# United States Patent [19]

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## [54] PRINTER RIBBON FEED


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[52] **U.S. Cl.** ..... **197/168,** 197/151

[51] **Int. Cl.** ..... **B41j 33/10**

[58] **Field of Search** ..... 197/168, 153, 157, 197/49, 151



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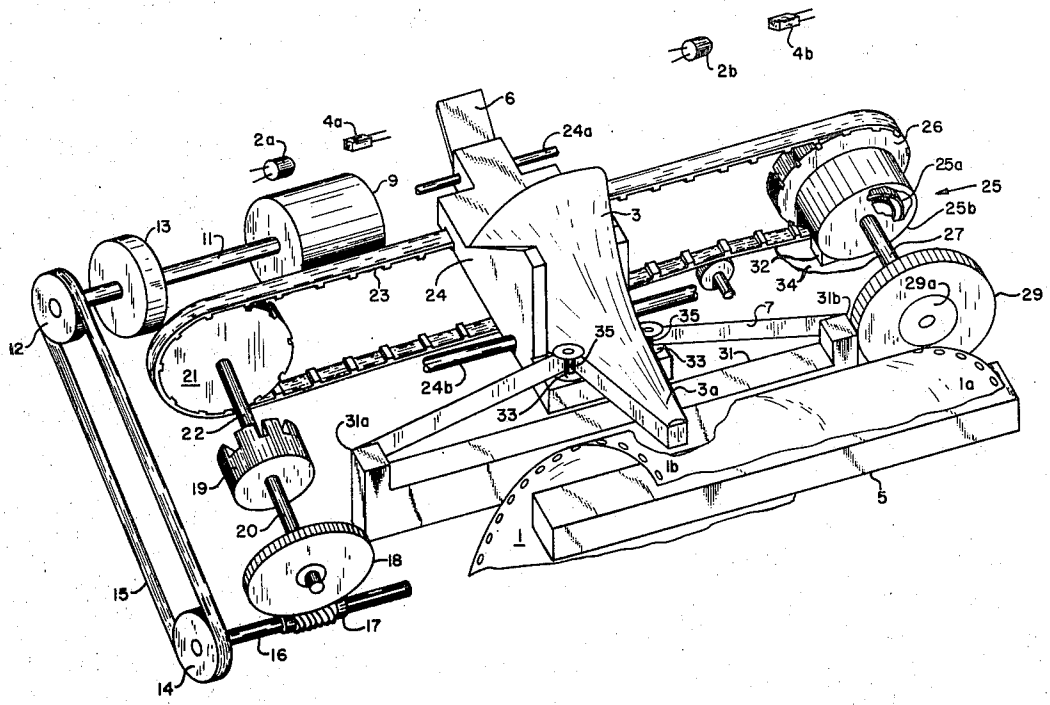
[57] **ABSTRACT**

A printer having a printhead which moves from left to right across the document to print a line and a ribbon located between the printing end of the printhead and the document. Ribbon supply means is provided at the right side of the document, ribbon take-up means is provided at the left side of the document and means for engaging the ribbon when the printhead moves from right to left is mounted on the printhead. During a printing operation with left-to-right movement of the printhead, the ribbon remains stationary and is traversed by the printhead. This provides a new area of the ribbon for printing each character. When the printhead returns to the left to begin a new line, printing does not occur and the engaging means connected to the printhead pulls the ribbon from the supply means. The resulting slack in the ribbon is taken up at the left side of the document by the take-up means and when the printhead reaches the left margin a new supply of ribbon has been provided for printing the next line. Since the printhead prints when moving toward the right, its velocity is slower in this direction. Preferably, the engaging means is fractionally operable to engage the ribbon at the higher speed during leftward movement but slides with respect to the ribbon at the slower velocity during rightward movement.


**4 Claims, 5 Drawing Figures**



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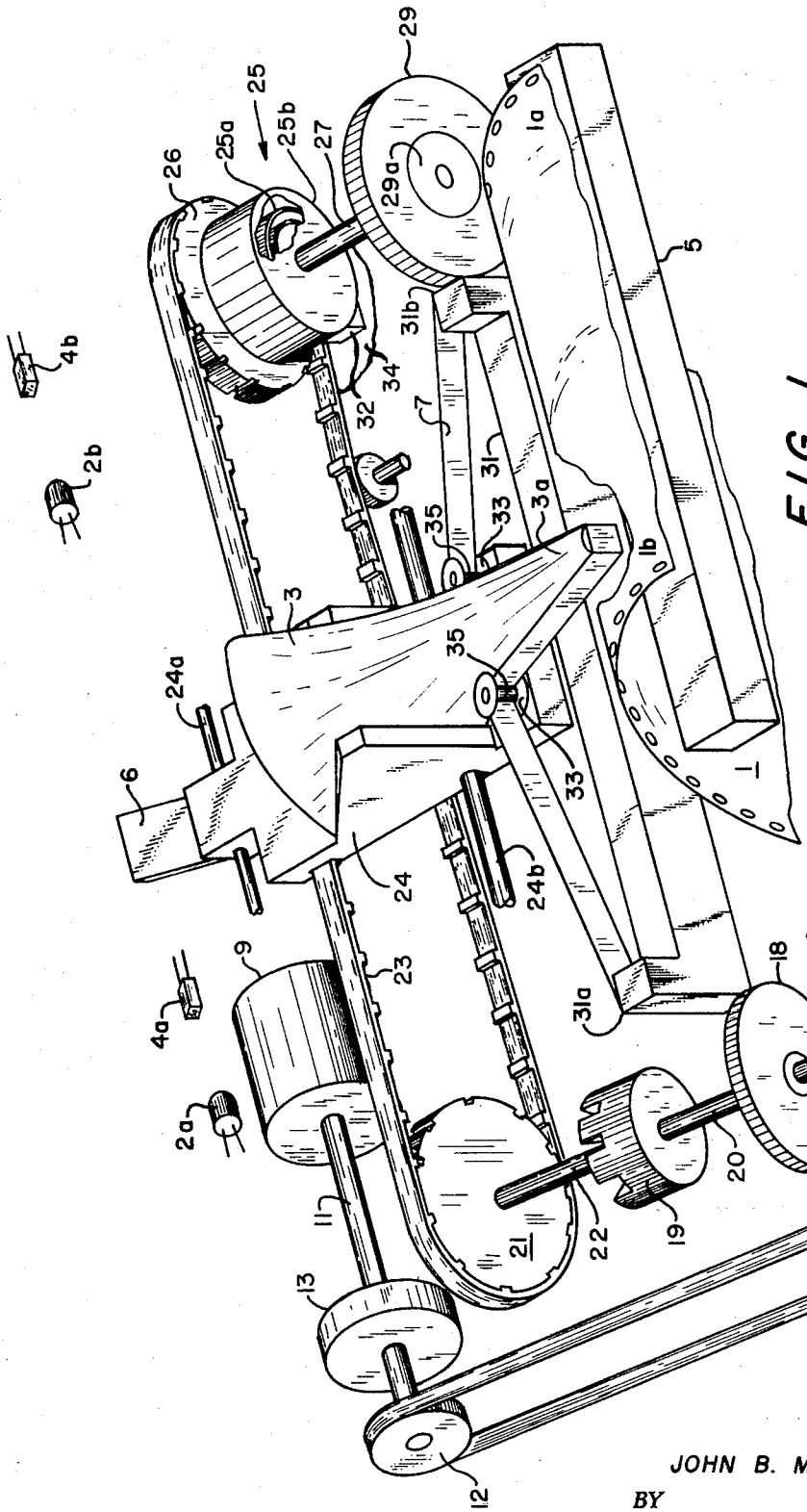


FIG. 1

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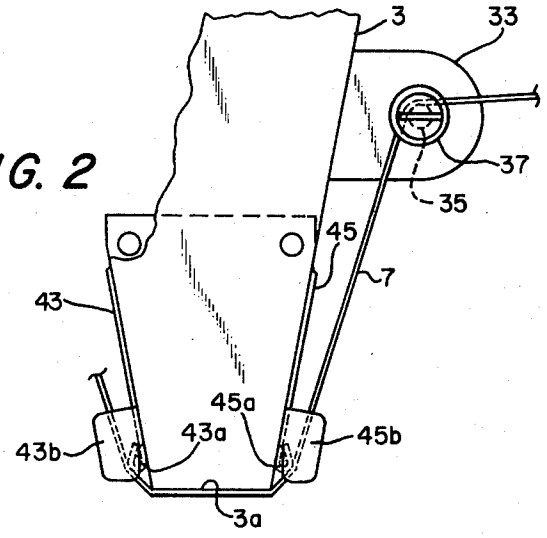
FIG. 2



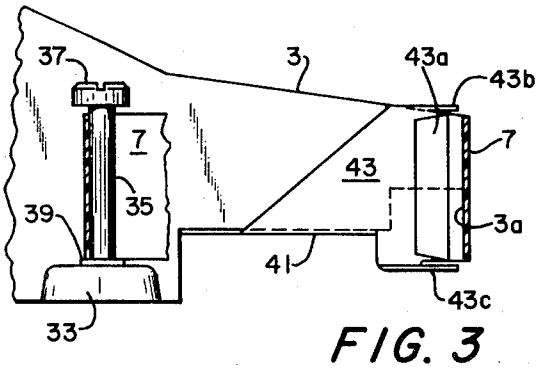




FIG. 3

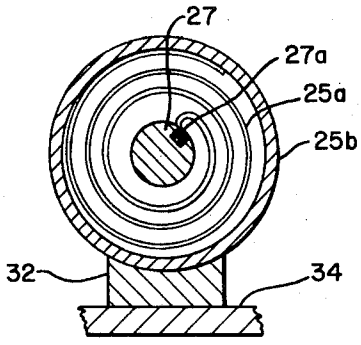



FIG. 5

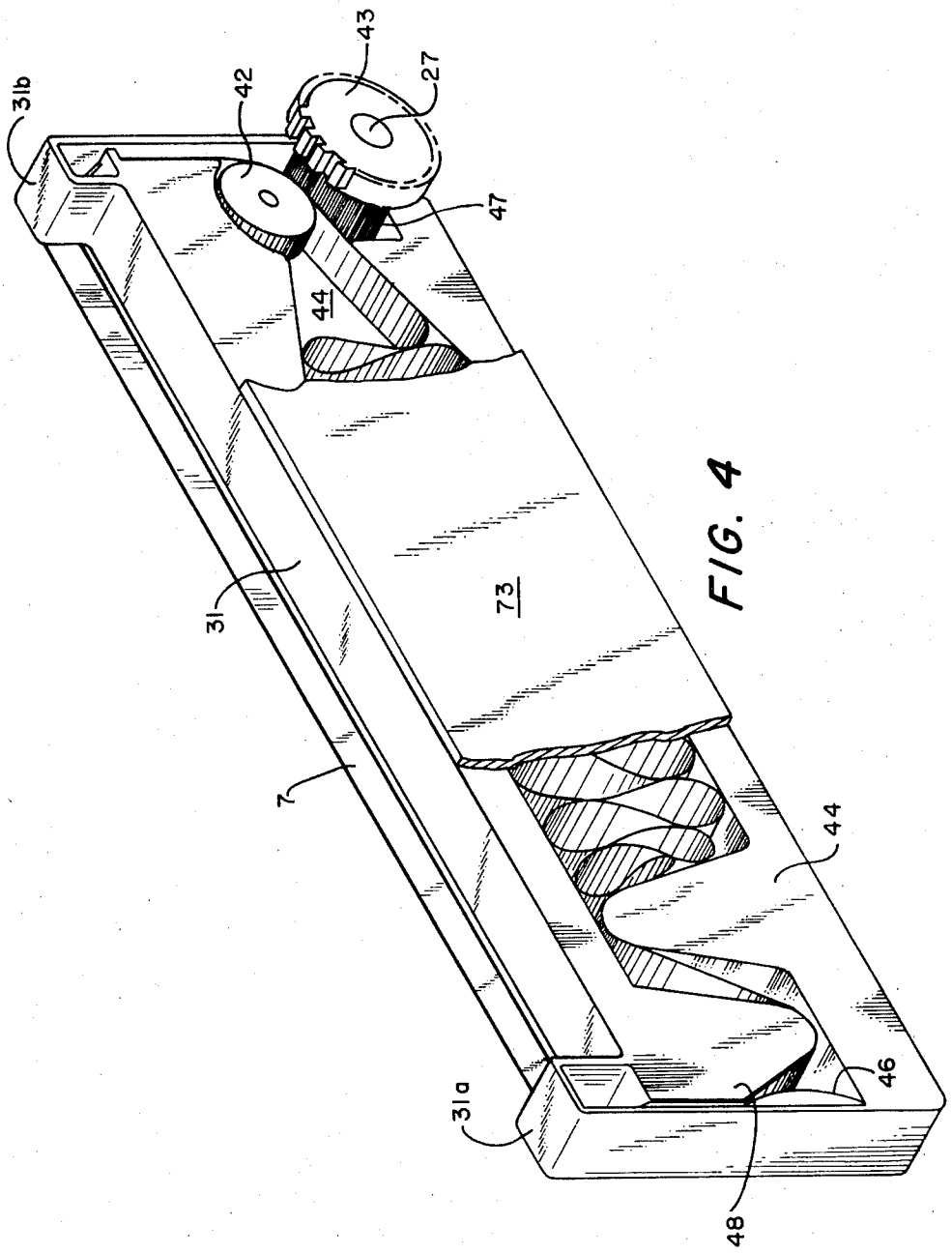



FIG. 4

# PRINTER RIBBON FEED

## BACKGROUND OF THE INVENTION

This invention relates to printers of the type wherein an inked ribbon is moved with respect to the document so that different areas of the ribbon may be used for printing. More particularly, this invention relates to feeding an inked ribbon in such a printer having a printhead which moves across the document to print a line.

Printers having printheads that move from the left to the right margin as they print a line, character by character, are well known. Upon completing a line, the printhead returns to the left margin to begin a new line while the document being printed upon is stepped to present a new blank area for printing. The necessary ink in many of these printers is provided by a ribbon located between the printhead and document. The ribbon is generally moved between locations adjacent the left and right margins of the document so that fresh ink is provided for printing successive lines. Such ribbon movement is often accomplished by a continually driven take-up reel at one margin which pulls the ribbon from a supply reel at the other margin. In order to utilize all the ribbon, it is generally moved at a slow speed so that some ribbon is not missed during return leftward movement of the printhead. However, by feeding it at a slow speed, some areas of the ribbon are used twice due to the faster speed of the printhead.

Obviously, those characters printed with this already used areas of the ribbon are lighter than those printed with the new ribbon. Each printed line thus contains characters of different densities.

## SUMMARY OF THE INVENTION

It is the primary object of this invention to provide a printer, having a printhead which moves across the document, with a ribbon feed that allows printing of each line with characters of uniform density.

It is a further object to provide a ribbon feed for such a printer which is simple, reliable and inexpensive.

These objects and others are achieved by the invention according to which a printer with a printhead that moves between two positions across the document to print a line is provided with a ribbon supply means at one side of the document and ribbon take-up means at the other. Means for engaging the ribbon is connected to the printhead and operable only when the printhead travels toward the take-up means and away from the supply means. During this movement, the ribbon is pulled from the supply means and gathered at the take-up means. Generally, the printhead in such a printer moves at a slower velocity in one direction during which it prints than in the other direction when it returns to begin a new line. Preferably, the engaging means is frictionally operable so that it engages the ribbon at the higher velocity but, at the lower velocity, the ribbon is allowed to slide with respect to it and the printhead. This allows each character of the line to be imprinted with a new supply of ink as the printhead traverses the ribbon while printing. Uniform character densities across the lines are thereby provided. As the printhead returns to begin a new line, the ribbon is engaged and a new supply pulled from the supply means.



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a printer incorporating a preferred embodiment of the invention.

FIG. 2 is a partial plan view of the printhead and the means connected to the printhead for engaging the ribbon.

FIG. 3 is an elevation view of the elements shown in FIG. 2.

FIG. 4 is a rear perspective view of the ribbon cassette (with its rear side partially cut-away) from which the ribbon is supplied and into which it is taken up.

FIG. 5 is a view of the spring mechanism for returning the printhead to the left margin.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a schematic rear view of a printer embodying the invention. Thus, the left margin of the document 1 being printed upon is designated 1*a* and appears at the right side in FIG. 1. Conversely, the right margin of the document is designated 1*b* and appears at the left in FIG. 1. The printer is of the type which prints characters, one by one, with a printhead 3 which moves across the document 1 from its left margin 1*a* to its right margin 1*b*. The printhead shown is of the well known matrix variety and thus contains a plurality of styli wires which are selectively projected out of its printing end 3*a* in patterns which form the characters on the document 1 as it moves from the left to the right margin (toward the left in FIG. 1). When printing, the styli wires force an inked ribbon 7 against the document 1 and a platen 5 located in back of the document to form their impressions. After printing each line, the printhead is returned to the left margin 1a to initiate a new line. During this "carriage return" movement, the document 1 is stepped (by means not shown) a one line increment so that a new blank area is provided for printing.

A motor 9 is provided for moving the printhead toward the right margin 1*b* when printing. This drive motor could also be utilized by appropriate means to step the document 1 after each line is printed. However, the document stepping means is not shown in FIG. 1 since any conventional apparatus could be utilized. The output shaft 11 of drive motor 9 having flywheel 13 thereon drives a pulley 14 via another pulley 12 and a belt 15. Pulley 14 via shaft 16 and worm 17 drives gear 18 which is connected to a driving gear 21 via shaft 20, clutch 19, and shaft 22. The motor 9 continually drives gear 18 and the clutch 19 is selectively operable to effect rotation of the driving gear 21. A toothed belt 23 is drivingly connected around the peripheries of the driving gear 21 and a further gear 26 to drivingly connect the two. The printhead 3 is connected to belt 23 by member 24 on which the printhead is mounted and which is rigidly attached to belt 23. Gears 21 and 26 are spaced apart at opposite ends of the document and, with the printhead attached to belt 23, rotation of these gears causes the printhead to move back and forth across the document 1 being printed upon. A pair of guide bars, 24*a* and 24*b* are slidably located through the mounting member 24 to guide movement adjacent to gear 26.

A spring mechanism **25** is mounted adjacent to gear **26**. FIG. **5** shows the spring mechanism from the rear of the printer similar to the view of FIG. **1**. Referring to both these FIGS., the mechanism **25** comprises a housing **25***b* within which a helical spring **25***a* is located. A shaft **27** extends through the spring mechanism **25** and is connected to gear **26** to rotate therewith. Within the housing **25***b*, the shaft **27** has a keyway **27***a* (FIG. **5**) within which one end of the spring **25***a* is secured. The other end of the spring **25***a* is connected to the housing **25***b* which, in turn, is held fixed by a mount **32** on a base **34**. With the shaft **27** connected to gear **26**, counter-clockwise rotation of the gear winds up the spring **25***a*.

During operation of the printer, the drive motor **9** continually operates to drive gear **18** and, when clutch **19** is engaged, gear **21** is rotated counter-clockwise (in FIG. **1**) to move belt **23** around gears **21** and **26**. As the gears rotate counter-clockwise, the printhead moves from the left **1***a* to the right **1***b* margin of the document **1**. During this movement of the printhead, a line of characters is printed on the document and spring **25***a* is wound due to the rotation of shaft **27** from gear **26**. After the line has been printed and the printhead has reached the right margin **1***b* of the document, light from the light source **2***a* normally received by a photocell **4***a* is interrupted by a shutter **6** mounted to the printhead mounting **24**. The resulting change in the photocell's output is utilized by appropriate circuitry to disengage clutch **19**. When disengaged, the clutch **19** allows gear **21** to freely rotate and due to the force of spring **25***a* gears **26** and **21** are caused to rotate clockwise and the printhead **3** is carried to the left margin **1***a* of the document. Just after reaching this left margin, the shutter **6** interrupts light between a second photocell **4***b* and light source **2***b*. The resulting change in the output of photocell **4***b* appropriate circuitry to now engage the clutch **19**. This obviously causes gear **21** to begin to rotate counter-clockwise and initiate printhead movement toward the left in FIG. **1** during which printing occurs.

The circuitry for controlling the clutch **19** in response to the photocells **2***a* and **2***b* is not shown or described since any suitable conventional circuit may be utilized and such a circuit forms no part of the invention. Similarly, the printhead itself and the circuits for controlling it are not illustrated since any suitable well known elements could be utilized and these do not form a part of the invention.

Referring again to FIG. **1**, the printer contains a ribbon cassette **31** for providing the ribbon **7**, which is endless, from its supply end **31***a* located adjacent the right margin **1***b* of the document. A shown, the ribbon is guided in a path from the supply end **31***a*, to around the printhead **3** and, thereafter, to the opposite end **31***b* of the cassette. At the printhead, the ribbon is engaged such that during movement by the printhead to the right margin **1***b* the printhead slides with respect to the ribbon. However, during movement of the printhead towards the left margin **1***a*, the ribbon is engaged at the head and pulled from the supply end **31***a* of the cassette. This obviously causes slack in the ribbon at the cassette's take-up end **31***b* which is taken care of by a ribbon drive gear **29** mounted on the shaft **27**. As previously disclosed, shaft **27** revolves with printhead movement to the left margin during carriage return. Ribbon drive gear **29** thus rotates during this time and engages a gear **43** shown in FIG. **4** to cause the slack ribbon to be taken-up into the cassette **31**.

A mechanical one-way clutch **29***a* is provided between gear **29** and the shaft **27** so that the ribbon drive gear **29** is not rotated during printhead movement to the right margin. The clutch **29***a* allows the gear to become drivingly engaged with shaft **27** only when the shaft is being rotated (clockwise in FIG. **1**) by the spring mechanism **25** during carriage return when ribbon slack occurs at the left margin and rotation of gear **29** is desired. Any appropriate one-way clutch may be used.

Referring to FIG. **4** which illustrates the cassette with its back side **73** partly cut-away, gear **43** is mounted at the end of a first pinch roller **47** which cooperates with a second pinch roller **42** to engage the ribbon between them and pull it into the cassette during carriage return. However, during printhead movement to the left margin, the two rollers operate to hold the ribbon stationary as it is traversed by the printhead. Between its supply end **31***a* and take-up end **31***b* the ribbon is stored in a series of vertical loops. At the supply end, the ribbon travels through an outlet passageway (not shown) from which it is pulled by the printhead. This outlet passageway and the inlet passageway (also not shown) at end **31***b* of the cassette are merely holes in the rear side **44** of the cassette. At the input end **31***b*, the ribbon **7** enters the input passageway, turns 90°, and then travels downwardly to become engaged between rollers **42** and **47**. At the output end **31***a*, the ribbon **7** passes between a spring **46** and a guide **48**, turns 90°, and thereafter passes out of the outlet passageway of the cassette. A spring **46** and guide **48** pinch the ribbon between them so that the ribbon may be pulled from the cassette with a constant tension.

As shown in FIG. **1**, the ribbon at the printhead takes a substantially U-shaped form since it travels around the printing end **3***a* of the printhead and passes around a pair of pins **35** located on opposite sides of the printhead **3** but disposed away from the printing end **3***a*. FIGS. **2** and **3** show the ribbon engaging means located at the printhead which causes the ribbon to take this path. The engaging means frictionally engages the ribbon during carriage return but allows the ribbon to slip with respect to it and the printhead during the printing operation. This action is achieved by and dependent upon the speed with which the printhead is moved across the document. When printing, the printhead necessarily moves at a slower velocity than during carriage return. At this slower speed, slippage occurs while the higher speed of the printhead during carriage return causes the ribbon to be frictionally engaged. With the preferred embodiment disclosed, it has been found that when the printhead is moved to print across the document from left margin **1***a* to right margin **1***b* at a relatively constant speed of 10 inches per second and, thereafter, returned to the left margin constantly accelerating from a zero velocity at the right margin 1b to a maximum velocity of approximately 65 inches per second at the left margin, the engaging means illustrated frictionally engages the ribbon during carriage return yet slips with respect to the ribbon during the printing operation. During carriage return, the

ribbon becomes engaged and pulled when the printhead reaches the velocity of 15 inches per second. These results were obtained with a conventional nylon ink ribbon and pins **35** and printhead **3** made of steel.

As noted above, during carriage return when the ribbon is engaged at the printhead, it is pulled from the output end **31***a* of the cassette and a new length of ribbon is provided for the next line. Since the ribbon is not instantaneously engaged at the start of the carriage return and the printhead must first achieve sufficient velocity (i.e., 15 ips), the ribbon pulled from the supply end of the cassette **31***a* is not exactly the length required to print a succeeding line. Thus, as indicated above, the output of photocell **4***b* is changed just after the printhead reaches the right margin **1***a* on carriage return. This allows a small additional length of ribbon to be pulled from the cassette making up the slippage which occurred when the carriage return was first initiated. Changing of the photocell's **4***b* output at this time may obviously be achieved by placing it and its cooperating light **2***b* a small distance to the right (as shown in FIG. **1**) of the left margin **1***a*.

FIGS. **2** and **3** show in detail the means at the printhead for engaging the ribbon. A pair of ears **33** are located on opposite sides of the printhead **3** and the pins **35** project upwardly therefrom. As shown in FIG. **3**, each pin **35** has a head **37** at its top and a flange **39** at its bottom where it is connected to ear **33**. These heads **37** and flanges **39** help to guide the ribbon should it slip vertically at the pins **35**.

FIGS. **2** and **3** also show a guide attached at the printing end **3***a* of the printhead. This guide comprises a bottom **41**, and two sides, **43** and **45**, projecting from the bottom **41**. As most clearly shown in FIG. **2**, the printhead projects over bottom **41** and between sides **43** and **45**. Sides **43** and **45** and bottom **41** are shaped to correspond to the printhead's shape at its printing end. As shown from FIGS. **2** and **3**, sides **43** and **45** terminate a distance away from the printing end **3***a* of the printer in loops **43***a* and **45***a* respectively. Loops **43***a* and **45***a* provide smooth surfaces for the ribbon to traverse from pins **35** to around the printhead **3***a*. As also shown in FIGS. **2** and **3**, the sides **43** and **45** each have a pair of top and bottom flanges. Side **45** has top flange **45***b* and bottom flange **45***c* while, similarly, side **43** has top flange **43***b* and bottom flange **43***c*. These flanges serve as safety guides so that if the ribbon **7** is displaced vertically from the printhead it is caught and thereafter guided by the top or bottom pair of flanges. Thus, the guide at the end of the printhead shown in FIGS. **2** and **3** together with the pins **35** at the sides of the printhead which project from ears **33** serve to guide the ribbon into a U-shaped form around the printing end **3***a* of the printhead and to frictionally engage the ribbon at the printhead's higher speed while allowing the ribbon to slip around its U-shaped form at the printhead's slower speed.

Although the ribbon engaging means shown in FIGS. **2** and **3** is preferred, there obviously are many possible arrangements which could serve to frictionally engage the ribbon at the higher velocity of the printhead while allowing slippage at the lower velocity. In the embodiment shown, the pins each have a diameter of about three-sixteenth inch, are located about 1.4 inches apart and the ribbon makes about a 90° wrap around each pin. The printing end **3***a* of the printhead is about five-eighth inch wide and the pins are located about 1 ¾ inches from the printing end **3***a*.

The ribbon's path between the pins **35** and loops **43***a* and **45***a* is on an angle of about 15° with respect to the centerline of the printhead. Further, the points on the loops (**43***a* and **45***a*) contacted by the ribbon are approximately two-sixteenth inch from the printing end of the printer. Also, the width of the ribbon is one-half inch and about half of it is in contact with the printing end **3***a* of the printhead (as shown in FIG. **3**).

It will be appreciated that various changes in the form and details of the above-described preferred embodiment may be effected by persons of ordinary skill without departing from the true spirit and scope of the invention.

I claim:

**1.** In a printer having a reciprocating carriage for generating linear relative movement between a print medium and a print mechanism and further including print control means for causing the print mechanism to print a line of characters on the print medium during movement of said carriage in a first direction, ink ribbon handling means comprising, in combination:

a case containing a loosely folded supply of ink ribbon with a length of said ribbon extending outside of said case through a first slot provided in a side thereof;

drag means acting against said ribbon in an area adjacent said slot;

ribbon guide means supporting said outside-extending length of ribbon along a path lying between said print medium and said print mechanism, a portion of said guide means being mounted on said print mechanism and including at least one relatively sharp edge projecting into the ribbon path;

take-up means for holding said ribbon stationary during movement of said carriage in said first direction;

means for moving said carriage in said first direction at a first velocity and for accelerating said carriage in the return direction after completion of said line of printing, whereby the frictional force exerted on said ribbon by said guide means during carriage return exceeding the friction force exerted by said drag means thereby causing said guide means to pull an additional length of ribbon out of said case during said return movement; and

said takeup means taking up the slack in said ribbon caused by the pulling of said ribbon during said return movement.

**2.** The printer set forth in claim **1** wherein said print mechanism is fixed to and moves with said carriage and said print medium and said case remain stationary during the printing operation.

**3.** The printer set forth in claim **1** wherein said takeup means comprises:

a pair of pinch rolls acting on the ribbon; and

means driven by said carriage moving means for rotating said pinch rolls during the return movement of said carriage.

**4.** The printer set forth in claim **1** wherein:

said ribbon is in the form of an endless band; and

said takeup means operates to feed the ribbon back into said case through a second slot provided on a side of said case opposite said first slot.

* * * * *