

# TITLE OF THE INVENTION

SERIAL PRINTER WHICH PROVIDES ACCELERATION CONTROL OF CARRIER

## BACKGROUND OF THE INVENTION

5           This invention relates to a serial printer which prints while moving a carrier provided with a print head.

          In this type of serial printer, a print head facing a platen is mounted on a carrier. The serial  
10       printer includes a carrier motor composed of a direct-current (DC) motor for driving the carrier and provides acceleration and deceleration control of the carrier motor and moves the carrier along the platen in the direction of main scanning, thereby printing line by  
15       line.

          Specifically, to print one line, the carrier is accelerated by controlling the carrier motor on the basis of the acceleration data preset so that the carrier may reach a specific constant speed  $V_0$  by the  
20       time it has arrived at the print start position as shown in FIG. 14. After the carrier motor has reached the constant speed, the print head starts to print. After the printing has been done, the carrier is decelerated by controlling the carrier motor on the  
25       basis of the preset deceleration data and is stopped at a specific position. In this way, printing is done line by line repeatedly until one page of print has

been completed.

Recently, there have been demands for printers capable of printing at higher speeds. To realize high-speed printing with a serial printer as described above,  
5 the constant speed  $V_0$ , the speed of the carrier in printing, has to be increased.

As the constant speed  $V_0$  is made higher, the distance required for acceleration (the acceleration distance) and the distance required for deceleration  
10 (the deceleration distance) must be made longer. Because in a serial printer as described above, acceleration control must be completed and constant-speed control be in operation by the time the carrier has reached the print start position. Therefore, the  
15 moving range  $W$  of the carrier must be made so much longer, leading to the problem of making the printer larger. An attempt to accelerate and decelerate at a stretch in a short distance would cause damping and permit the speed of the carrier to fluctuate as shown  
20 in FIG. 15. As a result, the movement of the carrier would be slow in becoming stable and have an adverse effect on the result of printing, leading to, for example, the corruption of the printed image.

Although printing may be done during acceleration  
25 or deceleration control of the carrier, variations in the speed of the carrier caused by the occurrence of damping during acceleration or deceleration control

can have an adverse effect on the result of printing, leading to, for example, the corruption of the printed image.

#### BRIEF SUMMARY OF THE INVENTION

5           The object of the present invention is to provide a serial printer capable of printing at high speed without lengthening the moving range of the carrier or degrading the quality of the result of printing, by suppressing the variation of the speed of the carrier  
10           during acceleration or deceleration control and enabling printing even during the suppression.

          The foregoing object is accomplished by providing a serial printer apparatus comprising: a print head for printing on a medium according to a received character  
15           signal; carrier means on which the print head is provided and which runs the print head over an unprintable region and a printable region; and control means for monitoring the running speed of the carrier means and controlling the speed of the carrier means  
20           by accelerating or decelerating while suppressing the amount of fluctuation of the speed at least in the printable region.

          With this configuration, the unprintable region can be set narrower because the print head is  
25           accelerated even in the printable region instead of accelerating the print head to a constant speed in the unprintable region and then printing at the constant

speed in the printable region as in the prior art. Similarly, since deceleration of the print head are performed in the printable region too, it is possible to make the unprintable region more narrow. Moreover, 5 the acceleration and deceleration of the print head are controlled so as to suppress it at least in the printable region, which prevents the quality of print from deteriorating due to extreme acceleration or deceleration. This makes it possible to provide a 10 compact serial printer that ensures a constant quality of print.

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 15 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 hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING 20 The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments 25 given below, serve to explain the principles of the invention.

FIG. 1 is a diagram to help explain the

configuration of the platen and its vicinities in  
a wire dot printer according to a first embodiment of  
the present invention;

FIG. 2 is a block diagram illustrating the  
5 configuration of the wire dot printer of FIG. 1;

FIGS. 3A and 3B are flowcharts for printing  
control performed by the CPU of FIG. 1;

FIG. 4 is a flowchart for acceleration control of  
the carrier motor involving acceleration suppression  
10 shown in FIGS. 3A and 3B;

FIG. 5 is a flowchart for deceleration control of  
the carrier motor involving deceleration suppression of  
FIGS. 3A and 3B;

FIG. 6 shows the relationship between the speed of  
15 the carrier and the output pulse of the encoder in the  
first embodiment;

FIG. 7 shows the relationship between the print  
start position and print end position and the timing of  
speed control of the carrier in printing control in the  
20 first embodiment;

FIGS. 8A and 8B are flowcharts for printing  
control performed by a CPU in a second embodiment of  
the present invention;

FIG. 9 is a flowchart for acceleration control  
25 of the carrier motor without acceleration suppression  
shown in FIGS. 8A and 8B;

FIG. 10 is a flowchart for deceleration control of

the carrier motor without deceleration suppression of  
FIGS. 8A and 8B;

FIG. 11 shows the relationship between the print  
start position and print end position and the timing of  
5 speed control of the carrier in printing control in the  
second embodiment;

FIG. 12 is a flowchart for acceleration control of  
the carrier motor without acceleration suppression of  
FIGS. 8A and 8B in printing control performed by a CPU  
10 in a third embodiment of the present invention;

FIG. 13 shows the relationship between the print  
start position and print end position and the timing of  
speed control of the carrier in printing control in the  
third embodiment;

15 FIG. 14 shows the relationship between the print  
start position and print end position and the timing  
of speed control of the carrier in printing control in  
a conventional serial printer; and

FIG. 15 shows the relationship between the speed  
20 of the carrier and the output pulse of the encoder  
when the speed of the carrier is increased in the  
conventional serial printer.

#### DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, a wire dot printer according to  
25 a first embodiment of the present invention will be  
explained by reference to FIGS. 1 to 7.

FIG. 1 shows the configuration of a platen and

its vicinities in the first embodiment. In FIG. 1,  
a platen 1 is pivotally supported at both its ends.  
A carrier shaft 2 is provided along the platen 1.  
A carrier 3 is provided on the carrier shaft in such  
5 a manner that it can move along the shaft in the  
direction of main scanning. The carrier 3 is provided  
with a print head 4 and an ink ribbon cassette 5.  
In the print head 4, holes through which the tips of  
wires can go in and out have been made. An ink ribbon  
10 in the ink ribbon cassette 5 is stretched in such  
a manner that it intervenes between the print head 4  
and platen 1.

The carrier 3 is provided on a carrier belt (not  
shown) stretched along the carrier shaft 2. On one end  
15 of the carrier shaft 2, a carrier motor 6 functioning  
as carrier driving means is provided. The carrier  
motor 6 moves the carrier 3 by means of the carrier  
belt along the carrier axis 2.

The carrier motor 6 is composed of a direct-  
20 current (DC) servo motor. The carrier motor 6 is  
provided with an encoder 7 that generates pulses  
according to the rotation of the motor. A CPU,  
explained later, monitors the output pulse of the  
encoder 7, thereby sensing the position and varying  
25 speed of the carrier 3.

The encoder 7 is not necessarily provided on the  
carrier motor 6 and may be provided on an idle pulley.

Instead, a linear encoder may be used which is provided in the direction in which the carrier 3 moves.

5 The carrier 3 is designed to be movable in the carrier moving range W from one end of the carrier shaft, the home position, to the other end in FIG. 1. Accordingly, in the carrier moving range, it is necessary to set a range where the print head 4 can print, that is, a printable range V (the range from the print start position to the print end position in  
10 FIG. 1). What position in the printable range printing output (dot output) is started at differs according to the printing data.

FIG. 2 is a block diagram illustrating the configuration of the wire dot printer in the first  
15 embodiment. The wire dot printer includes a CPU (central processing unit) 11 constituting the main part of the control section, a ROM (read-only memory) 12 in which programs and data required for the CPU 11 to control each section have been stored, a RAM (random  
20 access memory) 13 in which various memory areas for temporarily storing the data processed by the CPU 11 are to be stored, an I/O port 14, an interface (I/F) 15, and a mechanical controller 16. The CPU 11, ROM 12, RAM 13, I/O port 14, I/F 15, and mechanical controller  
25 16 are connected to each other by means of bus lines 17 including an address bus, a data bus, and a control bus.

Connected to the mechanical controller 16 are

a head driver 18 for driving the print head 4, a motor driver 19 for driving the carrier motor 6 that moves the carrier 3 along the carrier shaft 2, a motor driver 22 for driving a feed motor 21 that drives the platen 1 for feed, various sensors 23 including a sensor that senses the leading edge of a sheet of paper, and the encoder 7.

A host computer 24 is connected to the I/F 15 via a communication cable. An operation panel 25 is connected to the I/O port 14. With the operation panel 25, the operator performs various operations.

The CPU 11 performs printing control as shown in FIGS. 3A and 3B. The CPU 11 first sets a print start position and a print end position at step 1 (ST1). As a result, the printable range V shown in FIG. 1 is determined. Then, at step 2 (ST2), the CPU 11 sets a constant speed of V0 at which constant-speed control is performed and a carrier stop position. This determines the carrier moving range W shown in FIG. 1.

Next, at step 3 (ST3), the CPU 11 starts to drive the carrier motor 6 and judges on the basis of the output of the encoder 7 at step 4 (ST4) whether the carrier 3 has reached the print start position. If having judged at ST4 that the carrier 3 has not reached the print start position, the CPU 11 will perform acceleration control of the carrier motor 6 involving acceleration suppression at step 5 (ST5).

In acceleration control of the carrier motor 6 involving acceleration suppression, as shown in FIG. 4, the carrier motor 6 is accelerated at step 21 (ST21) by controlling the carrier motor 6 on the basis of the preset acceleration data. At step 22 (ST22), it is judged whether the waveform of the output pulse from the encoder 7 is normal (or changes smoothly with no damping). Specifically, it is judged whether the waveform is corrupted.

If the acceleration of the carrier motor 6 is smooth, the width of the output pulse from the encoder 7 will change gradually. If damping has occurred, the waveform of the output pulse from the encoder 7 will be corrupted in such a manner that, for example, the width of the pulse will become shorter or longer as shown in FIG. 15. Sensing the corruption of the pulse width determines whether the acceleration is stable or whether the speed of the carrier has fluctuated or damping has occurred. Specifically, in FIG. 6, if expression  $X1 > X2 > X3 > X4 \dots > Xn$  is fulfilled, it will be judged that the waveform of the output pulse from the encoder 7 is normal (or that the speed of the carrier has not fluctuated). If the expression is not fulfilled, it will be judged that the waveform of the output pulse from the encoder 7 is not normal (or that the speed of the carrier has fluctuated).

If it has been judged at ST22 that the waveform of

the output pulse is not normal or that the speed of the carrier has fluctuated, the amount of acceleration of the carrier motor 6 will be decreased at step 23 (ST23) and control be returned to ST22. By doing this, stable  
5 acceleration control can be achieved as shown in FIG. 6 where the width of the output pulse from the encoder 7 becomes shorter gradually.

If it has been judged at ST22 that the output pulse from the encoder 7 is normal or that the speed  
10 of the carrier has not fluctuated, control will be returned to ST4 in FIGS. 3A and 3B.

If it has been judged at ST4 that the carrier 3 has reached the print start position, print output control will be started at ST6. Namely, one line of  
15 output will be printed on the basis of the printing data received from the host computer 24.

Next, it is judged at ST7 whether the speed of the carrier motor 6 has reached the constant speed  $V_0$ . If it has been judged at ST7 that the constant speed has  
20 not been reached, acceleration control of the carrier motor 6 involving acceleration suppression of FIG. 4 will be performed at ST8 and control be returned to ST7. If it has been judged at ST7 that the constant speed  $V_0$  has been reached, constant-speed control of the carrier  
25 motor 6 will be performed at ST9 to maintain the constant speed  $V_0$ .

Then, it is judged at ST10 whether the carrier 3

has reached a point a specific distance ahead of the print end position. This judgment is made to determine the timing with which deceleration is started. The judgment is needed to perform deceleration control  
5 before the completion of printing. Therefore, how much distance ahead of the print end position the deceleration control should be started must be determined on the basis of the distance that enables stable deceleration. As an example, it is judged whether  
10 the carrier 3 has reached a position an X number of characters ahead of the print end position.

If it has been judged at ST10 that the carrier 3 has not reached a position an X number of characters ahead of the print end position, control will be  
15 returned to ST9. If it has been judged at ST10 that the carrier 3 has reached a position an X number of characters ahead of the print end position, deceleration control of the carrier motor 6 involving deceleration suppression will be performed at ST11.

20 In deceleration control of the carrier motor 6 involving deceleration suppression, as shown in FIG. 5, the carrier motor 6 is decelerated by controlling the carrier motor 6 on the basis of the preset deceleration data at step 31 (ST31). As in acceleration control of  
25 the carrier motor 6, it is judged at step 32 (ST32) whether the waveform of the output pulse from the encoder 7 is normal (or the waveform changes smoothly

with no damping). This determines whether the speed of the carrier has fluctuated or damping has occurred.

5 If it has been judged at ST32 that the waveform of the output pulse from the encoder 7 is not normal or that the speed of the carrier has fluctuated, the amount of deceleration of the carrier motor 6 will be decreased at step 33 (ST33) and control be returned to ST32. By doing this, deceleration control is achieved stably while suppressing the fluctuation of the speed  
10 of the carrier. If it has been judged at ST32 that the waveform of the output pulse from the encoder 7 is normal or that the speed of the carrier has not fluctuated, control will be returned to ST12 in FIGS. 3A and 3B.

15 Specifically, it is judged at ST12 whether the carrier 3 has reached the carrier stop position. If it has been judged at ST12 that the carrier 3 has not reached the carrier stop position, control will be returned to ST11. If it has been judged at ST12 that  
20 the carrier 3 has reached the carrier stop position, reverse control of the carrier motor 6 will be performed at ST13 to return the carrier to the home position.

25 Then, it is judged at step 14 (ST14) whether all the printing has been done. If it has been judged at ST14 that all the printing has not been completed, control will be returned to ST3. If it has been judged

at ST14 that all the printing has been completed, the printing control will be ended.

With the first embodiment constructed as described above, when one line is printed, the waveform of the output pulse from the encoder 7 is monitored in acceleration control of the carrier motor 6. If a fluctuation in the speed of the carrier, such as the corruption of the waveform, has been sensed, the smooth acceleration of the carrier 3 will be maintained by reducing the amount of acceleration. At the same time, the carrier will be controlled so that it may reach a specific print start position in the direction of main scanning before the speed of the carrier reaches the constant speed  $V_0$  as shown in FIG. 7.

Consequently, the carrier can be brought into a print output enable state before the speed of the carrier has reached the constant speed  $V_0$ , or in the course of acceleration control. This makes it possible to secure a sufficient distance needed for acceleration of the carrier 3 without lengthening the moving range of the carrier, even when printing is done at high speed. Because stable speed control is performed during acceleration control, even when printing is done during acceleration control, the printing can be effected at high speed without degrading the quality of the result of printing.

Even during deceleration control of the carrier

motor 6, the waveform of the output pulse from the encoder 7 is monitored. If a fluctuation in the speed of the carrier, such as the corruption of the waveform, has been sensed, the amount of the deceleration will be decreased. This secures the smooth deceleration of the carrier 3 and brings the carrier into deceleration control before the carrier has reached the print end position (or when the carrier has reached a place an X number of characters ahead of the print end position) as shown in FIG. 7.

Therefore, the carrier 3 can be brought into the print output enable state even in the course of deceleration control. This makes it possible to secure a sufficient distance needed for deceleration of the carrier 3 without lengthening the moving range of the carrier, even when printing is done at high speed.

Because speed control is performed stably during deceleration control, even when printing is done during deceleration control, printing can be effected at high speed without degrading the result of printing.

With the first embodiment, because the moving range of the carrier 3 can be made shorter while securing the quality of printing, the entire size of the printer can be made smaller and its cost be reduced.

In the first embodiment, the present invention has been applied to one-side printing control. In one-side printing control, printing is done when the carrier

moves forward, whereas printing is not effected when the carrier returns to the home position. The invention may be applied to two-way printing control in which printing is done not only when the carrier moves forward but also when it returns to the home position.

Furthermore, the present invention may be applied to not only a wire dot printer but also other general printers that print while moving the print head in the direction of main scanning, such as a thermal printer or an ink-jet printer.

Hereinafter, a wire dot printer according to a second embodiment of the present invention will be explained by reference to FIGS. 8A to 11. A diagram illustrating the configuration of the wire dot printer of the second embodiment and its vicinities and a block diagram of the wire dot printer are the same as those in FIGS. 1 and 2, so a detailed explanation of them will not be given.

The second embodiment differs from the first embodiment in that acceleration suppression of the carrier 3 is performed during the time from when the carrier has entered the printable range V until it has reached the constant speed  $V_0$  as shown in FIG. 11. In contrast, in the first embodiment, acceleration control of the carrier 3 is performed during the time from when acceleration control of the carrier 3 has been started until the carrier has reached the constant speed  $V_0$ .

The CPU 11 of the second embodiment is designed to perform printing control as shown in FIGS. 8A and 8B. The processes at steps 51 (ST51) to 54 (ST54) of FIGS. 8A and 8B are the same as those at ST1 to ST4 of  
5 FIGS. 3A and 3B.

If it has been judged at ST54 that the carrier 3 has not reached the print start position, acceleration control of the carrier motor 6 without acceleration suppression will be performed at ST55. That is, only  
10 acceleration control of the carrier motor 6 will be performed without monitoring a fluctuation in the speed of the carrier as shown in FIG. 9.

Because the carrier 3 has not entered the printable range V yet at this time, the presence or  
15 absence of a fluctuation in the speed of the carrier need not be considered. This makes it possible to set the acceleration data so that acceleration control may be performed in a shorter distance than in the first embodiment.

20 The processes at steps 56 (ST56) to 60 (ST60) are the same as those at ST6 to ST10 of FIGS. 3A and 3B.

The processes at step 58 (ST58) performs acceleration control of the carrier motor 6 with suppressing acceleration. That is the processes shown  
25 in FIG. 4 are performed.

If it has been judged at ST60 that the carrier 3 has reached a position an X number of characters ahead

of the print start position, deceleration control of the carrier motor 6 involving deceleration suppression will be performed at step 61 (ST61). That is, the processes shown in FIG. 5 will be performed.

5           Then, it is judged at step 62 (ST62) whether the carrier 3 has reached the print end position. If it has been judged at ST62 that the carrier 3 has not reached the print end position, control will be returned to ST61. If it has been judged at ST63 that  
10       the carrier 3 has reached the print end position, deceleration control of the carrier motor 6 without deceleration suppression will be performed at step 63 (ST63). That is, only deceleration control of the carrier motor 6 will be performed without monitoring  
15       a fluctuation in the speed of the carrier as shown in FIG. 10.

          Because the carrier 3 has passed the printable range V, the presence or absence of a fluctuation in the speed of the carrier need not be considered. This  
20       makes it possible to set the deceleration data so that the carrier may be decelerated in a shorter distance than in the first embodiment.

          Then, it is judged at step 64 (ST64) whether the carrier 3 has reached the print stop position. If it  
25       has been judged at ST64 that the carrier 3 has not reached the print stop position, control will be returned to the process at ST63. If it has been judged

at ST64 that the carrier 3 has reached the print stop position, reverse control of the carrier motor 6 will be performed at step 65 (ST65) to return the carrier 3 to the home position.

5           With the second embodiment, as shown in FIG. 11, in acceleration control of the carrier 3, during the time from when the carrier 3 has started to be driven until the carrier 3 has entered the printable range V, acceleration control without acceleration suppression  
10 is performed. During the time from when the carrier has entered the printable range V until the carrier has reached the constant speed  $V_0$ , acceleration control involving acceleration suppression is performed.

          Before the carrier has reached the print start  
15 position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered, the acceleration data can be set so that acceleration control may be performed in a shorter distance than  
20 in the first embodiment (shown by a dot-dash line in FIG. 11). This makes it possible to print at higher speed without degrading the quality of the result of printing and shorten the moving range W of the carrier.

          In deceleration control of the carrier 3, too, deceleration with deceleration suppression is performed  
25 until the carrier 3 has passed the printable range V. After the carrier 3 has passed the printable range V, deceleration control without deceleration control is

performed.

After the carrier has passed the print end position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered, the deceleration data can be set so that deceleration control may be performed in a shorter distance than in the first embodiment. This makes it possible to print at higher speed without degrading the quality of the result of printing and shorten the moving range W of the carrier.

Next, a wire dot printer according to a third embodiment of the present invention will be explained by reference to FIGS. 12 and 13. A diagram illustrating the configuration of the wire dot printer of the third embodiment and its vicinities and a block diagram of the wire dot printer are the same as those in FIGS. 1 and 2, so a detailed explanation of them will not be given. The flowchart for printing control performed by the CPU 11 of the third embodiment is the same as that of FIGS. 8A and 8B in the second embodiment.

The third embodiment differs in printing control from the second embodiment in that at ST55, the carrier is accelerated at a stretch to a preset specific speed V1 lower than the constant speed V0 in acceleration control of the carrier motor 6 without acceleration suppression performed until the carrier has entered the

printable range. In contrast, in the second embodiment,  
at ST55, only acceleration control of the carrier 3 is  
performed in acceleration control of the carrier motor  
6 without acceleration control performed until the  
5 carrier has entered the printable range.

Specifically, in the third embodiment, if the CPU  
11 has judged at ST54 in FIGS. 8A and 8B that the  
carrier 3 has not reached the print start position, it  
will perform acceleration control of the carrier motor  
10 6 without acceleration suppression at ST54 as shown in  
FIG. 12. Namely, the carrier motor 6 is accelerated  
on the basis of the preset acceleration data at ST71.  
In this case, the acceleration data has only to be set  
so that the speed of the carrier may reach a specific  
15 speed V1 before the carrier reaches the print start  
position.

Then, it is judged at step 72 (ST72) whether the  
speed of the carrier has reached the specific speed V1.  
If it has been judged at ST72 that the speed of the  
20 carrier has not reached the specific speed V1, control  
will be returned to ST54. If it has been judged at  
ST72 that the speed of the carrier has reached the  
specific speed V1, the amount of acceleration will be  
reduced at step 73 (ST73) so that the acceleration of  
25 the carrier 3 may enter the printable range V more  
stably and control will be returned to ST54 in FIGS. 8A  
and 8B.

As described above, the speed of the carrier is accelerated at a stretch to the specific speed  $V_1$  preset lower than the constant speed  $V_0$ , which brings the carrier 3 to the speed  $V_1$  faster than in the second embodiment before it has reached the print start position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered. Therefore, the acceleration data can be set so that acceleration control may be performed in a shorter distance than in the second embodiment. This makes it possible to print at much higher speed without degrading the quality of the result of printing and make the carrier moving range  $W$  still shorter.

Furthermore, the speed of the carrier can be brought to the constant speed  $V_0$  faster than in the second embodiment by bringing the carrier 3 to the still faster speed  $V_1$  before the carrier has reached the print start position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered. This makes it possible to shorten the distance required for acceleration control without acceleration suppression in FIG. 11 and prevent the distance for constant-speed control to keep the constant speed  $V_0$  from becoming shorter.

As described in detail, with the present invention, it is possible to provide a serial printer capable of printing at high speed without lengthening the carrier

moving range or degrading the quality of the result of printing and of making the entire system smaller.

Furthermore, in acceleration control of the carrier, acceleration control with acceleration suppression is performed during the time from when the carrier has entered the printable range V until the speed of the carrier has reached the constant speed  $V_0$ . Therefore, the acceleration data can be set so that acceleration control may be performed in a shorter distance before the carrier has reached the print start position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered. This makes it possible to print at still higher speed without degrading the quality of the result of printing and shorten the carrier moving range W.

Furthermore, in deceleration control of the carrier, deceleration control with deceleration suppression is performed until the carrier has passed the printable range V. Therefore, the deceleration data can be set so that deceleration control may be performed in a shorter distance after the carrier has passed the print end position, when the presence or absence of a fluctuation in the speed of the carrier need not be considered. This makes it possible to print at still higher speed without degrading the quality of the result of printing and shorten the carrier moving range W.

Moreover, the speed of the carrier can be brought to a constant speed still faster by bringing the carrier to a still faster speed before the carrier has reached the print start position, when the presence or  
5 absence of a fluctuation in the speed of the carrier need not be considered. This prevents the distance needed for constant-speed control to keep the constant speed from becoming shorter.

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



# CLAIMS

1. A serial printer apparatus comprising:  
a print head for printing on a medium according to  
a received character signal;

5 carrier means on which the print head is provided  
and which runs the print head over an unprintable  
region and a printable region; and

control means for monitoring the running speed of  
the carrier means and controlling the speed of the  
10 carrier means by accelerating or decelerating the  
carrier means while suppressing the amount of  
fluctuation of the speed at least in the printable  
region.

2. A serial printer apparatus according to  
15 claim 1, wherein the control means includes

second control means for monitoring the running  
speed of the carrier means, suppressing the accel-  
eration so that the acceleration may be equal or  
lower than a specific value when the carrier means  
20 accelerates and a variation of the running speed of the  
carrier means are detected, accelerating the carrier  
means not only in the unprintable region but also in  
the printable region, and once the carrier means has  
reached a constant speed, keeping the speed.

25 3. A serial printer apparatus according to  
claim 1, wherein the control means includes

second control means for monitoring the running



speed of the carrier means, suppressing the deceleration so that the deceleration may be equal or lower than a specific value when the carrier means decelerates from the constant speed and a variation of the running speed of the carrier means are detected, and decelerating the carrier means not only in the unprintable region but also in the printable region.

4. A serial printer apparatus according to claim 1, wherein the control means includes

second control means for monitoring the running speed of the carrier means, accelerating the carrier means without acceleration suppression in the unprintable region and with acceleration suppression in the printable region, and once the carrier means has reached a constant speed, keeping the speed.

5. A serial printer apparatus according to claim 1, wherein the control means includes

second control means for monitoring the running speed of the carrier means, decelerating the carrier means with deceleration suppression in the printable region and without deceleration suppression in the unprintable region to stop the carrier means.

6. A serial printer apparatus according to claim 1, wherein the control means includes

second control means for monitoring the running speed of the carrier means, accelerating the carrier means without acceleration suppression in the



unprintable region and with acceleration suppression in the printable region, and once the carrier means has reached the constant speed, keeping the speed, and thereafter, when the carrier means has reached a specific place, decelerating the carrier means with deceleration suppression, and when the carrier means has entered the unprintable region, decelerating the carrier means without deceleration suppression to stop the carrier means.

10           7. A serial printer apparatus according to claim 1, wherein the control means includes

          second control means for monitoring the running speed of the carrier means, accelerating the carrier means without acceleration suppression in the unprintable region until the carrier means has reached a specific speed and with acceleration suppression after the carrier means has reached the specific speed, and accelerating the carrier means with acceleration suppression in the printable region, and once the carrier means has reached the constant speed, keeping the speed.

20           8. A serial printer apparatus according to claim 1, wherein the control means includes

          second control means for monitoring the speed of the carrier means on the basis of the pulse outputted from an encoder sharing the same axis with a carrier motor that drives the carrier means and controlling the



speed of the carrier means while suppressing the amount of fluctuation of the speed at least in the printable region.

5           9. A serial printer which provides acceleration control of carrier, substantially as hereinbefore described with reference to the accompanying drawings.