

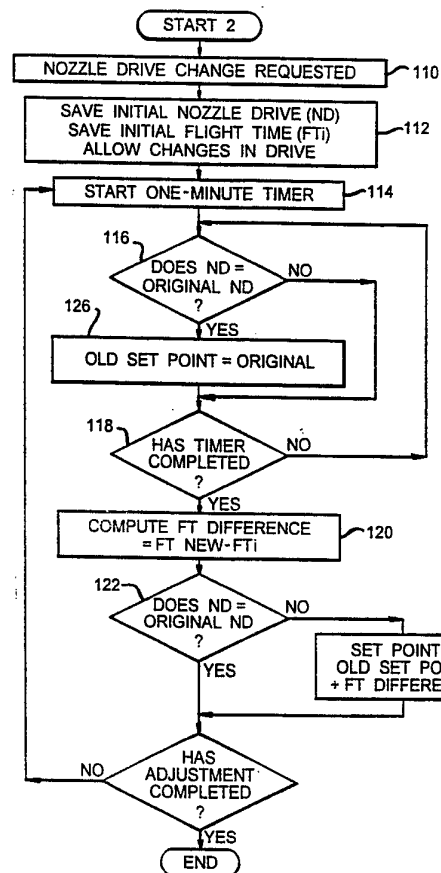


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>5</sup> : <b>B41J 2/12, 2/115</b>	<b>A1</b>	(11) International Publication Number: <b>WO 94/02318</b> (43) International Publication Date: 3 February 1994 (03.02.94)
<p>(21) International Application Number: PCT/GB93/01602</p> <p>(22) International Filing Date: 28 July 1993 (28.07.93)</p> <p>(30) Priority data: 07/920,797                      28 July 1992 (28.07.92)                      US</p> <p>(71) Applicant: GENERAL ELECTRIC COMPANY PLC [GB/GB]; 1 Stanhope Gate, London W1A 1EH (GB).</p> <p>(72) Inventors: STAMER, Michael, E. ; 6648 N. Avers, Lincolnwood, IL 60645 (US). ARWAY, George ; 8260 W. Argyle Avenue, Norridge, IL 60656 (US).</p> <p>(74) Agent: GODDIN, Jeremy, Robert; GEC Patent Department, Waterhouse Lane, Chelmsford, Essex CM1 2QX (GB).</p>	<p>(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	
(54) Title: INK JET PRINTERS AND METHODS FOR THEIR OPERATION		

## (57) Abstract

Flight time of a stream of ink drops is measured and compared against a set point to determine variations therefrom. Variations due to changes in the ink composition are compensated by adding or withholding solvent in proportion to the detected change. Changes due to variations in nozzle drive voltage result in the computation and use of a new flight time set point value to avoid erroneous corrective action.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NE	Niger
BE	Belgium	GN	Guinea	NL	Netherlands
BF	Burkina Faso	GR	Greece	NO	Norway
BG	Bulgaria	HU	Hungary	NZ	New Zealand
BJ	Benin	IE	Ireland	PL	Poland
BR	Brazil	IT	Italy	PT	Portugal
BY	Belarus	JP	Japan	RO	Romania
CA	Canada	KP	Democratic People's Republic of Korea	RU	Russian Federation
CF	Central African Republic	KR	Republic of Korea	SD	Sudan
CG	Congo	KZ	Kazakhstan	SE	Sweden
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovak Republic
CM	Cameroon	LU	Luxembourg	SN	Senegal
CN	China	LV	Latvia	TD	Chad
CS	Czechoslovakia	MC	Monaco	TG	Togo
CZ	Czech Republic	MG	Madagascar	UA	Ukraine
DE	Germany	ML	Mali	US	United States of America
DK	Denmark	MN	Mongolia	UZ	Uzbekistan
ES	Spain			VN	Viet Nam
FI	Finland				

INK JET PRINTERS AND METHODS FOR THEIR OPERATION

This invention relates to ink jet printers and to methods of operating ink jet printers. More specifically, it relates to ink jet printers having a time of flight based control system in which ink drops issuing from the print head are monitored to detect changes in flight time due to various causes.

In ink jet printers it is known that changes in ink composition occur over time and, if not compensated, will result in a deterioration of print quality or shut down of the printer. For this reason, it is common practice to monitor the ink in such systems. In continuous jet printers, ink is recirculated until it is printed onto a substrate. Because the ink contains volatile substances, such as solvents, it will thicken over time as these evaporate resulting in changes in ink composition.

U.S. Patent Nos. 4,555,712, and 4,827,280 teach that the flow rate of ink from the ink supply system to the nozzle should be monitored. This is achieved by passing the ink through a small cylindrical tank provided with float switches. The time required for the ink level to drop from a first point to a second point is monitored and changes in this time are indicative of changes in ink composition. Detected changes in ink composition are compensated in any of several ways including changing the ink temperature, changing the pressure applied to the ink, and adding or withholding solvent. For example, in U.S. Patent No. 4,555,712, solvent is either added in a predetermined quantity or withheld. In U.S. Patent No. 4,827,280, a valve is operated

to add solvent for a period proportional to the error in flow time, that is a servo control.

Flow rate control works generally satisfactorily but is accompanied by various disadvantages including errors and uncertainties due to the inaccuracy of the float switches, and the need for a separate measurement tank.

It is generally known from the prior art for an ink jet printer to be provided with means for supplying ink to a nozzle under pressure for projection as an ink stream towards a surface to be marked, means for applying a stimulation voltage to the nozzle to cause the ink stream to break-up into discrete ink drops, means for electrically charging selected ink drops to control their deflection, and printer control means including time measuring means for measuring the time of flight of selected charged ink drops for various purposes. For example U.S. Patent No. 4,217,594 teaches that ink drop velocity should be controlled as a function of temperature variation. U.S. Patent No. 4,535,339 teaches that flight velocity should be measured and ink pressure adjusted to maintain velocity at a target value. International Patent Application No. WO89/03768 discloses a control system, for maintaining constant flight time, in which flight time is monitored and the ink pressure is adjusted, as necessary, to maintain flight time constant; if the required pressure increase exceeds a present value, solvent is added for a fixed time to decrease ink viscosity, that is a predetermined quantity of solvent is added to the ink.

According to one aspect of the invention the printer control means includes

means responsive to the time measuring means for periodically comparing the measured flight time of a charged ink drop against a reference value, and means for altering the viscosity of the ink by an amount related to the variation in flight time. The time measuring means may include first and second electrodes disposed at different points along the flight path of the ink drops for detecting charges thereon and for measuring the elapsed time between detection of a charged ink drop by each electrode. In the case where the printer includes a catcher for receiving uncharged or weakly charged drops, the second electrode may be associated with the ink catcher.

When an ink jet printer is placed into operation it is often the case that the user will manually adjust or "fine-tune" the nozzle drive voltage to maximise print quality. Such adjustments may also be periodically performed while the printer is on line. As will be apparent to those skilled in the art, such adjustments may materially affect flight time and/or the measurement of flight time and may cause a control system to improperly alter operating pressure and/or ink composition causing print quality to deteriorate. If the operator tries to compensate by further adjustments to the nozzle drive, a degenerative condition can occur eventually requiring printer shut down to re-establish correct operating conditions.

According to the invention, in the case where the means for electrically charging selected ink drops is a charge tunnel, the first electrode may be associated with the charge tunnel to measure the elapsed time between a weakly charged ink drop leaving

the charge tunnel and being detected by the second electrode as the time of flight measurement, and the printer control means also includes means for altering the reference value if there has been a change in stimulation voltage amplitude, whereby differences in flight time due to changes in stimulation voltage will be compensated to prevent erroneous adjustments in ink viscosity. In this manner the invention provides a time of flight control system which can determine the nature of a change in flight time and can compensate correctly depending upon the reason for such change. More particularly the present invention provides a time of flight control system which can maintain ink composition relatively stable and adjust time of flight set point when necessary due to nozzle drive voltage adjustments.

It is generally known from the prior art for a method of operating an ink jet printer to include projecting a stream of discrete ink drops towards a surface to be marked, electrically charging selected ink drops to control their deflection, and measuring the flight time of the selected charged ink drops for various purposes.

According to another aspect of the invention a method of operating an ink jet printer also includes periodically comparing the measured flight time with a reference value, and altering the viscosity of the ink responsive to detection of a variation in flight time from the reference value by an amount related to the variation in flight time. The method may also include measuring the flight time of selected charged ink drops between a means for electrically charging the drops and a catcher intended to receive uncharged or weakly charged drops, detecting changes in a stimulation voltage

amplitude for generating the stream of ink drops, and appropriately altering the reference value used for future comparisons if a variation in flight time is detected and there has been a change in the stimulation voltage amplitude. In this case the method may also include altering the reference value by appropriately adding or subtracting the magnitude of the detected variation thereto.

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

Figure 1 is a diagram illustrating the operation of a flow time control system according to the prior art;

Figure 2 is a diagram illustrating the operation of a time of flight control system according to the present invention;

Figure 3a, 3b, 3c and 3d illustrate various printer configurations for use with the present invention, and

Figures 4 and 5 are flow diagrams indicating the operation of the flight control system according to the present invention.

Measurement of ink flow rate from an ink supply system to a printhead is important in order to maintain ink quality over extended periods of printer operation.

As ink thickens, due to loss of solvent, changes in temperature or other reasons, it is necessary to adjust the ink composition. Prior United States Patent No. 4,555,712 and 4,827,280 teach that such flow rate measurements require a small cylindrical tank provided with float switches. The time required for the fluid to flow from an upper float switch to a lower float switch is a direct measurement of flow rate and can be used to adjust ink composition. Such a system, however, requires the aforementioned separate cylindrical tank and a fill cycle to permit this type of measurement.

Recently, electrical pumps have been employed for pressurizing the ink, eliminating pneumatic pump cycles. In addition, noise is introduced into the flow rate measurement by the less than perfect operation of the float switches. Figure 1 illustrates the operation of a flow rate measuring system. Despite the use of improved float switches it will be seen that there is a substantial amount of noise primarily caused by the operation of the float switches.

The present invention teaches that the ink composition should be controlled in response to the measured time of flight of drops which separate from the stream after ejection from the nozzle. Time of flight is, of course, related to flow time. The advantages of time of flight measurement include the ability to use electric pump systems, the elimination of any need for separate cylindrical tanks and associated switches, and the avoidance of float noise associated with such float switches.

Figure 2 illustrates operation of a time of flight based control system according

to the present invention, the ink being pressurized by an electrical pump. A comparison with Figure 1 indicates the significantly improved quality of the signal due to the reduced noise component.

Figures 3a, 3b, 3c and 3d diagrammatically illustrate printhead arrangements suitable for use with the present invention. In each Figure a nozzle 20 of known orifice size is used to eject a solid ink stream 22 past a charge tunnel electrode structure 24 to a catcher 26. As is very well known in this art, the nozzle 20 has a stimulation voltage (or nozzle drive) of a known amplitude and frequency applied to it for breaking the ink stream up into a stream of drops within the charge tunnel electrode structure 24. Selected ink drops are given an electric charge and are deflected away from the catcher 26 by a deflection electrode (not shown for purposes of clarity).

In the embodiment of Figure 3a, two sensing electrodes 28 and 30 are provided along the flight path 25 of the ink drops. Time of flight measurements are made of one or more ink drops in succession by locating the sensing electrodes 28 and 30 in close proximity along the flight path of the ink drops. As a charged ink drop passes each electrode, it produces an electrical impulse. The time between the first and second pulses is the flight time. Such a measurement can be conducted during a set-up mode as well as during actual operation of the printer. Flight time can be measured on a regular basis, for example at intervals of about four seconds, and an average of several readings taken to determine the value of the flight time to be used

for further operation of the control system. Of course, the number of measurements per unit time will vary depending upon the particular printer system to which the invention is applied.

Figure 3b shows a modified arrangement which is identical to that already described with reference to Figure 3a except for the elimination of the second electrode 30. Instead, the catcher 26 functions as the second electrode. In this embodiment the test drops are provided with very small electrical charges and are consequently not deflected from the catcher 26. The time a test drop takes to pass from the first electrode 28 to the catcher 26 is a measure of the flight time and hence the flow rate of the ink.

Figures 3c and 3d illustrate a third embodiment of the invention in which the charge tunnel 24 functions as the first electrode whilst the catcher 26 functions as the second electrode. In this manner no separate electrodes are required to measure the time of flight. However this simplified arrangement incurs a complication whenever the nozzle drive changes. Figures 3c and 3d illustrate operation with different stimulation voltages and it will be seen that the drop break-off point 32 within the charge tunnel 24 varies with the stimulation voltage. As the charge signal applied at the charge tunnel 24 starts the time measurement, and the impulse sensed by the catcher 26 ends the time measurement, movement of the break-off point 32 will result in a change in flight time unrelated to any change in ink viscosity or temperature. Accordingly any variation in flight time, due to a change in nozzle drive, will cause the

control system to adjust the ink composition incorrectly.

When the embodiment of Figures 3c and 3d is to be used, the present invention accordingly enables the control system to be operated in a manner to minimize changes in ink composition occasioned by changes in nozzle drive.

The operation of the controller associated with the ink jet printer is now described with reference to Figures 4 and 5. It is known in the art that virtually all ink jet printers employ a microprocessor or similar controller for operation. Such devices have a memory for storing a control program and various information concerning font sizes and font sizes and drop placement. Figures 4 and 5 are flow diagrams indicating the functions which such a control program would perform in order to implement the present invention.

In Figure 4, the control program periodically, say every 1 to 3 minutes, processes an average of recent flight time measurements as step 102. At step 103, the magnitude of the error is determined. At step 104, the solvent add valve is operated for a period of time related to the magnitude of the error. A preferred relation between error and valve on time is disclosed in U.S. Patent No. 4,287,280 which is hereby incorporated by reference and discloses, particularly in Figures 8A-D and the text relating thereto, a proportional control scheme suitable for use with the present invention. Subsequent flight time measurements should indicate that the flight time begins to approach the set point due to such modification in ink composition.

Figure 5 illustrates a flow diagram that can be used to compensate for a change in nozzle drive voltage if the embodiment of Figures 3c and 3d is used. A change in nozzle drive will occur when an operator adjusts the amplitude of the voltage in an effort to optimize print quality. Changing the nozzle drive will change flight time as measured by the sensors 24 and 26 and the ink control program of Figure 4 would respond as though ink viscosity had changed. However, the present invention enables the control system to compensate for nozzle drive changes by keeping track of flight time before and after the nozzle drive change. Provided that the elapsed time of the nozzle drive adjustment is short (for example, of the order of one or two minutes), any concurrent change in flight time due to viscosity change can be neglected. That being the case, any detected change in flight time is due to nozzle drive adjustment and its magnitude can be added to the original set point flight time to generate a revised set point.

In describing the operation of the flow diagram of Figure 5, it is assumed that the original flight time set point and nozzle drive have been determined at the time the printer is set up using a fresh supply of ink. When a nozzle drive change is requested, that is step 110, the initial nozzle drive value is saved along with the initial flight time, that is step 112. Changes in nozzle drive voltage are then permitted.

After changes are enabled, a timer is started, that is step 114 which may be of the order of one or two minutes depending upon the system. A check is made at 116 to determine whether the present nozzle drive equals the original nozzle drive. If it

does not, a check is made by step 118 to determine if the timer of step 114 has timed out. If not, the program repeatedly loops back to step 116 until the timer has timed out. At that point, if the nozzle drive is not equal to the original value, it is desired to change the flight time set point. At step 120 the difference in flight time is computed and the program branches, via step 122, to step 124 where the set point is set equal to the original set point plus the flight time difference. Assuming no further nozzle drive adjustments are made, the routine ends.

Additional functions are provided in Figure 5 in recognition of the fact that a system which permits changes to its set point is subject to long term drift. Accordingly, the original set up flight time reference, determined with fresh ink for a particular nozzle drive, is remembered. If that drive level is again utilized, then the reference flight time corresponding thereto is re-established when computing further set point changes. For that purpose, a check is made at 116 to determine if current nozzle drive equals the original value. If so, the program branches to 126 where the set point flight time is set equal to its original value. The program then continues at steps 118 through 122 as previously explained.

From the foregoing it will be seen that the present invention enables flight time to be monitored thereby determining changes in flow rate of the ink and modifying ink composition as necessary. In the case of nozzle drive adjustment with the embodiment of Figures 3c and 3d, the flight time set point is compensated to avoid erroneous adjustments to the ink composition.

**WHAT IS CLAIMED:**

1. An ink jet printer including means for supplying ink to a nozzle under pressure for projection as an ink stream towards a surface to be marked, means for applying a stimulation voltage to the nozzle to cause the ink stream to break-up into discrete ink drops, means for electrically charging selected ink drops to control their deflection and printer control means including time measuring means for measuring the time of flight of selected charged ink drops, characterised in that the printer control means includes means (103) responsive to the time measuring means (102) for periodically comparing the measured flight time of a charged ink drop against a reference value, and means (104) for altering the viscosity of the ink by an amount related to the variation in flight time.
2. An ink jet printer, as claimed in Claim 1, characterised in that the time measuring means (102) includes first and second electrodes (28, 30) disposed at different points along the flight path (25) of the ink drops for detecting charges thereon and for measuring the elapsed time between detection of a charged ink drop by each electrode.
3. An ink jet printer, as in Claim 2 and in which the printer includes a catcher (26) for receiving uncharged or weakly charged drops, characterised in that the second electrode (30) is associated with the ink catcher (26).

4. An ink jet printer, as in Claim 2 or 3 and in which the means for electrically charging selected ink drops is a charge tunnel, characterised in that the first electrode (28) is associated with the charge tunnel (24) to measure the elapsed time between a weakly charged ink drop leaving the charge tunnel (24) and being detected by the second electrode (30) as the time of flight measurement, and the printer control means also includes means (122,124) for altering the reference value if there has been a change in stimulation voltage amplitude, whereby differences in flight time due to changes in stimulation voltage will be compensated to prevent erroneous adjustments in ink viscosity.

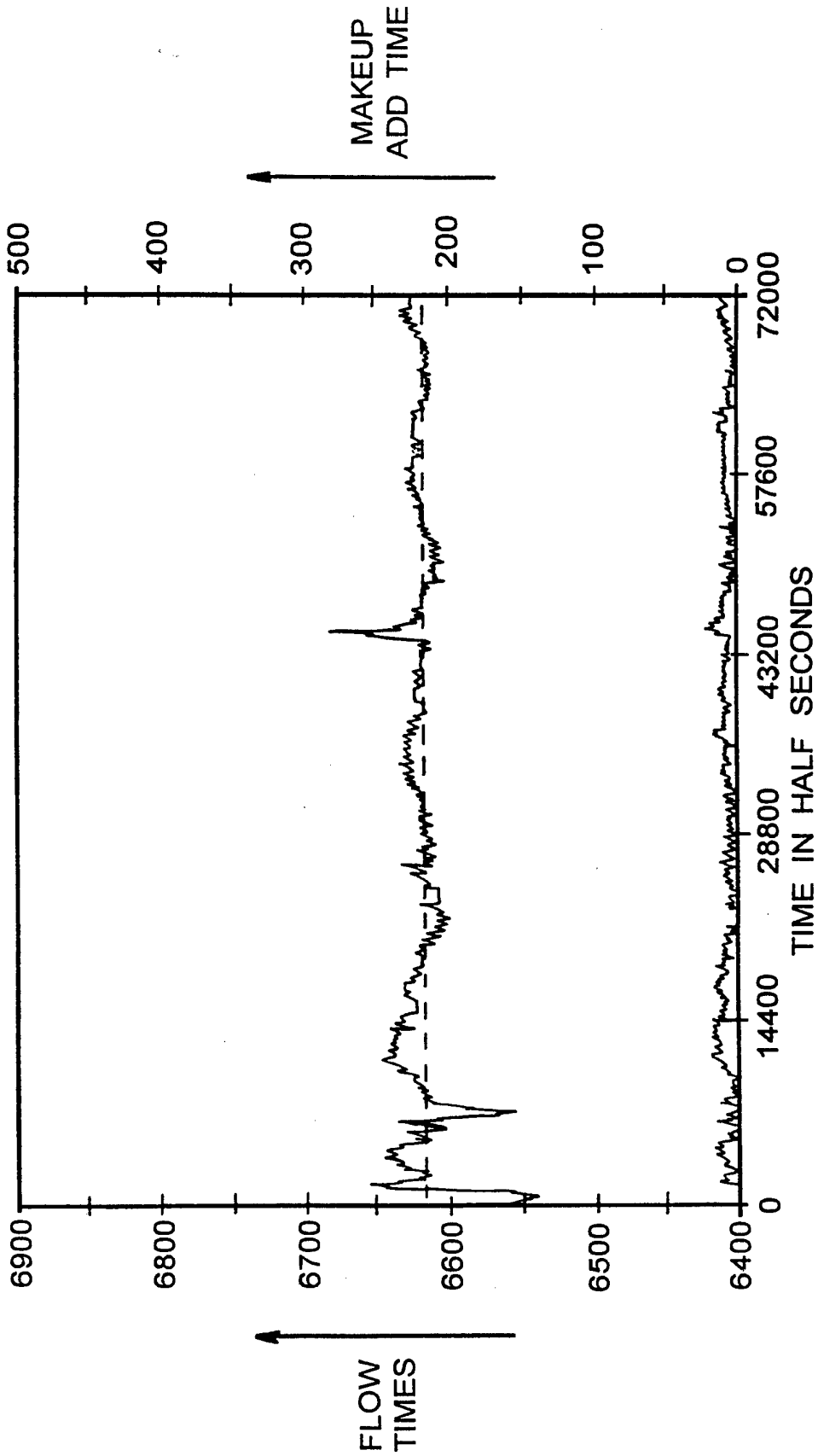
5. A method of operating an ink jet printer including projecting a stream of discrete ink drops towards a surface to be marked, electrically charging selected ink drops to control their deflection, and measuring the flight time of the selected charged ink drops, characterised by periodically comparing the measured flight time with a reference value, and altering the viscosity of the ink responsive to detection of a variation in flight time from the reference value by an amount related to the variation in flight time.

6. The method, as in Claim 5, characterised by measuring the flight time of selected charged ink drops between a means for electrically charging the drops and a catcher intended to receive uncharged or weakly charged drops, detecting changes in a stimulation voltage amplitude for generating the stream of ink drops, and appropriately altering the reference value used for future comparisons if a variation in

flight time is detected and there has been a change in the stimulation voltage amplitude.

7. The method, as in Claim 6, characterised by altering the reference value by appropriately adding or subtracting the magnitude of the detected variation thereto.

//5



**FIG. 1**  
PRIOR ART

2/5

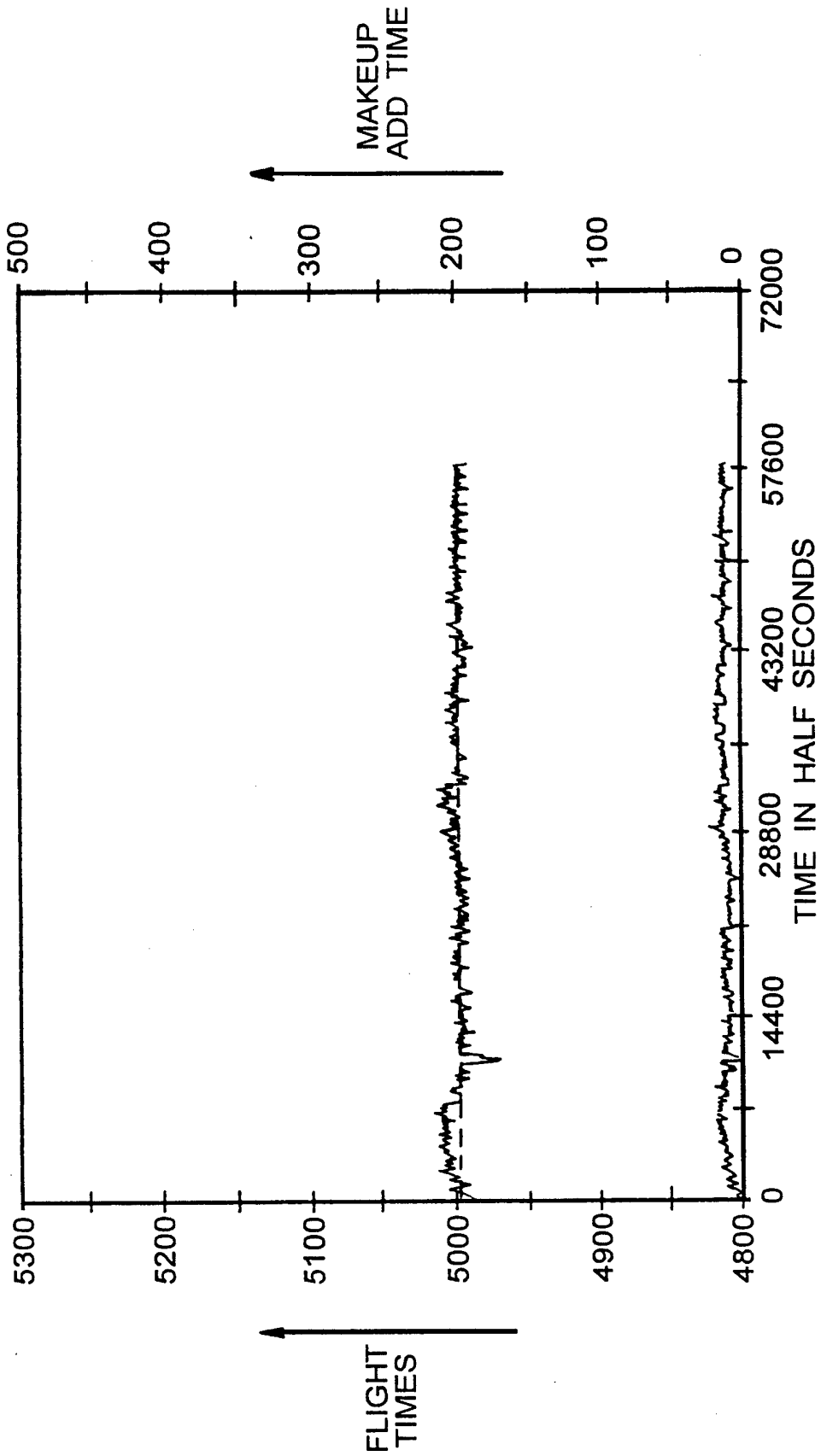


FIG. 2

3/5

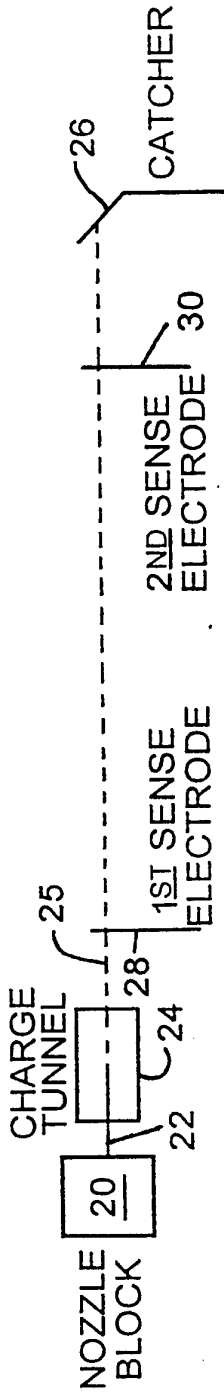


FIG. 3a

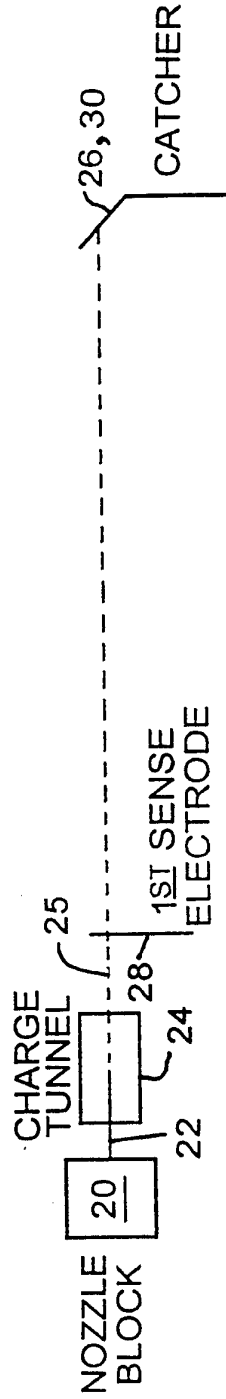


FIG. 3b

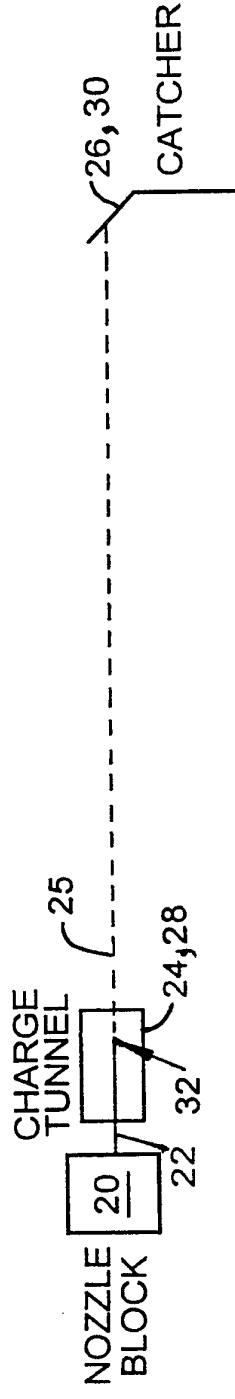


FIG. 3c

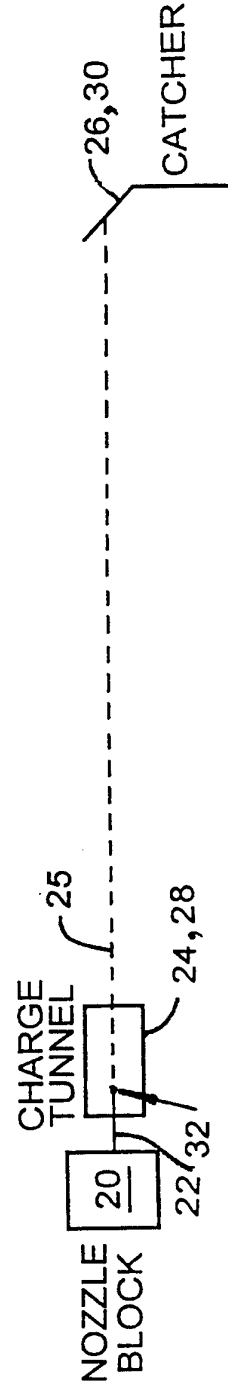
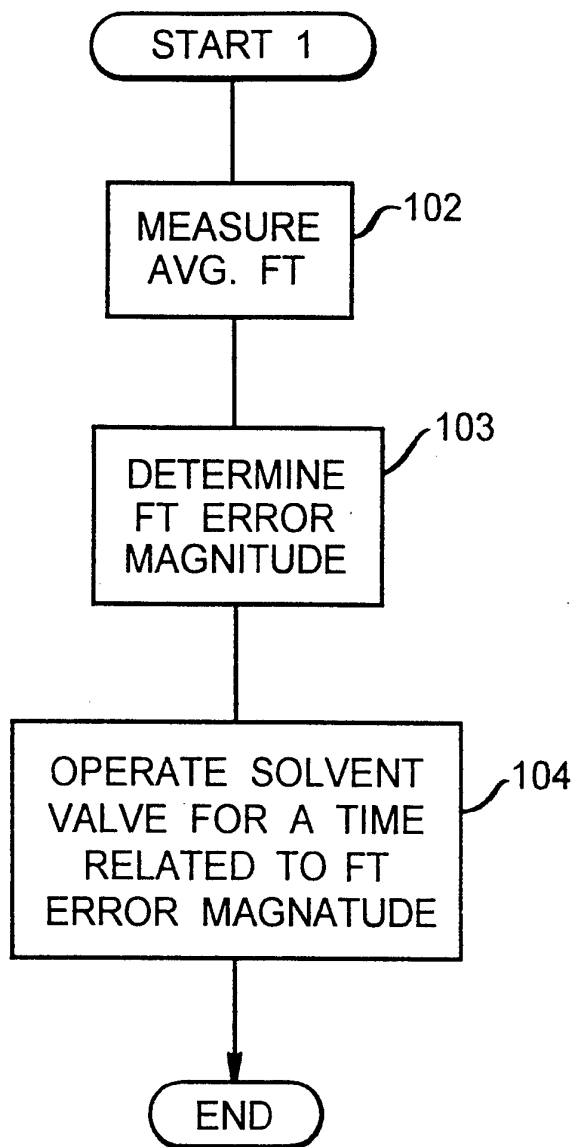


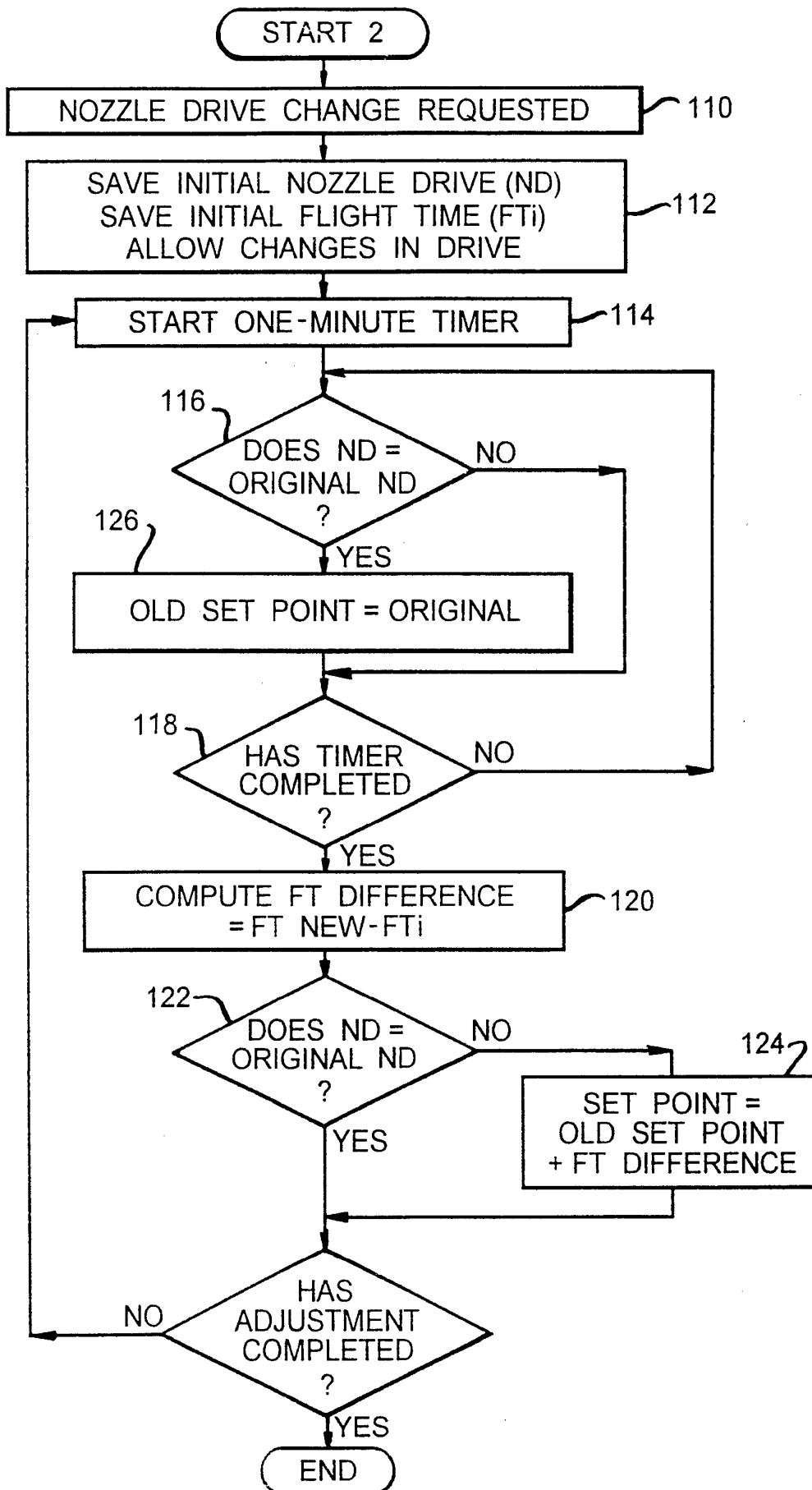
FIG. 3d

4/5



**FIG.4**

5/5



**FIG. 5**  
**SUBSTITUTE SHEET**

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 93/01602

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 5 B41J2/12 B41J2/115

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 5 B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,89 03768 (LINX PRINTING TECHNOLOGIES LIMITED) 5 May 1989 cited in the application see page 12, line 15 - line 21 see page 21, line 1 - line 28 see page 22, line 35 - page 24, line 12 see page 45, line 13 - page 46, line 12 see page 47, line 35 - page 48, line 8 see page 49, line 12 - line 20 see page 79, line 21 - line 32; claims 23,24,35,36	1-7
X	--- GB,A,2 250 236 (LINX PRINTING TECHNOLOGIES LIMITED) 3 June 1992 see the whole document --- <div style="text-align: center;">-/--</div>	1-7

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

2 November 1993

Date of mailing of the international search report

22. 11. 93

Name and mailing address of the ISA  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

JOOSTING, T

## INTERNATIONAL SEARCH REPORT

Int. onal Application No

PCT/GB 93/01602

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 250 235 (LINX PRINTING TECHNOLOGIES LIMITED) 3 June 1992 see the whole document ---	1-7
A	US,A,4 521 789 (JINNAI, KOICHIRO) 4 June 1985 see the whole document ---	1-7
A	US,A,4 542 385 (JINNAI ET AL.) 17 September 1985 see column 2, line 9 - line 30 ---	1-7
A	US,A,4 555 712 (ARWAY ET AL.) 26 November 1985 cited in the application see the whole document ---	1-7
A	US,A,4 827 280 (STAMER ET AL.) 2 May 1989 cited in the application see the whole document ---	1,4,5,7
A	US,A,4 535 339 (HORIKE ET AL.) 13 August 1985 cited in the application see the whole document -----	1-7

## INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/GB 93/01602

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-8903768	05-05-89	AU-A- 2605188	23-05-89
		EP-A, B 0386049	12-09-90
		EP-A- 0551967	21-07-93
		GB-A- 2236713	17-04-91
		GB-A, B 2250235	03-06-92
		GB-A, B 2250236	03-06-92
		JP-T- 3500749	21-02-91
GB-A-2250236	03-06-92	AU-A- 2605188	23-05-89
		EP-A, B 0386049	12-09-90
		EP-A- 0551967	21-07-93
		WO-A- 8903768	05-05-89
		GB-A- 2236713	17-04-91
		GB-A, B 2250235	03-06-92
		JP-T- 3500749	21-02-91
GB-A-2250235	03-06-92	AU-A- 2605188	23-05-89
		EP-A, B 0386049	12-09-90
		EP-A- 0551967	21-07-93
		WO-A- 8903768	05-05-89
		GB-A- 2236713	17-04-91
		GB-A, B 2250236	03-06-92
		JP-T- 3500749	21-02-91
US-A-4521789	04-06-85	JP-A- 59007055	14-01-84
		DE-A- 3324191	05-01-84
US-A-4542385	17-09-85	JP-A- 58031765	24-02-83
		DE-A, C 3231105	03-03-83
US-A-4555712	26-11-85	CA-A- 1238238	21-06-88
		EP-A, B 0170449	05-02-86
		JP-A- 61041555	27-02-86
US-A-4827280	02-05-89	EP-A- 0354715	14-02-90
		JP-A- 2196664	03-08-90
US-A-4535339	13-08-85	JP-C- 1717076	14-12-92
		JP-B- 4004153	27-01-92
		JP-A- 59041273	07-03-84

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 93/01602

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4535339		DE-A,C 3331587	01-03-84