This invention relates to printers for use with electronic computers, and particularly to a novel electromechanical, so-called "on-the-fly" type printer. More specifically this invention relates to the ribbon drive mechanism employed in the printer.

Very briefly, a printer embodying the invention includes a continuously rotated print drum having characters spaced radially around the drum in horizontal rows of identical characters to be printed. Printing takes place by causing hammers to drive the paper against the linked surface of a ribbon, and the opposite surface of the ribbon against the characters on the drum. For a complete disclosure of the entire printer reference is made to application serial No. 138,157 entitled High Speed Printer.

The printer disclosed therein may be used in conjunction with a computer-buffer combination as a medium and/or high speed data processing system. For example, the particular embodiment of the printer disclosed therein is capable of printing 120 character lines at a rate of 150 lines per minute, and under special circumstances at a rate of 600 lines per minute for all numeric characters. In commercially available printers of this general performance, a rather costly "towel" type carbon roll is usually employed. In contrast to this an object of our invention is to make use of a relatively inexpensive ribbon of the kind used in conventional typewriters.

Another object of the invention is to provide a drive mechanism that will move the ribbon at a constant speed sufficient to prevent the ribbon from running out of ink as it moves along the printing station.

Another object of the invention is to provide a ribbon drive mechanism that will maintain a constant tension on the ribbon at all times.

Another object of the invention is to provide a ribbon drive mechanism that automatically reverses the direction of the ribbon drive when the unloading ribbon spool is empty.

Another object of the invention is to effect reversal of the ribbon drive quickly and without losing tension so as to eliminate smudging of the print which would occur if the ribbon were allowed to lose its tension.

A still further object of the invention is to provide a typewriter type ribbon drive mechanism in an "on-the-fly" type printer in which the location and tension of the ribbon are such as to prevent the ribbon from winding up on the adjacent print drum.

Still another object of the invention is to provide a ribbon drive mechanism having means to prevent the top edge of the ribbon from becoming caught by the characters formed on the rotating print drum.

Another object of the invention is to provide a ribbon drive mechanism in which the typewriter type ribbon is positioned so as to be struck by the print hammers along the lower third of the ribbon so as to prevent the ribbon from bowing transversely with the edges thereof coming too close to the print drum and from sagging downwardly when several characters are being printed simultaneously to the extent that the center portion of the ribbon may become completely displaced from the printing station.

Another object of the invention is to provide a ribbon drive mechanism having a micro-switch and a magnetic clutch associated with each ribbon spool, the direction of the ribbon drive being determined by alternate energization of the magnetic clutches.

Another object of the invention is to provide in a ribbon drive mechanism in which the magnetic clutches are energized through a relay so that the energization of one clutch and the de-energization of the other clutch occur simultaneously, thus maintaining tension on the ribbon even during the reversing operation.

Still another object of the invention is to provide a printer ribbon drive mechanism in which the ribbon may be changed easily. A still further object of the invention is to provide means, in a printer in which the ribbon drive mechanism is mounted on an arm that is pivotable from a horizontal to a vertical position, for preventing the ribbon from falling off the ribbon spools.

Another object of the invention is to provide a magnetic clutch-operated ribbon drive mechanism in which the magnetic clutches have adjustable spring tensioning means so as to maintain tension in the ribbon at all times, including when the printer power is shut off.

These and other objects and advantages of the invention will become apparent by reference to the following specification and the accompanying drawings, wherein:

FIGURE 1 is a front elevational view of a portion of the printer disclosed in the previously referenced application, and shows our ribbon drive mechanism mounted on the print drum support arm.

FIGURE 2 is an enlarged elevational view taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a perspective view of our ribbon drive mechanism shown separated from FIGURE 1.

FIGURE 4 is a schematic view showing the relationship of a print hammer, the print drum, and the paper and ribbon theretbetween.

FIGURE 5 is a simplified wiring diagram showing a relay-clutch control circuit which can be used for reversing the direction of ribbon motion.

Background

As mentioned before, a complete description of a printer with which our ribbon drive mechanism 271 (FIGURE 3) can be used is found in application Serial No. 138,157. Among other structures, the printer has a main frame to which horizontal pivot pin 374 (FIGURE 1) is attached. A casting forming a support or support arm 273 (FIGURES 1 and 2) is pivoted on pin 374 enabling the support to be latched down in an operating position by latch pin 342, or to be swung vertically to a non-operating position. The purpose is to facilitate removal and replacement of the pin fed paper 157 (FIGURE 4) or print drum 109. Print drum 109 having horizontal rows of characters 161 (FIGURE 4) is mounted for rotation on support 273, and our ribbon drive mechanism 271 is also mounted on the same support. It is preferred that drum 109 be removable (to exchange fonts) and latch mechanism 285 (described more fully in the pending application) enables this to be easily accomplished.

The optical assembly 275 to the left of FIGURE 1, functions as a shaft encoder, and is operative with the print drum 109 to signal the position of the particular row of characters (FIGURE 4) reaching the print position. The print position is defined as the position at which the row of characters is in alignment with the motion of print hammers 160 (only one shown in FIGURE 4). The hammers are constrained to rectilinear motion by guides 190 and 191 attached to the main frame of the printer.
The details of the paper support and drive mechanisms are not important to our invention, and they are not shown herein. It is sufficient to note that the paper 157 is moved in the direction of the arrow (FIGURE 4) and is located between the hammer impact faces 181 and 182. FIGURE 1 shows a set of engaging brushes 359 attached to arm 370 which is adjustable by mechanism 372 to select the desired paper tension.

Print ribbon mechanism

The configuration of our print ribbon drive mechanism 271 is seen best in FIGURE 3. The mechanism includes a ribbon drive motor 351 and an intermediate shaft 352 mounted axially movable on bearings 353 and 354, as long as the printer power is turned on. Electromagnetic clutches or clutch coupling devices 356R and 356L are connected to the ends of shaft 352, and to the adjacent end of aligned outer or end shafts 359R and 359L. The clutch coupling devices 356R and 356L are mounted in bearings formed (or supported) in bosses 360 excuding from the support 273.

Ribbon spoils 359R and 359L are detachably secured to shafts 359R and 359L by conventional latch devices (not shown) which can be identical to those used in ordinary typewriters. Also, like typewriter operation, our ribbon is pulled from the "full" spoil by the "empty" spoil as described below.

A conventional relay 362 (shown as a polarized relay for convenience), is used to energize one or the other of the clutches 356R and 356L, depending upon which spoil is to be driven. For this function we have switches 363 and 364 interposed in lines 363A and 364A which are connected to the input terminals of relay 362 and to electrical signal sources. The movable contact 362A of the relay is connected to an electrical power source over line 362B (preferably under the control of the main power switch of the printer, not shown) and is moved and held left or right (as oriented) depending on which of the two switches 363 or 364 is momentarily closed. When the movable contact is in the left position (shown) the power source is connected to clutch 356L thereby energizing that clutch and causing it to couple shaft 352 to shaft 359L which drives spoil 359L.

The movable contact was shown in FIGURE 2 in this position and a signal was provided over line 364A to relay 362, in which case the contact 362A will move to the right and thereby disconnect the power source from clutch 356L and connect the power source to clutch 356R. The result is that shaft 352 becomes coupled with and drives shaft 359R to which spoil 359R is attached.

FIGURE 1 and 2 show our ribbon drive mechanism 271 attached to the support 273 of the printer. The ribbon 162 has one end attached to spoil 359L and it is guided by roller guides 359A and 359B between which are switch 363 and a superposed fixed plate 366L. Switch 363 has a switch arm 367L, contacting one surface of the ribbon, while the opposite surface of the ribbon contacts plate 366L. Projections such as eyelets 365 near the ends of the ribbon are of a thickness sufficient to actuate the switch arm 367L when one of them passes between the plate and switch arm.

Ribbon 162 extends over the ends of guide member 376 which is attached to support 273 adjacent to the hammers 160 and the print drum 109. A stretch of the ribbon 162 between spaced guide hooks 377 of member 376 confronts a cut away part 376A of member 376, and it is this stretch of the ribbon which is driven against the paper 157 upon actuation of the hammers 160. From here the ribbon is guided by roller guides 359C and 359D to spoil 359R. Switch 364, its arm and cooperating plate 366R are secured to support 273 between the latter roller guides. It is understood that just before the unwinding spoil becomes empty, an eyelet 365 will actuate switch 364 and cause the relay to operate as described above in connection with relay operation caused by switch 363.

It is important that ribbon tension be maintained at all times. Thus, drag springs 361L and 361R are mounted on shafts 359L and 258R. One end of each spring engages a stop collar abutment 378 which is axially adjustably secured to the outer shaft. The other end of each spring engages the armature of the respective clutch 356L and 356R with which it is associated. The springs provide frictional drag on the clutches to maintain ribbon tension in the stretch of ribbon being used, i.e. between guides 377. This is effective for the non-driving clutch end of the ribbon, whether it be the left or right clutch. The ribbon tension problem is also coped with in another way. Spring members 368L and 368R are attached to support 273, and they engage the ribbon on the two spoils. Not only do these members tension the ribbon during its motion, but they keep the tape on the spoils when the support arm 273 is lifted.

In summary, most "on-the-fly" type printers do not use a typewriter ribbon; rather, they use a "towel" roll of carbon-backed material that extends across the entire print drum and moves in the same direction as the paper. We use a considerably more economical typewriter ribbon, and cause it to move at right angles to the paper motion, i.e., horizontally across the printing station between the paper 157 and print drum 109.

It is necessary to maintain the ribbon very close to the continuously rotating print drum (space exaggerated in FIGURE 4). The raised characters 161 of the drum can accidentally catch the upper edge of the ribbon and wind it around the drum, and the likelihood of this is increased if the hammers 160 are made to impact the ribbon 162 along its centerline. This has tendency to cause the ribbon to bow transversely with the edges curling toward drum 109. Slack in the ribbon will obviously make matters worse, and this demonstrates the importance of the tension devices for the ribbon.

To overcome adverse effects of ribbon bow or curl discussed above, we use approximately the lower third of the ribbon for impact (see FIGURE 4 for the hammer, ribbon and drum character positional relation). This prevents the ribbon from bowing transversely and tends to maintain the upper edge of the ribbon in the print drum. Guide member 376 (see FIGURE 3) also serves this purpose.

Various modifications may be made without departing from the protection of the following claims.

What we claim as our invention is:

1. A printer ribbon drive mechanism, comprising a continuously driving motor, an intermediate shaft driven by said motor, end shafts aligned with said intermediate shaft, a ribbon spoil mounted on each of said end shafts, a magnetic clutch connection between said intermediate shaft and each of said end shafts, a typewriter type ribbon having ends secured to said spoils and threadfeed through said printer, spring means for maintaining said ribbon in tension, and means for automatically reversing the direction of the ribbon drive, said reversing means including a switch mounted adjacent each of said spoils, a switch actuating arm pivotally fastened to each of said switches, a pair of metal eyelets fastened on said ribbon substantially near the ends thereof, a plate mounted immediately above each of said switch actuating arms so as to prevent any upward movement of said ribbon and said eyelets, said plate further causing said switch actuating arms to be depressed downwardly to actuate one of said switches upon being contacted by one of said metal eyelets, and a relay for energizing one of said magnetic
clutches and de-energizing the other of said clutches once one of said switches is operated by one of said actuating arms.

2. In a printer having a ribbon, a ribbon drive mechanism comprising an intermediate shaft, end shafts mounted in alignment with said intermediate shaft, a ribbon spool mounted for rotation with each of said end shafts, the ends of the ribbon attached to the respective spools, and means for continuously driving said intermediate shaft, an electromagnetic clutch mounted between said intermediate shaft and each end shaft, each electromagnetic clutch having an electromagnet and an armature, the electromagnets of said clutches being secured to said intermediate shaft, and the armatures of said clutches being rotationally drivingly secured to said end shafts and axially slideable thereon, spring abutments adjustably mounted on said end shafts, a spring mounted between each abutment and armature for maintaining the length of ribbon between spools in tension at all times, a switch mounted adjacent to each of said spools, means on each end of said ribbon for actuating said switches as one or the other of said spools becomes nearly empty, an electric circuit including said switches and clutches and a relay for simultaneously energizing the electromagnetic clutch for one spool and deenergizing the clutch for the other spool so as to cause a reversal in the direction in which the ribbon is driven.

3. In a printer, a ribbon drive mechanism comprising an intermediate shaft, means for continuously driving said intermediate shaft, end shafts mounted in alignment with said intermediate shaft, a ribbon spool mounted for rotation with each of said end shafts, an electromagnetic clutch having an electromagnet and an armature, said clutches mounted between said intermediate shaft and said end shafts, the electromagnet of each of said clutches being secured on said intermediate shaft and the armature thereof being rotationally fixed to said end shafts and axially slideable thereon, a spring abutment adjustably mounted on each of said end shafts, a compression spring mounted between each of said abutments and said armatures to spring-load said armatures an amount depending on the adjusted position of its abutment, a ribbon having ends secured to said spools, a switch mounted adjacent to each spool, an electric circuit including said switches, said clutches and a relay for simultaneously energizing the clutch for one spool and deenergizing the clutch for the other spool so as to cause a reversal in the direction in which said ribbon is driven, means on each end of said ribbon for actuating said switches as one or the other of the spools becomes nearly empty, said switch actuating means including a pivoted switch arm for each switch, projections near the ends of the ribbon, a plate mounted immediately adjacent to each of said switch arms to prevent movement of said ribbon and projections transverse to the normal direction of movement of the ribbon, and said plates causing the pivotal actuation of said switch arms in response to either of said projections pivoting between and engaging one of said plates and the adjacent switch arm.

4. A printer ribbon drive mechanism comprising a continuously driving motor, an intermediate shaft driven by said motor, end shafts aligned with said intermediate shaft, a ribbon spool mounted on each of said end shafts, an electromagnetic clutch connection between said intermediate shaft and each of said end shafts, a ribbon having ends secured to said spools, and means for automatically reversing the direction of the ribbon drive mechanism, said means including a switch mounted adjacent to each of said spools, a switch actuating arm pivotally connected with each switch, a pair of projections fixed to said ribbon near the ends thereof, a plate mounted immediately adjacent to each of said arms so as to prevent movement of said ribbon and said projections in a direction transverse to the normal motion of the ribbon, and said plate causing the actuation of said switches when said projections are moved with said ribbon between said plates and said arms.

5. In an on-the-fly printer having a continuously rotated drum which rotates about an axis of rotation and which has longitudinal rows of raised characters on the surface thereof to print on an adjacent record strip which is movable substantially tangent to the drum and slightly spaced from the character rows instantaneously confronting the strip as the drum rotates; means including a row of print hammers to impact said record strip and drive it toward the characters of the instantaneously confronting row on the drum; a typewriter ribbon having ends and an intermediate portion, said portion located in said space between the record strip and the rows of characters on the drum as they respectively confront said hammers; means connected with the ends of said ribbon to drive said intermediate portion in said space in a direction transverse to the movement of the record strip and transverse to the direction of motion of the drum surface and parallel and adjacent to the rows of characters as they confront the ribbon and strip; and means for maintaining the first longitudinal edge of the intermediate portion past which the rows of characters first move as the drum rotates, spaced further away from said drum than the opposite longitudinal edge so that transverse bowing of the ribbon due to hammer impact is tolerable without the first edge of the ribbon being engaged and pulled by the rotating characters.

6. The subject matter of claim 5 wherein said ribbon maintaining means include a longitudinal guide member having ribbon supports engaging said opposite longitudinal edge of the ribbon, and said guide members so positioned with respect to said row of hammers and the rows of characters as they move past the hammers, that less than one half of the width of the ribbon measured from the tape centerline is presented to the hammers for impact against the characters.

7. The subject matter of claim 6 wherein said guide member has a portion located between the print drum and said first longitudinal edge of the ribbon to further aid in preventing said first edge from being engaged and pulled by the rotating characters on said drum.

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