This invention relates to a printer apparatus and more particularly to a serial printer in which printing occurs on-the-fly. While not necessarily limited thereto, the present invention is practiced in a printer device having particular utility as an output apparatus for a teleprocessing system.

Serial on-the-fly printers are known which comprise a continuously moving type carrier, such as a print drum or wheel, that carries movable type elements. The type elements are arranged circumferentially on the drum in a single row so that by rotating the drum, the type elements are presented serially at a print location where a platen supports a record medium. As the drum rotates, the type elements are selectively activated and causing them to extend outwardly from the drum in position to impact the record medium at the print location.

In one form of such a printer, centrifugal force is relied upon to effect the displacement of the type elements relative to the drum to effect printing. In such cases, the holding means is provided which retains the type element in a retracted or nonprinting position. As the drum rotates relative to the print medium, the particular type elements are advanced by the drum toward the print location and release means, operated in timed relation to the movement of the drum, disengage the type elements in a serial manner from the holding means. Centrifugal force, caused by the rotation of the drum, impels the type elements to fly outwardly to impact the record medium. In a specific type of drum printer the type elements are made with magnetic material, and magnetic devices are used both as holding and release means.

It is readily appreciated that the operation of the release means must be precisely timed and the flight time of the type elements from their nonprint to their print position must be closely controlled in order to get uniformly sharp impressions of the characters at accurately registered position on the record medium. This is particularly true of printer devices where the drums are operating at relatively high rotational speeds. In prior art devices, considerable effort has been made to overcome timing problems by various expedients, all of which require an extreme degree of precision in parts manufacture and assembly. Variations which occur within the bounds of conventional manufacturing tolerances as well as fluctuations and conditions during the operation of the print apparatus seriously affect the quality of performance, resulting in degraded print quality. Further difficulties are to be expected where magnetic type with magnetic holding means and release devices are used.

A principal object of the present invention is to provide a serial on-the-fly printer of the rotatable drum type in which improved print quality and registration are readily attained.

Further objects of the present invention are to provide a serial on-the-fly drum printer in which magnetic type are used and which have improved magnetic holding and release devices; to provide a printer apparatus of the above type which can be readily adapted to operate at different rotative drum speeds; and to provide a serial on-the-fly printing device having apparatus by which the impact time and impact location of the type members are more accurately controlled.

The foregoing and other objects are attained with the present invention by providing a rotatable support drum having a plurality of type members pivotally mounted thereon and movable from a stored position to a printing position. Means are provided to releasably retain the members in the stored position until a member is releasable by selectively operable release means. The released type member moves against adjacent guide means and is held in a position between the stored and printing positions after selection. The selected type member moves along the guide means which then serves to direct the type member to the proper print location on a record medium and time the impact of the type member thereon. After impact, restoring means returns the selected member to the carrier for subsequent selection. Braising means constantly urge the type members away from the carrier and aid in increasing the impact of the type member on the record medium.

This arrangement advantageously permits the early selection of a type member from the carrier means, allowing the type member to stabilize after selection and before printing occurs. The guide means is thus able to accurately time the point and degree of impact when printing occurs.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings in which:

FIGURE 1 is an elevation view of the printing apparatus of the invention showing particularly the type members and carrier and record member carriage;

FIGURE 2 is a plan view of the printing apparatus shown partially in cross section along irregular section line 2--2 in FIG. 1;

FIGURE 3 is an enlarged sectional view taken along the line 2--2 in FIG. 1 showing the displacement of a type member at the platen;

FIGURE 4 is an end elevation view of the type members shown in FIG. 3;

FIGURE 5 is an elevation view of an enlarged portion of the type carrier and type members shown in FIG. 1.

Referring to FIGS. 1 and 2, the printing apparatus comprises generally a base plate 10 on which is mounted type carrier means 11 supporting individual type members 12, carriage means 13 for holding and moving the record medium 14, and a driving motor 15 supplying power to operate the type carrier means and carriage means. The base plate is substantially rectangular and equipped with legs 16 to provide clearance for a cam mechanism indicated generally as 17 on the underside of the base plate. Secured to the top of the base plate is a support pedestal 18 in which a worm shaft 19 is journaled for rotation in bearings 20. Dynamic motor 15 supplies power via pulleys 21, 22 and belt 23 to rotate shaft 19.

The type carrier 11 is a cylindrical hub 30 fixed on shaft 19 by key 31 and has a radial flange portion 32 with a plurality of fins 33 formed thereon. The fins form slots 34 in which individual type members 12 are pivotally supported. The base of each fin is provided with a
Type member selection is accomplished by energizing electromagnet 71 which counteracts the flux path through pole pieces 51, permanent magnet 50 and pole piece 52 for the particular type member desired. Electromagnet 71 is mounted by means of a bracket 72 to the housing surrounding the type carrier. The core 73 of the electromagnet is preferably no thicker than the width of an individual pole piece 51 for a type member and runs through the core 71, looping inwardly (FIG. 2) to direct the flux therein toward the inner ends of pole pieces 51, 52. The electrical current through electromagnet 71 is in a direction to oppose the direction of flux in the permanent magnet assembly and selected type slug thus permitting centrifugal force and bias spring 57 to urge type member 12 to pivot outwardly from the carrier means 11. Electromagnet 71 with the core 73 is located in advance of the impact point on the record medium, such as that illustrated as being approximately 180° from the point of impact.

In order to direct the selected type member 12 to the proper point of release, there is provided an arcurate guide 75 having a surface 76 which contacts the type slug 43 on both sides of the embossed character 44 thereon. Guide 75 is substantially concentric with the circumference of type carrier 11 and holds the released type element sufficiently far from the magnetic field of permanent magnet 50 so that the type element remains on the guide 75 and slides therealong on surface 76. The support offered by guide 75 terminates at point 77, as seen in FIGS. 1 and 5, releasing the type member and permitting the centrifugal force and spring 57 to cause the type member to fly outwardly toward the point of impact 78.

Due to friction at the pivot point of each type member and variation in mass of the type member or slug, the free flight time from guide 75 to the point of impact 70 varies from member to member. The direct result is variations in vertical registration in the print line. The variations are overcome by providing a supplemental cam 78 having surface 79 which engages projection 45 on the selected type member to direct it to the impact point. The supplemental cam guide 78 extends partially over the stored type members on the carrier means 11 but is spaced therefrom so that the projections 45 to unselected type members clear the cam 78 without interference. However, upon selection and release of a type member to guide 75, its projection 45 moves outwardly a sufficient distance to engage cam surface 79 whereby the type member is positively directed to the point of impact. When impact occurs, the selected type member thrusts an inkling ribbon 80 against record medium 14 thereby causing an impression of the character to be placed on the record medium.

In order to reset or return the selected type member to carrier means 11 after impact, a reset ramp 82 engages type slug 43 on both sides of the embossed character 44. The tip 84 of the reset ramp extends sufficiently near the point of impact so that, upon rebound from the record medium and ribbon, the type slug engages ramp surface 83. Surface 83 is formed to gradually bring the selected type member within the magnetic field of the permanent magnet 50 into the position where it assumes once again the stored position approximately at point 85.

The advancement and positioning of record member 14 during printing is accomplished by cam mechanism 17 under base plate 10. As seen in FIG. 1, record member 14 is fed forward so that the arrows over guide 92, platen 93, and the surface of support block 94. During the printing of a line of information, carriage means 13 is moved continuously relative to the type carrier from top to bottom in FIG. 2. Upon completion of a line of print, the carriage means is returned upward to the position shown. The reciprocating carriage motion is derived from worm 96 on rotating
print carrier shaft 19 and engages gear 97 on shaft 98. The gear may be fixed on shaft 98 or be freely rotatable thereon and secured instead to a conventional single-revolution clutch (not shown) which would permit stopping the carriage when printing is not being done. When the drive gear 97 is clutch controlled, the carriage is started when printing is to occur and can be stopped at either extreme of carriage travel.

Assuming merely for purposes of description that gear 97 is fixed on shaft 98, then the shaft is rotated in the direction of the arrow and also rotates cam 99 under base plate 10. As seen in FIG. 2, the cam has a recessed track 100 in which roller 101 rides. The roller is freely rotatable on follower arm 102 that is pivotally mounted on shaft 103 fixed in base plate 10. The rotation of cam 99 thus causes the bifurcated outboard end 104 of the follower arm 102 to sweep an arc having its center at pivot 103. End 104 engages pin 105 fixed in carriage base 106 and reciprocates the carriage on shaft 107 secured across an opening 108 in the base plate. A rear supporting guide is provided on carriage base 106 by bifurcated slide 109 in engagement with aligner bar 110. It is thus seen that, as shaft 98 is rotated, cam 99 thereon causes carriage base 106 to reciprocate relative to both base plate 10 and type carriage 11 and, in so doing, continuously exposes a new printing location at impact position 70 on record medium 14. Cam track 100 is formed to move the carriage means slowly downward in FIG. 2 at a uniform rate and, upon return, to restore upwardly in approximately one third of the time required for full downward travel. When the carriage is operated with a single-revolution clutch, the gear 97 and shaft 98, it is preferable to disengage the clutch when the carriage is at the lower extreme of travel so that the print line is fully exposed.

Carriage means 13 is actuated to advance record member 14 one printing line each time the carriage is returned to the position shown in FIG. 2. During printing, the record member is held in place by stationary blades 115 secured by screws to support block 94. The blades are of a material having some resiliency, such as spring steel, and are located in recesses in the support block under record member 14. The blades engage the record member to permit the advancement of record member 14 but pinch the record member against feed bar 117 to prevent reverse movement.

The record paper is advanced by the gripping action of feed blades 118 against the feed bar 117. The feed bar is reciprocated at each end of the carriage travel. Each arm 119 has a pin 121 secured therein on which downwardly bent ear portion 122 of the feed bar is pivotally supported. The ear portion is formed with a notch 123 that is engaged by tooth 124 of bell crank 125. The bell crank is pivotally supported on pin 126 also on arm 119. Spring 127 urges tooth 124 into the notch so that the feed bar is held in the position shown in FIG. 1. Spring 128 urges the feed bar to rotate about pivot 121 when tooth 124 is removed from the notch. End 129 of bell crank 125 rests in a depression in rotatable hub 130 so that when the handle 131 is moved clockwise, end 129 is carried upward against the force of spring 127 to withdraw tooth 124 from the notch 123. This opens the feed bar for insertion of the paper.

Feed blades 118 are supported on ears 132 on vertical arm 119. As vertical arm 119 moves clockwise on shaft 120, stationary blades 115 in conjunction with feed bar 117 engage and hold the record member from moving. Because of the angle of feed blade 118 relative to the record member, the feed blades move the record member from left to right. The feed bar is moved clockwise a distance equivalent to a line space, and subsequently counterclockwise to advance the record member by gripping the paper between the feed blades 118 and feed bar 117. The feed bar is not moved sufficiently in either direction to pass beyond stationary blades 115. The required reciprocating motion is imparted to shaft 120 and vertical arms 119 by the movement of carriage means 13 along shaft 107. Referring to FIG. 2, there is secured to base plate 10 a bracket 135 providing a ramp 136. The ramp is engaged by a roller 137 on arm 138 which pivots on pin 139 supported in bracket 140. The bracket is rigidly fastened to carriage base 106. The motion of arm 138 is transferred (FIG. 1) by link 141 to lever 142 secured to shaft 120. As the carriage means moves downward in printing in FIG. 2, roller 137 rolls down ramp 136 to engage link 141 up in FIG. 1. This causes lever 142 to rotate shaft 120 and, hence, feed bar 117 in the counterclockwise direction in FIG. 1. The feed bar remains at its clockwise extreme until the carriage is restored, at which time roller 137 engages ramp 136 to cause link 141 to move lever 142 counterclockwise and advance the feed bar and record member 14 also counterclockwise. It will be noted that feed bar 117 can be used as a tear bar, if desired. Support shaft 144 for roller 137 is adjustably mounted by knurled knob 145 to permit variation of the line spacing.

Ink ribbon 80 is illustrated in FIG. 1 as the type having supply and take-up reels in a unitary cartridge 150. The ribbon is fed in the direction of the arrow about idle 151 over the exterior of a guide 75, over reset ramp 82 and to a take-up spool in cartridge 150. The ribbon moves over the guide and reset ramp in a recess 152. The ribbon can be advanced by any well-known incrementing mechanism, and the mechanism can be driven from rotating shaft 98.

During operation, type member selection is preferably limited to one character per revolution of the type carriage means 11 because of possible over-printing. Carriage means 13 moves at a constant rate during its progression from top to bottom in FIG. 2. The movement is synchronized with the carrier rotation and equals, in one revolution of the type carriage, the character center-to-center distance desired. In order to further provide character spacing and permit random selection, the characters are helically arranged about the carrier as illustrated in FIG. 4 by the characters on type elements 43. It is seen that the horizontal centers of the "G" and "F" are displaced from each other. The amount of displacement of adjacent characters is equal to the character center-to-center distance on record 14 divided by the number of type elements on the carrier. Type element "E" is shown forward in the printing position at impact time.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a device for printing on a record medium, the combination comprising:
   rotary type carrier means having a plurality of type members pivotally supported thereon and each movable from a stored position to a print position; means for rotating said carrier to urge said type members outwardly from said carrier by centrifugal force and move said members successively past a printing location on said record medium;
   means in addition to said centrifugal force for continuously biasing each said type member outwardly from said carrier;
   means on said carrier for producing a force holding each said type member in said stored position;
   means operable to counteract said holding force and selectively release said type members from said holding means;
   first guide means adjacent said carrier means for receiving released ones of said members and providing a force in a direction opposite to said centrifugal
force and said biasing means for restraining said members in a position intermediate said stored and print positions; and

second guide means operable at the termination of said first guide means for applying an outward force in the same direction as said centrifugal force and said biasing means to direct said members in said intermediate position to said print position at said printing location.

2. Apparatus as described in claim 1 wherein:

said biasing means includes an individual spring acting against each said member;

said holding means includes a magnet having individual pole pieces for providing an individual magnetic flux path for each said type member; and

said release means includes an electromagnet arranged relative to said magnet to counteract the holding flux of said magnet when said electromagnet is energized.

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