21. After one character code is read out in the step S21, the step S22 is effected. In the step S22, a pattern generator corresponding to the bar code type stored in the preset data register 3A is selected, and a bar

code pattern corresponding to the readout character code is read out from the pattern generator which is selected according to the character code and is then written into part of the RAM 3. The bar code pattern is constructed
5 by a combination of elements each representing a narrow bar, narrow space, wide bar or wide space. The elements included in the bar code pattern are sequentially read out according to the arrangement thereof by repeatedly effecting the step S23. When one element is read out in
10 the step S23, it is checked in the step S24 whether the element is a bar or not. When the element is detected to be a bar, it is checked in the step S25 whether the element is a narrow bar or not. When the element is detected to be a narrow bar, dot data "1" of a column
15 number corresponding to the narrow bar dot number stored in the preset data register 3A is set into the printing buffer 3C in the step S26. On the other hand, when the element is detected to be a wide bar, dot data "1" of a column number corresponding to the wide bar dot number
20 stored in the preset data register 3A is set into the printing buffer 3C in the step S27.

Further, the element which is checked in the step S24 is detected to be a space, it is checked in the step S28 whether the element is a narrow space or not. If
25 the element is detected to be a narrow space, dot data "0" of a column number corresponding to the narrow space dot number stored in the preset data register 3A is set

into the printing buffer 3C in the step S29. On the other hand, when the element is detected to be a wide space, dot data "0" of a column number corresponding to the wide space dot number stored in the preset data register 3A is set into the printing buffer 3C in the step S30.

In the step S31 following the steps S26, S27, S29 and S30, it is checked whether the development for the bar code element of one character is completed or not. If the development is not yet completed, the step S23 is effected again. On the other hand, if the development is completed, it is checked in the step S32 whether the development for all the characters is completed or not. If the development for all the characters is not yet completed, dot data "0" of a column number corresponding to the dot number of a space between the characters stored in the preset data register 3A is set into the printing buffer 3C in the step S30 and then the step S21 is effected again.

If the development for all the characters is completed, the printing pattern of a bar code stored in the printing buffer 3C is set to a preset length in the step S34. That is, a series of dot data items are stored in a row of memory cells of the printing buffer 3C after the development for all the characters is completed. Therefore, an identical series of dot data items are stored in other consecutive rows of memory

cells which are selected in accordance with the necessary bar length in the step S34. When the process is completed, the step S18 shown in Fig. 4 is effected.

5 With the above bar code printer, it is possible to change the printing density of the thermal head without changing the operation flow described above.

For example, when the thermal head 7 having the printing density of 10.5 dots/mm is used, the narrow bar and wide bar are respectively set to the following

10 widths according to the dot numbers input as the preset data. That is, when "2" and "6" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.190 mm and 0.571 mm. When "3" and "9" are

15 respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.286 mm and 0.857 mm. When "4" and "12" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and

20 wide bar width are respectively set to 0.381 mm and 1.143 mm. When "5" and "15" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.476 mm and 1.429 mm. When "6" and "18" are respec-

25 tively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.571 mm and 1.714 mm.

Further, when the thermal head 7 having the printing density of 11.4 dots/mm is used, the narrow bar and wide bar are respectively set to the following widths according to the dot numbers input as the preset data.

5 That is, when "2" and "6" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.175 mm and 0.526 mm. When "3" and "9" are respectively input as the narrow bar dot number and wide bar
10 dot number, the narrow bar width and wide bar width are respectively set to 0.263 mm and 0.789 mm. When "4" and "12" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.351 mm and 1.053 mm.
15 When "5" and "15" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.439 mm and 1.439 mm. When "6" and "18" are respectively input as the narrow bar dot number and wide bar
20 dot number, the narrow bar width and wide bar width are respectively set to 0.526 mm and 1.579 mm.

Further, when the thermal head 7 having the printing density of 15.2 dots/mm is used, the narrow bar and wide bar are respectively set to the following widths
25 according to the dot numbers input as the preset data. That is, when "2" and "6" are respectively input as the narrow bar dot number and wide bar dot number, the

narrow bar width and wide bar width are respectively set to 0.132 mm and 0.395 mm. When "3" and "9" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are
5 respectively set to 0.197 mm and 0.592 mm. When "4" and "12" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.263 mm and 0.789 mm. When "5" and "15" are respectively input as the narrow
10 bar dot number and wide bar dot number, the narrow bar width and wide bar width are respectively set to 0.329 mm and 0.987 mm. When "6" and "18" are respectively input as the narrow bar dot number and wide bar dot number, the narrow bar width and wide bar width are
15 respectively set to 0.395 mm and 1.184 mm.

According to the above embodiment, even when the printing density of the thermal head is enhanced, it is possible to print the bar code with a desired element width ratio by inputting the type of the bar code and
20 the dot number specifying the widths of the bar code elements such as the narrow bar and wide bar. Further, even when the number of types of the bar codes increases, occurrence of problems can be prevented by using bar code pattern generators corresponding in num-
25 ber to the types. That is, unlike the prior art, the bar code printer of this embodiment creates the bar code printing pattern without using a module table so that

increase in the memory capacity due to increase in the number of types of bar codes or increase in the printing density can be suppressed.

5 This invention is not limited to the above embodiment and can be variously modified without departing from the technical scope thereof.

For example, the thermal head 7 of the above embodiment can be replaced by a printing head of an ink-jet type.

10 Further, the widths of bar code elements such as a narrow bar, narrow space, wide bar and wide space are separately input in the above embodiment. However, in a case where a bar code type such as JAN in which the ratio of the widths of the narrow element and the wide
15 element is determined to be 1:3 by the standard is used, for example, it becomes possible to input only the narrow element width and then derive the wide element width by multiplying the narrow element width by a preset number.

20 In the embodiment described above, the width of each bar code element is represented by the number of dots. However, the width of each bar code element can be represented in millimeter, for example, In this case, an additional process is provided prior to step
25 S17 which converts the widths of the bar code elements input in millimeters to the numbers of dots with reference to the printing density of the head 7.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, and the embodiment shown and
5 described. Accordingly, departures may be made from such details without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. A bar code printer comprising:

a printing section;

memory means having memory areas respectively serving as pattern generators for generating various bar code patterns and a memory area serving as a printing buffer;

input means for inputting the type of bar code and the width of at least one bar code element; and

control means for selecting one of said pattern generators according to the bar code type input via said input means, causing the selected pattern generator to sequentially generate bar code patterns of desired characters, developing the bar code patterns generated from the selected pattern generator by adjusting the widths of all the bar code elements included in each bar code pattern according to the element width input via said input means, storing, as a printing pattern of the bar code, the developed bar code patterns in said printing buffer, and causing said printing section to print the printing pattern stored in said printing buffer.

2. A printer according to claim 1, wherein said control means includes a control circuit for setting the bar code elements of each bar code pattern to have widths input via said input means, said widths being specified by the numbers of dots.

3. A printer according to claim 2, wherein said

control circuit includes means for determining the width
of another bar code element by multiplying the element
width input via said input means by a preset number when
the bar code is of a type in which the ratio of the
5 widths of bar code elements are determined by a
standard.

4. A printer according to claim 1, wherein said
control means includes means for converting the element
width input via said input means to the number of dots
10 with reference to the printing density of said printing
section.

5. A printer according to claim 1, wherein said
bar code pattern is formed of a combination of bar code
elements selected from a narrow bar, wide bar, narrow
15 space, and wide space.

6. A printer according to claim 1, wherein said
printing section includes a thermal head.

7. A bar code printer, substantially as herein-
before described with reference to Figs. 3 to 5B of the
20 accompanying drawings.