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TYPE ARRANGEMENT IN ENDLESS BAND LINE PRINTERS

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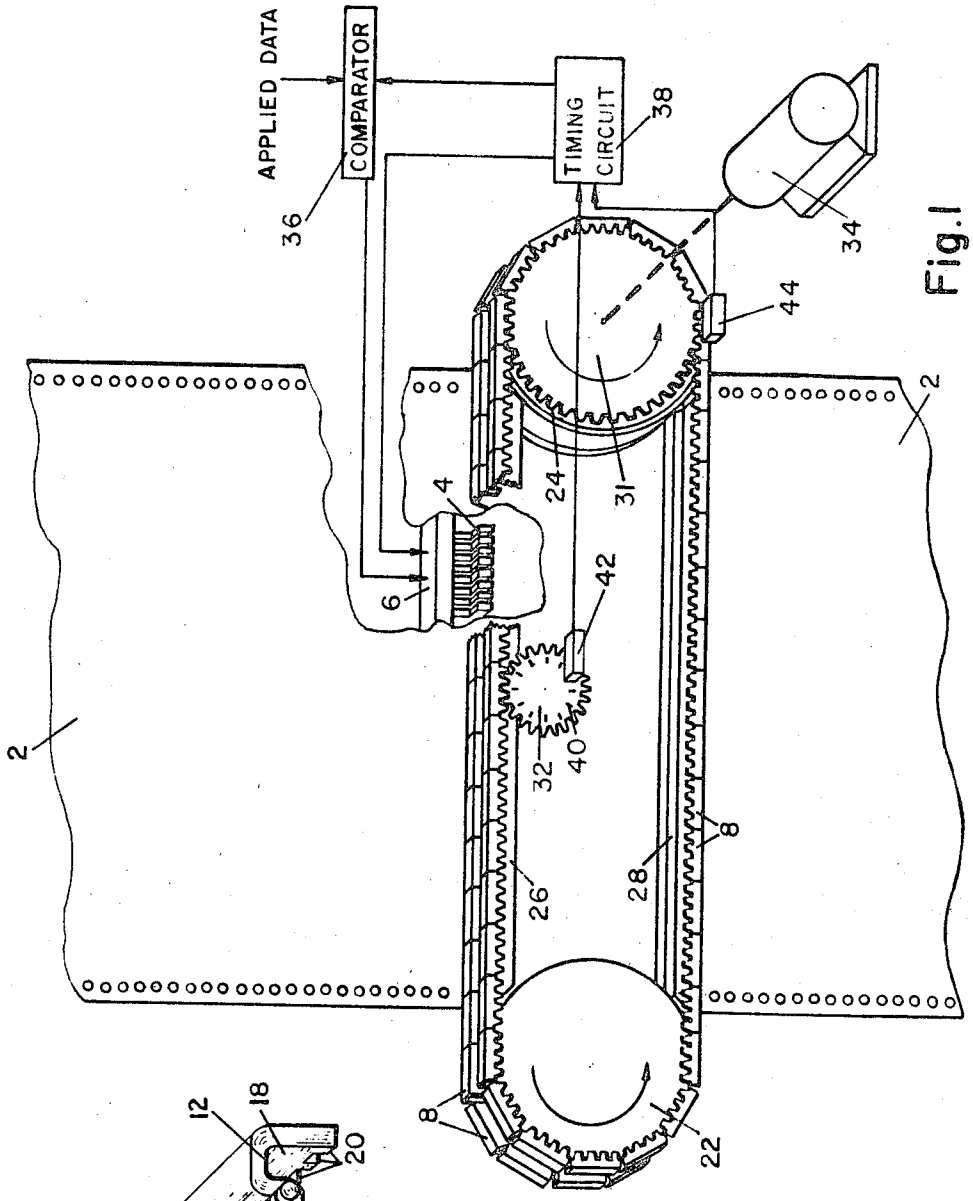


Fig. 1

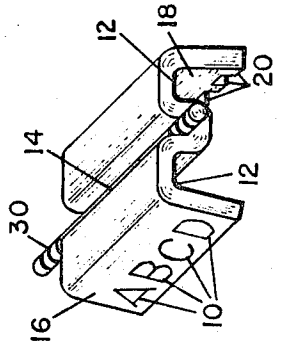


Fig. 2

INVENTOR
JOHN C. SIMS, JR.
BY Francis J. Thomas
ATTORNEY

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TYPE ARRANGEMENT IN ENDLESS BAND LINE PRINTERS

John C. Sims, Jr., Sudbury, Mass., assignor to Mohawk Data Sciences Corporation, East Herkimer, N.Y., a corporation of New York

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ABSTRACT OF THE DISCLOSURE

A type carrier for an on-the-fly printer includes a plurality of non-connected, abutting type slugs moving at a constant velocity about a closed path defined by a pair of parallel rails and two rotatable pulleys having peripheral surfaces tangent to the ends of the rails. Each type slug is provided with a longitudinal groove on a side of the slug opposite the side which contacts the path and a resilient band encircles the path through the slug grooves to hold the slugs in place. The pulleys are provided with teeth and one of the pulleys is driven to propel the slugs, which have mating teeth, along the path.

This invention relates to printing and, in particular, to line-by-line printers of the type employing a sequence of type characters which are continuously moved past a line that is to be printed, where printing is accomplished by actuation of transducers, such as hammers, when the type characters are appropriately positioned.

Line printers of this type often employ a closed chain of type which is moved around a loop and past the line to be printed. Consequently, changing character types is relatively complicated, requiring that the chain be removed and dismantled. This disadvantage is partially overcome by using a train of loose type elements which travel between constraining tracks or within a slot. In this case, however, the mechanism containing the type elements is relatively complex. In the present invention, loose type elements are maintained against a type race by tension with a loop of spring. In this simple manner, the type elements are constrained to movement along the path defined by the type race and replacement or reordering of type elements can be accomplished by merely stretching the spring.

In the preferred embodiment of the invention, several type characters are supported on each type element to reduce the number of type elements required and to enable the use of more manageable (larger) type elements while retaining closely-spaced type characters.

A further advantage is gained by the unique location of the type characters on the type elements. In printers of this general form, the type characters are located on the outer surface of the loop; that is, the surfaces of the type characters are perpendicular to the plane of the loop. Since it is generally desirable to pass the document to be printed in the upward and backward direction past the printing mechanism to permit the document to be read immediately after printing, the train of type lies in a plane that is perpendicular to the plane of the document, with the result that the printer is inherently bulky. This disadvantage is overcome in the present invention by placing the type characters on an edge of the type elements; that is, the surface of the type characters is essentially parallel to the plane of the loop. As a result, the plane of the loop is essentially parallel to the plane of the document, reducing the physical size of the printer.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a functional design of the inventive printer showing, in particular, the preferred configuration of the type elements.

FIGURE 2 is a detailed drawing showing a type element.

As shown in FIG. 1, a document **2** is incrementally moved upward, one line at a time to be printed. Printing is accomplished by forcing the document against type characters by the use of printing transducers **4**, such as hammers, under the control of a hammer drive assembly **6**. An inked ribbon is located between the document and the type elements, but is not shown for simplicity. The type characters are raised on the rear surfaces of type elements **8** and are continuously moved past the line of printing transducers.

As shown in greater detail in FIG. 2, several raised type characters **10** are supported on each type element **8**. The type elements contain two flat surfaces **12** separated by a groove **14**. The type characters are supported on a surface **16** which is parallel to the length of the groove **14** and which extends in essentially the same direction as the depth of the groove. Actually, the type-character supporting surface **16** is slanted slightly (as shown in FIG. 2) to permit the document **2** (FIG. 1) to approach the printing region from below and slightly behind the printing mechanism for convenience of construction. Each type element also contains a drive surface **18** (FIG. 2) containing teeth **20**.

The type elements **8** are maintained in a type race with the configuration of a closed loop or path, as shown in FIG. 1. The type race consists of an idler pulley **22**, a drive pulley **24**, and two straight sections of track **26**, **28**. The pulleys and tracks are shaped to loosely conform to the shape of the type elements; that is, the pulleys and tracks are grooved to conform with the under section of the type elements and the outer rear surface of the pulleys and tracks are slanted to conform with the slope of the type-element supporting surface **16**.

The type elements **8** are maintained in the type race by a loop of curled spring **30** of the type generally used to drive the take-up reels in motion picture projectors. The spring **30** engages the grooved portions of the type elements as shown in FIG. 2. Thus, by merely stretching the spring slightly, type elements can be replaced or rearranged in the type race.

The type elements are driven around the type race at a substantially constant speed by a drive gear **31** mounted on drive pulley **24**. A motor **34** provides continuous rotation to the drive gear which, in turn, coacts with the teeth **20** (FIG. 2) on the type elements. The direction of rotation of the drive pulley **24** (counterclockwise in FIG 1) is selected to push the type elements along the printing line to avoid slack between the type elements.

The printing transducers **4** are selectively actuated at appropriate times as the type characters pass the document line. While a separate transducer is shown for each character position along the line to be printed, a lesser number of transducers can obviously be used in conjunction with various techniques that are known in the art, such as lateral paper shifting or double-width transducers with spaced character types. The actuation of the transducers is controlled by the hammer driver assembly **6** which, in turn, is controlled by the output of a comparator **36** and a timing unit **38**, according to well-known techniques that are used in conventional chain or train printers. The timing circuit **38** receives data which depends upon the position of the character types in the type race as the printing mechanism is in operation. This timing data can be received in coded form in parallel by magnetic, optic or other techniques, or can be developed by the timing circuit from a sequence of timing pulses. The

latter technique is preferred as it reduces the complexity of the required sensing mechanism. As shown in FIG. 1, a timing gear **32** is mounted at the center of track **26** and is driven by the teeth on the type elements. The timing gear contains radial, magnetically-sensible markings **40**, which are spaced apart to coincide with the spacing between character types **10** on the character elements **8**. (Obviously, a lesser number of markings **40** can be used in conjunction with an oscillator or other timing pulse generator to provide intermediate timing data.) The markings **40** are magnetically secured by a transducer **42** to supply signals to the timing circuit **38**. Since the timing gear is centered along the printing line, irregularities in the dimensions of the type elements cause a minimum of timing error. Overall synchronization is accomplished by another magnetic transducer **44** which senses a single marking which is placed on only one of the type elements **8** for each complete type font. In the preferable case, where several fonts of type are present around the type race, this synchronizing marking is present on a corresponding type element in each font (e.g. the first type element in each font).

The comparator **36** receives applied data indicative of the characters to be printed and timing data indicative of the positions of the character types. As a result of comparisons, signals are supplied to the hammer driver assembly **6** to actuate the appropriate hammers. Signals from the timing circuit **38** are also applied to the hammer driver assembly to control the selection of the appropriate hammers for actuation.

In the preferred embodiment of the invention, the character types **10** (FIG. 2) are spaced slightly farther apart than are the character positions (columns) on the document. This produces the well-known "Doppler effect," wherein the character types are aligned with the character positions on the document in sequence, rather than all at one time. In this manner, sequential comparison with a single comparator is possible, reducing the complexity and expense of the hammer control system. Obviously, the character types can alternatively be spaced slightly closer together than the character positions to permit similar advantages.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A printer for presenting characters along a printing line on a surface of a document, comprising in combination:

a sequence of type elements mounted for travel around a closed track having a straight section adjacent to the printing line on the document and having a return section, both said sections lying in a common plane that is substantially parallel to the surface of the document, each type element containing at least one raised type character on an edge of the element that is essentially parallel to the plane of the track, the type elements and type characters being movable along the straight section of the track adjacent to the printing line and then back along the return section of the track;

means for providing substantially constant movement of the type elements around the track;

at least one transducer arranged to force a document against a type character to effect printing when the transducer is actuated; and

transducer control means responsive to applied data and to the position of the type elements in the track to actuate the transducer to print a predetermined character.

2. The device described in claim **1**, wherein a plurality of transducers are employed, one for each of a plurality of character positions along a printing line.

3. The device described in claim **2**, wherein a separate transducer corresponds to each character position along a printing line.

4. The device described in claim **1**, wherein the type elements are arranged in a track without being physically connected to their neighboring type elements.

5. The device described in claim **4**, wherein the track rigidly defines the closed path of travel and wherein the type elements are maintained against the track by a flexible member.

6. The device described in claim **1**, wherein each type element contains a plurality of type characters.

7. The device described in claim **1**, wherein the position of the type elements in the path is determined by magnetic sensing means.

8. A type carrier for an on-the-fly printer, comprising, in combination:

support means defining a closed path;

a plurality of type members adapted to move along said path, each said member supporting at least one type character and having a grooved recess on a side opposite a side of said member which contacts said support means;

a band encircling said path in the grooves of said type members whereby said members are maintained in contact with said support means; and

means for propelling said members along said path.

9. The type carrier set forth in claim **8** wherein said support means comprises:

a pair of parallel rails; and

a pair of rotatable pulleys mounted between the ends of said rails, said pulleys having peripheral surfaces substantially tangent to outer surfaces of said rails.

10. The type carrier set forth in claim **9** wherein said propelling means comprises:

motor means for rotating at least one of said pulleys.

11. The type carrier set forth in claim **9** wherein:

said rails and pulleys are provided with a continuous central groove and wherein said type members are shaped substantially in the form of a W, the central point thereof being adapted to reside in said central groove and to define said band receiving grooved recess and one of the outer legs thereof being adapted to support said type character.

12. The type carrier set forth in claim **10** wherein said type members are provided with teeth and said pulleys are provided with mating drive teeth, whereby said type members are positively propelled along said path.

13. The type carrier set forth in claim **8** wherein said type members are in abutting relationship with one another whereby each is propelled along said path by the pushing force exerted by the adjacent member.

14. The type carrier set forth in claim **8** wherein said band is made of elastic material.

15. The combination set forth in claim **8**, further comprising:

a hammer mounted adjacent said type carrier and spaced apart therefrom by an amount sufficient to admit a record medium; and

actuating means operating in timed relation with the movement of said type members to drive said hammer against said record medium to force the latter against a selected one of said type characters whereby an impression of said character is formed on said record medium.

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WILLIAM B. PENN, *Primary Examiner.*