July 5, 1966 C. I. WASSERMANN 3,259,288

VACUUM TENSIONING OF PAPER IN A HIGH SPEED PRINTER

Filed March 9, 1964 2 Sheets-Sheet 1

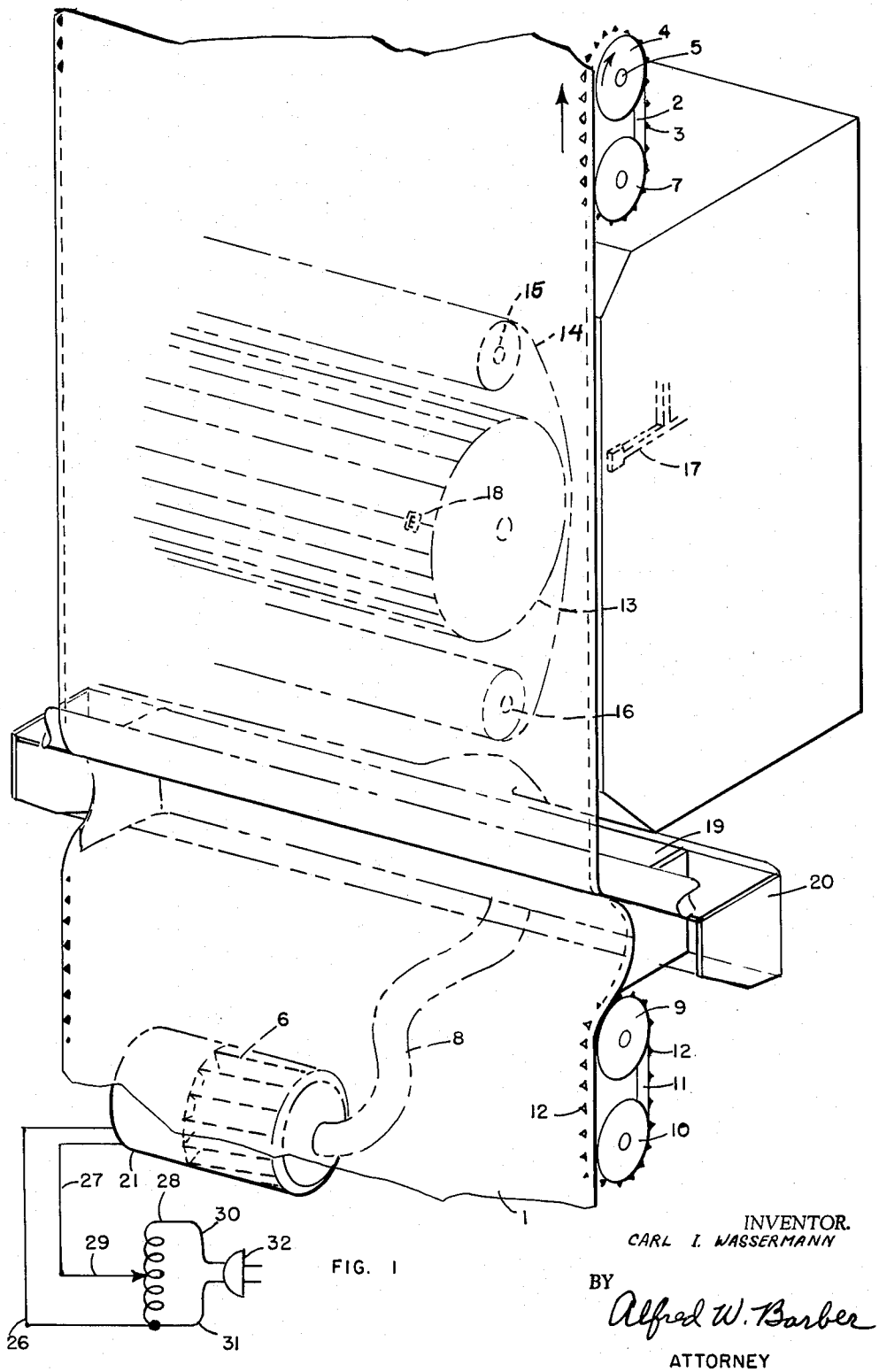

FIG. 1

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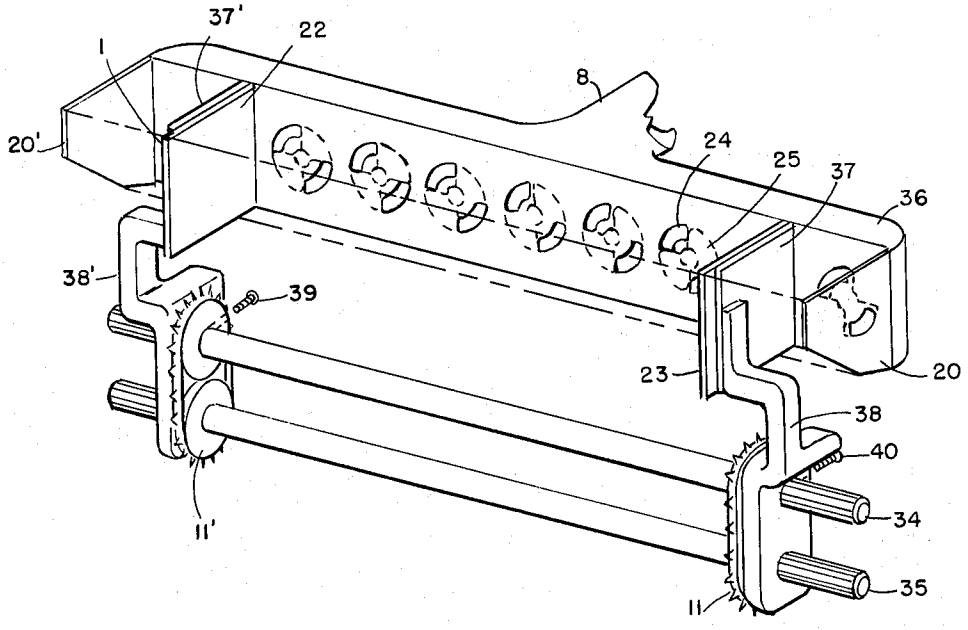

FIG. 2

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VACUUM TENSIONING OF PAPER IN A HIGH SPEED PRINTER

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8 Claims. (Cl. 226—60)

The present invention concerns paper handling and, in particular, methods of and means for improving tensioning in sprocket transported high speed printer paper handling.

The present invention is particularly concerned with, although not limited to, that type of printing device having a continuously rotating typewheel cooperating with printing hammers. The paper is fed between the typewheel and the hammers, and at appropriate times the several hammers are independently actuated to print the different characters involved. This arrangement is now well known in the art as a means for printing the output of an electronic computer. While such printers are in wide use, many problems still remain unsolved. In addition, many operating characteristics of such printers are in great need of improvement. Furthermore, more stringent requirements are being made as, for example, greater speed of operation and greater reliability are constantly being sought. The handling of the paper to be printed upon is one of the constant problems in high speed printers. Problems connected with paper feeding include handling paper of various widths, handling paper of various thickness properly tensioning the paper, starting and stopping the paper motion without jitter or tearing, etc. Some attempts have been made to solve these problems by means of complicated mechanisms requiring tedious and repeated adjustments. The present invention provides methods of and means for solving these problems in a simple manner and with a resulting mechanism which is simple to use, inexpensive to build, and which has a long life expectance of reliable operation.

Going into detail, the paper used on the machines which are the subject of the present invention is provided with equally spaced sprocket holes along its two edges. This paper is moved past the printing area by means of two sets of toothed sprockets. In order to provide increased traction with the paper to prevent tearing at high speed, these sprocket teeth may be mounted on flexible chain links and directed to travel with the paper over a distance equal to several times the spacing between adjacent sprocket holes. In the usual arrangement one set of sprockets pulls the paper while the other set acts as a follower holding the paper back sufficiently to provide the required tension on the paper across the marking area. Difficulty arises, however, with this system for a number of reasons. The paper is easily torn at the sprocket holes if the tracking of the follower sprockets is not substantially perfect. Complex means have been devised and much time has been required in set-up and during operation to phase the sprockets and to provide optimum paper tension.

It has been found in accordance with the present invention that a simple vacuum device can be used to tension the paper and to eliminate the need for phasing means. Not only is the operation of the printer greatly simplified but its operating characteristics are greatly improved. Starting and stopping the paper is smoother. Wear on the sprocket teeth is reduced. Tensioning can be easily and accurately controlled.

Accordingly, one object of the present invention is to provide methods of and means for handling paper in high speed printers which is simple and less expensive than previously and yields improved handling characteristics.

Another object is to simplify loading and to eliminate the need for delicate and time consuming adjustments of paper tension and sprocket phasing hitherto required.

Still another object is to provide for changes in paper dimensions such as those due to humidity effects causing changes in tension due to elongation of sprocket holes.

A further object is to improve transient response by a substantially inertialess tensioning system providing wide-band response.

These and other objects will be apparent from the detailed description of the invention given in connection with the various figures of the drawings.

In the drawing:

FIGURE 1 is diagrammatic side view of a printer and paper feed system in accordance with the present invention.

FIGURE 2 is a perspective view of the vacuum chamber used in the system of FIG. 1.

FIG. 1 shows a perforated paper **1** which is driven by sprocket teeth **3** carried by a sprocket chain **2**. The sprocket chain **2** in turn is driven by a toothed sprocket **4** on shaft **5** turned by a suitable means not shown. Sprocket chain or belt **2** is supported in a predetermined elliptical path by idler sprocket **7**. While not shown, it will be understood that a second set of sprockets and a sprocket chain similar to the one just described are provided for the far edge of the paper. These sprockets and chains make up the driving pair.

The follower means is made up of sprockets **9** and **10** and chain or belt **11** carrying teeth **12** together with a similar set, not shown, at the far edge of the paper. This second pair is slave driven in synchronism from the first drive sprockets by a suitable belt or chain not shown.

Printing on the paper **1** is accomplished by suitable means such as continuously rotating type drum **13** carrying a great plurality of type faces **18** and hammer **17** actuated by suitable driving means, not shown, to print by pressing paper **1** against preselected type faces **18** through inked ribbon **14**. Ribbon **14** is moved between rollers **15** and **16** by suitable means, not shown.

Auxiliary tensioning is provided by means of a vacuum drawn in chamber **19** extending at least across the width of the paper **1**. Vacuum in chamber **19** is produced by a suitable motor **21** driving fan **6**. Suction from fan **6** to chamber **19** is accomplished over tube **8**. The degree of tensioning provided by the vacuum drawn against the paper **1** may be controlled by varying the degree of vacuum in chamber **19**. One simple manner of controlling the degree of the vacuum is to control the speed of the motor **21** as by means of a variable auto-transformer **28** having a movable tap **29** and connected to motor **21** over leads **26–27** and to a suitable source of alternating current by means of plug **32** and leads **30–31**.

FIG. 2 is a perspective view showing details of the vacuum chamber briefly described above. The sides of the chamber have been omitted in order to permit a better view of certain features. The suction pipe **8** couples to the rear of the vacuum chamber as by a flared extension **36**. Between extension **36** and the inside of the vacuum chamber itself are provided a plurality of port holes **25** provided with adjustable shutters **24** for auxiliary control of the vacuum within the chamber and for shutting off air flow beyond the edges of the paper. In order to adapt the chamber readily to various paper widths, adjustable end plates **22** and **23** are provided. This adjustment for paper width is automatic since end plates **22** and **23** are carried by brackets **38'** and **38** attached to tractors **11'** and **11** respectively. Thus, when the tractors are adjusted along their supporting rods **34** and **35** in order to match the

desired paper width, the vacuum chamber is automatically adjusted to a corresponding width. Felt pads **37** and **37'** may be provided to provide a flexible seal to the vacuum chamber regardless of its width adjustment. In order to maintain the proper tractor separation and at the same time vacuum chamber width, locking means such as thumb screws **39** and **40** are provided for longitudinally positioning and locking tractors **11'** and **11** to shaft **34**.

It will be appreciated that the tensioning of the paper by the vacuum means described above provides substantially inertialess tensioning. This has the effect of raising the cut-off frequency of the equivalent mechanical circuit and thus provides a wide-band response. Also, since the vacuum chamber end plates are attached by means of brackets to the tractors, the chamber width is automatically adjusted for paper width when the tractors are so adjusted. In fact loading of the paper and the optimum adjustment of tension, in the present system, is greatly simplified over systems hitherto available.

While only one form of the present invention has been shown and described, many modifications will be apparent to those skilled in the art and within the spirit and scope of the invention as set forth in particular in the appended claims.

What is claimed is:

1. In a high speed printer, the combination of, paper pulling means, at least two paper follower means one for each edge of the paper, means for maintaining predetermined separation between follower means in accordance with the width of paper to be accommodated, vacuum tensioning means extending across the path of said paper between said pulling means and said follower means, and laterally adjustable means for determining the effective width of said vacuum means across said paper path.

2. High speed printing means as set forth in claim **1** and including means for varying the pull of said vacuum tensioning means.

3. High speed printing means as set forth in claim **1** wherein said vacuum tensioning means includes a motor driven fan and a speed control means for said motor.

4. High speed printing means as set forth in claim **1** wherein said vacuum tensioning means includes adjustable ports for adjusting the pull exerted upon said paper by said vacuum.

5. High speed printing means as set forth in claim **1** wherein said vacuum width determining means are coupled to said follower means.

6. In a high speed printer, the combination of, at least two sprocketed paper pulling means, at least two laterally spaced sprocketed paper follower means adjustable to accommodate paper of different widths, vacuum tensioning means between said pulling means and said follower means, and means for automatically adapting said vacuum tensioning means to a given paper width in response to paper width setting of said follower means.

7. High speed printing means as set forth in claim **6** and including means for controlling said vacuum comprising an adjustable speed motor driven fan.

8. In a high speed printer, the combination of, at least two sprockets for pulling paper to be printed upon, at least two sprocketed paper followers, means for maintaining predetermined lateral separation between said followers in accordance with the width of said paper, vacuum tensioning means extending across the path of said paper and located between said pulling means and said follower means, and means for confining the effective width of said vacuum means across the width of said paper in order to optimize tensioning paper of different widths.

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