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PATENT ABSTRACTS OF JAPAN, vol. 6, no. 216 (M-168)(1094), 29 October 1982

PATENT ABSTRACTS OF JAPAN, vol. 10, no. 304 (M-526)(2360), 16 October 1986

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Description

TECHNICAL FIELD

The present invention relates to an assembly for moving a print medium through a printer according to the preamble of claim 1 and to a print medium feeder according to the preamble of claim 5. The predominant current usage of the improved medium drive mechanism is as a means for causing a medium such as paper to move through the printer and past the printing area in a thermal ink-jet printer.

BACKGROUND ART

A number of various means have been employed to move a medium such as paper through computer hard copy printers. The first of these was the traditional typewriter roller arrangement. This arrangement proved unsatisfactory for automated computer printers, however, because it was not well suited for automatically accepting single sheets of medium as they were fed into the printer.

Other methods that have been tried have included tractor feed mechanisms wherein drive sprockets engage holes in the medium. This method works well for form-feed type documents and other media; however, it is not adaptable for use with single sheets of media.

Current drive mechanisms for thermal ink-jet printers frequently include roller mechanisms wherein the medium is passed between two opposing rollers as in the rollers of an old fashioned washing machine. This arrangement works well because it provides a positive feed for the medium and allows the medium to exit the drive area in a straight line.

However, the problem with this arrangement is that there is frequently insufficient roof to easily include a pair of opposed rollers. This problem is particularly acute as regards the top roller, as it may interfere with the movement of the printhead if it is placed too near.

It is desirable to place the drive mechanism as close to the printhead as possible, because the less distance the medium has to travel from the drive mechanism to the print-head, the less chance there is of it buckling in that interval. Further, if the printhead could be placed nearer to the drive area, necessary top and bottom margins could be greatly reduced. This is considered to be a highly desirable feature. Therefore, printer designers have been faced with the dilemma of having to place the drive mechanism as close as possible to the printhead to avoid buckling and to reduce necessary top and bottom margin sizes, and also having to remove the drive mechanism from the printhead sufficiently far to provide room for a top roller. This dilemma has been compounded by the fact that the height of the printhead above the medium must also be minimized, as this is an important factor in print quality.

Obviously, it would be desirable to provide a means for driving media through printers which did not include a top roller and therefore could be placed as close as is desired to the printhead. However, previous attempts to design such a mechanism have been less than successful. For instance, if the top roller is replaced with a flat surface, the medium has tended to feed improperly and to jam in the drive mechanism unless an additional pair of drive rollers is provided, thereby allowing for a clearance between the drive roller and the flat surface.

The JP-A-57/120 476 discloses a paper feeding mechanism comprising a round drive roller as a high friction moving surface, a low friction stationary surface for causing the medium to be pressed against the roller and means for tensioning said stationary surface toward said moving surface.

The JP-A-62/100 342 discribes a non-rotating path idler which is provided with an arcuate member positioned closely adjacent to a drive roller for the paper feeding mechanism, said arcuate member being made from an ultra-high molecular weight polyethylene.

The object of the invention is to provide a mechanism for driving medium through a printer which can successfully meet desirable size restrictions so as to reduce the overall size of the printer and also to allow the drive mechanism to be placed very close to the printhead. The medium drive mechanism of the invention should avoid the problems of medium buckling, and also avoid the problems of medium misfeed and jamming, and further cause the medium to exit the drive mechanism in a straight line parallel to the printhead. Further, the mechanism for driving medium through a printer shall allow for producing top and bottom margins as small as 2 to 3 millimeters.

This object is solved by an assembly for moving a print medium through a printer comprising the features of claim 1 and by a print medium feeder comprising the features of claims 5.

DISCLOSURE OF INVENTION

This invention relates to a medium drive mechanism for a computer hard copy printer having an extremely low friction surface opposed to a high friction drive surface. This combination provides a positive medium drive formerly available only with dual roller drive systems.

Briefly, the preferred embodiment of the present invention is a medium-drive mechanism

constructed such that a high friction rubber drive roller imparts a motive force to a sheet print medium. The medium is held in place against the rubber drive roller by means of a guide plate including a structural backing mechanism and an extremely low friction surface. According to the present invention, the low friction surface is constructed of ultra-high molecular weight (UHMW) polyethylene. UHMW polyethylene has been found by the inventor to provide the best combination of low friction properties and wear resistance. It has been found by the inventor that drive mechanisms so constructed are no more prone to jamming or medium misalignment than are dual roller drive mechanisms.

The superior drive qualities of the inventive drive mechanism are largely due to the fact that the sum of forces on the medium produced by the inventive drive actually produces a greater total force in the intended drive direction than have similar prior art drive mechanisms.

The inventive medium drive mechanism subassembly may be placed closer to the printhead in a printer assembly than is possible with a dual roller medium drive mechanism, because the guide surface does not interfere with the movement of the printhead as does a top roller. Of course, the greater distance the medium has to travel after leaving the drive mechanism and before getting to the printing area of a printer, the greater the likelihood that buckling or other medium misalignment may occur. But the primary advantages of the inventive drive mechanism are that the amount of necessary top and bottom margins are greatly reduced, and that high image quality may be maintained by allowing placement of the printhead close to the medium and to the drive assembly.

Therefore, the inventive method is conducive to the highest print quality possible, since medium orientation to the printhead is optimized. That placement of the drive mechanism close to the printhead is desirable has long been known. However, prior attempts to design mechanisms which could be placed closer to the printhead have failed because all such attempts have resulted in mechanisms that were more prone to jamming or other problems than were the conventional dual roller drive mechanisms. Therefore, prior to the present invention, dual roller mechanisms have been incorporated into ink-jet printer assemblies.

Another desirable factor of the present invention is that a drive mechanism constructed according to the invention may be made smaller than conventional medium drive mechanisms, thereby facilitating a reduction in overall printer size.

An advantage of the present invention is that the size of top and bottom margins on the print medium may be decreased.

Another advantage of the present invention is that a sprinter medium drive mechanism may be placed horizontally closer to an ink-jet printer printhead.

Yet another advantage of the present invention is that image quality is improved by allowing placement of the printhead vertically closer to the medium.

A further advantage of the present invention is that a tendency of medium to jam in the drive mechanism is reduced.

A still further advantage of the present invention is that the unsupported area between a drive mechanism and a printhead wherein a medium might buckle is reduced.

Yet another advantage of the present invention is that overall printer size may be reduced.

These and other objects and advantages of the present invention will become clear to those skilled in the art in view of the description of the best presently known mode of carrying out the invention and the industrial applicability of the preferred embodiment as described herein and as illustrated in the several figures of the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic representation of a side view of a portion of a printer including the drive mechanism of the present invention;

FIG. 2 is a diagrammatic representation similar to FIG. 1, showing the low friction surface of the present invention replaced with a prior art pinch roller; and

FIG. 3 is a representation of the various forces exerted on a print medium by a drive mechanism.

BEST MODES FOR CARRYING OUT INVENTION

The best presently known mode for carrying out the invention is a thermal ink-jet printer incorporating a conventional printer pen and pen traversing mechanism, but also using a medium drive mechanism in accordance with the present invention, wherein motive force is transferred to the medium via a high friction surface and the medium is held against the high friction surface by an opposing low friction surface. The medium drive mechanism of the present invention is more compact then comparable prior art drive mechanisms, and also provides for more accurate medium placements than has been considered to be feasible using compact drive mechanisms. In the best presently known embodiment of the present invention, the friction differential necessary to the success of the invention is achieved by use of an ultrahigh molecular weight (UHMW) polyethylene

tape on the low friction surface. The sum of the resultant forces produced on the medium by the inventive drive mechanism is greater in a desired drive direction than that which is produced by comparable prior art drive mechanisms.

The predominant expected usage of the inventive medium drive mechanism is in thermal ink-jet printers, wherein clearance of the drive mechanism to the printhead pen is critical, and especially in applications, wherein the height of the combined assembly is a concern, such as in a portable or small desk top units, and in applications wherein minimal top and bottom margins are required.

A portion of the thermal ink-jet printer assembly of the presently preferred embodiment of the present invention is illustrated in diagrammatic form in a side view in FIG. 1 and is designated therein by the general reference character **10**. In most of its substantial components, the printer **10** does not differ significantly from conventional thermal ink-jet printers.

The conventional elements of the printer **10** include a printhead **12** and a printhead traversing mechanism (not shown) for moving the printhead **12** across a piece of medium **14**, thus positioning the printhead **12** for printing upon the medium **14**.

The medium **14** is moved through the printer by means of a high friction drive surface **16**. In the presently preferred embodiment of the present invention, the drive surface **16** is made of high friction rubber and constitutes the surface **16** of a drive roller **18**. A drive plate **20** is provided to hold the medium **14** firmly against the drive surface **16**. A means for pressing the drive plate **20** toward the drive surface **16** in a force direction **22** is provided in the presently preferred embodiment of the invention by constructing the drive plate **20** of spring steel and tensioning it against the drive roller **18** in force direction **22**.

The tangent point **24** of the drive roller **18** to the drive plate **20**, according to the present invention, transfers motive force to the medium **14** in a medium advance direction **26** as the drive roller **18** rotates in a rotational direction **28**. Therefore, normal force in force direction **22** must be sufficiently great to prevent slipping and mishandling of the medium **14**. The actual amount of necessary normal force in force direction **22** may vary depending upon the type of medium **14** used and other variables, but this can be quickly and easily adjusted according to the exact application to which the present invention is applied.

Contrary to previous beliefs about printer drive mechanisms, the inventor has found that sufficient normal force in force direction **22** may be applied to prevent slippage and resultant jamming of the medium **14** when tangent point **24** is the point of transfer of motive force from the high friction drive surface **16** to the medium **14**. In the best presently known embodiment of the present invention, an ultrahigh molecular weight (UHMW) polyethylene tape **30** is applied to the drive plate **20**.

Using the UHMW polyethylene tape **30**, friction differential as between the first junction **32** of the high friction drive surface **16** to the medium **14**, and the second junction **34** of drive plate **20** to the medium **14**, sufficient to prevent problems previously believed to be unavoidable in such an application, may be created. UHMW polyethylene tape may be obtained from 3M Company, Industrial Tape Division, St. Paul, Minnesota, under their part number 5425. The tape is provided with a solvent-resistant acrylic adhesive backing (not shown) for adhering the UHMW polyethylene tape **30** to the drive plate **20**.

As opposed to prior art mechanisms, as depicted in FIG. 2, wherein a pinch roller **44** is used to reduce drag, the polyethylene tape of the presently preferred embodiment of the present invention allows the printhead **12** (FIG. 1 and FIG. 2) to be placed closer to the tangent point **24** while not necessitating raising the printhead **12** higher above the medium. This is an important advantage in thermal ink-jet printers, since maintaining the printhead **12** at a minimal height above the medium **14** is necessary to print quality, and since placement of the printhead **12** close to the drive tangent point **24** allows printing on a greater portion of the medium **14**, thereby reducing the size of top and bottom margins (not shown).

Referring now to FIG. 3, wherein is depicted a drive force **46**, a drag force **48**, and two normal forces **50** acting on a print medium **14**, it can be seen that the sum of forces **46, 48,** and **50** will influence movement of the medium **14** in the medium advance direction **26**. The normal forces **50** are produced, in the best presently known embodiment of the present invention, by tensioning of the drive plate **20** toward the drive roller **18**. Since the drive plate **20** and the drive roller **18** are immobile in the plane of the normal forces **50**, the two normal forces **50** are necessarily equal in magnitude and opposite in direction. The drive force **44** in medium advance direction **26** acting on the medium **14** is a function of the product of the normal force **50** and a friction factor between the high friction drive surface **16** and the medium. The drag force **46** acting in a direction opposite to medium advance direction **26** is a function of the product of the normal force **50** and a friction factor between the low friction surface **30** and the medium **14**. As can be appreciated by one skilled in the art, greatly reducing the friction factor between the medium **14** and the drive plate **20** by addition of the low friction surface **30**, causes the ratio of the drive force **44** to the drag force **46** to be greatly

increased. The sum of forces acting on the medium **14** in a plane parallel to the medium drive direction **26** is the drive force **44** minus the drag force **46**. The normal force **50** can be increased, in accordance with the present invention, to a value necessary to provide sure and positive handling of various types of medium **14** without slippage or other mishandling of the medium **14**.

Various modifications may be made within the scope of the invention as defined by the claims. For example, the high friction drive surface **16** may be part of a flat sliding plate, rather than a roller. Another conceivable alteration would be to use another very low friction surfacing material as a substitute for the UHMW polyethylene tape **30**.

All of the above are only some of the examples of available embodiments of the present invention. Those skilled in the art will readily observe that numerous other modifications, alterations, and adaptations may be made without departing from the scope of the invention.

INDUSTRIAL APPLICABILITY

Thermal ink-jet printers have found wide acceptance in the marketplace. Among the many desirable qualities of thermal ink-jet printers are the high print quality and the ease of use of these printers. The present invention has been found to enhance both of these qualities. The print quality of thermal ink-jet printers is enhanced through use of the drive mechanism of the present invention by virtue of the fact that the printhead may be placed at a height which is relatively close to the medium as compared with prior art arrangements, and because the height relationship of the medium to the printhead is held relatively constant by virtue of the fact that the medium is supported close to the printhead by the inventive drive assembly.

Since printing is accomplished in a thermal ink-jet printer by ejecting droplets of ink onto the medium, any variations in the plane of the medium relative to the surface of the printhead from which the ink is ejected will result in a reduction of print quality. Since the marketplace for thermal ink-jet printers is quite competitive and since one of the major differentiating factors of such printers is the print quality, any innovation such as the present invention which will enhance quality will greatly enhance the utility of the printer in the marketplace.

Furthermore, since the printhead may be placed very close to the drive assembly, according to the present invention, the top and bottom margins (unprinted areas) may be greatly reduced. These margins are a function of the distance from the drive assembly to the printhead, since the medium must necessarily be supported in the drive assembly when printing is being accomplished, and since the absolute minimum margin would be the distance from the printhead to point at which the medium is supported by the drive assembly. It is thought that this factor alone will provide a major benefit to the users of printers employing the inventive drive mechanism.

Ease of use of thermal ink-jet printers is greatly reduced by any jamming or mishandling of medium within the printer. Minor variations in medium handling will result in print being improperly placed upon the medium. Major mishandling problems require operator intervention and are considered to be extremely detrimental to user satisfaction. For this reason, dual roller type medium drive mechanisms have been used in spite of the fact that they are less than ideal for other reasons discussed herein.

However, the inventive mechanism has been found to be as conducive to error-free medium handling as have prior art dual roller mechanisms. Therefore, it is anticipated that medium drive mechanisms according to the present invention will greatly enhance the usability of thermal ink-jet printers.

Another factor which may increase the acceptance and usefulness of the inventive drive mechanism is that the need for smaller printers is increasing. In fact, portable printers to accompany portable computers may be a future application.

Since the medium drive mechanisms of the present invention may be readily constructed and are easily incorporated into printer designs, it is expected that they will be accepted in the industry as substitutes for conventional medium drive mechanisms.

For these and other reasons, it is expected that the utility and industrial applicability of the invention will both significant in scope and long lasting in duration.

Claims

1. An assembly for moving a print medium (14) through a printer (12), comprising
a high friction moving surface (16) for transmitting motive force to the medium (14), wherein said high friction moving surface (16) is affixed to a drive roller (18);
means for causing said drive roller to rotate; an extremely low friction stationary surface (30) for causing the medium (14) to be pressed against said high friction moving surface (16); and
means (20) for tensioning said extremely low friction stationary surface toward said high friction moving surface (16),
characterized in that
said extremely low friction stationary surface

(30) is an ultra-high molecular weight polyethylene material; and said means for tensioning said extremely low friction stationary surface (30) toward said high friction moving surface includes a backing plate (20) on said extremely low friction stationary surface (30).

2. The assembly for moving a print medium of claim 1,
characterized in that said low friction surface (30) is one side of a tape attached to said drive plate (20) at least at an area tangent to said drive roller (18).

3. The assembly for moving a print medium of claim 1 or 2,
characterized in that said ultra-high molecular weight material is adhered to said drive plate by means of a solvent resistant acrylic adhesive.

4. The assembly for moving a print medium of claim 1, 2 or 3,
characterized in that said backing plate (20) is made of spring steel.

5. A print medium feeder, comprising
propelling means (20) for propelling a print medium (14); and means (16, 18) for holding the medium (14) against said propelling means;
characterized in that said means for holding the medium (14) against said propelling means comprises an ultra-high molecular weight polyethylene surface; and said propelling means includes:
a flat plate;
a high friction surface on said flat plate;
a means for moving said flat plate parallel to said ultra-high molecular weight polyethylene surface.

Patentansprüche

1. Anordnung zum Bewegen eines Druckmediums (14) durch einen Drucker (12) mit einer sich bewegenden Fläche (16) hoher Reibung zum Übertragen einer Antriebskraft auf das Druckmedium (14) wobei die Fläche (16) an einer Antriebsrolle (18) angebracht ist; umfassend
Mittel zum Drehen der Antriebsrolle;
eine stationäre Fläche (30) extrem geringer Reibung zum Veranlassen des Druckmediums (14) zum Fressen gegen die Fläche (16) hoher Reibung und
Mittel (20) zum Spannen der stationären Fläche extrem geringer Reibung gegen die sich bewegende Fläche (16) hoher Reibung,
dadurch **gekennzeichnet**,
daß die stationäre Fläche (30) extrem geringer Reibung aus einem Polyethylen-Werkstoff ultrahohen Molekulargewichtes ist und die Mittel zum Spannen der stationären Fläche (30) extrem geringer Reibung gegen die sich bewegende Fläche hoher Reibung eine Stützplatte (20) an der stationären Fläche (30) extrem geringer Reibung aufweist.

2. Anordnung zum Bewegen eines Druckmediums nach Anspruch 1, dadurch **gekennzeichnet**, daß die Fläche (30) geringer Reibung eine Seite eines an der Stützplatte (20) befestigten Bandes ist, zumindest in einem die Antriebsrolle (18) tangierenden Bereich.

3. Anordnung zum Bewegen eines Druckmediums gemäß Anspruch 1 oder 2, dadurch **gekennzeichnet,** daß der Werkstoff ultrahohen Molekulargewichts an der Stützplatte mittels eines Acrylklebers befestigt ist, der lösungsmittelresistent ist.

4. Anordnung zum Bewegen eines Druckmediums nach Anspruch 1, 2 oder 3, dadurch **gekennzeichnet,** daß die Stützplatte (20) aus Federstahl hergestellt ist.

5. Druckmedium-Zuführer umfassend
Antriebsmittel (20) zum Antreiben eines Druckmediums (14) und Mittel (16, 18) zum Halten des Druckmediums (14) gegen die Antriebsmittel, dadurch **gekennzeichnet**, daß die Mittel zum Halten des Druckmediums (14) gegen die Antriebsmittel eine Oberfläche aus Polyethylen ultrahohen Molekulargewichts umfaßt und daß die Antriebsmittel umfassen:
eine ebene Platte;
eine Fläche hoher Reibung an der ebenen Platte;
Mittel zum Bewegen der ebenen Platte parallel zu der Oberfläche aus Polyethylen ultrahohen Molekulargewichtes.

Revendications

1. Un ensemble destiné à déplacer un milieu d'impression (14) à travers une imprimante (12), comprenant:
une surface en déplacement (16) à friction élevée servant à transmettre une force motrice au milieu (14), ladite surface en mouvement (16) à friction élevée étant fixée à un rouleau d'entraînement (18);
un moyen d'amener ledit rouleau d'entraînement à tourner;

une surface stationnaire (30) à friction extrêmement basse qui sert à amener le milieu (14) à être appuyé contre ladite surface en déplacement (16) à friction élevée; et

un moyen (20) de mise en tension de ladite surface stationnaire à friction extrêmement basse vers ladite surface en déplacement (16) à friction élevée,

caractérisé en ce que

ladite surface stationnaire (30) à friction extrêmement basse est une matière de polyéthylène à poids moléculaire extrêmement élevé; et ledit moyen de mise en tension de ladite surface stationnaire (30) à extrêmement basse friction vers ladite surface en déplacement à haute friction inclut une plaque de renfort (20) sur ladite surface stationnaire (30) à friction extrêmement basse.

2. L'ensemble destiné à déplacer un milieu d'impression selon la revendication 1,

caractérisé en ce que ladite surface (30) à faible friction est un côté d'un ruban attaché à ladite plaque d'entraînement (20) au moins à une zone tangente audit rouleau d'entraînement (18).

3. L'ensemble à déplacer un milieu d'impression selon la revendication 1 ou 2,

caractérisé en ce que ladite matière à poids moléculaire extrêmement élevé est amenée à adhérer à ladite plaque d'entraînement au moyen d'un adhésif acrylique résistant aux solvants.

4. L'ensemble à déplacer un milieu d'impression selon la revendication 1, 2 ou 3,

caractérisé en ce que ladite plaque de renfort (20) est en acier à ressorts.

5. Un dispositif d'alimentation de milieu d'impression, comprenant

un moyen propulseur (20) pour propulser un milieu d'impression (14);

et un moyen (16, 18) de maintien du milieu (14) contre ledit moyen propulseur;

caractérisé en ce que ledit moyen de maintien du milieu (14) contre ledit moyen propulseur comprend une surface de polyéthylène à poids moléculaire extrêmement élevé; et ledit moyen propulseur inclut:

une plaque plate;

une surface à friction élevée sur ladite plaque plate;

un moyen servant à déplacer ladite plaque plate parallèlement à ladite surface de polyéthylène à poids moléculaire extrêmement élevé.

Fig. 1.

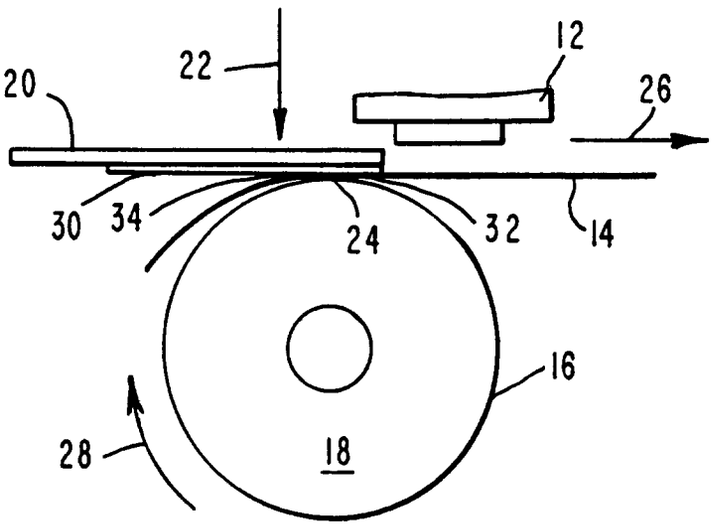

Fig. 3.

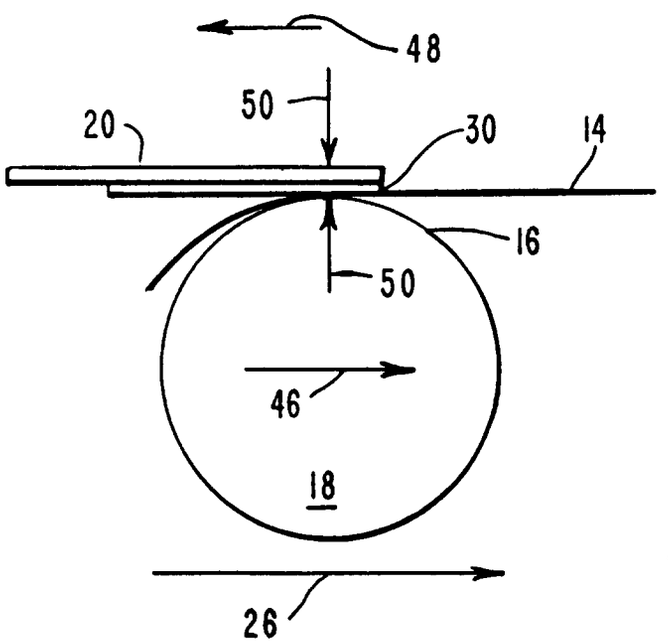

Fig. 2.