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[54] **PAPER MOTION SENSOR APPARATUS**

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[52] **U.S. Cl.** ..... **226/38;** 197/133 R; 226/45; 226/100; 340/259

[51] **Int. Cl.²** **B65H 23/10**

[58] **Field of Search** ..... 226/11, 25, 33, 45, 100, 226/38; 235/92 V, 92 PE, 92 DP; 250/219 DF; 340/259; 197/133 R

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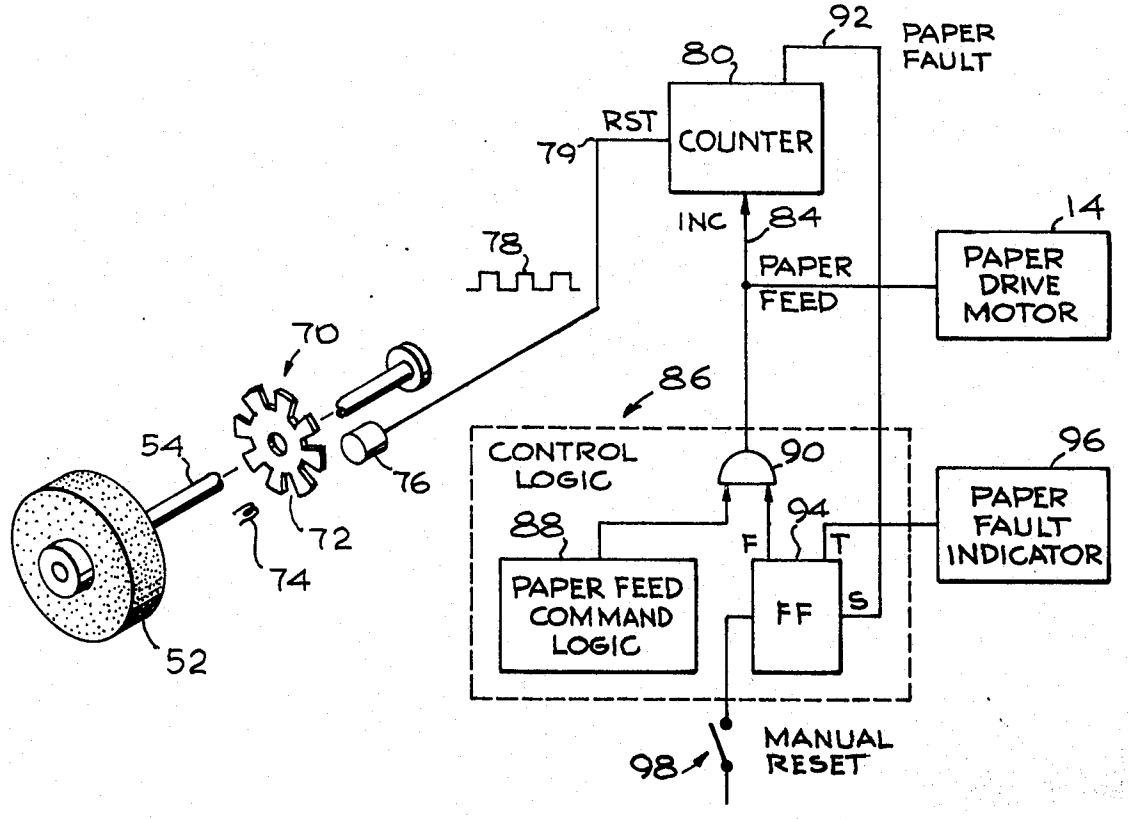
[57] **ABSTRACT**

Apparatus useful in a printer for monitoring paper movement to stop operation of the printer when a paper jam is detected. The monitoring apparatus includes a friction wheel mounted adjacent to a paper path such that the paper engages the wheel and rotates the wheel as the paper is stepped. The friction wheel is secured to a rotatable shaft carrying an encoder disc mounted in an optical path between a light source and light sensor. As the encoder disc rotates in response to the paper movement, it periodically interrupts the optical path causing the light sensor to produce an electrical pulse train. The pulse train is coupled to the reset input terminal of a counter which is incremented in response to paper feed commands supplied by the printer control logic. In normal operation, the counter is reset after each feed command. In the event of a paper jam, however, the feed commands will continue but there will be no corresponding paper motion to reset the counter. Consequently, the counter will count to a predetermined level at which a paper fault signal is generated to terminate further operation of the printer.

5 Claims, 3 Drawing Figures



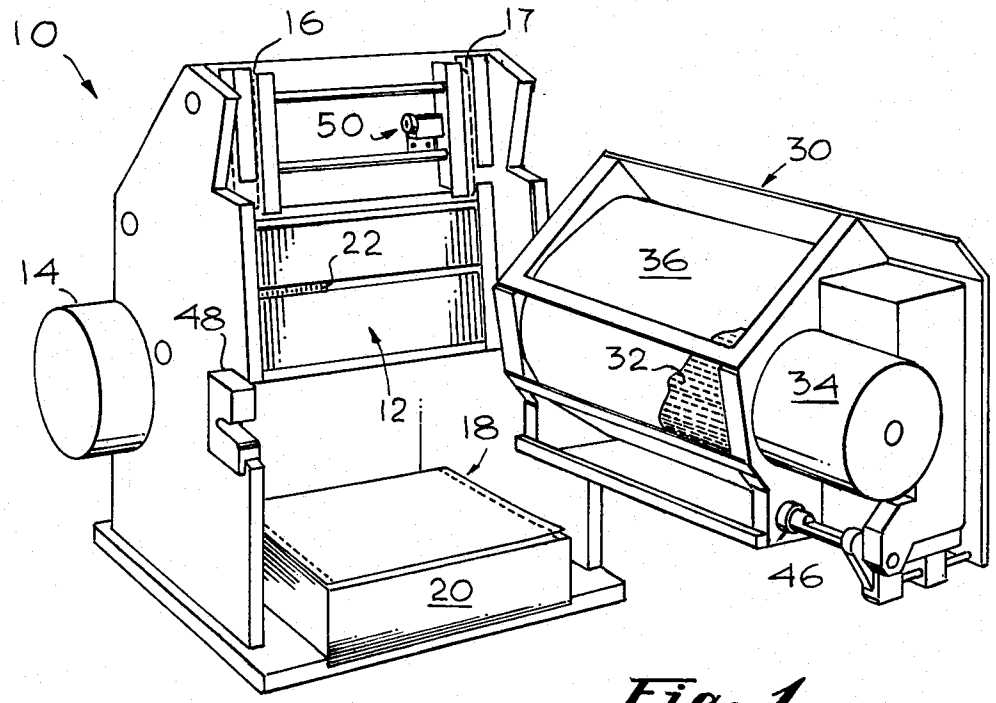


Fig. 1

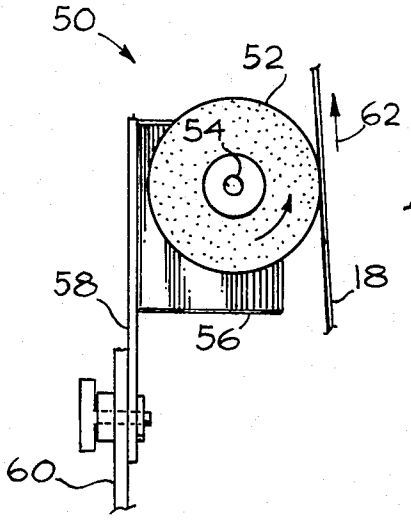


Fig. 2

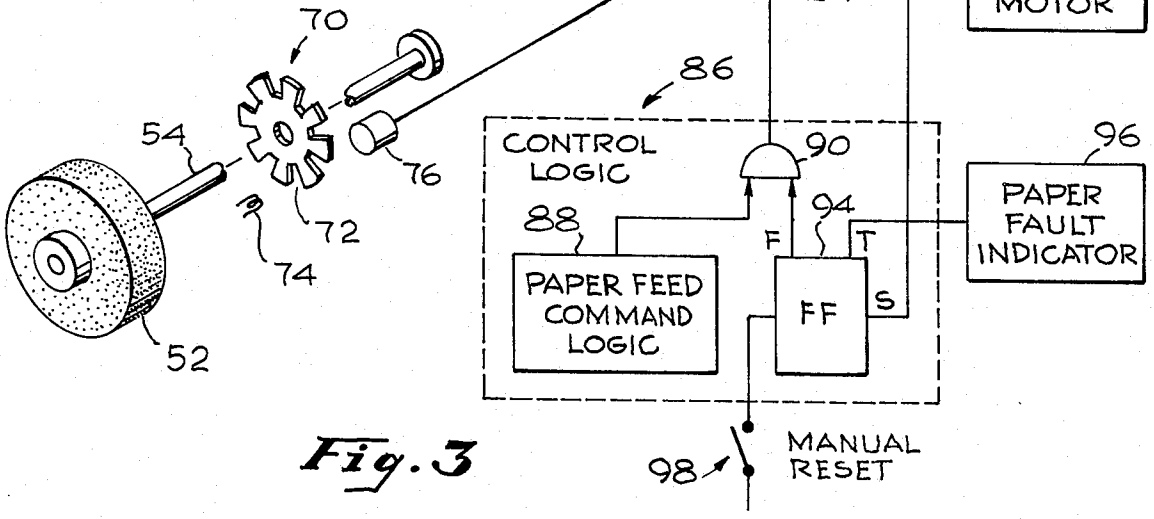


Fig. 3

PAPER MOTION SENSOR APPARATUS

BACKGROUND OF THE INVENTION

This invention relates generally to improvements in printing devices and more particularly to means useful therein for monitoring paper movement.

Various types of printer mechanisms are known in the prior art in which a paper web to be printed upon is stepped past a print station. Such printers are, of course, used in many different applications including use as data processing system output devices. A typical printer employed for data processing applications consists of a moving type bearing surface, such as a chain or drum, which carries characters past a plurality of aligned hammers. A paper web and a printing ribbon are mounted so as to be incrementally moved along paths extending between the hammers and type bearing surface. The hammers normally extend across the width of the paper so as to be able to print a line of text each time the paper is stepped to a new position. Each hammer prints in a particular column position along the line and since a full set of characters moves past each hammer, any character can be printed by a hammer by impacting that hammer against the type bearing surface at the appropriate time. Typically, the hammer impacts against the rear surface of the paper forcing it against the ribbon and type bearing surface to thereby print the impacted character on the front surface of the paper.

The paper is normally moved in response to a paper feed command supplied by the printer control logic to a paper drive mechanism. The paper drive mechanism typically includes a motor which drives tractor chains or sprocket gears engaged with edge perforations in the paper web.

In all known printers, paper jams occasionally occur in which the paper web fails to move in response to a paper feed command. As a consequence of this condition, the paper will usually tear as the hammers keep impacting against the same line of paper. At best, the paper jam merely results in lost operating time once the jam is discovered. At worst, damage may be done to the printer.

SUMMARY OF THE INVENTION

The present invention is directed to apparatus useful in a printer for monitoring paper movement to detect the occurrence of a paper jam.

Briefly, an apparatus in accordance with the present invention includes a friction wheel mounted adjacent to the paper path and in tangential contact with the paper. Movement of the paper rotates the wheel to in turn produce an electrical pulse which resets a counter. The counter is incremented by each paper feed command supplied by the control logic. In the event of a paper jam, the counter will not be reset and will as a consequence count up to a count which produces a paper fault signal.

In accordance with a preferred embodiment of the invention, the friction wheel is secured to a rotatable shaft carrying an encoder disc mounted in an optical path between a light source and a light sensor. As the encoder disc rotates in response to the paper movement, it periodically interrupts the optical path causing the sensor to produce an electrical pulse train. The pulse train is coupled to the reset input terminal of a counter which is incremented in response to paper feed commands supplied by the printer control logic. In normal operation, the counter is reset after each feed command as the paper moves in response thereto. In the event a paper jam occurs, the feed commands will continue but there will be no corresponding paper motion to reset the counter. Consequently, the counter will count to a predetermined level at which a paper fault signal is generated to terminate further operation of the printer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a typical high speed impact printer incorporating a paper motion sensor apparatus in accordance with the present invention;

FIG. 2 is a sectional view taken substantially along the plane 2—2 of FIG. 1 illustrating a paper motion sensor apparatus in accordance with the present invention; and

FIG. 3 is a schematic block diagram illustrating a paper motion sensor apparatus in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Attention is now called to FIG. 1 which illustrates a high speed impact printer exemplary of the type generally employed with data processing applications. Briefly, the printer of FIG. 1 is comprised of a first frame **10** supporting a hammer bank assembly **12** and a paper drive system generally comprised of motor **14** driving tractor chains **16.** The chains **16** carry sprockets **17** which engage edge perforations in a paper web **18** to pull the paper from a fanfolded supply stack **20** past the hammer faces **22** of the hammer bank assembly **12.** The printer of FIG. **1** also includes a second frame **30** which is hinged with respect to the frame **10.** The frame **30** supports a movable type bearing surface such as a multitrack drum **32** which is normally horizontally oriented and rotated about its axis by a motor **34.** Means are provided for passing a printing ribbon **36** between the rotating character drum **32** and the hammer faces **22.**

In the operation of the printer of FIG. **1,** the edge perforations on the paper web **18** are engaged with the sprockets **17** on tractor chains **16** to thus enable the motor **14** to pull the paper past the hammer faces **22.** Normally, the motor **14** steps the paper one line at a time. Printing, of course, can be accomplished only when the frame **30** is pivoted to a closed position relative to the frame **10** and locked thereto as by cooperating latch portions **46** and **48.** In this closed operative position, the hammer faces **22** will be disposed very close to the paper which in turn will be disposed very close to the printing ribbon **36.** As the character drum **32** rotates, it cyclically passes different raised characters in front of each hammer face. By actuating a hammer at an appropriate time, the hammer face is propelled against the back side of the paper **18,** forcing the paper against the ribbon **36** and drum **32** to thus print a character on the front side of the paper.

The prior art is replete with high speed printers of the type briefly described thus far. The present invention is directed primarily to a paper motion sensor apparatus **50** intended for use in a printer of the type in which a paper web is stepped past a print station as is generally depicted in FIG. **1.**

As is best shown in FIG. 2, the paper motion sensor apparatus 50 includes a friction wheel 52, preferably formed of sponge-like material secured to a rotatable shaft 54. The shaft 54 extends into a housing 56 which contains transducer means to be discussed hereinafter in connection with FIG. 3. The housing 56 is secured to a bracket 58 which in turn is bolted to the frame 60 of the printer. The apparatus 50 is mounted on the printer frame 60 such that the path of the paper web 18 is substantially tangential to and in contact with the periphery of the friction wheel 52. Thus, as the paper 18 is stepped a unit distance in a linear direction, it will rotate the friction wheel 52 through a unit angle.

Transducer means to be discussed in detail in connection with FIG. 3 are contained within the housing 56 for the purpose of monitoring the rotation of the friction wheel 52 and for developing a paper fault signal in the event a certain number of paper feed commands occur without the paper exhibiting corresponding movement.

Attention is now called to FIG. 3 which illustrates the transducer means for monitoring the rotational movement of the friction wheel 52 which, of course, is indicative of the movement of the paper web 18. As previously noted, the friction wheel 52 is secured to shaft 54 which is mounted for rotation. Also secured to the shaft 54 is an encoder disc 70 which has a plurality of marks, for example in the form of notches 72, uniformly and annularly distributed thereon. The encoder disc is mounted between a light source 74 and a light sensor 76. When the encoder disc 70 rotates, as each notch 72 passes between the source 74 and sensor 76, the light pulse incident on the sensor 76 will produce an electrical pulse 78. Thus, in normal operation of the printer, as the paper 18 is stepped along its path, the sensor 76 will provide a pulse train comprised of one pulse for each paper step. The pulses provided by sensor 76 are coupled to the reset input terminal 79 of a counter 80. The counter 80 preferably comprises a multistage digital counter. Such counters are readily commercially available and are well known in the prior art. For exemplary purposes herein, it will be assumed that the counter 80 comprises a scale of eight ring counter capable of counting as follows: 0, 1, 2, 3 . . . 6, 7, 0, 1 . . . .

The counter 80 is incremented in response to pulses applied to its incrementing input terminal 84. In accordance with the present invention, paper feed command signals are applied to the counter incrementing input terminal 84 by the printer control logic 86.

More particularly, each printer apparatus includes some type of timing and control means therein which periodically provides a paper feed command to the paper drive motor 14 to step the paper by a unit distance. The means for periodically providing the paper feed command signals is represented in FIG. 3 by the paper feed command logic 88. In accordance with the present invention, the paper feed commands are provided through gating means 90 both to the paper drive motor 14 and to the incrementing input terminal 84 of counter 80.

In the normal operation of the printer, that is, when the paper 18 does indeed properly move in response to a paper feed command, the counter 80 will be incremented by one count in response to each paper feed command and then will be promptly reset as the paper moves in response to the command to produce an electrical pulse via the sensor 76. The present invention is primarily directed toward means for detecting when the paper fails to properly move in response to paper feed commands.

In the event the paper jams for some reason and fails to move in response to paper feed commands, then the paper feed commands will continue to increment the counter 80 but the counter will not be reset since there will be no corresponding paper movement to generate the pulses 78. In this event, it is desirable that after a predetermined number of paper feed commands without corresponding paper movement, that the printer operation be shut down and that the operator be alerted.

In accordance with the preferred embodiment of the invention, the counter output terminal 92 is connected to provide a true logical signal when the count defined by counter 80 reaches the maximum count of seven. This logical signal, constituting a paper fault signal, is coupled to the set input terminal of a flip-flop 94 to switch the flip-flop to a true state. Under normal operating conditions, the flip-flop 94 remains in a false state and, as illustrated in FIG. 3, it is the false state of flip-flop 94 which enables gating means 90 to pass the paper feed command signals to the paper drive motor 14. When the counter 80 reaches a count of seven to generate the paper fault signal, the flip-flop 94 is switched true to thereby disable gating means 90. In addition, when flip-flop 94 switches true, it sets a paper fault indicator 96 which alerts an operator of the paper jam condition. The operator, after determining the cause of the paper jam and taking steps to rectify it, can thereafter reset the flip-flop 94 by actuation of the manual reset switch 98. This action resets both flip-flop 94 and the counter 80.

From the foregoing, it should now be recognized that means have been disclosed for use in a printer of the type in which a paper web is stepped past a print station in response to the generation of periodic paper feed command signals, for monitoring the movement of the paper to recognize the occurrence of a paper jam.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a printer including (1) control means for periodically generating paper feed command and (2) drive means responsive to said commands for moving a paper web along a prescribed path, the improvement comprising:

friction wheel means tangentially engaged with said paper web for rotating in response to linear movement of said paper web;

transducer means for generating a pulse in response to each unit of rotation of said friction means;

counter means for counting the number of paper feed commands supplied by said control means;

means responsive to each pulse generated by said transducer means for resetting said counter means;

said counter means including means for generating a fault signal in response to a predetermined number of paper feed commands occurring between successive pulses generated by said transducer means; and

means responsive to said fault signal for inhibiting generation of said paper feed commands.

2. The improvement of claim 1 wherein said transducer means includes an encoder disc having a plurality of marks annularly distributed thereon;

means mounting said encoder disc for rotation with said friction wheel; and

sensor means supported adjacent said encoder disc for generating a pulse in response to each mark moving therepast.

3. The improvement of claim 1 wherein said transducer means includes an encoder disc having a plurality of annularly distributed openings defined therein;

means mounting said encoder disc for rotation with said friction wheel;

a light source supported adjacent one side of said disc; and

light sensor means supported adjacent a second side of said disc for generating a pulse signal in response to the passage of one of said openings.

4. A printing apparatus including:

paper drive means for supporting a paper web for linear movement along a defined path;

control means for periodically supplying paper feed commands to said paper drive means for incrementally stepping said paper web along said path;

friction wheel means supported adjacent to said path and tangentially engaged with said paper web for rotational movement in response to said linear movement of said paper web;

transducer means for sensing unit movements of said friction wheel means;

counter means for counting the number of paper feed commands supplied by said control means between successive unit movements of said friction wheel means;

said counter means including means for generating a fault signal in response to a predetermined number of paper feed commands occurring between successive pulses generated by said transducer means; and

means responsive to said fault signal for inhibiting generation of said paper feed commands.

5. The apparatus of claim 4 wherein said transducer means includes an encoder disc having a plurality of marks annularly distributed thereon;

means mounting said encoder disc for rotation with said friction wheel; and

sensor means supported adjacent said encoder disc for generating a pulse in response to each mark moving therepast.

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