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54 **A printer having a print head with an S/P converter and a driving circuit.**

57 In a printer, a serial-to-parallel converter and a driving circuit are mounted in the print head which is detachable from a carriage for spacing movement. Serial printing information from a control circuit is transmitted through a cable to the serial-to-parallel converter and converted into parallel printing information, and used to control the driving circuit.

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A PRINTER HAVING A PRINT HEAD WITH AN S/P CONVERTER AND A DRIVING CIRCUIT

BACKGROUND OF THE INVENTION

This invention relates to a printer, particularly to a driving circuit.

A conventional driving circuit employs a control unit having a control circuit for controlling a space motor for moving a carriage on which the print head is mounted and a line feed motor for performing a line feed, and a driving circuit for driving a print head.

The space motor, the line feed motor and the print head are respectively connected to the control unit through connection cables.

Fig. 1 is a schematic view illustrating a conventional driving circuit. As illustrated, a control unit 1 comprises a control circuit 2, a driving circuit 3 and a connector 4. A carriage 5 comprises a connector 6 and a print head 7. The connectors 4 and 6 are connected to each other by a cable 8.

Fig. 2 shows a concrete example of the conventional driving circuit illustrated in Fig. 1. In Fig. 2, 9A and 9B represent timing signals to determine periods for which the driving power is supplied.

Transistors 10A and 10B are turned on and off in response to the signals 9A and 9B. Driving signals 1101 to 1124 respectively correspond to 24 printing dot pins, not shown, contained in the print head 7. Transistors 1201 to 1224 are provided to be turned on and off in response to the driving signals 1101-1124 for controlling the electric currents through driving coils 1301 to 1324, which in turn drive the respective dot pins in the print head 7.

Assuming a number of the printing dot pins contained in the print head 7 is N, (N+1) signal lines are required for driving the dot pins when the dot pins are aligned along a single vertical line and (N+2) lines are required when the dot pins are aligned in two staggered vertical lines as in a stagger head.

In other words, when a multi-pin head is used to print Chinese characters (Kanji) which are complicated or to perform high quality printing, the number of the signal lines are increased, and the cable 8, and the connectors 4 and 6 become bulky and more expensive.

In another system, a serial-to-parallel converter is mounted on the carriage, and driving information is transmitted serially from the control circuit to the serial-to-parallel converter, and converted into parallel information. This scheme, proposed in Japanese Patent Application No. 97426/84 filed by the Assignee of the present application, intends to reduce the number of the signal lines.

Since in this type of driving circuit, however, serial-to-parallel conversion is performed in the carriage, parallel signals must be transmitted from the carriage to the print head by a cable through connectors so that it still requires the same number of the signal lines as the first-mentioned prior type and also requires a large space for interconnection. It also requires multi-terminal connectors.

Moreover, it has a shortcoming that the same carriage cannot be used if the number of the printing elements in the print head differs from one type of print head to another.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a printer in which the number of signal lines are reduced.

Another object of the present invention is to provide a printer which permits the cable and the carriage to be commonly used between different types of a print head.

To accomplish the above objects, the present invention is characterized by incorporating a serial-to-parallel converter and a driving circuit into the print head.

According to the present invention, serial printing information is transmitted to the serial-to-parallel converter of the print head through the connectors and the cable and converted into parallel printing information.

Control signals from the control circuit concerning the driving are transmitted to the driving circuit of the print head, and converted and then selectively applied to the driving elements of the print head so that the driving elements designated by the parallel printing information are driven in accordance with the control signals.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view illustrating a conventional driving circuit.

Fig. 2 is a circuit diagram showing a concrete example of conventional driving circuit illustrated in Fig. 1.

Fig. 3 is a circuit diagram showing a printer with a print head.

Fig. 4 is a timing chart showing operation of a serial-to-parallel converter 27 shown in Fig. 3.

Fig. 5 is a circuit diagram illustrating a driving time generation circuit 31 shown in Fig. 3.

Fig. 6 is a chart illustrating how a print head 14 is assembled with other components.

Fig. 7 is a timing chart showing operation of the printer shown in Fig. 3.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Fig. 3 shows a printer having circuit for driving a print head according to an embodiment of the present invention.

In the drawing, 14 represents a print head with 24 pins (not shown); 15 represents a control unit for generating printing information to be supplied to the print head 14; 16 represents a cable for connecting the control unit 15 and the print head 16; 17 and 18 are connectors for connection with the cable 16; 19 represents a control circuit composed of a microprocessor and the like and transmits, through signal lines 20, 21 and 22 of the cable 16 to the print head 14, a clock signal C, a data signal D in the form of serial printing information and a trigger signal T instructing printing timing and data transmission. 23 represents a power supply unit, a logic power supply VI and a ground E of which are connected to the control circuit 19. The logic power supply VI and the ground E as well as a driving power supply Vd of which is respectively connected to the print head 14 through power lines 23, 24 and 25 of the cable 16.

2601-2624 represent driving coils which serve as printing elements for the printing pins. 27 represents a serial-to-parallel converter (S/P converter) which is composed of a 24-bit shift register 28 and a 24-bit latch circuit 29 and converts serial printing information from the control circuit 19 into parallel printing information.

Fig. 4 is a timing chart showing the operation of the converter 27.

The shift register 28 of the converter 27 successively receives and shifts a series of data signals (bits) D designating activation (printing) or non-activation (non-printing) for the respective ones of the 24 printing pins, in synchronism with the clock signal C, following a trigger signal T. Upon the subsequent occurrence of the trigger signal T, the latch circuit 29 latches the series of the data signals D. The contents of the latch circuit 29 are output as on/off driving signals Dr1-Dr24.

30 represents a driving circuit for driving the coils 2601-2624. 31 represents a driving time generation circuit for generating a driving time.

Fig. 5 is a circuit diagram illustrating the driving time generation circuit in which the driving time generation circuit 31 comprises a charge-discharge circuit composed of a capacitor C1 and a resistor R1 and a comparator CP comparing a potential on

the capacitor C1 with a reference voltage Va set by voltage-dividing resistors R2 and R3.

After being discharged by the trigger signal T, the capacitor C1 is charged. While the voltage on the capacitor is lower than the reference voltage Va, the comparator CP maintains its output, i.e., a driving signal Dr0 to be high, thereby keeping the transistor Tr0 on, to supply the driving power Vd to one terminal of each of all the coils 2601-2624.

The time for which the driving power is applied is determined to be the time necessary for printing.

In Fig. 5, +Vcc and 5V represent respective terminals for the driving power supplies. Transistors Tr1-Tr24 are disposed to couple the other terminal of each of the coils 2601-2624 to the ground E and are turned on when the corresponding signals Dr1 to Dr24 from the S/P converter 27 are high. As a result, the coils 2601-2624 are energized for the above-mentioned period of printing when the corresponding bits of the printing data supplied from the S/P converter 27 are high ("1").

Fig. 6 shows how the print head 14 and other parts are assembled.

The print head 14 has electric components, generally denoted by reference numeral 33, which include the S/P converter 27 and the driving circuit 30 mounted on a printed circuit board 32. The electric components 33 are covered by a cover 34.

The print head 14 is mounted on a carriage 35 in such a way that a male connector 36 of the printed circuit board 32 is inserted in a female connector 18 attached to the carriage 35. The female connector 18 of the carriage 35 is connected by the cable 16 to the control unit 19.

In Fig. 6, 37 represents a guide shaft to which the carriage 35 is mounted such that it is movable along the guide shaft 37 from side to side of the printer, 38 represents a platen on which a printing paper is passed. An ink ribbon, not shown, is interposed between the print head and the printing paper on the platen 38.

Now, the operation of the above structure will be explained with reference to Fig. 7.

When the trigger signal T from the control circuit 19 falls at time t1, the driving time generation circuit 31 the capacitor C1 releases its charge in a moment and then begins to be charged.

At the beginning of charging, as the potential of the capacitor C1 is lower than the reference voltage Va, the driving signal Dr0 output from the comparator CP is at the high level so that the transistor Tr0 is on.

In this moment, some of the driving signals (Dr1 and Dr24, of those illustrated) from the converter 27 are shown to be at the high level and other driving signal (Dr2) is shown to be at the low level, the transistors (Tr1 and Tr24) corresponding to the driving signals (Dr1 and Dr24) that are high

are turned on and electric currents (I1 and I24) through the corresponding coils (2601 and 2624) increase. The corresponding printing pins are thereby driven toward the platen to perform respective dots of printing.

When the potential of the capacitor C1 reaches the reference voltage Va, the driving signal Dr0 becomes low so that the transistor Tr0 turns off and the coil currents I1 and I24 are interrupted. The printing pins are thereby retracted.

In the above embodiment, although the control circuit 19 and the S/P converter 27 are connected to each other via three signal lines, a plurality of alarm signals and the like can be added to perform interruption of printing or alteration of printing cycle time.

Also, as shown in Fig. 4, data signal D' having additional driving time control information D1 and D2 together with the series of signals D1 to D24 can be used in place of the data signal D.

Where the two rows of the 24 pin head, are driven with staggered timings, a delay time information can be added in which case bit numbers of the shift register 28 and the latch circuit 29 are increased to accommodate the delay time information.

Further, in the driving time generation circuit illustrated in Fig. 5, the resistor R1 can be made variable so as to permit control of the printing head 14 in accordance with temperature information and the resistor R2 can be made variable so as to permit control in accordance with the driving time information.

Claims

1. A printer comprising:
a carriage capable of reciprocating movement;
a print head installed on the carriage for printing;
the print head including a plurality of printing elements;
a control circuit for supplying serial printing information to the print head;
a serial-to-parallel converter for converting the serial printing information from the control circuit into parallel printing information;
a driving circuit responsive to the outputs of the serial-to-parallel converter for driving the printing elements of the print head;
said serial-to-parallel converter and the driving circuit being mounted in the print head; and
means for connecting the control circuit to the print head by means of connectors and a cable.

2. A printer according to claim 1, wherein said driving circuit generates driving signals in accordance with the outputs from the serial-to-parallel converter and supplying the driving signals to the printing elements.

3. A printer according to claim 1, wherein said serial printing information includes printing signals corresponding to the respective printing elements and indicating whether or not the corresponding printing elements should be energized in a particular print cycle; and said driving signals from the driving circuit are supplied to the respective printing elements.

4. A printer according to claim 1, wherein the printing elements comprises electromagnets for actuation of printing pins and the driving circuit comprises a driving time generation circuit for generating driving signals and driving transistors connected in series with the electromagnets and being respectively turned on and off by the outputs of the serial-to-parallel converter and the driving time generation circuit.

5. A printer according to claim 1, wherein the print head is inserted into the connector securely attached on the carriage.

6. A printer according to claim 1 wherein said print head is detachably mounted on said carriage.

7. A printer according to claim 1, wherein said carriage is movable along a guide shaft extending in parallel with a platen on which a printing paper is passed.

FIG. 1
PRIOR ART

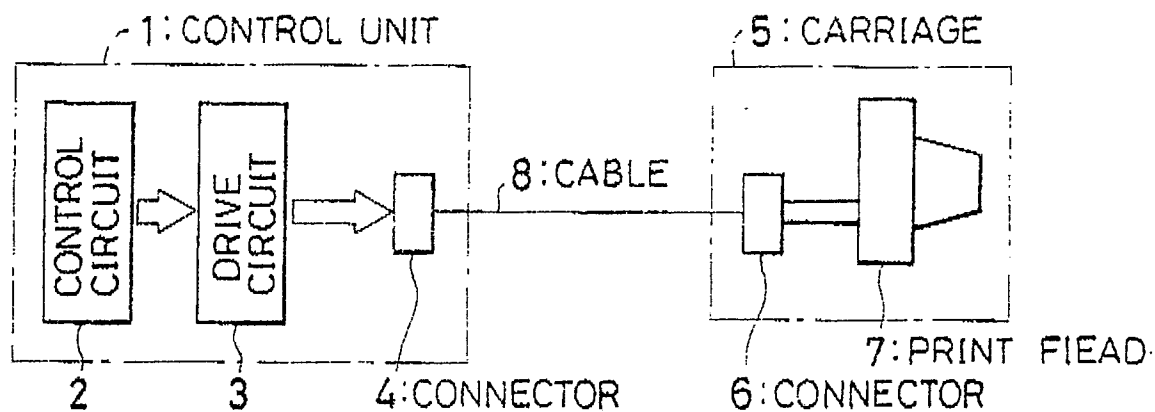
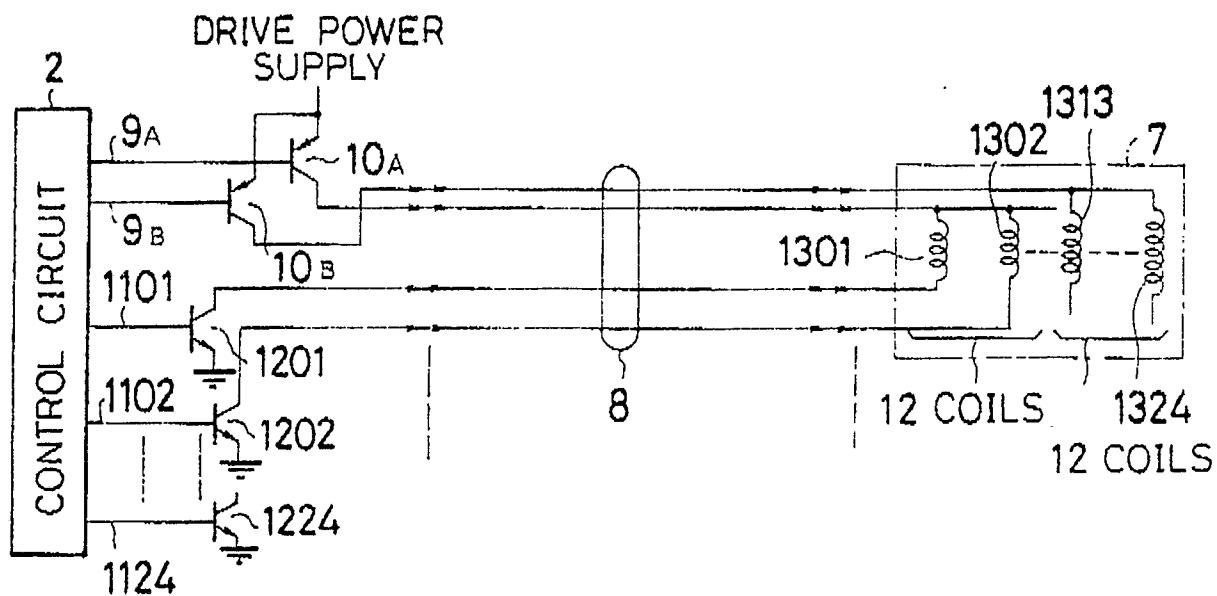


FIG. 2
PRIOR ART



POOR QUALITY

FIG. 3

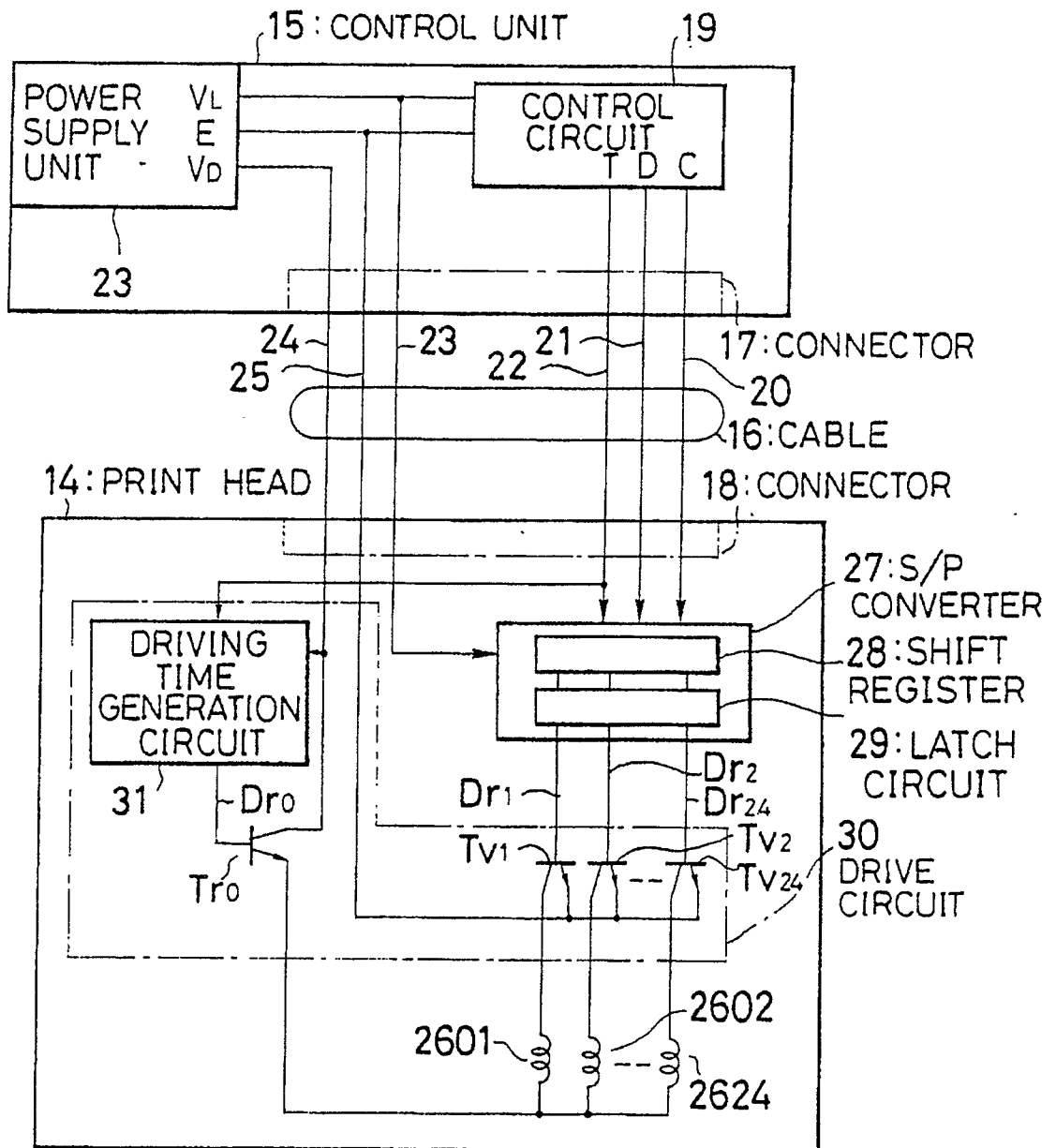


FIG. 4

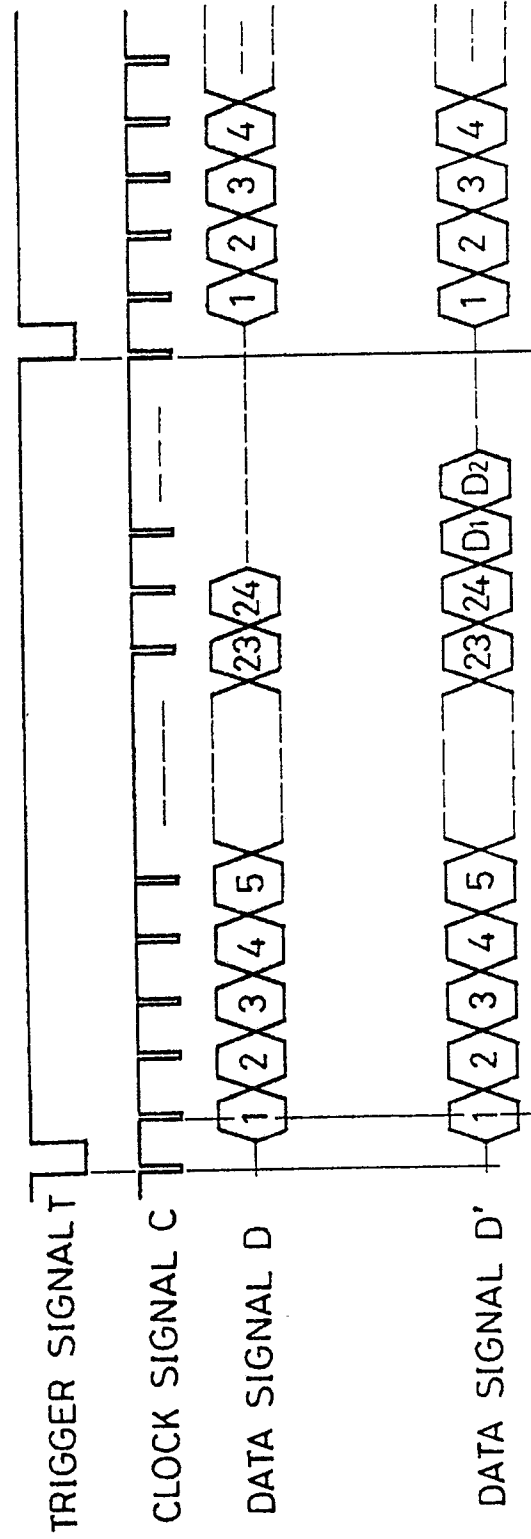


FIG. 5

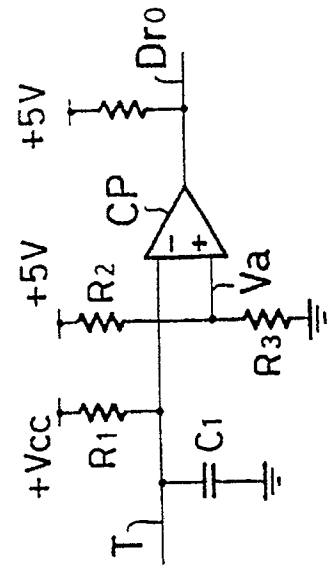


FIG. 6

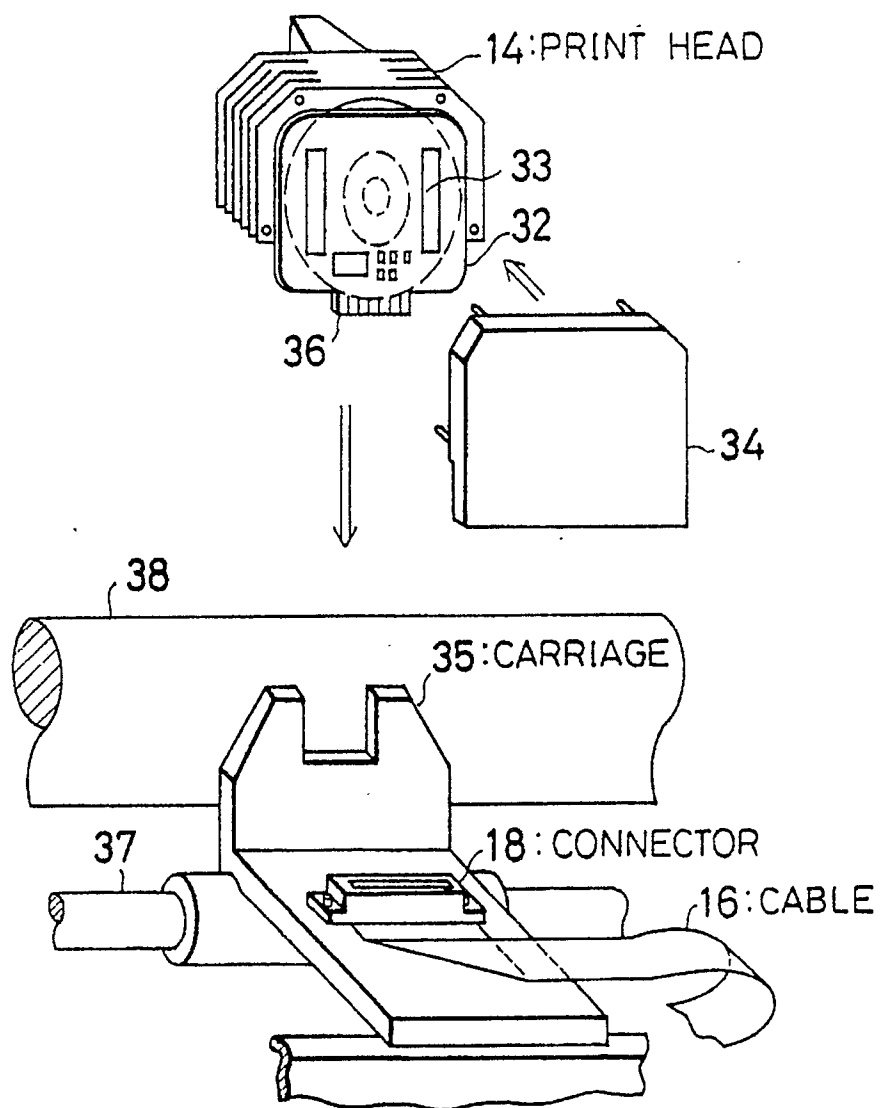


FIG. 7

