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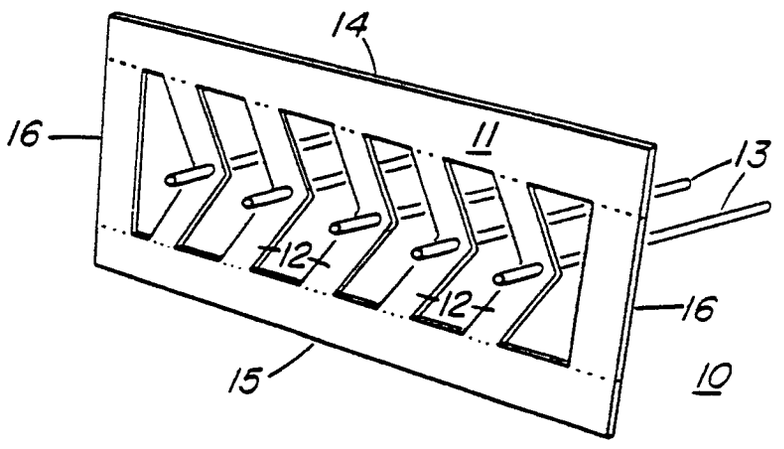
(54) Flexible print wire guide for dot matrix printers.

(57) A flexible print wire guide assembly (10) for use with dot matrix printers having combination frame (14,15,16) and plurality of angularly shaped flexible print wire guides (12) formed or etched from a single plate. The angularly shaped flexible print wire guides (12) are in parallel spaced relationship so as to place the vertices of the print wire guides (12) in a predetermined pattern. Print wires (13) extend through apertures (22) near the vertex of each wire guide and are welded or brazed to the flexible wire guides (12). The print wires (13) are directly attached at the opposite ends to solenoid drivers (18). When a particular solenoid driver (18) is actuated, the print wire (13) is pushed forward, with the flexible print wire guide (12) bending to allow the forward motion.

FIG 1



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FLEXIBLE PRINT WIRE GUIDE FOR DOT MATRIX PRINTERS

Background of the Invention

1. Field of Invention:

This invention relates to flexible print wire guides for positioning the print wires of a dot matrix printer.

2. Description of the Prior Art:

Dot matrix printers are well known in the art and are commonly used for printing applications. Legible characters are created by means of impinging a small printing wire against a ribbon to print a small dot onto paper or other print media. Matrices of closely spaced dots create the legible graphic patterns or alphanumeric characters of information.

There are two types of dot matrix printers in use today. They can be generally classified as serial printers and line printers. Serial printers have a cluster of closely spaced print wires which are positioned in the printing head with each print wire having its own solenoid operated actuator. The graphic information or characters in any particular printed line of information are printed one at a time and in sequential order as the printhead moves across the line either from left to right or right to left. A dot pattern stored in a permanent memory built into the printer is utilized to energize the solenoid actuators for the specific print wires needed to form any particular character.

A second, and faster system in use with dot matrix printers is called line printing. All of the graphic information or individual alphanumeric characters for the line of information to be printed on the paper are entered into the printer memory.

The print head containing the print wires moves horizontally across the page to simultaneously print a complete line of dots for all of the matrices of all of the individual characters to be printed on that particular line. The paper is then advanced a small amount and the next line of dots in the matrices is printed. In this manner all of the graphic information or individual characters for the line of information is printed simultaneously. If a plurality of print wires are used, less horizontal travel across the paper is necessary. Medium speed line printers usually have print heads with up to 132 print wires in parallel spaced relationship, which travel horizontally only a few tenths of an inch.

In each case, serial and line printers, one current technology is to attach the print wire to its solenoid actuator and to pass it through a guide bearing hole in the print bar or head. Typically these guide bearings are made from gem stones such as rubies. In all cases they are subject to manufacturing and wear tolerances which result in alignment problems. IKEDA, Patent Number 4,156,960, dated June 5, 1979, is representative of this type of technology and discloses a print wire passing through a sleeve.

These manufacturing tolerances and alignment problems inherent to systems using guide bearings allow misalignment of the print wires which results in irregular spacing of the printed dots. Additionally, other alignment problems are caused by the fact that the solenoid actuators are much larger than the print wires and have to be positioned in slightly different orientations in order to fit them all into the print head and/or print bar. The print wires are angled toward each other to form the desired cluster or row patterns at their tips. The angles can cause misalignment problems which are usually aggravated as the bearing holes wear, thus allowing the print wires to angle more through the hole than as originally designed.

Misalignment problems cause irregular spacing of the dots in the matrix and result in a gradual deterioration in the quality of the printed characters.

Additional problems are incurred because the speed limiting factor for high speed printers is the time necessary to actuate the solenoid drivers. Usually solenoids utilizing magnetic forces are used. The result is that in order to increase the speed of the printer, the mass of the print wire assembly and drivers must be reduced. Concurrent with the reduction in mass and resulting increases in speed, additional frictional forces are incurred as the print wires strike against a faster moving medium, relative to the print head, such as carbon paper or ribbon.

Of particular concern are: the horizontal forces and the horizontal displacement of the print wires resulting from frictional engagement of the print wires with a printing medium such as the ribbon; the magnetic cross talk between the various solenoid drivers; and also, the dynamic forces induced by the oscillation of the print head back and forth, from side to side, across the paper. These problems are identified in BINGHURST, Patent Number 4,134,336, dated January 16, 1979, wherein the current state of technological development is described in detail.

BINGHURST utilizes a bracing system to dampen horizontal displacements of the print styli. An-

other type of proposed solution can be seen in East German Patent Number 141,137, dated April 16, 1980, wherein the print head plate has an array of resilient tongues, off-set from one another, and equipped with printing style used to generate the dots of the matrix. The device disclosed in East German Patent Number 141,137, if used as disclosed, could be characterized as a serial printer wherein the print head prints a complete vertical line of dots at one time to form a vertical line of the matrix of any particular character as the print head moves horizontally across the paper from left to right. In doing so, the resilient tongues are subject to alternating compressive and tensional forces. Even if the device were to be rotated 180 degrees so as to function as a horizontal line printer, the identical forces are present.

The previously described speed limiting situation develops with both designs. To increase speed, mass must be reduced. But as mass is reduced and speed increases, the increased speed results in increased horizontal forces on the print head guide wires. At some point speed cannot be further increased because of the lowered mass print head's ability to withstand the increased horizontal forces. The net effect is that printer speeds cannot be further increased unless a print head with both low mass and high strength can be developed.

Another problem with the device disclosed in East German Patent Number 141,137 is that the design inherently creates opposing angular displacements for the styli which reduces the quality of the dot matrix because of misalignment problems caused by said angular displacement.

Finally, the devices described in BINGHURST Patent Number 4,134,336 and East German Patent Number 141,137 as well as TALVARD, et al Patent Number 4,077,336, dated March 7, 1978, all require impact type mechanical connection between the solenoid driver mechanism and the print wire guides. This reduces reliability and increases the wear on the mechanism. Ideally, the print wire should be directly connected to the driver without any impact type mechanical interfaces.

Summary of the Invention

It is an object of this invention to produce a print wire guide which does not utilize any bearing surfaces to hold a longitudinally moving print wire in position. Additionally, it is an object of this invention to produce a flexible wire guide wherein traverse displacement of the print wire, if any, is uniform and unidirectional for all print wires.

Another object of this invention is to produce a flexible wire guide with reduced mass and increased strength to withstand the frictional and dynamic forces associated with high speed dot matrix printing.

Finally, it is an object of this invention to produce a flexible wire guide with few moving parts and where assembly and alignment of the print wires is simple and automatic.

These objects are accomplished by the use of a flexible wire guide assembly in which a combination frame and a plurality of angularly shaped flexible print wire guides are stamped or etched from a single plate. The angularly shaped flexible print wire guides are in parallel spaced relationship so as to place the vertices of said angular shaped guides in a straight line or other predetermined pattern. An aperture is formed in the vicinity of the vertex of each angular wire guide.

The print wires extend through the vertex apertures and are welded or brazed to the flexible wire guides. The print wires all extend a predetermined length through the vertex apertures of the flexible print wire guides of the assembly for printing or impinging against the ribbon. The other ends of the print wires are directly attached to their associated solenoid drivers which, in turn, are positioned on the print head frame.

When a particular solenoid driver is actuated the associated print wire is pushed forward, with the flexible print wire guide bending to allow the forward motion.

Brief Description of the Drawings

Figure 1 is a representational, perspective view of a flexible wire guide for a print head for a dot matrix printer.

Figure 2 is a representational side view of the flexible wire guide shown in Figure 1.

Figure 3 is a top view of the flexible wire guide shown in Figure 1 showing selected print wires in extended position.

Figure 4 is a frontal view of a combined perimeter frame and wire guide assembly.

Figure 5 is a representational frontal view showing triangular shaped apertures in flexible wire guides.

Figure 6 is a representational frontal view showing notch shaped apertures in flexible wire guides.

Detailed Description of the Preferred Embodiment

First referring to Figure 1, a flexible wire guide assembly generally described as 10 comprises plate assembly 11 constructed of first plate 14 and second plate 15, both supported in parallel spaced

relationship by vertical support plates 16.

As a part of the manufacturing process, flexible wire guides 12 are formed as an integral part of plate assembly 11. Figure 1 illustrates flexible wire guide assembly print head 10 having only five sets of flexible wire guides 12 and print wires 13; however, a print head used in a high-speed dot matrix line printer may have as many as 132 print wires 13 and associated flexible wire guides 12. Figure 4, which is a front view of another frame and flexible wire guide assembly 21 illustrates the typical spacing of flexible wire guides for use with a dot matrix line printer. While the flexible wire guides 12 and the associated holes 22 are shown spaced equidistant one from another with holes 22 aligned in a straight line, it is not a requirement that the spacing of the flexible wire guides 12 be uniform or that the holes 22 be aligned in a straight line. For example, the flexible wire guides may be arranged in pairs, each pair separated from another pair by a first distance while each flexible wire guide in each pair is separated one from the other by a second distance. Further, the holes in each pair may be offset one from the other in such a manner that two rows of dots are printed in each pass of the printhead.

A primary advantage of plate assembly 11 is that first plate 14, second plate 15, vertical support plate 16 and flexible wire guides 12 are manufactured as an integrated, one piece assembly. This facilitates precise alignment of flexible wire guides 12 and precise positioning of holes 22 (as shown in Figure 4). Additionally, there are substantial costs savings realized as a result of being able to produce the plate assembly as one integrated piece. Plate assembly 11 may be fabricated from a beryllium-copper or similar alloy utilizing a chemical etching process.

Referring to Figures 1, 2 and 4, the construction and operation of flexible wire guide assembly 10 is shown. Print wires 13 extending through holes 22 are held in position by means of brazed joints 17.

Figures 5 and 6 shown alternative embodiments to the circular holes 22 as shown in Figure 4. In lieu of the circular holes 22 of Figure 4, Figure 5 discloses triangular shaped holes 23. The triangular hole can be much larger than the wire yet provide precise alignment if the wire is, after insertion, set into a specified vertex of the triangular aperture. It should be apparent that other configurations of the aperture will provide this same alignment feature as long as it contains at least one vertex. The notches 24 as shown in Figure 6 are another alternative embodiment which also facilitates precise alignment of print wires 13.

As shown in the representational side view of Figure 2, lower support frame 19 provides rigid support for second plate 15 and holds in position solenoid driver 18. Upper support frame 20 is provided to brace first plate 14. Print wire 13 is directly connected to solenoid driver 18 without any impact type mechanical interface.

Referring to Figures 2 and 3, when solenoid driver 18 is energized print wire 13 is thrust forward to impinge upon an ink ribbon, not shown, in order to produce a dot on paper or other print media. Flexible wire guides 12 as are shown in Figure 3, allow the print wires 13 to move forward. In practice it has been found that if print wires 13 are more rigid than the flexible wire guides 12, the angular displacement of the portion of print wires 13 extending through holes 22 in wire guides 12 is minimized, thus allowing the impacting ends of print wires 13 to strike the ribbon squarely, as opposed to at an angle.

Additionally, as can be seen from figures 1, 3 and 4, when the solenoid drivers 18 are energized, the lateral displacement of the various print wires 13 has to be, and in fact is, uniform. Hence, the quality of printed characters formed by the dot matrix are uniformly enhanced. Since the displacement of print wires 13 is uniform, the entire line of graphic information or alphanumeric characters is uniformly displaced a minimal amount either to the left or right, depending upon the orientation of the flexible wire guide assembly. Further, since this small displacement is uniform, it may be ignored or, if necessary, may be compensated for by print media placement or offsetting of the wire guide assembly 10.

While there is shown and described the present preferred embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto but may be variously embodied to practice within the scope of the following claims.

Claims

1. A print wire guide assembly which comprises:

a frame (14,15) having a first plate (14) and a second plate (15) in spaced relationship;

characterized by

a plurality of angularly shaped flexible print wire guides (12) each having at least one vertex, said angularly shaped print wire guides (12) aligned in parallel spaced relationship so as to place the vertices of said angular shaped print wire guides (12) in a predetermined pattern with one end of each of said flexible print wire guides (12) attached to the first plate (14), and the other end of each of said print wire guides (12) attached to the second plate (15);

a plurality of print wires (13); and

means (17) for attaching a separate one of said plurality of print wires (13) to each of the angularly shaped, flexible print wire guides (12).

2. The print wire guide assembly as in Claim 1 characterized in that said frame (14,15) and said plurality of angularly shaped flexible print wire guides (12) are constructed as an integral, one piece, assembly.

3. The print wire guide assembly as in one of the preceding claims characterized in that said angularly shaped flexible print wire guides (12) have, at their vertices, an aperture (22) for receiving one end of a print wire (13).

4. The print wire guide assembly as in one of the preceding claims characterized in that said print wires (13) are more rigid than said flexible print wire guides (12).

5. The print wire guide assembly as in one of the preceding claims characterized in that said means (17) for attaching the print wires (13) to the flexible print wire guides (12) further comprises:

each print wire (13) extending through an aperture (22) in a flexible print wire guide (12); and

means (17) for rigidly attaching each print wire (13) to a flexible print wire guide (12) at the point where the print wire (13) passes through the aperture (22) in the flexible wire guide (12).

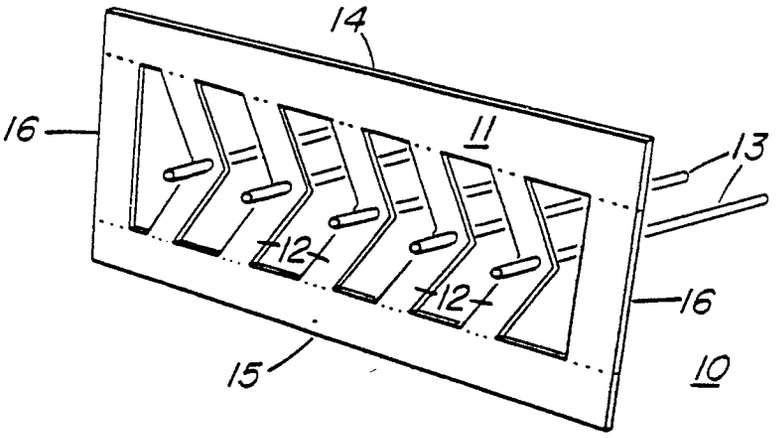
6. The print wire guide assembly as in one of the preceding claims characterized in that said aperture (22) is configured so that it has at least one vertex.

7. The print wire guide assembly as in one of the preceding claims characterized in that said aperture is a notch (24) in the flexible print wire guide (12).

8. The print wire guide assembly as in Claim 5 characterized in that said aperture (22) is circular in shape.

9. The print wire guide assembly of as in any one of the preceding claims characterized in that said print wires (13) are more rigid than said flexible wire guides (12).

FIG 1



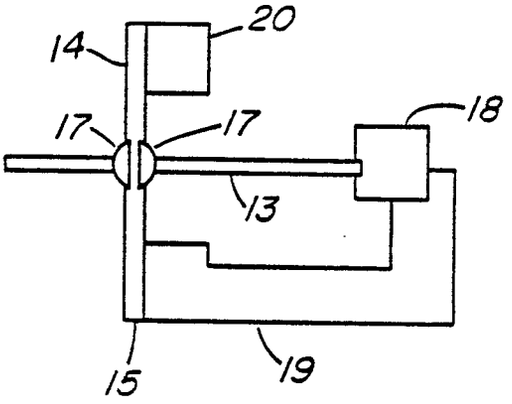
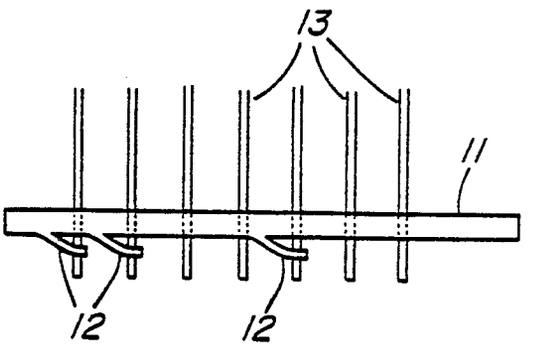


FIG 2

FIG 3



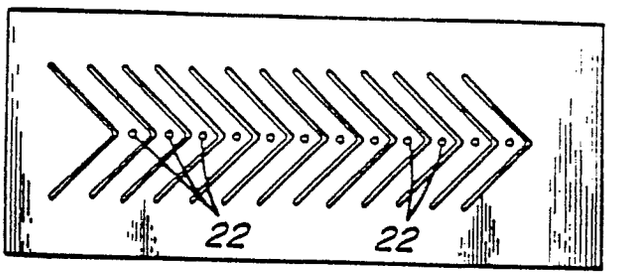


FIG 4

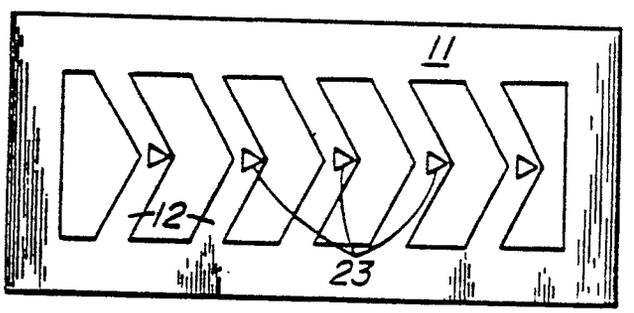


FIG 5

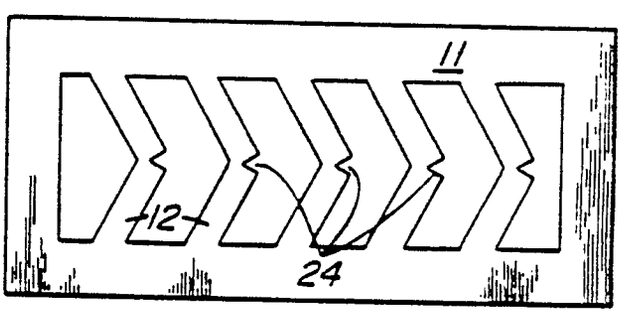


FIG 6