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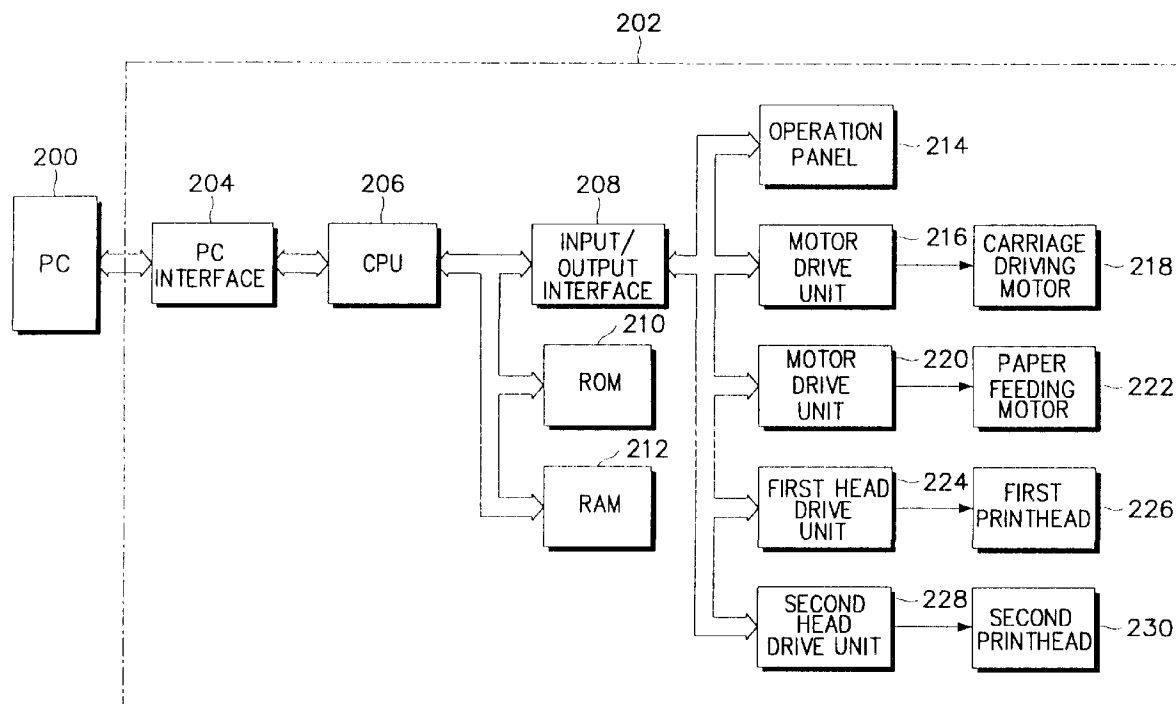
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NL PT SE**(30) Priority: **02.09.1996 KR 9637910**(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon City, Kyungki-do (KR)(72) Inventor: **Lee, Sung-Hee****Gunpo-city, Kyungki-do (KR)**(74) Representative: **Tunstall, Christopher Stephen****Dibb Lupton Alsop,****Fountain Precinct****Balm Green, Sheffield S1 1RZ (GB)**(54) **Printing method of a dual head ink-jet printer**

(57) A printing method for a dual head ink-jet printer is described. The printer has first and second printhead installation positions for receiving monochrome and/or colour printheads. For each printhead installation posi-

tion, it is confirmed whether a monochrome or colour printhead is installed. The appropriate installed printhead corresponding to the type of print data received is selected and an image is printed in accordance with the print data using the selected printhead.

**FIG. 2****EP 0 829 367 A2**

Description

Background of the Invention

The present invention relates to an ink-jet printer, and more particularly a printing method of a dual head ink-jet printer with a monochrome and a colour printhead mounted simultaneously.

Generally, the ink-jet printer can print not only black-and-white but also colour images, the former being printed by a monochrome printhead and the latter by a colour printhead. The monochrome and colour printheads are each provided with a nozzle from which ink is jetted under pressure, wherein the ink is heated by a heating element provided on the printhead to form bubbles which then expand and are ejected from the nozzle, thus being fired on to the printing medium. The monochrome and the colour printheads are each incorporated integrally with black and colour ink cartridges respectively. When operating the ink-jet printer, the printheads are moved laterally and print desired images on the print medium by selective heating of the heating elements.

A conventional ink-jet printer has a single printhead. A monochrome printhead is installed for black printing and a colour printhead for colour printing. The user must interchange the black and colour printheads whenever changing the print colour mode, which causes inconvenience to the user.

To eliminate such inconvenience, an improved ink-jet printer has been developed on which the monochrome and colour printheads can simultaneously be mounted and which is referred to as a "dual head ink-jet printer". In the dual head ink-jet printer, the monochrome and colour printheads each have their own mounting position. In other words, the monochrome and colour printheads are to be mounted on dedicated carriers respectively.

Fig. 1 illustrates the installed monochrome and colour printheads in the conventional dual head ink-jet printer. As seen, in front of the printer 100, the monochrome printhead 102 is mounted on the monochrome carrier 106, and the colour printhead 104 on the colour carrier 108. As already described above, the monochrome and colour printheads are each incorporated with the respective monochrome and colour ink-jet cartridges, but for the sake of convenience sake, the terms "monochrome and colour ink-jet cartridges" will not be used in the following description.

As shown in Fig. 1, the monochrome and colour carriers 106, 108 are in the replacing position, and they are integrally installed on a carriage mechanism, moving together in the direction x-x'. When opening the cover 110 in the replacing position, the user can check or replace the monochrome and/or colour printheads 102, 104. The central control unit of the printer 100 moves the monochrome and colour carriers 106, 108 to the replacing position when the user actuates the operation button or printer errors or malfunctions occur. The mono-

chrome and colour carriers 106, 108 are each provided with corresponding head connectors which electrically connect the monochrome and colour printheads 102, 104 with the respective head drive units 224, 228 within the printer 100. The printing papers are fed by means of the paper feeder 112 and ejected from the paper outlet in front of the printer 100 after printing.

In the above dual head ink-jet printer, if the monochrome and colour printheads 102, 104 are incorrectly placed in the wrong positions, different from their respective dedicated positions, the printer will not operate. Accordingly, the user must take care to avoid such errors. Further, when any one of the head connectors is defective, or when any one of the printheads is missing, even while another printhead is properly installed, the properly installed printhead also does not work. Usually, when the print heads 102, 104 are erroneously placed in reversed positions, or the electrical connections between the printheads and the head drive units are defective, an error indicator blinks or sounds, advising the user of the error.

As described above, if the monochrome and colour printheads are installed in reversed positions, the printer does not operate, and thus the user must check the installation of the printheads to reinstall them or correct their positions, and although either of the monochrome and colour printheads 102, 104 may be correctly installed and its electrical connection is also normal, the printer will not operate, which causes inconvenience to the user, being the major drawback of conventional ink-jet printers.

Summary of the Invention

It is an object of the present invention to provide a method of enabling normal print operation in spite of the incorrect installation of the monochrome and colour printheads or defective electrical connection with one or other.

Thus, according to the present invention, there is provided a printing method for a dual head ink-jet printer having first and second printhead installation positions for receiving monochrome and/or colour printheads, the method comprising, for each printhead installation position, confirming whether a monochrome or colour printhead is installed, selecting the appropriate installed printhead corresponding to the type of print data received and printing an image in accordance with the print data using the selected printhead.

Preferably, the method further comprises enabling a head drive unit connected with the said appropriate installed printhead and in which the image is printing with a print start position of the printhead in conformity with the installation position of the printhead.

For example, a first head drive unit connected with the monochrome printhead may be enabled when the print data are monochrome print data and a second head drive unit connected with the colour printhead may

be enabled when the print data are colour print data.

Alternatively, a second head drive unit connected with the colour printhead may be enabled when the print data are monochrome print data and no monochrome printhead is installed and a monochrome image is printed according to the monochrome print data by setting the head drive unit to a composite black mode.

Preferably, confirming whether a monochrome or colour printhead is installed in each printhead installation position is confirmed when the printer is initialized.

An error signal may be generated when the print data are colour print data and no colour printhead is installed or when no printhead is installed.

A printhead may be determined not to be installed if the head connector connecting the printhead to a corresponding head drive unit is defective.

Brief Description of the Drawings

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

Fig. 1 is a perspective view of a conventional dual head ink-jet printer;

Fig. 2 is a constitutional block diagram of a general dual head ink-jet printer according to the present invention;

Fig. 3 is a flow chart illustrating the procedure for detecting the installation of the printheads;

Fig. 4 is a flow chart illustrating the procedure for processing monochrome print data; and

Fig. 5 is a flow chart illustrating the procedure for processing colour print data.

Detailed Description of the Preferred Embodiment

Referring to Fig. 2, the printer 202 connected with the PC as a host computer consists of a PC interface 204, a CPU 206, an input/output interface 208, a ROM 210, a RAM 212, an operation panel 214, motor drive units 216, 220, a carriage driving motor 218, a paper feeding motor 222, first and second head drive units 224, 228, and first and second printheads 226, 230.

The PC interface 204 receives various commands and print data to further pass them to CPU 206. The PC interface 204 is a parallel interface capable of bidirectional communication. The CPU 206 executes the program stored in ROM 210, thereby controls the component parts of the printer through input/output interface 208. The ROM 210 stores various programs and reference data to be executed by CPU 206. The RAM 212 temporarily stores data resulting from the CPU operations. The input/output interface 208 interfaces between CPU 206 and the input/output device, i.e., operation panel 214, motor drive units 216, 220, and first and second head drive units 224, 228, thereby passing the input/output signals bidirectionally. The operation panel

214 provides a plurality of keys for entering various commands and a display window for displaying the operating status under the control of CPU 206.

The motor drive unit 216 drives carriage driving motor 218 under the control of CPU 206, thereby moving the carriers 106, 108 as shown in Fig. 1 on which first and second printheads 226, 230 are mounted. The above carriage driving motor 218 is also called C/R motor. The motor drive unit 220 drives the paper feeding motor 222 under the control of CPU 206 to feed papers. The above paper feeding motor 222 is also called L/F motor. The first head drive unit 224 is enabled under the control of CPU 206 to further actuate first printhead 226 so as to print image data on printing medium. The second head drive units 228 is enabled under the control of CPU 206 to further actuate second printheads 230 so as to print image data on printing medium.

The above first and second printheads 226, 230 correspond to the monochrome printhead 102 and the colour printhead 104 respectively as shown in Fig. 1. Namely in case that the monochrome and colour printheads as shown by reference numerals 102, 104 in Fig. 1 are both installed normally in the respective dedicated mounting positions, the monochrome printhead 102 corresponds to first printhead 226 and the colour printhead 104 to second printhead 230.

For the dual head ink-jet printer as described above, the CPU operation procedures as illustrated in Figs. 3, 4, 5 are programmed according to the present invention and incorporated into the ROM 210.

Fig. 3 is a flow chart illustrating the procedure for confirming in advance the mounting positions of the monochrome and colour printheads each installed in either of mounting positions of first and second printheads 226, 230. The procedure is performed by the CPU 206 during the initializing operation when turning on the printer at first or resetting the printer after replacing the printheads.

First in step 300, the CPU 206 checks through first head drive unit 224 whether first printhead 226 is installed, and if any, identifies which of the monochrome and colour printheads is installed as first printhead 226. At this time, first head drive unit 224 assumes non-installation of a first printhead when neither of the monochrome and colour printheads is actually installed as well as when the electrical connection between first head drive unit 224 and first printhead 226 is defective.

To give the latest instance of the art that detects the presence of printheads installed and identifies their type, a "circuit and method for detecting the presence of ink cartridge installed in the ink-jet printing device" is described in Korean patent application under No. 95-35823. According to that application, when the voltage level of the power source is dropped by heating the heating elements of the head drive units, the dropped voltage level is detected and compared with a prescribed reference voltage level, whereby the presence as well as the type of the ink cartridge, i.e., printhead

can be detected.

As the result of detecting the presence of the first printhead installed, the CPU 206 checks in step 302 whether the monochrome printhead is installed as first printhead 226. When detecting the monochrome printhead installed as first printhead 226, the CPU 206 proceeds to step 304 to set first head flag HEAD1 to "mono" state and further performs the step 312. To the contrary in step 302, when the monochrome printhead is not installed, the CPU 206 proceeds to step 306 to check whether the colour printhead is installed as first printhead 226. When detecting the colour printhead installed as first printhead 226, the CPU 206 proceeds to step 308 to set first head flag HEAD1 to "colour" state and further performs step 312. To the contrary in step 306, when the colour printhead is not installed, it means that none of the printheads is installed, i.e., non-installation of the printheads, and accordingly in step 310, the CPU 206 sets first head flag HEAD1 to "non-installed" state, and further proceeds to step 312. As explained above, when any one of the printheads is installed, first head flag HEAD1 is used to represent the presence of first printhead 226 installed as well as the type of the printheads, i.e., monochrome or colour.

In step 312, the CPU 206 checks through second head drive unit 228 whether second printhead 226 is installed, and if any, identifies which of the monochrome and colour printheads is installed as second printhead 230. Likewise in the same way as used for checking the presence of first printhead 226 and confirming the type of the printheads installed, the CPU 206 checks in step 314 whether the monochrome printhead is installed as second print head 230. When the monochrome printhead is installed, the CPU 206 proceeds to step 316 to set second head flag HEAD2 to "mono" state, and further performs step 324. To the contrary in step 314, when the monochrome printhead is not installed, the CPU 206 proceeds to step 318 to check whether the colour printhead is installed as second printhead 230. When detecting the colour printhead installed as second printhead 230, the CPU 206 proceeds to step 320 to set second head flag HEAD2 to "colour" state and further performs step 324. To the contrary in step 318, when the colour printhead is not installed, it means that none of the printheads is installed, i.e., non-installation of the printheads, and accordingly in step 322, the CPU 206 sets second head flag HEAD2 to "non-installed" state, and further proceeds to step 324. As explained above, when any one of the printheads is installed, second head flag HEAD2 is used to represent the presence of second printhead 230 installed as well as the type of the printheads, i.e., monochrome or colour.

In step 324, if it is confirmed that both of first and second head flags HEAD1, HEAD2 are set to "non-installed" state, the CPU 206 takes this to be abnormal and generates an error message or sound, etc., and when any one of first and second printheads 226, 230 is installed, the CPU 206 terminates the operation pro-

cedure of Fig. 3, the printer then being kept in standby mode.

When print data is received from PC 200, the CPU 206 performs the procedure specified in the flow chart of Fig. 4 or Fig. 5 according to the type of print data received. That is, the CPU 206 enables one of first and second head drive units 224, 228, the one being connected with the printhead corresponding to the print data received so as to print the image based on the print data received, thereafter keeping the printer on standby mode.

Fig. 4 is a flow chart illustrating the procedure for processing the monochrome print data according to the embodiment of the present invention. When receiving the monochrome print data from PC 200, the CPU 206 enables one of first and second head drive units 224, 228 according to the state of first head flag HEAD1, the one being connected with the monochrome printhead, and sets the print start position in conformity with the installation position of the printhead concerned, so as to print the image according to the monochrome print data received.

At first, in steps 400-410, the CPU 206 checks the states of first and second head flags HEAD1, HEAD2, and when first flag HEAD1 represents "mono" and second flag HEAD2 "colour", or when first flag HEAD1 represents "mono" and second flag HEAD2 "non-installed", the CPU 206 proceeds to step 412. In step 412, the CPU 206 enables first head drive unit 224 and sets the print start position of first printhead 226 in conformity with its installation position, thereafter proceeding to step 414 to print the monochrome image according to the monochrome print data received. In this case, if the monochrome printhead is installed in the dedicated installation position as first printhead 226, the monochrome print operation is normally performed independent of the presence and the type of second printhead 230.

Resulting from the checking operation in steps 400-410, when first head flag HEAD1 represents "colour" and second head flag HEAD2 "mono", or when first head flag HEAD1 represents "non-installed" and second head flag HEAD2 "mono", the CPU 206 proceeds to step 416. In step 416, the CPU 206 enables second head drive unit 228 and sets the print start position of second printhead 230 in conformity with its installation position, thereafter proceeding to step 414 to print the image according to the print data received. In this case, although the monochrome printhead is installed not in the dedicated position of first printhead 226 but in the position of second printhead 230, the monochrome print operation is possible, thereby printing the monochrome image normally.

Besides, resulting from the checking operation in steps 400-410, when first head flag HEAD1 represents "colour" and second head flag HEAD2 "non-installed", the CPU 206 proceeds to step 418. In step 418, the CPU 206 enables first head drive unit 224, at the same time setting it to the composite black mode, and sets the print

start position of first printhead 226 in conformity with its installation position, thereafter proceeding to step 414 to print the image according to the print data received.

On the other hand, as the result of the checking operation in steps 400-410, when first head flag HEAD1 represents "non-installed" and second head flag HEAD2 "colour", the CPU 206 proceeds to step 420. In step 420, the CPU 206 enables second head drive unit 228, at the same time setting it to the composite black mode and sets the print start position of second printhead 230 in conformity with its installation position, thereafter proceeding to step 414 to print the image according to the print data received.

Thus, although the monochrome printhead is installed in neither position of first and second printheads 226, 230, but the colour printhead is installed in either position of first and second printheads 226, 230, the monochrome print operation can be performed by the composite black mode in which the colour printhead is used for the monochrome printing.

As the result of the checking operation in steps 400-410, when first and second head flags HEAD1, HEAD2 represent both "non-installed", the CPU 206 generates error signal because the printer is not ready for print operation.

Now, the setting of the print start position for first and second printheads 226, 230 is described in detail in the following. When printing by using first printhead 226 installed on the monochrome carrier 106 as shown in Fig. 1 at the left side of the printer, the printhead must print every line, starting from the right and moving to the left every time as seen from the front of the printer. On the other hand, when printing by using second printhead 230 installed on the colour carrier 108, the printhead must print every line, starting from the left and moving to the right. The reason is that the monochrome carrier 106 is positioned on the left, and the colour carrier 108 on the right.

Accordingly, the print start position is set in consideration of these points. Thus, when printing by using first printhead 226 installed on the monochrome carrier 106 as shown in Fig. 1, the print start position is set to the same print start position as that for the normal monochrome printing operation, and when printing by using second printhead 230 installed on the colour carrier 108, the print start position is set to the same print start position as that for the normal colour printing operation.

Consequently, even when the mounting position of the monochrome printhead may have changed, the monochrome printing operation can be normally performed, and when only the colour printhead is installed, the monochrome printing operation can be also normally performed by setting the colour printhead to the composite black mode.

Fig. 5 is a flow chart illustrating the procedure for processing the colour print data according to the present invention. On the contrary to Fig. 4, when receiving the colour print data from PC 200, the CPU 206 enables one

of first and second head drive units 224, 228 according to the state setting of second head flag HEAD2, the one being connected with the colour printhead, and sets the print start position in conformity with the installation position of the printhead concerned so as to print the image according to the colour print data received.

At first, in steps 500-506, the CPU 206 checks the states of first and second head flags HEAD1, HEAD2, and when first flag HEAD1 represents "mono" and second flag HEAD2 "colour", or when first flag HEAD1 represents "non-installed" state and second flag HEAD2 "colour" state, the CPU 206 proceeds to step 506. In step 506, the CPU 206 enables second head drive unit 228 and sets the print start position of first printhead 230 in conformity with its installation position, thereafter proceeding to step 512 to print the colour image according to the colour print data received. In this case, if the colour printhead is installed in the dedicated mounting position as second printhead 230, the colour print operation is normally performed independent of the presence and the type of first printhead 226.

Resulting from the checking operation in steps 500-506, when first head flag HEAD1 represents "colour" and second head flag HEAD2 "mono", or when first head flag HEAD1 represents "colour" and second head flag HEAD2 "non-installed", the CPU 206 proceeds to step 510. In step 510, the CPU 206 enables first head drive unit 224 and sets the print start position of first printhead 226 in conformity with its installation position, thereafter proceeding to step 512 to print the colour image according to the colour print data received. In this case, although the colour printhead is installed not in the dedicated position of second printhead 230 but in the position of first printhead 226, the colour print operation can be performed, thereby normally printing the colour image.

As the result of the checking operation in steps 500-506, when first and second head flags HEAD1, HEAD2 represent both "non-installed", and when only monochrome printheads are installed on both carriers, the CPU 206 generates error signal because the colour printing operation is impossible. Consequently, even when the installation position of the colour printhead is changed, the colour printing operation can be normally performed.

As described above, the present invention has the advantages in that the printing operations can be normally performed even when the monochrome and colour printheads are installed in reversed positions, eliminating inconveniences caused by installing the printheads always in the specified positions, and when any one of the monochrome and colour printheads is installed and the electrical connections are perfect, the monochrome printing operation can be performed.

Claims

reference to and as illustrated in FIGs. 2 et seq. of the accompanying drawings.

1. A printing method for a dual head ink-jet printer having first and second printhead installation positions for receiving monochrome and/or colour print-heads, the method comprising, for each printhead installation position, confirming whether a mono-chrome or colour printhead is installed, selecting the appropriate installed printhead corresponding to the type of print data received and printing an im-
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age in accordance with the print data using the se-
lected printhead.
2. A printing method according to claim 1 further com-
prising enabling a head drive unit connected with
the said appropriate installed printhead and in
which the image is printing with a print start position
of the printhead in conformity with the installation
position of the printhead.
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3. A printing method according to claim 2 in which a
first head drive unit connected with the mono-
chrome printhead is enabled when the print data are
monochrome print data and a second head drive
unit connected with the colour printhead is enabled
when the print data are colour print data.
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4. A printing method according to claim 1 or claim 2 in
which a second head drive unit connected with the
colour printhead is enabled when the print data are
monochrome print data and no monochrome print-
head is installed and a monochrome image is print-
ed according to the monochrome print data by set-
ting the head drive unit to a composite black mode.
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5. A printing method according to any preceding claim
in which confirming whether a monochrome or col-
our printhead is installed in each printhead installa-
tion position is confirmed when the printer is initial-
ized.
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6. A printing method according to claim 1 in which an
error signal is generated when the print data are col-
our print data and no colour printhead is installed.
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7. A printing method according to claim 1 in which an
error signal is generated when no printhead is in-
stalled.
8. A method according to any preceding claim in which
a printhead is determined not to be installed if the
head connector connecting the printhead to a cor-
responding head drive unit is defective.
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9. A printing method for a dual head ink-jet printer hav-
ing first and second printhead installation positions
for receiving monochrome and/or colour print-
heads, the method being as described herein with
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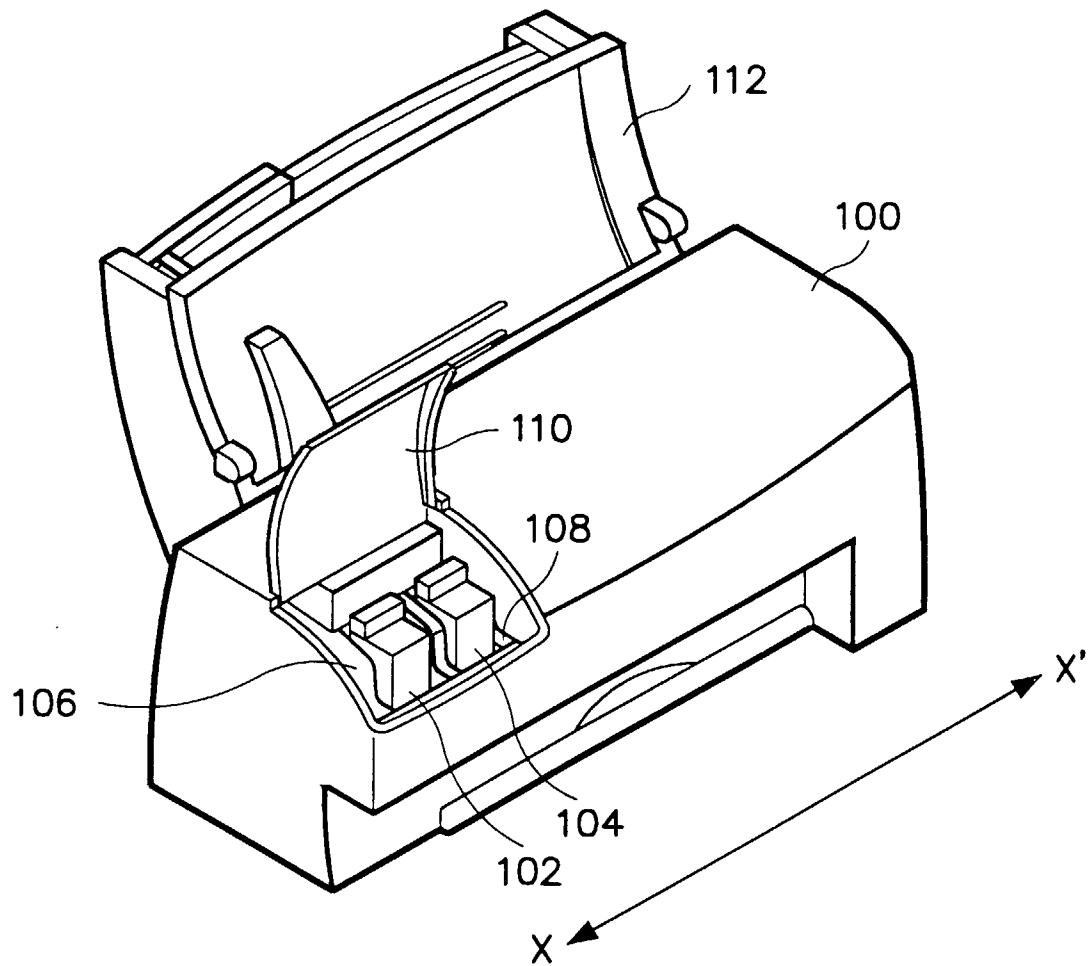


FIG. 1

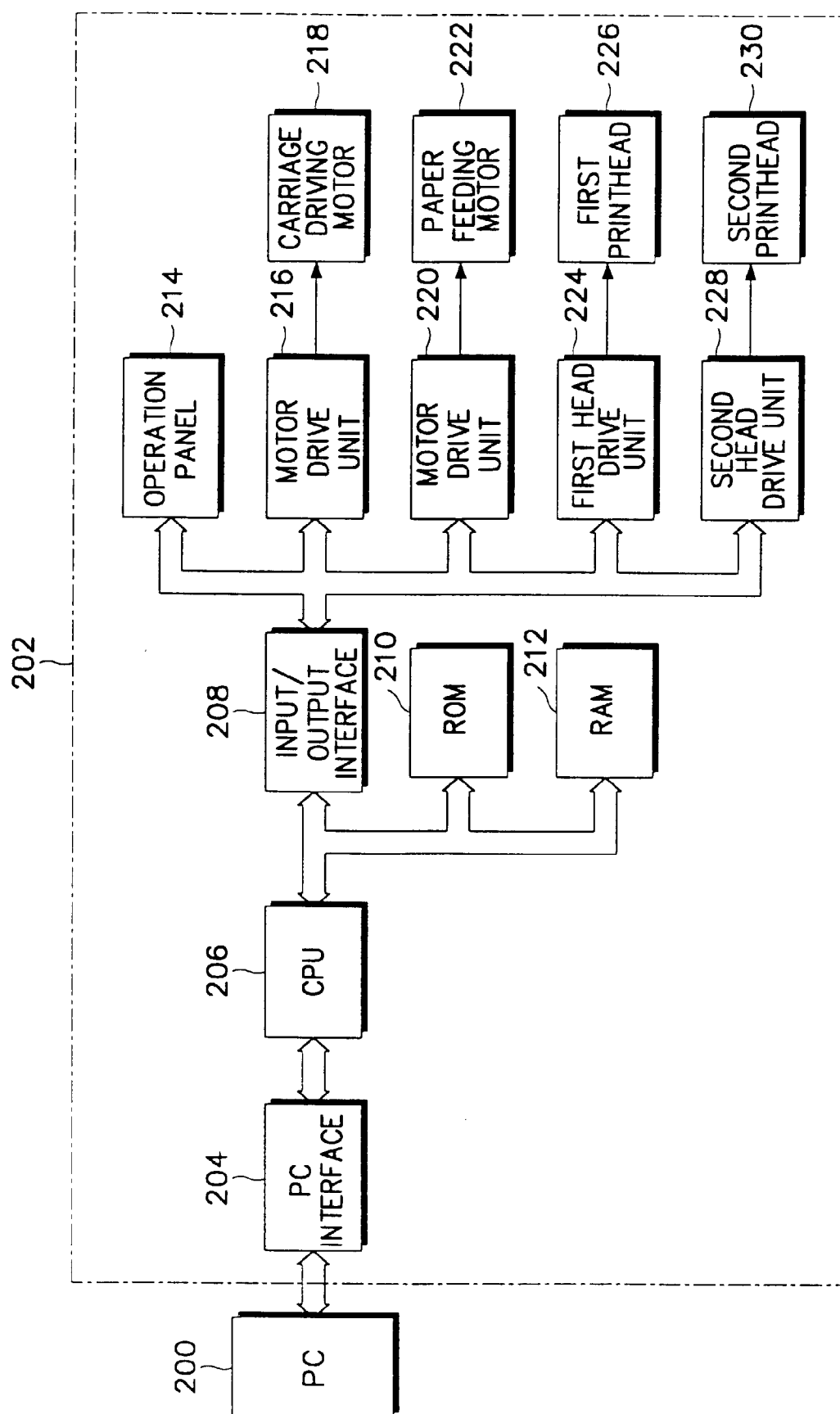
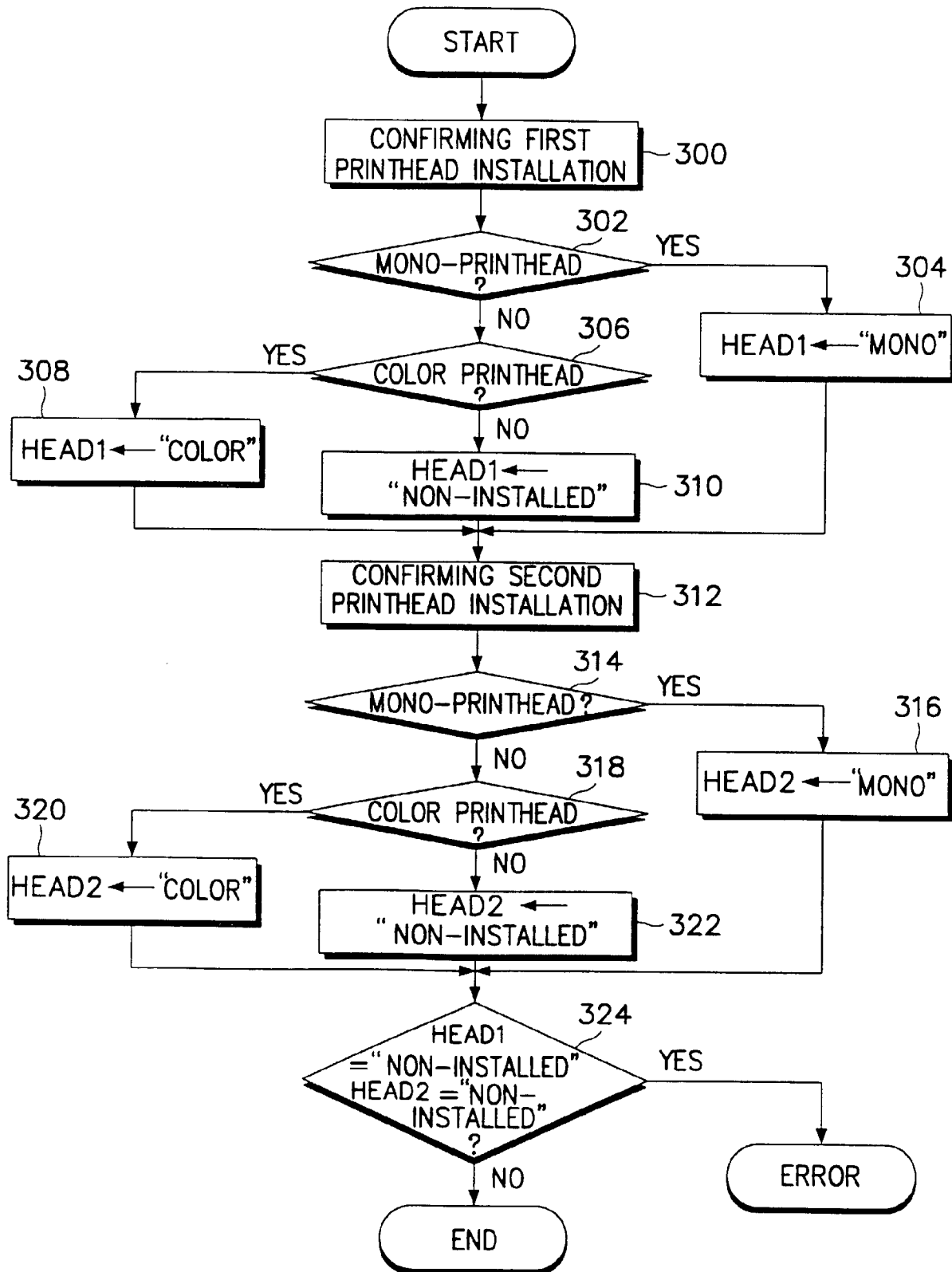


FIG. 2

*FIG. 3*

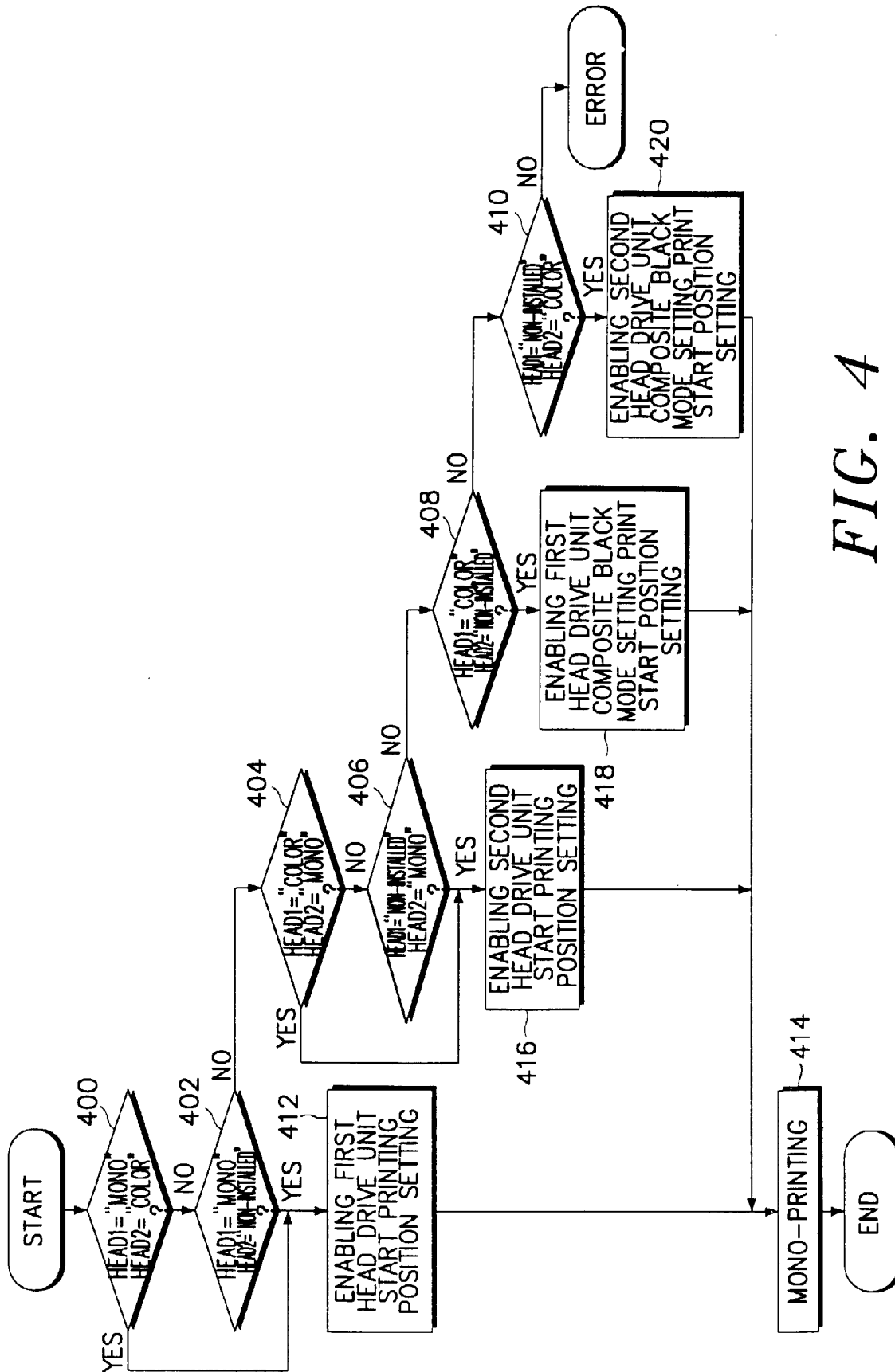
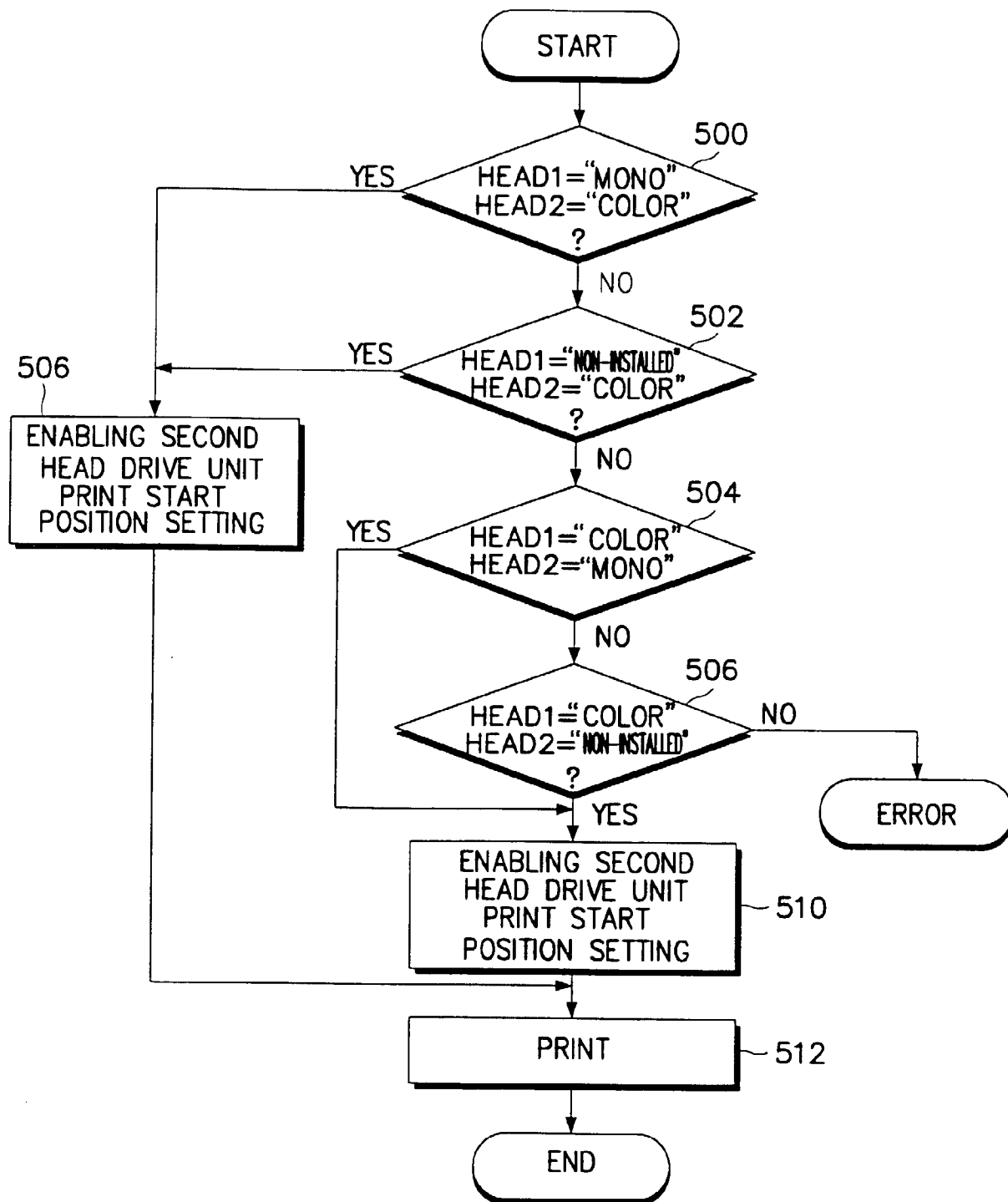


FIG. 4

*FIG. 5*