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54 **Apparatus and method for clogging prevention in paper feeding devices of computer printers.**

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Description

The present invention relates to an apparatus and method for clogging prevention in paper feeding devices of computer printers, particularly in printers which can use a multiple copy continuous form as well as single paper sheets and which are provided to this purpose with pushing tractors and a rotatable platen or equivalent device.

High speed impact printers, generally serial printers, are available on the market (see for example EP-A-258026).

In order to meet differing user needs they are suitable for printing on multiple copy continuous form as well as on single sheets.

In the most recent products and in order to enable first the printing on a continuous form, then the printing on single sheets and subsequently again on the continuous form, without need to remove and insert again the continuous form from/into the feeding devices, feeding devices are used for the continuous form, which are defined as pushing tractors, in that they are located upstream a platen and convey or push the continuous form towards the platen.

The platen, which is preferably in form of a rotating drum and is provided with pressure rollers is controlled to revolve with a peripheral speed equal or slightly greater than the tractors feeding speed.

It cooperates with the tractors in feeding the continuous form, when the continuous form is used.

In addition it may be controlled independently of the tractors for the feeding of single sheets.

Whilst the feeding of single copy continuous forms, as well as the feeding of single sheets, does not cause any problem, the feeding of multiple copy continuous forms involves difficulties and problems which cannot be easily solved.

The tractors perform a simultaneous pull on all the copies of the continuous form, owing to the insertion of tractor pins in openings provided at the edges of the continuous form.

However, in the zone downstream the tractors, where the continuous form is released and pushed away from the tractors, the paper advancement is largely affected by the configuration of the path and the features of the feeding devices which are encountered.

A very common drawback is for instance the relative offsetting of the several copies, owing to idle roller or resilient leaves which press the continuous form against the platen.

The copy sheet in contact with the platen, or rear sheet, is fed more effectively than the other sheets and the front sheet.

The front sheet is braked by the rollers and tends to form a wave first, then accumulation sacks which cause the clogging of the feeding devices.

The phenomenon may be further exalted by the

path shaping, if, as it often occurs, the continuous form is wound for a certain arc on the revolving platen so that the path followed by the inner sheet is shorter than the one followed by the intermediate sheets and the outer one.

Even if it may appear contradictory the reverse phenomenon may occur. If the feeding action of the platen is essentially due to an effective pinching performed by the pressure rollers, which locally prevent any relative slipping of the sheets, and if the path followed by the several sheets has a differing length due to a partial winding on the platen, the outer sheet tends to advance more than the inner sheet, which forms an accumulation sack between the platen and the tractors. The phenomenon to be faced is therefore largely dependent on contact pressures, frictions and continuous form properties (frictions among the several sheets), hence dependent on parameters which are difficult to be controlled, variable in the time, from model to model, from unit to unit.

The drawback occurrence is therefore unpredictable and difficult to be corrected.

As a consequence the several solutions which have been proposed to overcome the drawback have proved to be inadequate and anyhow limited to specific arrangements.

These drawbacks are overcome by the apparatus and method of the present invention which does not aim to prevent the unpredictable slipping among copies of a continuous form, but which aims to contain such slipping within predetermined allowable limits so as not to hamper the functionality of the feeding devices.

Considering that the slipping amount is proportional to the amount by which the continuous form is advanced, this result is obtained with an apparatus which comprises means for performing the following steps:

- detecting that the continuous form has been advanced for a predetermined amount,
- stopping the continuous form advancement once it has reached a predetermined amount,
- controlling the movement of the continuous form in the opposite direction, that is a continuous form return, for a predetermined amount having at least an order of magnitude lesser than the one of the prior advancement, said return being followed by the forward advancement of the continuous form for another predetermined amount.

Such other amount may be equal to the return amount or may differ from it by a predetermined amount.

Preferably but not necessarily the apparatus means are only active when their intervention is required, on direct command by operator or indirectly when the printer is preset to operate with forms having a predetermined thickness, implying the use of multiple copy modules. The features and the advantages

of the invention will appear more clearly from the following description of a preferred form of embodiment of the invention and from the enclosed drawings where:

- Figure 1 is a block diagram, with mechanism side view, of a printer including the apparatus of the present invention

- Figure 2 is a block diagram of a control unit for the printer of fig. 1.

Figure 1 shows in block diagram, a printer including the apparatus of the invention.

The mechanical elements of the printer are shown in side view.

The printer comprises a tractor pair 2, one of the tractors being shown in the figure, a revolving platen 3, a printing member 8, a motor 1 for actuating the tractors and the platen, a control unit 19 and a control keyboard 20.

The tractors 2 push a continuous form 11 towards the platen 3 and a guiding element 6 drives the module along the periphery of the platen 3.

The continuous form interposes between the platen 3 and the printing member 8.

Pressure rollers 5 press the continuous form against the platen. In the zone comprised between the pressure rollers 5 and the tractors 2, the continuous form is pulled towards the printing line defined by the printing member 8, owing to the friction between module and revolving platen, with the drawbacks already mentioned in case a multiple copy continuous form is used.

Numerals 12 references an exemplary wave formed by the rear copy of the form, between tractors 2 and platen 3.

Form 11, downstream the pressure rollers 5, leaves the platen and rests on a laying down plane and a collection basket not shown.

A printer like the one shown may also use single sheets as a printing medium, in alternative to the continuous form.

A single sheet, referenced by numeral 13 is inserted between platen 3 and some pressure rollers 4. It is fed downward by rotation of the platen.

A guiding element 7 holds the single sheet in proximity of the platen.

Leaving the guiding element 7, the single sheet follows the same path of the continuous form: it is driven along the periphery of the platen by guiding element 6 until it interposes between printing member 8 and platen 3.

Then it inserts between platen 3 and pressure rollers 5 and leaves the platen to rest on a laying down plane.

A mechanical clutch 27, manually operated or controlled by unit 19 enables to decouple tractors 2 from motor 1, so that the platen may be rotated independently of the tractors.

If the motor 1 is a step motor, it may be operated

by unit 19 through leads 15, without need of feedback.

If the motor 1 is a DC motor, an encoder 14 coupled to the motor provides unit 19, through leads 16, with feedback signals which enable to detect the rotor position and, in case, its speed.

Control unit 19 controls, in known manner, the printing member 8, through leads 17.

A lever 9, acting on the position of the platen shaft, enables to change the platen distance from the printing member 8 as a function of the printing support thickness (single sheet, multiple copy continuous form).

The apparatus of the present invention essentially comprises some elements already present in the prior art printers, such as tractors 2, a motor 1 and a control unit 19.

It requires two additional elements in the control unit 19.

Figure 2 shows in block diagram the essential constitutive elements of control unit 19.

Unit 19 comprises a microprocessor 22, a read only control store 23 and a read/write memory 24.

A communication bus 25 enables the microprocessor to receive signals from several printer elements, via leads 16, 21, 18 and to forward suitable control signals, via leads 15, 17.

The microprocessor is controlled by suitable control programs, stored in control store 23.

Memory 24 is used as a "buffer" where to store and read information such as sequences of characters to be printed, line feed commands, and so on.

According to the invention the control unit further comprises a counter 26 and contains, in control store 23, a suitable control routine.

Counter 26 receives, through leads 15, the actuation commands forwarded to motor 1 and increments by one unit at each command sent to the motor which causes its rotor to move of a predetermined incremental amount, hence causing a predetermined feeding of the printing support.

In alternative but in a completely equivalent manner the signals for incrementing the counter may be obtained from encoder 14, through leads 16.

When the counter 26 reaches a predetermined counting state, corresponding to a predetermined forward feeding of the printing support, it generates an interrupt signal which is received by processor 22 through lead 29.

Due to this interrupt, processor 22 fetches a control routine 28, specific of this invention, from store 23.

This control routine, executed by processor 22, causes the operation of motor 1 in the reverse direction, so as to draw a predetermined amount of the printing support from the platen towards the tractors, then the operation of motor 1 in normal or forward direction so as to cause a predetermined amount of the printing support, preferably equal to the amount drawn in reverse direction, to be fed forward and last

the resetting of counter 26, through a lead 30.

The experimentation shows that the slipping occurring between the copies of a continuous form, in the course of its forward feeding for an amount in the order of 1-2 meters, is integrally recovered with a reverse motion in order of a tenth of centimeters.

This may be explained considering that slipping is due to an imperfect drawing of the module by the platen, which acts on the module portion comprised between rollers 5 and tractors 2.

By reverse, when the module is drawn back, the platen is not effective to perform the paper movement which is essentially controlled by tractors 2, with a pulling action which is exerted on all the module copies and causes their realignment.

Preferably, in order to avoid the execution of a realignment operation which is not required, the control routine 28 may be fetched only when the printing support is a multiple copy continuous form.

To this purpose, as shown in Fig. 1, a switch 10 may be provided, operated by lever 9 when it is set in a position corresponding to a printing support of greater thickness (multiple copy module).

Switch 10 forwards to control unit 19, through lead 18, an enabling signal for counter 26, which missing such signal does not increments or is held in reset status.

In alternative the enabling signal may be provided by keyboard 20 through lead 21 (Fig. 1).

It is therefore clear that the described apparatus and the method performed may be subject of several changes.

For instance counter 26 may be replaced by a register or a memory location 31 in memory 24 where to store the counting information. The incrementing operation on the contents of the memory location 31 may be performed by processor 22.

In this case the routine 28 which causes the execution of the method according to the invention may develop according to the following steps:

- 1) Control one motor step (printing program)
- 2) Is the printing support a multiple copy continuous form?
If yes go to step 3, otherwise return to printing program.
- 3) Read counter register into accumulator
- 4) Increment accumulator
- 5) Is accumulator contents equal or greater than C?
If yes go to step 6 otherwise to step 10.
- 6) Control M1 motor steps backward.
- 7) Control M2 motor steps forward ($M1=M2$).
- 8) Write 0 in counter register (Reset)
- 9) Go to N (printing program)
- 10) Write accumulator into counter register.
- 11) Go to N (Printing program)

As it can be seen the control routine is very simple and may lead to several changes.

For instance the order in which steps 6) and 7) are performed may be inverted and the quantity M1 by which the module is fed back may differ from the quantity M2 by which the module is fed forward.

In this case for instance, M2 may be greater than M1 and logical step 7) may comprise step 1) of the routine.

In other words, when the continuous form has been fed for an amount equal or greater than a predetermined amount, at the occurrence of one or more line feed commands NI, the module is fed by an amount $M2=M1+NI$, then fed back for the amount M1.

In alternative the module is first fed back for the amount M1, then advanced for the amount M2.

In order to avoid that slipping recovery performed in the course of printing one page, that is between two subsequent lines, printed on the same page, might result in uneven line pitch as to the previous and the following ones, the slipping recovery may be postponed until printing of a full page has been completed, that is until the control routine detects an end of page command or like signal.

Claims

1. Apparatus for clogging prevention of paper feeding devices in a computer printer of the type where a tractor pair pushes a multiple copy continuous form towards a platen, comprising:
 - counting means for generating an indication that the continuous form has been fed forward of a first predetermined amount, and
 - control means responsive to said indication for controlling said tractors to feed back said continuous form of a second predetermined amount, having at least an order of magnitude lesser than said first amount, and to feed forward said continuous form of a third amount equal or having the same order of magnitude of said second amount, said control means providing further to reset said counting means in a predetermined status.
2. Apparatus as in claim 1 comprising means for signalling the presence of a multiple copy continuous form in said printer and for enabling said counting and/or control means to perform only when the presence of a multiple copy continuous form is signalled in said printer.
3. Apparatus as in claim 1 comprising a control key for enabling said counting and/or control means to perform on command from said key.
4. A method for clogging preventing of paper feeding devices in a computer printer, of the type

where a tractor pair pushes a multiple copy continuous form towards a platen consisting in:

- detecting when the continuous form has been fed forward of at least a predetermined amount and upon said detection:
- feeding back said continuous form for a second predetermined amount, having at least an order of magnitude lesser than the magnitude of said first amount, and
- feeding forward said continuous form of a third predetermined amount having the same order of magnitude of said second amount.

Patentansprüche

1. Einrichtung zur Störungsverhütung in der Papierzufuhr eines EDV-Druckers, bei dem zwei Traktoren ein Durchschreib-Endlosformular einer Druckplatte zuführen, mit
 - einer Zählvorrichtung zum Erzeugen einer Anzeige, daß das Endlosformular um einen ersten vorgegebenen Betrag vorwärts bewegt wurde,
 - einer auf diese Anzeige ansprechenden Steuereinrichtung zum Steuern der Traktoren, um das Endlosformular um einen zweiten vorgegebenen Betrag rückwärts zu bewegen, der um wenigstens eine Größenordnung kleiner ist als der erstgenannte Betrag, und zum vorwärtsbewegen des Endlosformulars um einen dritten Betrag gleich oder von gleicher Größenordnung wie der zweite Betrag, wobei die Steuereinrichtung ferner die Zählvorrichtung in einen vorgegebenen Zustand zurücksetzt.
2. Einrichtung nach Anspruch 1 mit einer Vorrichtung zum Signalisieren der Anwesenheit eines Durchschreib-Endlosformulars im Drucker und zum Aktivieren der Zählvorrichtung und/oder der Steuereinrichtung nur dann, wenn die Anwesenheit eines Durchschreib-Endlosformulars im Drucker signalisiert wird.
3. Einrichtung nach Anspruch 1 mit einer Steuertaste zum Aktivieren der Zählvorrichtung und/oder der Steuereinrichtung auf Befehl dieser Taste.
4. Verfahren zur Störungsverhütung in der Papierzufuhr eines EDV-Druckers, bei dem zwei Traktoren ein Durchschreib-Endlosformular einer Druckplatte zuführen, bestehend aus
 - Detektieren, ob das Endlosformular wenigstens um einen vorgegebenen ersten Betrag vorwärts bewegt wurde, und bei einer solchen Feststellung:
 - Rückwärtsbewegen des Endlosformulars

um einen zweiten vorgegebenen Betrag, der wenigstens um eine Größenordnung kleiner ist als der erste Betrag, und

- Vorwärtsbewegen des Endlosformulars um einen dritten vorgegebenen Betrag von der gleichen Größenordnung wie der zweite Betrag.

Revendications

1. Appareil pour la prévention des perturbations dans l'entraînement du papier des imprimantes d'ordinateurs du type où une paire de dispositifs d'entraînement pousse un imprimé en continu à copies multiples vers un rouleau d'impression, comprenant :
 - des moyens de comptage pour produire une indication selon laquelle l'imprimé en continu a été alimenté en avant, d'une quantité prédéterminée,
 - et
 - des moyens de commande réagissant à ladite indication pour la commande desdits dispositifs d'entraînement pour alimenter en arrière ledit imprimé en continu d'une deuxième quantité prédéterminée, ayant au moins un ordre de grandeur plus petit que ladite première quantité, et pour alimenter en avant ledit imprimé en continu d'une troisième quantité égale ou du même ordre de grandeur que ladite deuxième quantité, lesdits moyens de commande effectuant, de plus, le recalage desdits moyens de comptage dans un état prédéterminé.
2. Appareil selon la revendication 1, comprenant des moyens pour signaler la présence d'un imprimé en continu à copies multiples dans ladite imprimante et pour autoriser lesdits moyens de comptage et/ou de commande à fonctionner uniquement quand la présence d'un imprimé en continu à copies multiples est signalée dans ladite imprimante.
3. Appareil selon la revendication 1, comprenant une clef de commande pour autoriser lesdits moyens de comptage et/ou de commande à fonctionner sur la commande de ladite clef.
4. Procédé pour la prévention des perturbations dans l'entraînement du papier des imprimantes d'ordinateurs du type où une paire de dispositifs d'entraînement pousse un imprimé en continu à copies multiples vers un rouleau d'impression, consistant à :
 - détecter quand l'imprimé en continu a été alimenté en avant d'au moins une quantité prédéterminée et, suite à ladite détection :

- alimenter en arrière ledit imprimé en continu d'une deuxième quantité prédéterminée, ayant au moins un ordre de grandeur plus petit que la valeur de ladite première quantité, et
- alimenter en avant ledit imprimé en continu d'une troisième quantité prédéterminée du même ordre de grandeur que ladite deuxième quantité.

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