

DOT PRINTER

This invention relates to dot printers capable of printing characters in boldface and, more particularly, to dot printers capable of printing some characters in boldface by causing a printing head to make two passes along the same line.

5 It is known to print desired characters in boldface when accentuation is required, using a dot printer. Figure 1 shows an example of a known method of printing in boldface, the letter "K" of "HKL" being printed in boldface. As will be appreciated according to this known method of printing in boldface, characters
10 are printed in synchronism with a print timing signal in an ordinary printing mode. A character in boldface is formed by printing an ordinary dot matrix pattern and repeating the same dot matrix pattern horizontally shifted one dot pitch from the successive dot position of the ordinary dot matrix pattern. This method
15 permits bold characters to be printed whilst the printing head makes only one pass along the line. Furthermore, it is easy to control this operation. However, the print quality, especially of characters containing oblique elements, is poor.

 The present invention seeks to provide a dot printer which
20 is equipped with a relatively simple mechanism that yields good print quality of bold characters each made up from a dot matrix and which is economical to manufacture.

According to the present invention there is provided a dot printer comprising: a printing head movable across a recording medium for forming characters in a dot matrix on a recording medium; a first character buffer means for storing dot matrix data for one line of characters; a second character buffer means having the same storage capacity as the first character buffer means for storing dot matrix data for characters which are to be printed in boldface; means for producing a print timing signal consisting of pulses that determine the timing at which characters are printed, the repetition period of the pulses being half of the pulse distance between pulses that determine standard dot positions; and a control circuit which, when the printing head is making a first pass along a line, causes the first character buffer means to be accessed in synchronism with one of odd and even pulses of the print timing signal and which, when the printing head is making a second pass along the same line, causes the second character buffer means to be accessed in synchronism with the other of the odd and even pulses.

In one embodiment the arrangement is such that the first and second passes of the printing head are made in opposite directions.

In another embodiment, the arrangement is such that the first and second passes of the printing head are made in the same direction.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is an enlarged view of characters formed by a known method of printing in boldface;

Figure 2 is a enlarged view of characters printed in boldface by a dot printer according to the present invention;

5 Figure 3 is a block diagram of a dot printer according to the present invention;

Figure 4 illustrates a character buffer of a dot printer of Figure 3 for storing font data; and

10 Figures 5A and 5B are flow charts illustrating a sequence of operations for printing characters in boldface using a dot printer according to the present invention.

Referring to Figure 2, there is shown three letters "H", "K" and "L" of which the letter "K" is printed in boldface by a dot printer according to the present invention. To achieve
15 this printing in boldface, print timing pulses have a repetition period which is half the pulse distance t between pulses that are employed to determine each normally arrayed dot matrix position. In general, in wire and similar printers, the pulse distance t for determining normally arrayed dot matrix positions is set to
20 a value approaching the limit at which a printing hammer (not shown) can no longer respond to the pulses, in order to obtain a high speed of printing. Accordingly, the printing hammer can accommodate the pulse distance t , but it is unable to adapt itself to the pulse distance $t/2$ or has an unstable response to the pulses.

25 In Figure 2, the dots in the odd columns are formed in synchronism with odd pulses, while the dots in the even columns

are formed in synchronism with even pulses. The dots in the odd columns are formed while the printing head makes a first pass along a line. Then, the dots in the even columns are formed while the head makes a second pass along the same line. Thus, characters are printed in boldface. Thereafter, the paper is fed to the next printing line.

Referring next to Figure 3, there is shown in block diagram form a dot printer according to the present invention. The dot printer includes a control circuit (CPU) 1, an information buffer 2, a font memory (character generator) 3, a character buffer 4, a printing head driver circuit 5, a carriage motor driver circuit 6, a line feed motor driver circuit 7, a printing head 8, a carriage motor 9, a line feed motor 10, and a print timing signal generator 11. The information buffer 2 is a RAM that temporarily stores information which is supplied from a host computer or other similar apparatus. The font memory 3 is a ROM in which full dot matrix data corresponding to characters to be printed have been previously stored. The dot matrix data from the font memory 3 is read into the control circuit 1, and then it is temporarily held in the character buffer 4 consisting of a RAM. Subsequently, the dot matrix data is used to print characters. The character buffer 4 is composed of a first character buffer device 4a and a second character buffer device 4b of the same storage capacity. The storage locations of the character buffer 4 are shown in Figure 4. The storage locations for the odd columns correspond to the first character buffer device 4a

whereas the locations for the even columns correspond to the second character buffer device 4b. The first and second character buffer devices 4a, 4b are accessed by odd and even pulses, respectively, of the printer timing signal shown in Figure 2.

5 The operation of the dot printer of Figure 3 will now be described with reference to the flow charts shown in Figures 5A and 5B. The information which is transferred from the host computer, etc. includes character codes, a print command, a designation command for a boldface mode, and a release command
10 for the boldface mode.

 It is now assumed that the character code corresponding to the letter "H", the designation command for the boldface mode, the character code corresponding to the letter "K", the release command for the boldface mode, the character code corresponding
15 to the letter "I" and the print command are sent to the information buffer 2 in order. When first the character code corresponding to the letter "H" is read into the control circuit 1, the character data or dot matrix data corresponding to the character codes is transferred from the font memory 3 into the odd column of
20 a first storage region of the character buffer 4 as shown in Figure 4. Then, the designation command for the boldface mode is read into the control circuit 1 to establish this mode. Under this condition, the character code corresponding to the letter "K" is read into the control circuit 1. Then the character data
25 or dot matrix data corresponding to the character code is transferred from the font memory 3 into the odd column of a second storage

region of the character buffer 4 shown in Figure 4. At the same time, the same dot matrix data is stored in the even column of the second storage region of the character buffer 4. Note that the actual positions at which the characters are printed are

5 shifted a distance half of the space between the successive dot positions from the previous positions. Subsequently, the boldface mode is terminated by the release command. Under this condition, the character code corresponding to the letter "L" is read into the control circuit 1, whereupon the character data or dot matrix

10 data is stored in the odd column of a third storage region of the character buffer 4, similar to the case of the character code corresponding to the letter "H". Then the print command is entered into the control circuit 1, which then causes the carriage motor 9 to rotate via the driver circuit 6. Thus, the

15 printing head 8 starts to move to the right, for example. During this movement of the printing head, the dot matrix data is read from the first character buffer device 4a in synchronism with odd pulses of the print timing signal shown in Figure 2, so that the driver circuit 5 causes the printing head 8 to print the

20 letters "HKL" on the paper (not shown).

The letters "HKL" printed in this way are each based on an ordinary matrix. Thereafter, the carriage motor 9 is reversed, so that backward movement (to the left) of the printing head 8 is initiated. During this second movement of the printing

25 head, the dot matrix data is read from the second character buffer device 4b in synchronism with even pulses of the print timing signal.

Then, only the letter "K", which is to be printed in the boldface mode, is printed on the paper at a position which is spaced half of the distance between the successive dot positions from the previous position. Thereafter, the driver circuit 7 causes the
5 line feed motor 10 to feed the paper a predetermined distance.

When a set of characters containing no bold character is printed, the operation performed is substantially similar to the operation carried out by the conventional dot printer. It is to be understood that the present invention can be applied to
10 either bi-directional or uni-directional printers. Further, the printing head may be of any desired type, including wire head, thermal head and ink jet head.

By applying the present invention to a dot printer, bold characters can be printed with good quality without introducing
15 the disadvantage that normal characters are printed at a slower speed. In addition, the circuitry for controlling the printing operation is relatively simple and hence the dot printer capable of printing bold characters can easily be manufactured at a relatively low cost.



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CLAIMS

1. A dot printer comprising: a printing head movable across a recording medium for forming characters in a dot matrix on a recording medium; a first character buffer means for storing dot matrix data for one line of characters; a second character
5 buffer means having the same storage capacity as the first character buffer means for storing dot matrix data for characters which are to be printed in boldface; means for producing a print timing signal consisting of pulses that determine the timing at which characters are printed, the repetition period of the pulses
10 being half of the pulse distance between pulses that determine standard dot positions; and a control circuit which, when the printing head is making a first pass along a line, causes the first character buffer means to be accessed in synchronism with one of odd and even pulses of the print timing signal and which,
15 when the printing head is making a second pass along the same line, causes the second character buffer means to be accessed in synchronism with the other of the odd and even pulses.
 2. A dot printer as claimed in claim 1 in which the arrangement is such that the first and second passes of the printing head
20 are made in opposite directions.
 3. A dot printer as claimed in claim 1 in which the arrangement is such that the first and second passes of the printing head are made in the same direction.
 4. A dot printer substantially as herein described with reference to
25 and as shown in Figures 2 to 4 of the accompanying drawings.
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