

[54] **WEB TENSIONER FOR HIGH SPEED PRINTER**
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[51] Int. Cl. B41j 15/16
[58] Field of Search 197/133, 49; 226/177, 195; 101/228, 93 C

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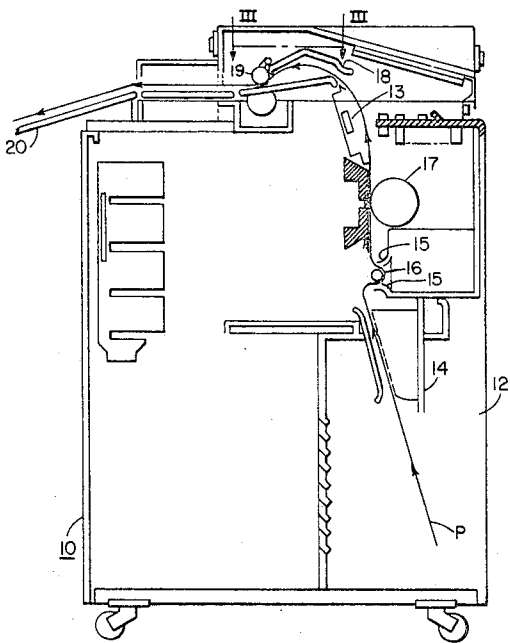
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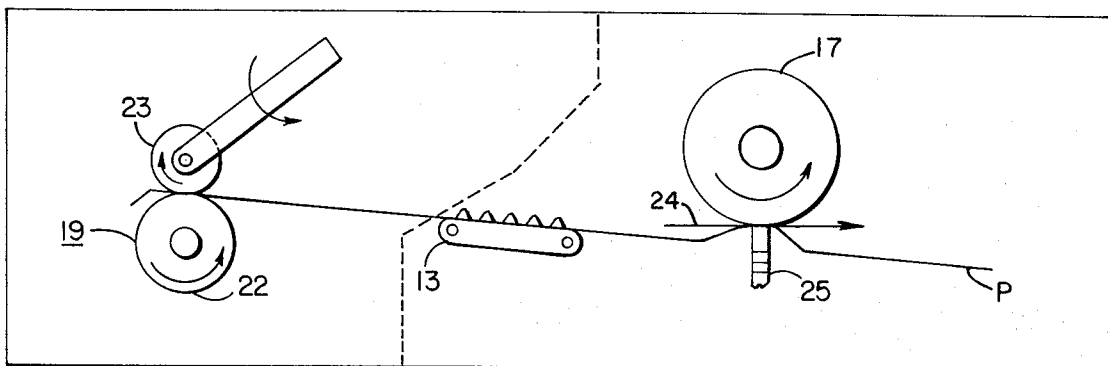
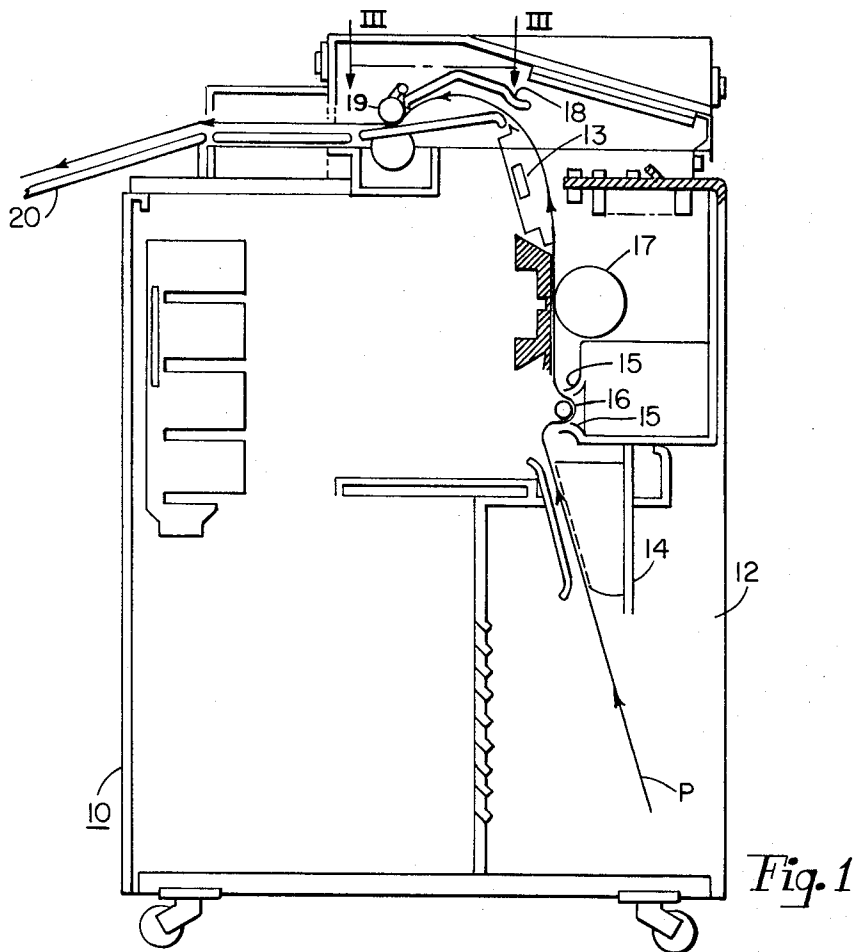
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[57] **ABSTRACT**

A high speed printer for use with data processing equipment wherein the printing is produced by feeding a paper web past a ribbon and rotating type roll, and striking the web against the type roll and ribbon with a plurality of hammers to produce the printed line. The web is fed in a path past the type roll by a tractor feed arrangement disposed after the type roll, and tensioning means is provided before the type roll to maintain tension in the web being drawn past the print station. A second tensioning means in the form of a pair of tensioning rolls is provided along the paper path after the tractor arrangement to produce an opposite or counter driving force to that force produced by the type roll action on the web during printing.

14 Claims, 6 Drawing Figures





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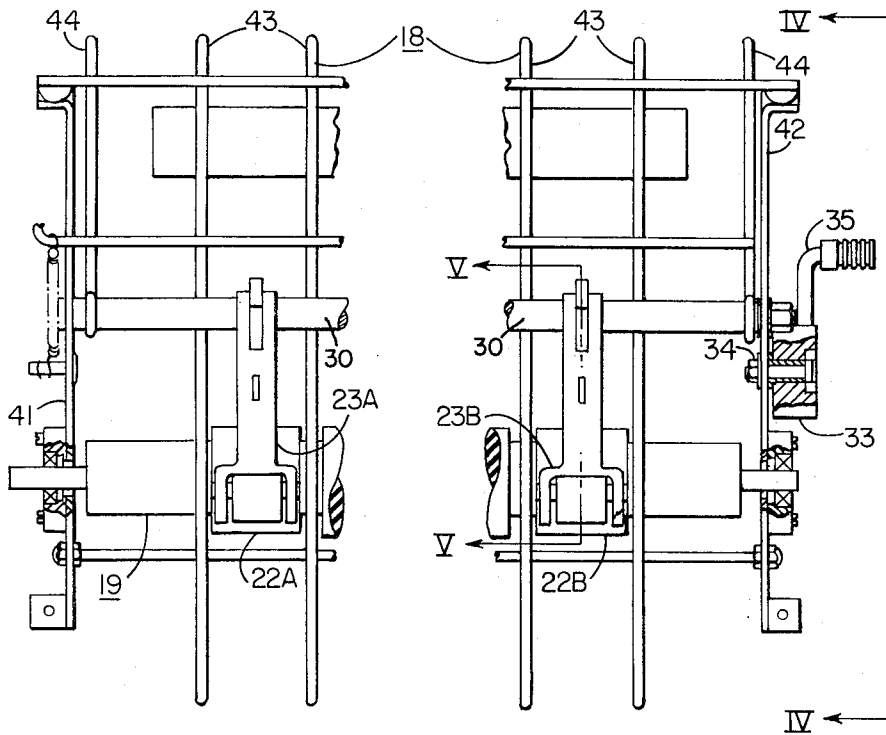


Fig. 3

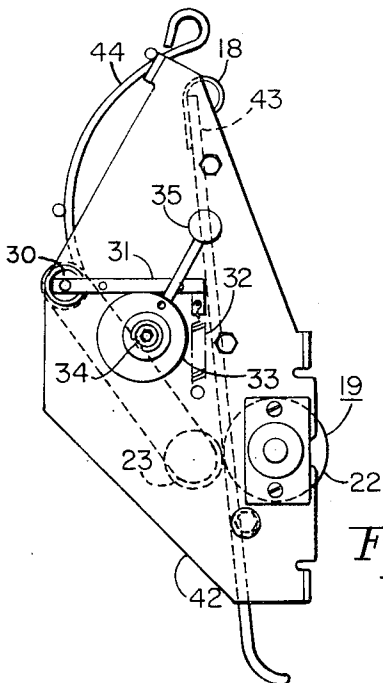


Fig. 4

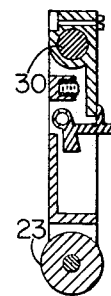


Fig. 5

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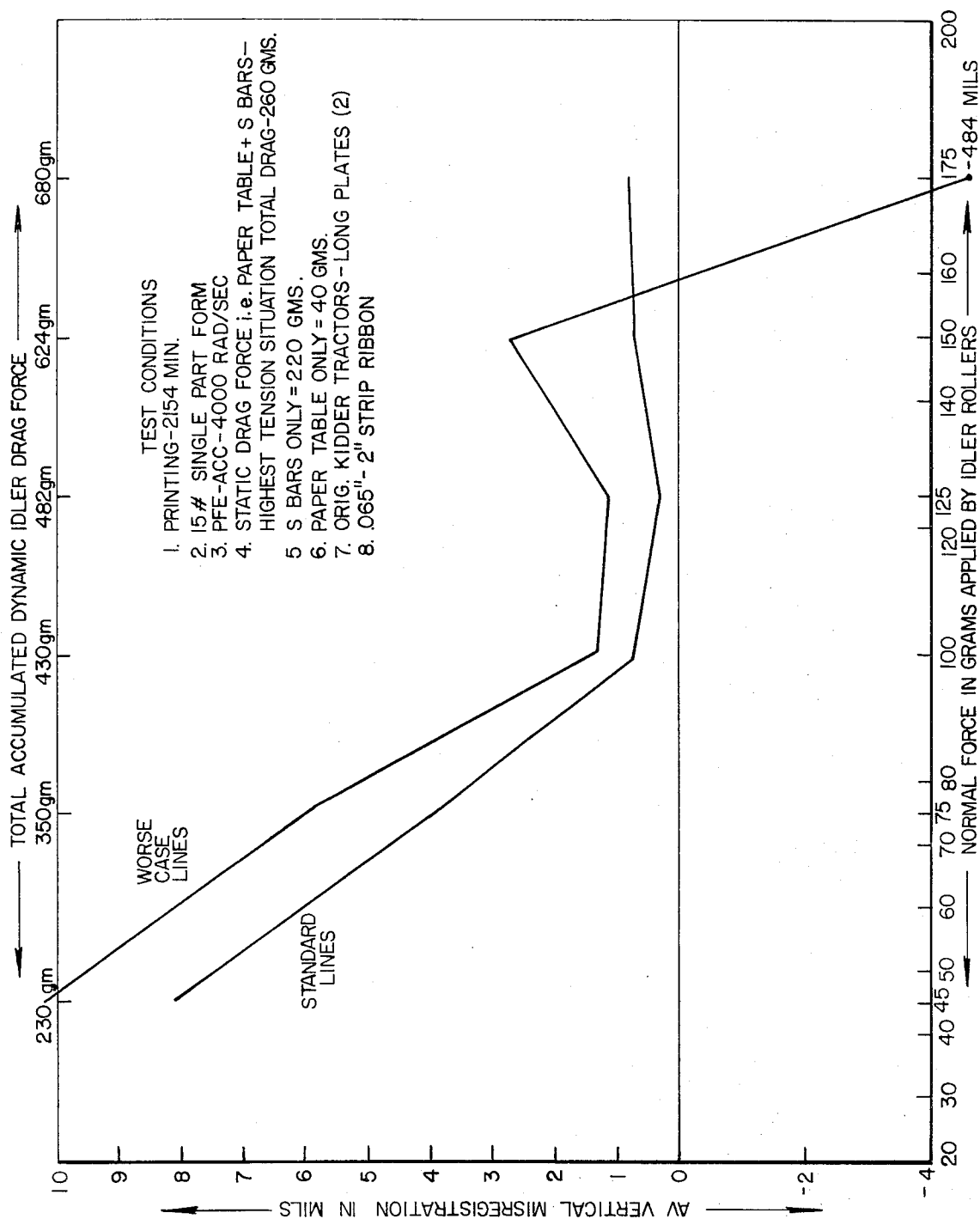


Fig. 6

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WEB TENSIONER FOR HIGH SPEED PRINTER

BACKGROUND OF THE INVENTION

The present invention relates to drum type printers, and more particularly, to a device for improving the vertical print line quality in high speed printers of this type.

One of the more common types of printers used with computers is the "drum impact printer" wherein a paper web is fed past a rotating type roll having a plurality of characters on its periphery, the print-out taking place by means of selected hammers forcing the paper against a ribbon and the type roll when the desired character is in registry with the hammer. While this type of printing device has become popular for high speed printers, a problem inherent in this arrangement is that of vertical misregistration of the paper with the print roll causing a "staggered" line of print to occur. While a certain amount of misregistration can be tolerated as a trade-off for the increased speed available from this type of printer, it has long been desirable to provide a drum type printer wherein this problem of misregistration is minimized to produce a line of print wherein any vertical misalignment of one character relative to the others is not discernable to the most critical eye.

It is therefore an object of the present invention to provide a high speed drum type printer which has the characteristic of improved line quality.

A further object of the invention is to provide a drum type printer which produces a line of print having improved vertical registration of the characters.

Another object of the invention is to provide a drum type printer wherein a force is provided opposite the force produced by the type roll motion on the paper to insure vertical print registration between the paper web and the print roll.

SUMMARY OF THE INVENTION

The above objects, and other objects which will become apparent as the description proceeds, are achieved by providing a document printer of the type described having a mechanism for advancing a web along a path into printing alignment with the printing mechanism, and wherein the advancing mechanism includes means disposed along the web path after the printing mechanism for driving the web along the path, and roller means disposed along the web path for applying a controlled tensile force to a web portion between the printing mechanism and the roller means. In a more detailed aspect, the roller means includes a pair of rolls, one drivingly engaged with a web portion and the other idly engaged with the opposite side of the web and applying a pre-set normal force to the drive roll to produce the controlled tensile force in the web.

BRIEF DESCRIPTION OF THE DRAWINGS

The various advantages and features of the invention will be more readily apparent from the following description, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic elevational view showing a drum type printer having the present invention employed therein;

FIG. 2 is a schematic view showing a portion of the structure of FIG. 1 laid out in a straight line configuration for clarity, and showing in greater detail elements of FIG. 1;

FIG. 3 is a top plan view taken along the lines III—III of FIG. 1, and showing details of the structure employed in that portion of the schematic view taken on an enlarged scale for clarity;

FIG. 4 is an elevational view of the structure of FIG. 3 taken substantially along the lines IV—IV in that Figure;

FIG. 5 is a detailed sectional view taken along the lines V—V of FIG. 3, showing a portion of an operative element of the invention; and,

FIG. 6 is a plot of curves relating to the function of the embodiment as substantially shown and described in the present application.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIG. 1, there is shown a high speed drum type printer 10 having a compartment 12 in which the forms to be printed, or other paper supply, are stored to be fed into the printer mechanism. The path of the paper web P is indicated by the arrows, as passing from the compartment 12 through the various portions of the printer 10 which portions have been shown schematically in FIG. 1. As will be observed by following the path of the paper web P, a tractor assembly 13, which may be of any type well-known in the art for causing movement of the paper web, is engaged with the web and effective to move the paper as indicated upwardly from the compartment 12. As the paper web P is moved from the compartment 12, it passes through a lower guide means 14 and into a lower tension means which is provided in the form of an S bar arrangement. The lower tension means comprises a pair of plates 15 and 15', each having a radial surface, one opposite the other, over which the web P passes, and a movable stationary bar 16 which is disposed in close proximity to the plates 15 and 15' causing the paper to assume a circuitous path around the bar 16.

The bar 16 is adjustable in the horizontal direction (by means not shown) to produce more, or less, tension in the portion of the web P between the tractor 13 and the bar 16 to maintain the web substantially "flat" as it passes through the print mechanism. While the specific S bar configuration shown has been advantageously employed as means for providing tension in the web portion above-mentioned, it will be evident to those familiar with the art that other tensioning means could be provided at this point in the web path to produce a drag force in that portion of the unprinted paper web P.

Referring still to FIG. 1, and following the path of web from the S bar 16, it will be noted that the paper web P passes through a print mechanism having a type roll 17, over the tractor 13, and into the main paper guide mechanism 18. Adjacent the exit portion of the paper guide mechanism 18 there is provided an upper tensioning device 19 which serves to control the tension in the portion of the paper web after the type roll 17 in a manner which will be described hereinafter. From the upper tensioning device 19, the paper web passes over an exit guide 20 and thence to a stacking

arrangement (not shown) which may be one of any type wellknown in the art suitable for handling printed web or forms.

Referring now to FIG. 2, the paper path of the paper web P is shown substantially in a straight line to depict in somewhat greater detail (although in schematic) the action of the paper tensioning device 19 on the web P. As will be noted, the paper tensioning device 19 comprises a drive roll 22 and an idler roll 23 which are positioned on opposite sides of the web path, the drive roll being rotated by a suitable drive motor (not shown) in a direction to urge the paper web P along the prescribed path, while the idler roll is adjustably mounted so as to produce a normal force against the drive roll 22 with the paper web P therebetween. It will further be noted that the type roll 17 is rotated in a direction such that the roll surface adjacent the web is moving counter to the direction of web travel. As is typical in print arrangement of this type, a movable ribbon 24 is provided adjacent the path of the web P, and a plurality of print hammers 25 located on the opposite side of the web, the print hammers being selectively actuated as the desired character comes into registry therewith to produce a line of print. While the type roll 17 may be of any configuration well-known in the art, the present invention has been used to great advantage with a type roll wherein the characters are "offset in groups" as used with the "time shared hammer drive" arrangement shown and described in U.S. Pat. No. 3,461,796 to Belson et al., and assigned to the assignee of the present invention. With the use of the offset characters on the type roll, as described in the aforementioned reference, the problem of vertical print line registration in high speed drum printers becomes more critical, and the solution to this problem which is disclosed in the present invention may be best appreciated.

The tractor or form driving device 13 is shown in FIG. 2 to be one of the type having studs which are engaged in perforations at the periphery of the web to drive the web P along the prescribed path. As such tractor arrangements are well-known in the art, and are advantageously used in a wide variety of computer-printer applications, further details of the device 13 are considered to be unnecessary for the purpose of the present description.

Referring now to FIGS. 3, 4, and 5, the reader will be more adequately apprised of the mode of operation of the web tensioning device 19 which is shown in greater mechanical detail than hereinbefore in these views. As will be observed, a pair of plates 41 and 42 are provided to support the tensioning device 19 and the paper guide mechanism 18 as referred to above. In the embodiment shown, the drive roll 22 is divided into a plurality of segments 22a, 22b, etc., while the idler roll 23 may be formed of a plurality of like rolls 23a, 23b, etc., each being of a corresponding width to, and in registration with the segments 22a, 22b, etc. It will further be noted that the guide mechanism 18 is comprised of a plurality of wire elements 43 which serve to form the lower portion of the guide mechanism 18 while a plurality of bent arcuate wire members 44 serve to form the upper portion of the guide mechanism 18. It should therefore be evident that the segmentation of the rolls 22 and 23 is designed such that the guide elements 43

are allowed to project between the rolls. The guide mechanism 18 is thereby effective to direct the web P into the rolls 22, 23 after it enters the gap between the upper portion 44 and the lower portion 43 of the guide mechanism. Further, by providing the arcuate portion 44, a paper web end which is thrust by the tractor 13 into the gap between the guides 44 and 43 is guided downwardly by the portion 44 and into the rolls 22 and 23 during start-up of the printer.

Referring to FIG. 5, the idler roll 23 is shown as fixedly mounted to a shaft 30 rotatably mounted in the plates 41 and 42. An arm 31 is affixed at one end to the shaft 30 and has the opposite end attached to a spring 32 connected to the plate 41. A disk 33 provided with a cam surface at its periphery is mounted on a shaft 34 and is rotated by means of a crank 35 connected thereto. It will be observed that the cam surface of the disk 33 is in contact with the arm 31 which is biased toward the disk by the spring 32. Movement of the crank 35 such that the arm 31 is rotated counter clockwise is thereby effective to cause the roll 23 to apply an increased pressure on the drive roll 22. Thus, there is provided a micrometer-like adjustment for producing the desired pressure between the rolls 22 and 23, which importance will become evident as the description proceeds.

It should here be mentioned, that the outer surface of the roll 22 should be of material which exhibits a relatively high coefficient of friction to produce the required driving force on the web, and thus impart the desired tension into the web. Advantageously, a Hycar rubber material was used in the embodiment described, however, any material of this type having a coefficient of friction in the range of from 0.3 to 0.5 could likewise be employed. With regard to the surfaces of the idler rolls 23, it has been found that the coefficient of friction should be substantially less on this surface due to the requirement that a small amount of slippage takes place when the paper web P is not being moved by the tractor 13. Thus, the idler rolls 23 depicted herein are constructed of a nylon or other plastic material with a relatively low coefficient friction, in the order of from 0.5 to 0.1 to allow some slippage to take place. It will also be evident that the surface of the idler roll 23 should be of a relatively smooth material such that marking or erasure of the printed form will not take place due to the roll being in contact with the printed surface of the web P (the high coefficient drive roll 22 being in contact with the unprinted side of the web).

In operation of the printer 10 with a computer or other input device, the web P is stepped through the print mechanism as each successive line of print becomes available for print-out. While the complex electronics and logic involved in such a system have not been herein described, it is considered to be within the capabilities of one skilled in the art to provide a system of this type. However, it should here be brought out with regard to this specific disclosure that the type roll rotation, ribbon movement, tractor operation, and drive roll rotation are connected into such system. In the present system, when a new line of print is called for, the tractor is energized to step the paper to a next line position, the drive roll being continuously operated during this time period. When the tractor is stopped, the drive roll continues to rotate applying a tensile

force to the web P. The force created by the roll is sufficient to overcome the force created by the type roll, hammer contact with the paper web, and maintain the web in vertical print line registration. It is apparent at this point that continued rotation of the drive roll and idler roll combination, if effective to feed the web, would possibly tear the web from the tractor, or cause localized damage to the web at the point of contact. However, with the combination of surface friction coefficients (as herein described) on rolls 22 and 23, slippage takes place and only the desired tensile force results. In the present system, the drive roll is rotated with the initiation of each print instruction and continues for four seconds after the print instruction is completed. In off-line mode of printing, or should print instructions occur at less than 4 second intervals, the drive roll operates continuously.

In operation therefore, it has been seen that the paper web P is moved in increments through the print mechanism by the tractor 13 and fed between the rolls 22 and 23. As the paper is fed, the printing of a line occurs through the actuating of the print hammers 25 to engage the web and force the web against the type roll 17, and thus produce the line of print. The time that the print hammers remain engaged with the type roll is generally referred to as the contact time. During this time period, the type roll will pull the slack out of the paper web P and even slightly distort the feed holes of the web which is driven by the tractor arrangement 13. It will be evident therefore, that the problem of misregistration lies in the fact that the print drum 17 will rotate and carry the web P out of registration during the time that the print hammers 25 are in contact with the web P, ribbon 24, and type roll 17 combination. The form or web P will attempt to recover its original position because of the elastic nature of the paper. Ideally, the form or web P should spring back to its original position after each printing operation, however, this is not the case in prior art devices. It should here be noted that the worse possible case of misregistration generally occurs when printing groups of the same characters that follow one another around the periphery of the type roll 17. This is no doubt due to the fact that the time is insufficient in this mode of operation for the elasticity to recover the paper to its original position.

Referring still to FIGS. 1 and 2, it will be seen that by employing the continuously rotating drive roll 22 in combination with the idler roll 23, a device is provided which is effective to produce a force in the web P which is of sufficient magnitude to off-set that force produced by the type roll 17 on the web P, and relative motion between the roll 17 and the web does not occur. Thus, the principle or theory of operation of the tensioning device 19 in the printing system is that the rolls 22 and 23 produce an opposite driving or counter force in the web to that produced by the type roll 17 to prevent web movement. The ability of the rolls 22 and 23 to produce the reactive force is dependent substantially on the coefficient of friction between the drive rolls 22 and the paper, and the normal force produced between the idler roll 23 and the drive roll. The rolls 22 and 23 in combination, therefore provide a dynamic web tension device which is constantly attempting to recover the paper web P or form that is continuously being

urged out of registration by the type roll 17 and hammers 25. As a result of using the tensioning device 19 in the present invention, in combination with the S bar 16 which serves to react the force of the tensioning device 19, it is possible to get the proper forms tension for both the printing and feeding operation, with little compromise to either mode of operation.

Referring to the curves shown in FIG. 6, the reader will better appreciate the effect of the tensioning device 19 in overcoming the problem of misregistration in a printer device of the type described. The data plotted was collected by operating a Model 112 Printer manufactured by the Honeywell Corporation having the present invention embodied therein. The printer was operated at 275 lines per minute using a single part 15 pound form as the print web. As will be noted, with both the "worse case" lines as shown by the upper plot and the standard lines, an idler normal force in the area of 100 to 200 grams is effective to produce a vertical line misregistration of less than 4 mils, which is a marked improvement over prior art devices and acceptable for most computer print-out purposes.

What is claimed is:

1. A document printer having a mechanism for advancing a web along a path into printing alignment with a printing mechanism having a type roll disposed for rotation adjacent said web for contacting said web during the printing operation, said advancing means having in combination, means disposed along said path after the said printing mechanism for driving said web along said path, and rotatable roller means contacting said web along said path after said driving means for applying a continuing dynamic tensile force during rotation thereof to a web portion extending between said printer mechanism and said roller means and in a direction opposite to the direction of the force produced on said web by the rotation of said type roll, said roller means being effective to move said web at the point of roller means contact an increment of length sufficient to compensate for stretching of said web portion and thereby maintain a tensile force of substantially constant value on said web during the printing operation.

2. The printer as set forth in claim 1 wherein said roller means comprises a drive roll with a surface having a high coefficient of friction contacting said web, and

means for rotating said roll in a direction to produce said force on said web to drive said web away from said printing mechanism.

3. The printer as set forth in claim 2 wherein said roller means further comprises an idler roll with a surface having a coefficient of friction substantially less than that of said drive roll surface, said idler roll being positioned to apply a normal force to said drive roll with said web disposed therebetween.

4. The printer as set forth in claim 3 which further includes means for adjustably increasing or decreasing the magnitude of normal force applied to said drive roll by said idler roll.

5. The printer as set forth in claim 4 wherein said drive roll surface is a rubber composition and said force applied to said drive roll by said idler roll is greater than 100 grams.

6. The printer as set forth in claim 2 wherein said printing mechanism comprises a plurality of print hammers disposed adjacent said type roll and movable to a position to force said web into driving relation with said type roll during rotation thereof.

7. The printer as set forth in claim 6 wherein said web is provided with perforations at an edge, and said driving means is provided with a plurality of studs engageable with said perforations to so drive said web along said path.

8. A printer as set forth in claim 1 which further includes other tensioning means disposed along said path before said printing mechanism for applying a static drag force to said web in the opposite direction to said tensile force.

9. In a document printer wherein a feed mechanism is disposed after said printing mechanism for driving a paper web through said printing mechanism and wherein said printing mechanism comprises a ribbon and rotatable print roll disposed adjacent one side of the web and a plurality of movable hammers disposed on the opposite side of said web for striking said web and forcing it into contact with said ribbon and print roll combination to produce a line of print, the improvement comprising tensioning means disposed after said feed mechanism for continuously applying a dynamic tensile force of substantially constant value during the printing operation to tension a web portion between said printing mechanism and said tensioning means.

10. The structure as set forth in claim 9 wherein said tensioning means comprises a drive roll having an outer surface with a high coefficient of friction for contacting said web and wherein said drive roll rotation is effective

to produce a tensile force in said web opposite to a tensile force produced in said web by contact of said rotating print roll and ribbon combination with said web when struck by one of said hammers.

11. The structure of claim 10 wherein said tensioning means further comprises an idler roll with a surface having a coefficient of friction substantially less than that of said drive roll surface, said idler roll being positioned to apply a force to said drive roll with said web disposed therebetween.

12. The structure of claim 11 which further includes means for adjustably increasing or decreasing the magnitude of force applied to said drive roll by said idler roll.

13. A printer as set forth in claim 9 which further includes other tensioning means disposed along said path before said printing means for applying a static drag force to said web in the opposite direction to said tensile force.

14. The method of feeding a paper web through a printer of the type wherein a ribbon and rotating type roll are disposed adjacent one side of the web and a plurality of movable hammers are disposed adjacent the opposite side of the web to strike the web and force it into the ribbon and rotating type roll to form a line of print on the web, which includes the steps of advancing the web in increments past the type roll, printing upon said web by means of said plurality of movable hammers and said ribbon and type roll, and continuously applying a substantially constant dynamic force on said web opposite the force produced on said web by contact of said type roll and ribbon combination with said web to maintain line registration of the web with said print roll during printing of an entire line.

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