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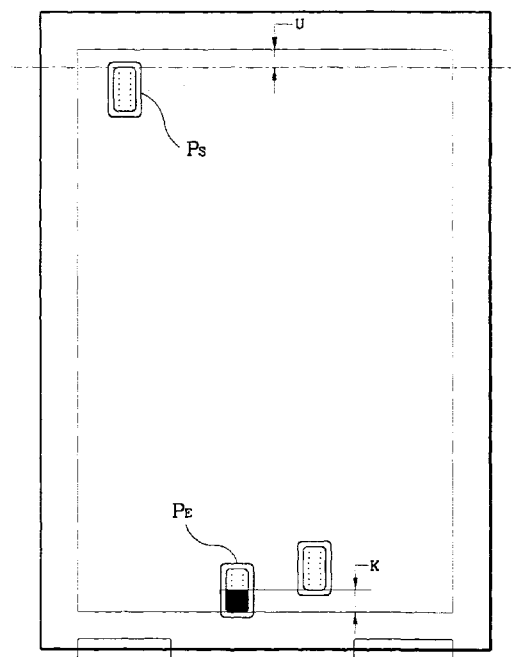
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(54) **Printing method**

(57) A printing method is described, for a printer having a print-head capable of printing more than one line of pixels onto a target document in one pass and in which the target document is advanced by a predetermined distance between successive passes of the print head. The method is designed to reduce print widening at the lower margin of a document when a user-defined upper margin is present. The print head is controlled to make successive printing passes until the penultimate printing pass has been completed. The target document is then advanced by a distance which is less than the said predetermined distance. Finally, the print head is controlled to make a final printing pass to print a selected number of adjacent lines of pixels which is smaller than the number of lines of pixels that the print head is capable of printing in one pass and which includes the line of pixels farthest from the said upper margin.

FIG. 7



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an printers such as ink-jet printers, in which the print-head is capable of printing more than one line of pixels onto a target document in one pass of the print head and the target document is advanced by a predetermined distance between successive passes of the print head.

BACKGROUND TO THE INVENTION

[0002] An ink-jet printer is a typical computer peripheral that users can buy relatively cheaply and which has excellent print quality. The general structure and an operating principle of the inkjet printer can be described as follows.

[0003] The ink-jet printer comprises a CPU, which outputs control signals according to program instructions from a system program within an EEPROM 21 storing a start setting value necessary to the printer operation, a ROM 12 equipped with various fonts and programs necessary for the control, a RAM, which is used to preserve data temporarily when a system operates, an ASIC circuit unit 20 carrying out the transmission of data to said CPU, a head driver circuit 30 controlling the driving of an ink cartridge 31 according to the control signal of the CPU 10 transmitted from said ASIC circuit 20, a carriage return motor driver circuit 40 controlling the motion of a carriage return motor 41, a line feed motor driver circuit 50 controlling the driver of a line feed motor 51 for supplying and ejecting paper, a power supplier 60 providing the drive voltage necessary for the whole of the printer device.

[0004] The printer performs a print by driving each motor 41, 51 according to a control signal from the CPU 10 received through the print interface from the computer. The ink cartridge 31 forms dots by jetting fine ink drops from a nozzle having several apertures.

[0005] The system structure is illustrated in FIG. 2 or FIG. 3. The ink cartridge 31 is driven by a moving belt 15 and the carriage return motor 41 and moves from left to right along a shaft 14. Document paper 100 is moved by a line feed roller 52 being rotated by the driving of the line feed motor 51. The document paper 100, supplied in a paper cassette 70 is inserted between a drive roller 73 and a pinch roller 72. And after completing the print motion, the paper is ejected by the rotation of a push-out roller 73 and a pinch roller 74.

[0006] The printer prints by transferring the ink ejected through several nozzles located in the print head to the paper 100 while the ink cartridge 31 is moving left and right. Recently computers are increasingly run under the Windows operating system. Windows ink-jet printer drivers make the printing images, based on the first nozzle position of the head used by the computer, the size of the nozzles and their separation. Image data

transmitted from the computer to the inkjet printer is transmitted to the printer by dividing the data by the height of the ink cartridge 31 in order from the top of the paper. A sequence of operations, like the loading of the paper and the ejection of the paper from the printer after printing, is carried out.

[0007] FIG. 4 shows the ideal form of printing motion. The paper 100 is fixed by two rollers R1, R2 even when printing the final print line. Here, Lt and Lb represent the height of the ink cartridge 31 and t indicates the top margin of the paper and b indicates the bottom margin of the paper.

[0008] As an example, let the number of head nozzles of the inkjet printer be 56 and their separation be 1/300 inch, then the maximum height it is possible to print at one time is 56/300 inches (vertical direction) and also the line feed distance after printing should be 56/300 inches. The overall maximum printing area is 56/300 x n inch and when a user does not assign a special top/bottom margin and fills up all images in the maximum block, then ideally, printing can be performed as in FIG. 4.

[0009] On the other hand, where a user adds a top margin, a problem occurs. FIG. 5 shows an example of a case where a user has added a top margin of 20/300 inches. The Windows printer driver always produces printing images, based on the first nozzle. Consequently, even though the actual print height in the final print line is less than 56/300 inches, printing is carried out only with nozzles corresponding to the height K, after feeding the paper 56/300 inches.

[0010] At this time, the paper is no longer held by the rollers R1, R2 and so accurate position control becomes difficult. Accordingly print widening occurs in which the spacing between printed characters near the bottom margin becomes irregular.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to reduce such print widening.

[0012] Accordingly, the present invention provides a method of operating a printer having a print-head capable of printing more than one line of pixels onto a target document in one pass of the print head and in which the target document is advanced by a predetermined distance between successive passes of the print head, the method comprising:

- determining the height of a user-defined upper margin;
- controlling the print head to make successive printing passes until the penultimate printing pass has been completed;
- advancing the target document by a distance which is less than the said predetermined distance; and
- controlling the print head to make a final printing pass to print a selected number of adjacent lines of

pixels which is smaller than the number of lines of pixels that the print head is capable of printing in one pass and does not include the one or more lines of pixels closest to the said upper margin.

[0013] Preferably, the said selected number of adjacent lines includes the one or more lines of pixels farthest from the said upper margin.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a block diagram illustrating the structure of a general inkjet printer;

FIG. 2 is a schematic perspective view of part of the structure of a general ink jet printer;

FIG. 3 is an schematic side view of part of the structure of a general ink jet printer;

FIG. 4 is a schematic illustration showing the ideal form of printing motion;

FIG. 5 is a schematic illustration showing the conventional situation where a user defines a top margin;

FIG. 6 is a flow diagram illustrating the method steps of the present invention; and

FIG. 7 is a schematic illustration showing the situation where a user defines a top margin according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] As shown in Figure 6, a Windows printer driver forms printing images by analysing images produced by the computer in the form of a bitmap. The size of this bitmap determines the spacing of the nozzles. That is, in the case of 300 dpi, 1/300 inch is the spacing of the nozzles and this one bitmap is used as print data of the nozzle units.

[0016] In the maximum block which the printer is capable of printing, the relative size of a user defined margin to this bitmap unit is established. This result is taken as basic data for determining how much line feed should be made when the final print is arranged. (Step S11).

[0017] The images are output until the final print line is reached. For a monochrome head having 56 nozzles and a nozzle distance of 1/300 inch, the maximum height which it is possible to print is 56/300 inches. That means, at any one time up to 56/300 inches can be printed in a vertical direction.

[0018] Therefore, the Windows printer driver detects 56 pieces of bitmap in length and stores the result in 56 bits of image buffer. This is transmitted to the printer. The result is a logical value having a value of "0" or "1",

where "0" means that there is no data to print, and "1" means the opposite. The data from the image buffer transmitted to the printer is the actual nozzle data corresponding to a nozzle one to one, and so is output to the printer head. (Step S12)

[0019] Line feeding is carried out having regard to a user defined margin, checked in Step S11 immediately before reaching the final print line. If the user-defined margin is 20/300, then the maximum print height of the final line is (56/300 inches - 20/300 inch), i.e. 36/300 inch. Accordingly, the resulting values in the image buffer are removed in 20 bit order, to be printed from the 36th nozzle. In addition, the line feed for the final line, as shown in FIG. 7, is (56/300 inches - 20/300 inches) (U) i.e. 36/300 inches (K). (Step S13)

[0020] As explained above, the present invention is intended to enable the print to be completed with the paper being in contact with the pinch roller and the feed roller. This has the effect of improving the print quality near the lower margin.

Claims

1. A method of operating a printer having a print-head capable of printing more than one line of pixels onto a target document in one pass of the print head and in which the target document is advanced by a predetermined distance between successive passes of the print head, the method comprising:

determining the height of a user-defined upper margin;

controlling the print head to make successive printing passes until the penultimate printing pass has been completed;

advancing the target document by a distance which is less than the said predetermined distance; and

controlling the print head to make a final printing pass to print a selected number of adjacent lines of pixels which is smaller than the number of lines of pixels that the print head is capable of printing in one pass and does not include the one or more lines of pixels closest to the said upper margin.

2. A method according to claim 1 in which the said selected number of adjacent lines includes the one or more lines of pixels farthest from the said upper margin.

3. A method of operating a printer as described herein with reference to figures 6 and 7 of the accompanying drawings.

FIG. 1

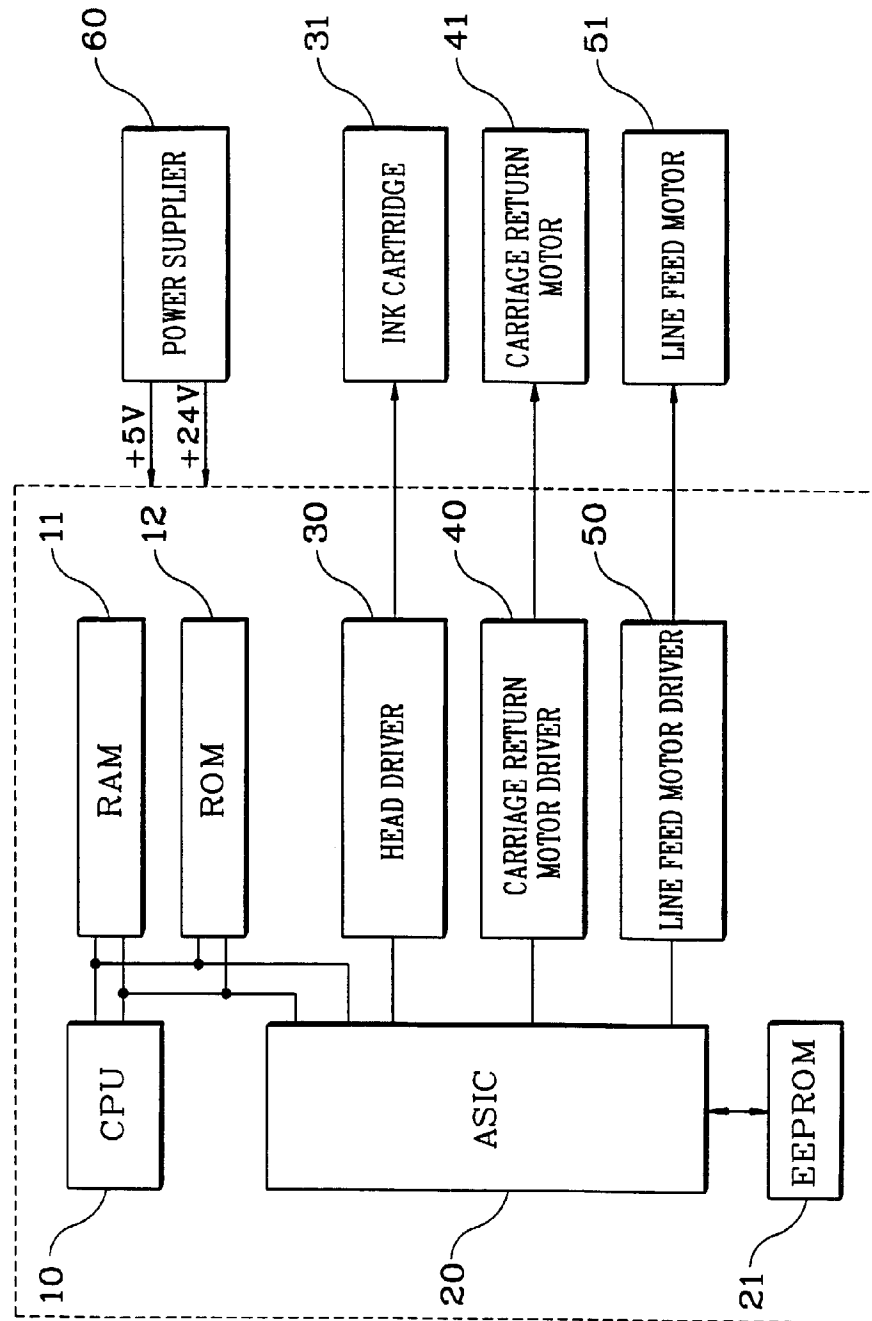


FIG. 2

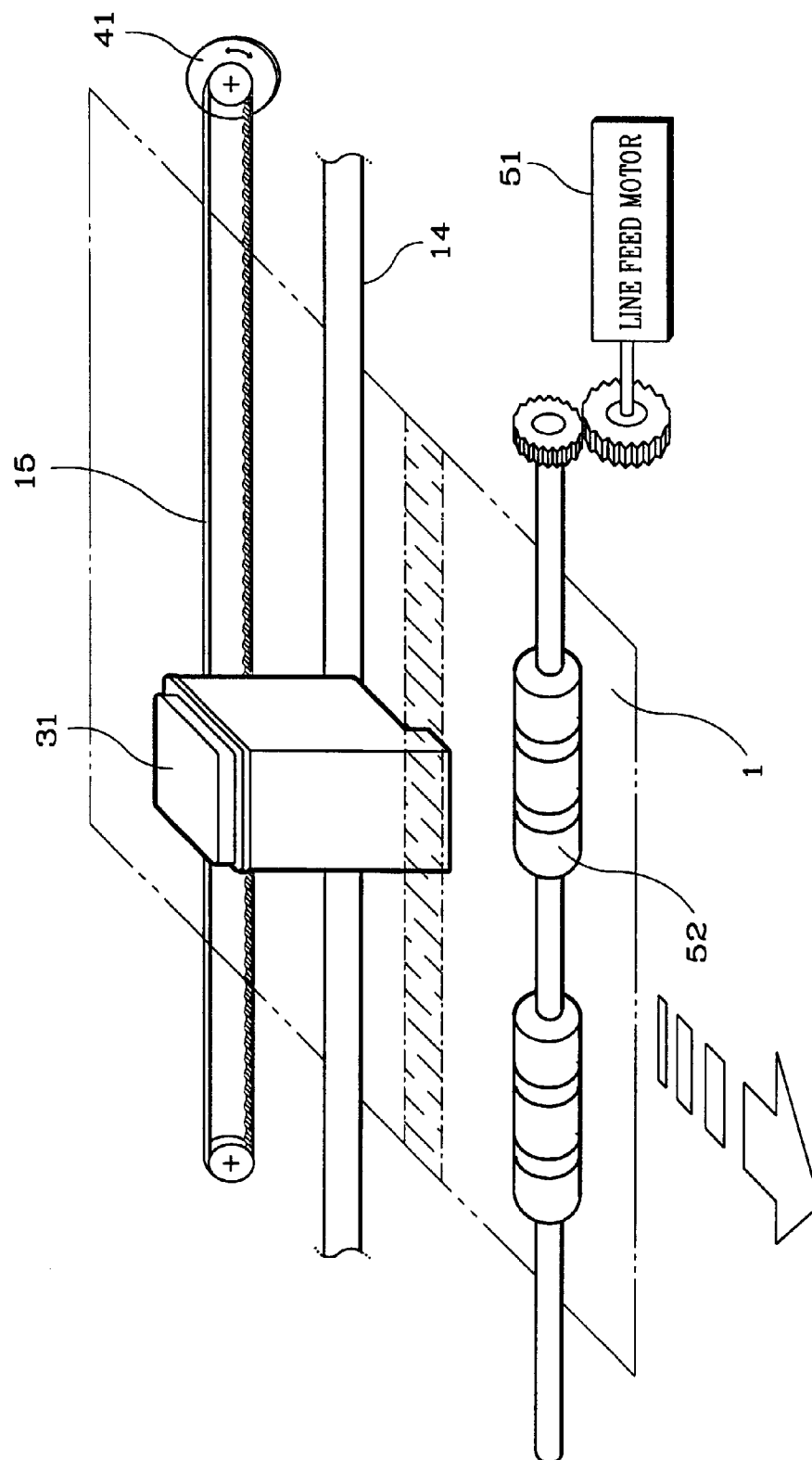


FIG. 3

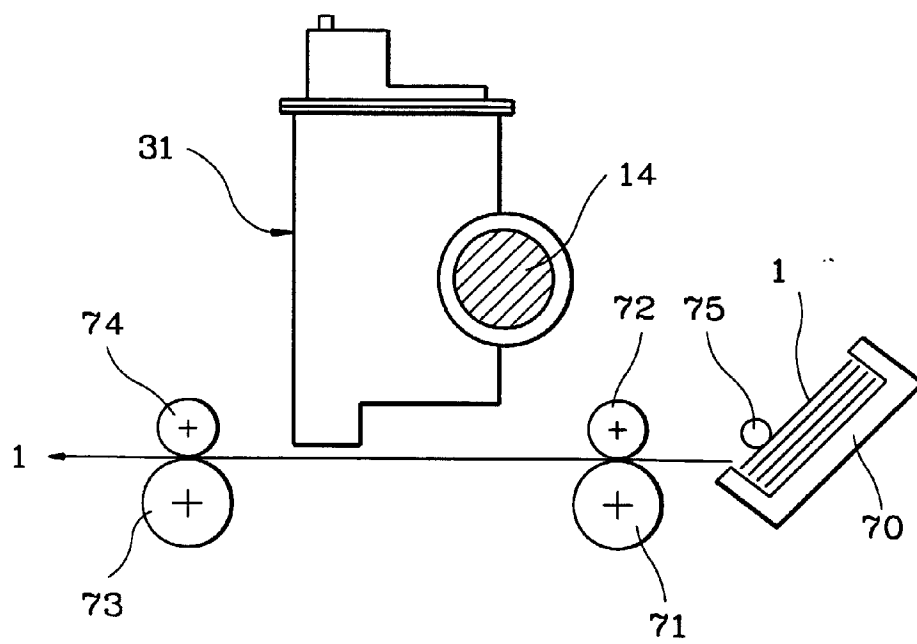


FIG. 4

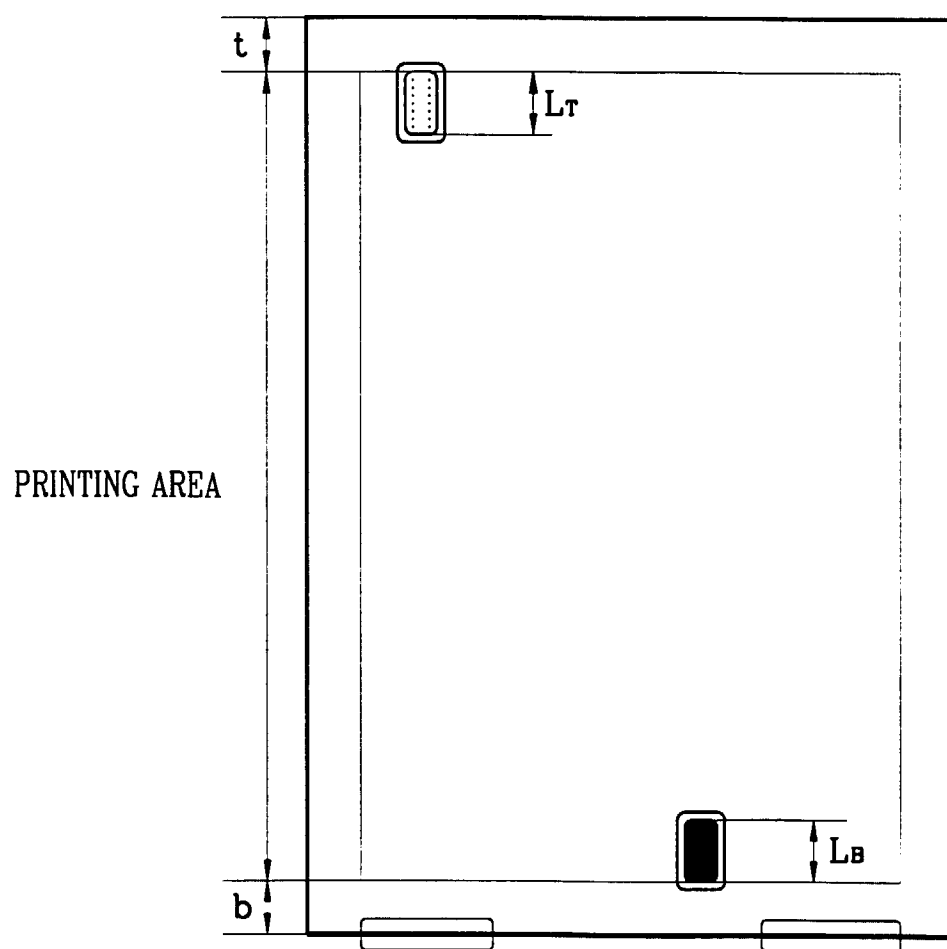


FIG. 5

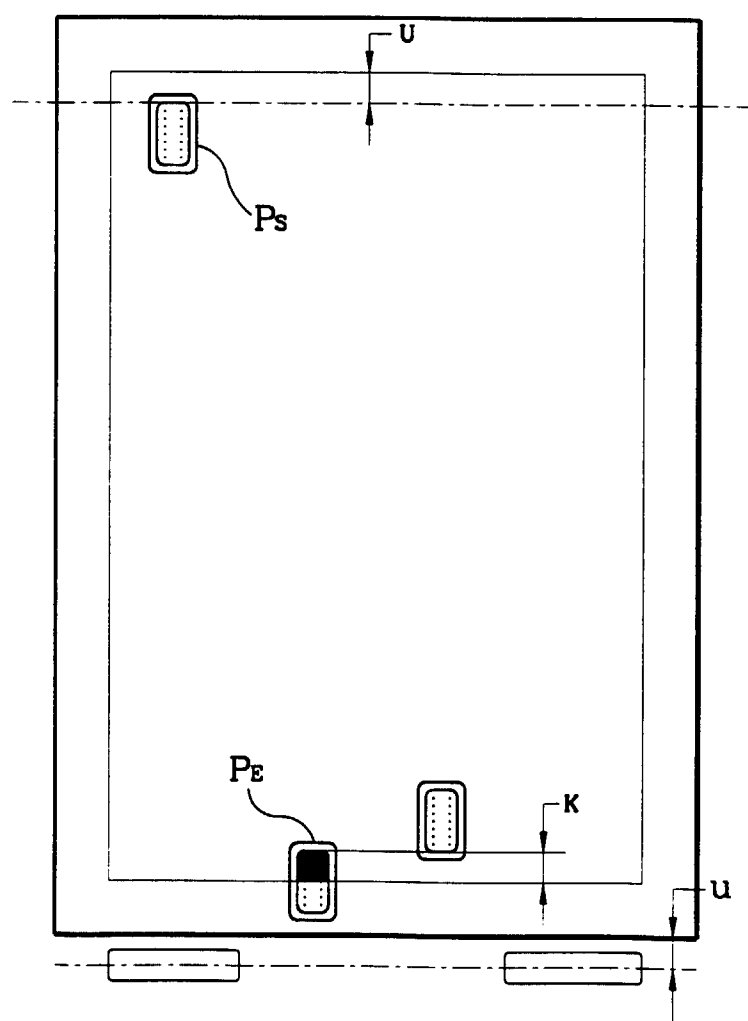


FIG. 6

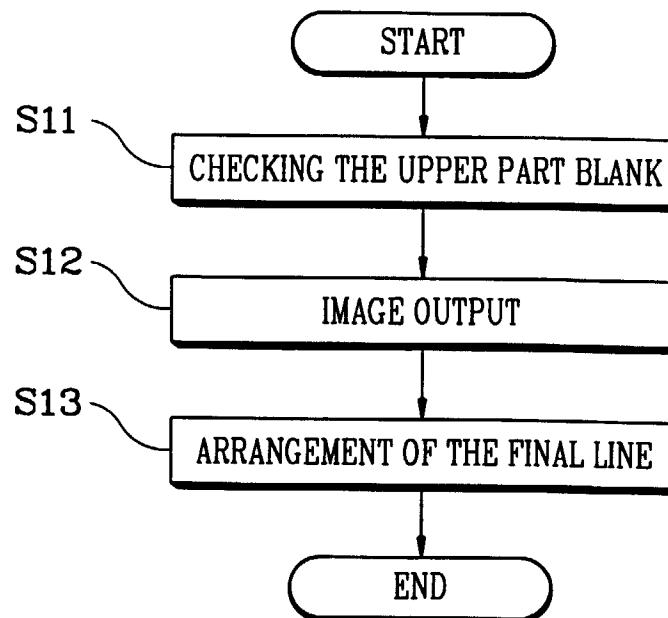


FIG. 7

