A media transport system is provided including providing a drive system, driving a drive train using the drive system, using the drive train to drive a media driver, and braking the drive train using a drive gear brake.
FIG. 4
MEDIA TRANSPORT SYSTEM

BACKGROUND ART

[0001] The present invention relates generally to media transport systems, and more particularly to printer media transport systems.

[0002] Inkjet printer devices generally incorporate one or more inkjet cartridges, often called "pens", which shoot drops of ink onto a page or sheet of print media. The pens are usually mounted on a carriage, which is arranged to scan across a scan axis relative to a sheet of print media as the pens print a series of individual drops of ink on the print media forming a band or "swath" of an image, such as a picture, chart or text.

[0003] Inkjet printers are generally arranged to print in a variety of print modes that offer differing trade-offs between print quality and throughput. In all print modes, the print media may be advanced relative to the carriage, by a distance equal to the height of a swath once a given swath is printed. In this manner, a further swath may then be printed adjacent to the earlier swath. By a repetition of this process, a complete printed page may be produced in an incremental manner. High quality print modes require very precise and accurate control of media position in the swath advance.

[0004] In general, paper motion is usually actuated by a DC-motor or stepper motor coupled to the belt pulley. Other paper transport devices such as pin-feed roller combinations engaging one or more surfaces of the sheet of paper are also known in the art. Note also that while in the state of the art ink-jet printing, where swaths of print are usually scanned sequentially in the x-axis, motion in the y-axis is generally, but not universally unidirectional. It is also known to have bidirectional paper motion in contact pen plotters.

[0005] The problem is in producing a relatively rapid motion of the paper in the y-axis in combination with accurate positioning relative to the pens. Design engineers must deal with the various subsystems of the media drive system, namely, gear train (also referred to hereinafter as "transmission") wind up, backlash, and lack of viscous damping. Both transmission wind up and backlash will generally result in poor line feed accuracy, contributing to poor image quality. A variety of individual or combinable solutions have been employed in the art.

[0006] One prior solution is to provide a direct drive, i.e., a direct coupling between the motor and media. Driving a mechanical system without gear reduction or transmission results in systems that are not optimized. Alternatively, a larger motor must be employed to accomplish what a smaller motor with gear reduction can achieve.

[0007] Another solution is to provide mechanisms for inducing friction. Friction intentionally added to a system will inevitably detract from performance because of lack of power, loss of efficiency, and the added expense of a viscous dashpot. Moreover, friction components are difficult to duplicate accurately for mass produced products.

[0008] A further solution is the use of anti-backlash gear trains. Anti-backlash gears can eliminate most of the problems produced by the backlash in a gear train, but it does not address the lower proportion of viscous friction with respect to dry friction in many systems. Servos for holding position are not symmetrical since one direction will have a distinctly different compliance. This solution does not address the issue of transmission wind up.

[0009] Thus, a need still remains for a solution that will allow rapid paper movement and quickly settle to a stop. In view of the ever-increasing demand for higher performance and photo quality prints, it is increasingly critical that answers be found to these problems. Solutions to these problems have been long sought but prior developments have not taught or suggested any solutions and, thus, solutions to these problems have long eluded those skilled in the art.

DISCLOSURE OF THE INVENTION

[0010] The present invention provides a media transport system provided including providing a drive system, driving a drive train using the drive system, using the drive train to drive a media driver, and braking the drive train using a drive train brake.

[0011] Certain embodiments of the invention have other aspects in addition to or in place of those mentioned or obvious from the above. The aspects will become apparent to those skilled in the art from a reading of the following detailed description when taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is an overview of a media transport mechanism including a drive gear brake, in an embodiment of the present invention;

[0013] FIG. 2 is a isometric view of a roller drive mechanism including the drive gear brake, in an embodiment of the present invention;

[0014] FIG. 3 is a cross-sectional view of the drive gear brake, in an embodiment of the present invention; and

[0015] FIG. 4 is a flow chart of a system for the media transport mechanism including the drive gear brake, in accordance with an embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] In the following description, numerous specific details are given to provide a thorough understanding of the invention. However, it will be apparent that the invention may be practiced without these specific details. In order to avoid obscuring the present invention, some well-known circuits, system configurations, and process steps are not disclosed in detail. Likewise, the drawings showing embodiments of the apparatus are semi-diagrammatic and not to scale and, particularly, some of the dimensions are for the clarity of presentation and are shown greatly exaggerated in the drawing FIGS. Generally, the device can be operated in any orientation. In addition, where multiple embodiments are disclosed and described having some features in common, for clarity and ease of illustration, description, and comprehension thereof, the same numbers are used in all the drawing figures to relate to the same elements.

[0017] The term "horizontal" as used herein is defined as a plane parallel to the conventional plane or surface of a
media path 104 regardless of its orientation. The term “vertical” refers to a direction perpendicular to the horizontal as just defined. Terms, such as “on,” “above,” “below,” “bottom,” “top,” “side” (as in “sidewall”), “higher,” “lower,” “upper,” “over,” and “under,” are defined with respect to the horizontal plane.

Referring now to FIG. 1, therein is shown an overview of the media transport system 100 including a drive gear brake 112, in an embodiment of the present invention. The media transport system 100 includes chassis brackets 102, a media path 104, a drive system including a DC motor 106 with a spline 108, a drive axle 110, the drive gear brake 112, drive train including a reduction gear 114 and a drive gear 116, media rollers 118, a cam drive gear 120, a two-sided cam 122, a media path cam follower 124 and a media roller pinch follower 126. The chassis brackets 102 support the media path 104, having a media handling zone 128 and a print swath 130, the DC motor 106, having the spline 108 attached to the main shaft, and the drive axle 110.

During the printing process, a media controller system including a media controller 111 sequenced the electrical components to initiate, step through, and complete the operation by sending electrical signals to the DC motor and the drive gear brake.

The media controller 111 simultaneously releases the drive gear brake 112 and activates the DC motor 106. As the DC motor 106 rotates, the reduction gear 114 transfers the motion to the drive gear 116, which rotates the drive axle 110 and the media rollers 118. The drive gear 116 also transfers motion to the cam drive gear 120, which rotates the two-sided cam 122. The rotation of the two-sided cam 122 activates the media path cam follower 124 and the media roller pinch follower 126. The operation of the media path cam follower 124 causes a sheet of media to be loaded into the media path 104. The operation of the media roller pinch follower 126 causes the media rollers 118 to engage the media and move it to the print swath 130 location.

When the media is in position for the print operation to start, the media controller 111 simultaneously stops the DC motor 106 and engages the drive gear brake 112. The DC motor 106 and the drive gear brake can be connected to similar electrical source, managed by the media controller 111, allowing the drive gear brake 112 to engage independent of the DC motor 106. After the print swath 130 has been printed, the media controller 111 releases the drive gear brake 112 and activates the DC motor 106 to move to the next printable strip into the print swath 130 location. When the media is advanced into the print swath 130, the DC motor 106 is stopped and the drive gear brake 112 is set. The next line is printed and the operation is repeated until the entire page is complete.

Referring now to FIG. 2, there in is shown an isometric view of a roller drive mechanism 200 including the drive gear brake 112, in an embodiment of the present invention. The isometric view of the roller drive mechanism 200 includes the spline 108, attached to the DC motor 106 of FIG. 1, the drive axle 110, the drive gear brake 112, the reduction gear 114, the drive gear 116, the media rollers 118, drive gear brake contacts 202, a brake piston 203, a brake piston 204 and a drive gear brake shoe 206.

The media controller 111 precisely positions the media rollers 118 and prevents the media rollers 118 from moving unexpectedly. While a drive train brake can be in a number of different locations in the drive train, it has been discovered that by placing the drive gear brake 112 on the drive gear 116, the issues of transmission backlash, overshoot and wind up can be minimized to the point of being eliminated.

By using the drive gear brake 112, the media controller 111 is assured the media rollers 118 have not moved. The spline 108 of the DC motor 106 engages the reduction gear 114 and supplies rotational motion to the drive train. The drive gear brake 112 is normally engaged actively stopping the drive gear 116, unless the media controller 111 has applied electrical power to the drive gear brake contacts 202. When electrical power is applied to the drive gear brake contacts 202, the brake piston 204 is retracted and the drive gear brake shoe 206 is removed from the drive gear 116. Thus, electrical power simultaneously releases the braking and starts the drive system.

The brake piston 204 is spring loaded in the normally engaged, extended direction and is drawn into the brake cylinder 203 of the drive gear brake 112 only when the drive gear brake contacts 202 are activated. The brake piston 204 motion is less than 1/8 of an inch, though removing the drive gear brake shoe 206 from the surface of the drive gear 116, only a few thousandths of an inch allows free motion. This arrangement allows the media controller 111 to activate and deactivate the DC motor 106 including the spline 108 and the drive gear brake contacts 202 at the same time if desired. This allows simplified operation.

The brake piston 204 can be implemented in a normally released mode as well. In this implementation the brake piston would be spring loaded in the retracted direction and the drive gear brake 112 would require electrical power applied to the drive gear brake contacts 202 to assert the drive gear brake 112. The media controller 111 is programmed to assert or remove electrical power to activate the drive gear brake 112 as required.

The drive gear brake shoe 206 is much larger than the brake piston 204. The contact area of the drive gear brake shoe 206 provides a significant mechanical advantage in holding the drive gear 116 motionless. The drive gear brake shoe 206 is positioned near the outer radius of the drive gear 116 in order to increase the mechanical advantage of the drive gear brake 112.

The drive gear brake 112 is made movable, as indicated by the arrows 205, to permit the adjusting of the braking torque on the drive train. By moving the drive gear brake shoe 206 radially inward, the braking torque is decreased. This allows simple adjustment of braking torque.

Referring now to FIG. 3, therein is shown a cross-sectional view of the drive gear brake 112, as shown in FIG. 2. The cross-sectional view of the drive gear brake 112 includes the drive gear brake contacts 202, the brake piston 204, the drive gear brake shoe 206, a brake actuation spring 302, a housing spring anchor 304, a piston spring anchor 306, a piston stop 308, an iron piston slug 310 and a brake actuation coil 312.

In the normal state, the brake actuation spring 302 is extended, applying pressure between the housing spring anchor 304 and the piston spring anchor 306. The piston stop 308 limits the extension of the brake piston 204 when it
contacts the housing spring anchor 304. The iron piston slug 310 is attached to the internal end of the brake piston 204. When the drive gear brake contacts 202 are activated, the brake actuation coil 312 pulls the iron piston slug 310 back into the field of the brake actuation coil 312 against the force of the brake actuation spring 302. The actuation of the brake actuation coil 312 in this embodiment deactivates the drive gear brake 112.

[0031] Many attempts have been made to speed-up the printing process and maintain good quality prints. In order to maintain good quality prints, the media position relative to the print swath 130 of FIG. 1 must be predictable and motionless during the printing of the swath. Most of the attempts, to halt the media, have added costly components that complicate the mechanical structure of the printing function, add cost to the product and only address some of the issues. The addition of the drive gear brake 112 is simple and performs any function that requires the media rollers 118 to remain motionless during their operation. Devices including the media transport system 100, such as FAX machines, plotters, laser printers, seismographs and copiers could all benefit from the motionless stability supplied by the drive gear brake 112.

[0032] Referring now to FIG. 4, therein is shown a flow chart of a media transport system 400 for the media transport system 100 in accordance with an embodiment of the present invention. The system 400 includes: providing a drive system in a block 402; driving a drive train using the drive system in a block 404; using the drive train to drive a media driver in a block 406; and braking the drive train using a drive train brake in a block 408.

[0033] In greater detail, the system 400 for the media transport system 100 according to an embodiment of the present invention, is performed as follows:

[0034] 1. A media path, wherein the media path comprises providing a media handling zone and a print swath. (FIG. 1)

[0035] 2. A drive gear comprising a drive axle connected to a media roller. (FIG. 1)

[0036] 3. A DC motor comprising an attached spline, wherein the spline is coupled to a reduction gear which transfers motion from the DC motor to the drive gear. (FIG. 1)

[0037] 4. A drive gear brake for halting the drive gear. (FIG. 2)

[0038] It has been discovered that the present invention thus has numerous beneficial aspects.

[0039] An aspect of the present invention is that the addition of the drive gear brake to the media transport mechanism allows the media controller to activate the brake release and the DC motor with similar power sources. This results in only minor changes to the firmware control processes that manage the media.

[0040] Another aspect is the addition of the drive gear brake improves the quality of print on the media because the media is held motionless during the printing or plotting process. Each step of the media is completely controlled then halted and held motionless. This process actually allows for faster printing because the media controller doesn’t have to wait for the transmission backlash, overshoot and lag to settle between each media motion. The elimination of the settle delay during media transport results in a dramatic improvement in performance.

[0041] Yet another aspect of the present invention is that it valuably supports and services the historical trend of reducing costs, simplifying systems, and increasing performance.

[0042] These and other valuable aspects of the present invention consequently further the state of the technology to at least the next level.

[0043] Thus, it has been discovered that the method and apparatus of the present invention furnish important and heretofore unknown and unavailable solutions, capabilities, and functional aspects for improving media output quality. The resulting processes and configurations are straightforward, cost-effective, uncomplicated, highly versatile and effective, can be implemented by adapting known technologies, and are thus readily suited for efficiently and economically manufacturing any media transport mechanism devices fully compatible with conventional manufacturing processes and technologies. The resulting processes and configurations are straightforward, cost-effective, uncomplicated, highly versatile, accurate, sensitive, and effective, and can be implemented by adapting known components for ready, efficient, and economical manufacturing, application, and utilization.

[0044] While the invention has been described in conjunction with a specific best mode, it is to be understood that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications, and variations which fall within the scope of the included claims. All matters hitherto set forth herein or shown in the accompanying drawings are to be interpreted in an illustrative and non-limiting sense.

1. A media transport system comprising:
   providing a drive system;
   driving a drive train using the drive system;
   using the drive train to drive a media driver; and
   braking the drive train at the media driver using a drive gear brake.

2. The system as claimed in claim 1 wherein braking the drive train includes having the drive gear brake normally engaged during braking and stopping.

3. The system as claimed in claim 1 wherein braking the drive train includes simultaneously stopping the drive system.

4. The system as claimed in claim 1 further comprising releasing the drive gear brake simultaneously with the starting of the drive system.

5. The system as claimed in claim 1 wherein braking the drive train includes adjusting braking torque on the drive train.

6. A media transport system comprising:
   providing a drive system including a DC motor;
   driving a reduction gear using the drive system, the reduction gear including a drive gear,
using the drive gear to drive a media driver including a print media roller for controlling the movement of a media through a print swath; and

braking the drive gear at the media driver using a drive gear brake having a drive gear brake shoe on a brake piston actuated by a brake cylinder with having a brake actuation spring and a brake actuation coil.

7. The system as claimed in claim 6 wherein braking the drive gear includes having the brake actuation spring normally engaged during braking and stopping.

8. The system as claimed in claim 6 wherein braking the drive gear includes simultaneously stopping power to the DC motor and the brake actuation coil.

9. The system as claimed in claim 6 further comprising starting the drive system and releasing the braking by applying power simultaneously to the brake actuation coil and the DC motor.

10. The system as claimed in claim 6 wherein braking the drive gear includes adjusting braking torque by moving the drive gear brake shoe radially inward or outward on the drive gear.

11. A media transport system comprising:

   a drive system;
   a drive train for being driven by the drive system;
   a media driver for being driven by the drive train to move a media; and
   a drive gear brake at the media driver for braking the drive train.

12. The system as claimed in claim 11 wherein the drive train includes the drive gear brake normally engaged for braking and stopping.

13. The system as claimed in claim 11 further comprising a media controller for simultaneously engaging the drive gear brake and stopping the drive system.

14. The system as claimed in claim 11 further comprising a media controller system for releasing the drive gear brake simultaneously with the starting of the drive system.

15. The system as claimed in claim 11 wherein the drive gear brake includes a mechanism for adjusting braking torque on the drive train.

16. The system as claimed in claim 11 wherein:

   the drive system includes a DC motor;
   the drive train includes a reduction gear for driving a drive gear;
   the drive train is connected to drive a media driver including a media roller for controlling the movement of a media through a print swath; and
   the drive gear brake includes a drive gear brake shoe on a brake piston actuation by a brake cylinder with a brake actuation spring and a brake actuation coil.

17. The system as claimed in claim 16 wherein the brake actuation spring is normally engaged for braking and stopping.

18. The system as claimed in claim 16 further comprising a media controller for simultaneously stopping power to the DC motor and the brake actuation coil.

19. The system as claimed in claim 16 further comprising a media controller for starting the drive system and releasing the braking by applying power simultaneously to the brake actuation coil and the DC motor.

20. The system as claimed in claim 16 wherein the drive gear brake includes a mechanism for adjusting braking torque by moving the drive gear brake shoe radially inward or outward on the drive gear.

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