

[54] **HIGH SPEED FRONT IMPACT PRINTER**

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[51] Int. Cl. **B41j 1/20, B41j 5/30**

[58] Field of Search **101/93 C, 110, 91, 111**

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[57]

ABSTRACT

A closed loop chain or train rotates continuously to move, along parallel paths, individual, laterally flexed, type carriers between a paper which moves continuously in the opposite direction and laterally shiftable latches. One end of a selected type carrier is momentarily arrested to deflect the type into contact with the moving paper for imprinting.

14 Claims, 6 Drawing Figures

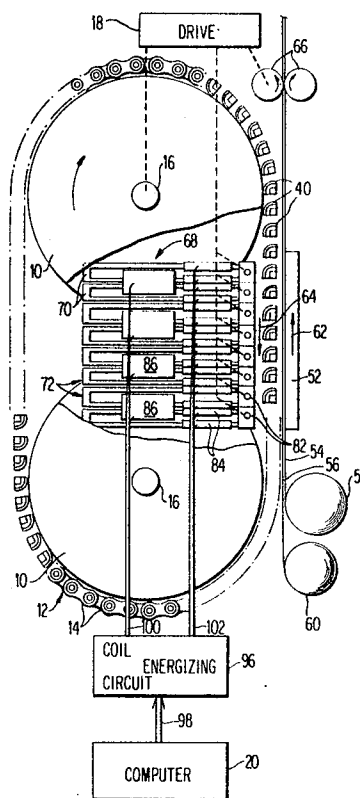


FIG. 1

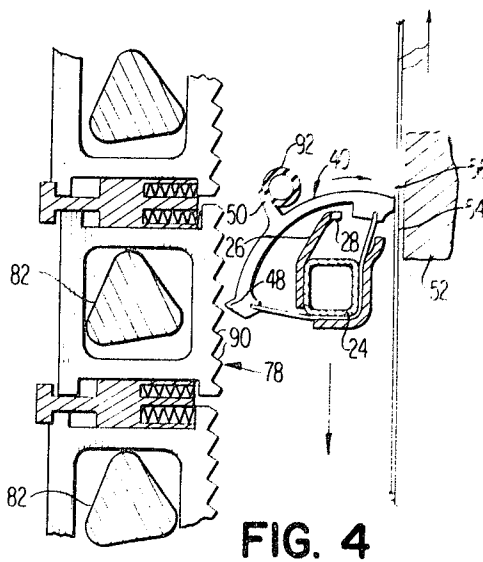
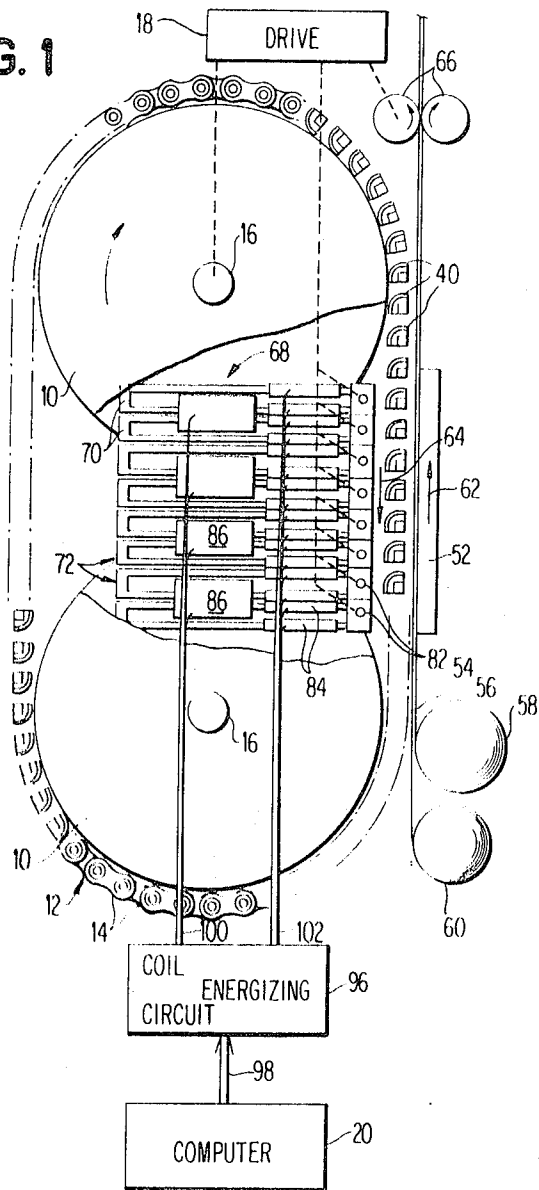


FIG. 4

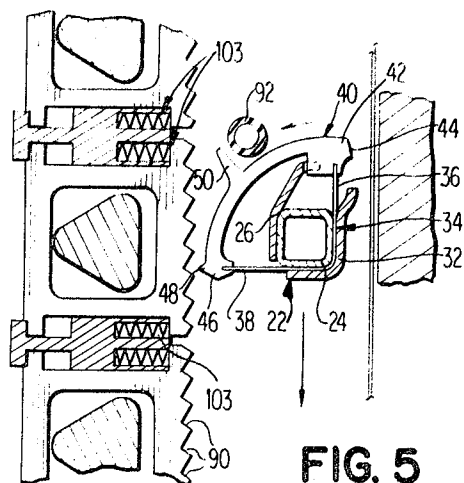


FIG. 5

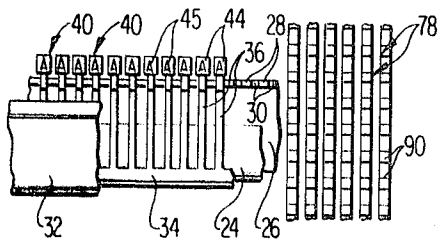


FIG. 3

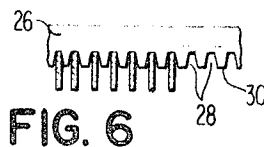
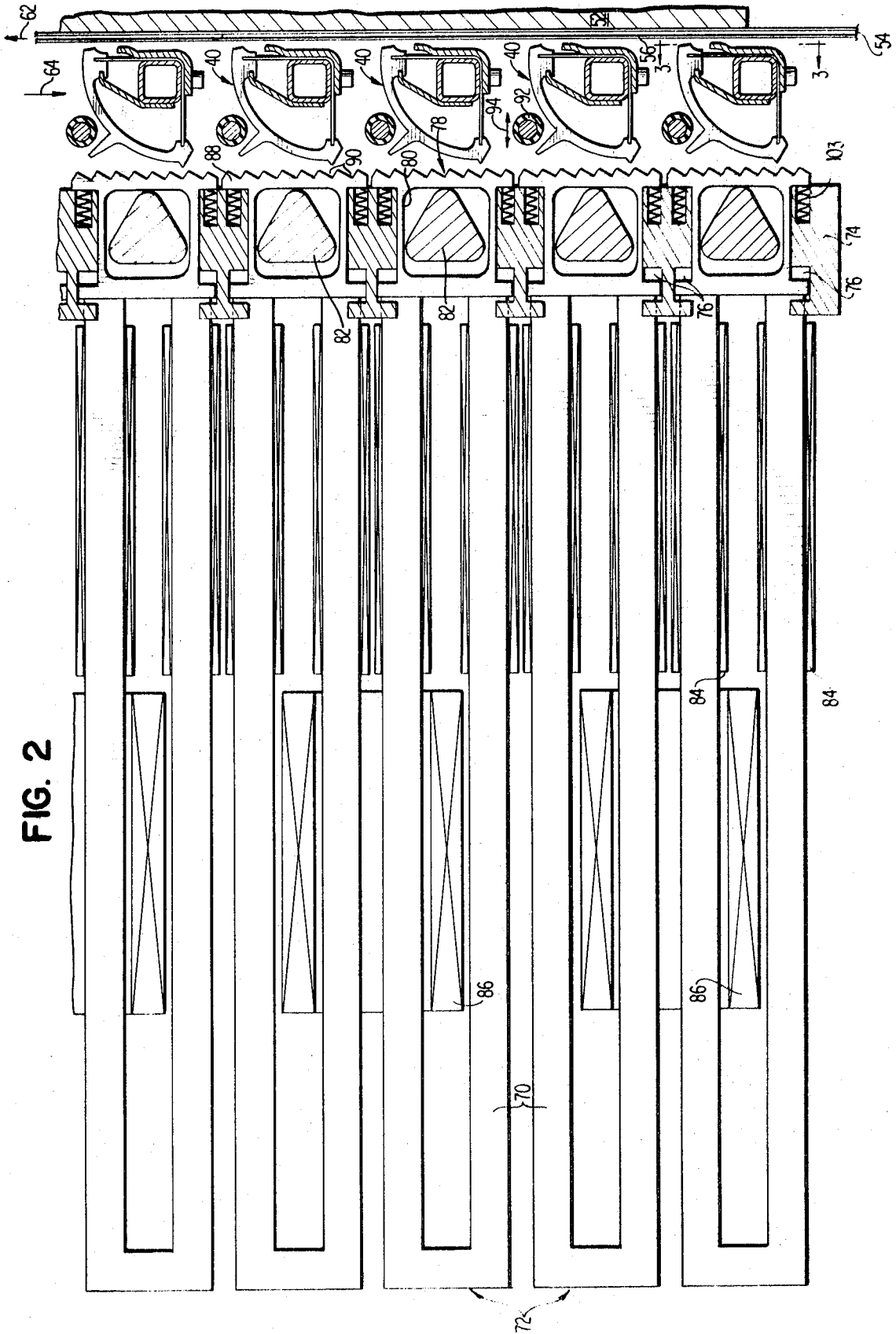


FIG. 6

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FIG. 2



HIGH SPEED FRONT IMPACT PRINTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to high speed impact type printers and more particularly to impact printers capable of imprinting 2,000 to 10,000 lines per minute.

2. Description of the Prior Art

High speed printers are common place in terms of peripheral equipment for use with computers but, the printers of today are not fast enough to meet the requirements of the computer output. One attempt to provide a high speed printer for use with computers is the so-called chain printer which constitutes a plurality of side-by-side, endless chains or belts in segmented form carrying individual type thereon and movable at relatively high speed in columnar arrays past individual print hammers for impacting the type relative to an impression paper or the like, lying adjacent to the path of movement of the type. To print, the hammers are selectively propelled against the paper to force the paper into contact with the type, with hammer movement being synchronized with the movement of the chains or belts. The known chain printers involve the principle of imprinting a line at a time, spacing the paper and having the type moving to bring the individual character to the column to be printed thereon. Printing speed is necessarily inhibited in such an operation.

SUMMARY OF THE INVENTION

The present invention is directed broadly to the employment of a type carrier movable longitudinally between an imprint surface adjacent a backing member on one side, and a laterally shiftable latch on the other side, for momentarily arresting movement of one end of the type carrier. By impact, the carrier has its type end pivoted into contact with the print medium, due to momentary latching of the opposite end. The energy to print comes from the movement of the type carrier itself.

Specifically, a plurality of transversely abutting flexibly supported type carriers form segments of endless chain and move along parallel paths. Laterally shiftable armatures each carry a plurality of longitudinally extending notches defining latches cause imprinting at different lines of said print medium, depending upon the longitudinal position of the carrier with respect to the armature when shifting occurs. Preferably, an electromagnet hold coil maintains the armature out of the path of the moving type carrier and a buck coil releases the same. Each type carrier is preferably of arcuate shape and supported on the movable carrier support shaft by right angle reeds with one end of the carrier carrying the type and the other end acting as a projection for entering a given latch. A radial projection on the arcuate carrier, intermediate of its end, limits self-induced flexing of the type carrier reed by contacting a shiftable impression contact abutment. Each lateral carrier shaft is provided with a carrier stop plate having fixed V-notches for receiving the enlarged type ends of the type carriers to reduce carrier rebound after imprinting. Means are provided for synchronizing energization of selected buck coils to a particular lines of characters correlated to the position of the moving chain. Preferably, the impression medium is movable in the opposite direction at a different speed from that of the type chain with the number of latch notches on each armature corresponding to the speed differential for increasing overall imprinting speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation, partially broken away, of a sectional side view of a preferred embodiment of the high speed impact printer of the present invention;

FIG. 2 is an enlarged sectional side view of a portion of the impact printer of FIG. 1, illustrating the basic elements thereof;

FIG. 3 is a front view, partially broken away, of a portion of the printer shown in FIG. 1;

FIG. 4 is a side elevational view of a portion of the printer shown in FIG. 2 with the type carrier in imprint position, the latch having made contact with the carrier and returning to normal;

FIG. 5 is a similar view to that of FIG. 4 but restored to the normal condition;

FIG. 6 is a top plan view of a portion of the individual type carrier and the rebound prevention means of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the high speed impact printer of the present invention is based on the concept of continuous paper feed, synchronized with the train of type forming one array per column which moves in the opposite direction to that of the paper, with the type being mounted in such a manner that each may pivot or flex to print as a front printer if latching or abutment means are momentarily moved into the path of the same. In this respect, the energy for printing comes directly from the type train movement.

Turning to the drawings, the front impact printer of the present invention makes use of a pair of large diameter sprocket wheels 10 (FIG. 1) which support spaced endless chains 12 formed of individual links 14. The wheels, in turn, are mounted for rotation about shafts 16 whose axes are horizontal in the embodiment shown. A drive motor or the like 18 is mechanically coupled to shaft 16 to drive the upper sprocket wheel 10 in a clockwise direction, as indicated by the arrow, under control of a central computer 20. On the chain links 14 and extending between chains 12, there are fixed thereto individual horizontally extending type carrier support members 22, these members including rectangular hollow shafts 24 having extending upwardly therefrom, sloped carrier stops 26 which carry V-notches 28 along the front edge 30 as indicated in FIG. 6. An L-shaped sheet metal element 32 acts to sandwich a unitary reed member 34 therebetween, such that sections 36 and 38 of the reed member 34 extend outwardly at right angles to each other in a vertical and horizontal direction respectively. Each type carrier 40 comprises a rigid, arcuate element formed of lightweight metal or the like and carrying an enlarged headed end 42 with a sloped face 44 carrying a type 45. The headed end 42 has a slot therein to receive the outer end of reed section 36. The opposite or inner end of the arcuate type carrier 40 is enlarged at 46 and carries a horizontal slot to receive the outer end of reed section 38, thus reed sections 36 and 38 define a flexible support for allowing flexing of the reed section and pivoting of the type carrier 40 about a horizontal axis defined by tubular shaft 24. A V-shaped projection 48 extends horizontally and rearwardly from the end 46 of the type carrier 40 and the type carrier is further provided with a radial projection 50 intermediate of its ends which extends rearwardly and upwardly.

The present high speed printer is characterized by a stationary plate 52 which is fixed so as to define a vertically oriented backing member, adjacent to which, travels, at relatively high speed, an imprinting medium, such as a paper 54. Paper 54 has, on the inside thereof, and between the paper and the moving type carriers, an inking ribbon 56 or the like. As shown schematically, the paper to be imprinted is carried on a roll 58 as is the inking ribbon 56 on roll 60, both of these web materials being moved in a direction opposite to the individual type carriers 40 as indicated by arrows 62 and 64, FIG. 1. The webs are driven in unison by pinch rollers 66 and mechanically in synchronism with chain 14 through a common drive mechanism 18.

An important aspect of the present invention resides in the means for momentary latching of the projection 48 of each type carrier 40 to effect pivoting or flexing of the type carrier 40 into imprint position. In this respect, interiorly of type carriers 40, there is provided a stationary assembly 68 which comprises stationary magnetic cores 70 defining eight magnet units in a vertical array, for the illustrated embodiment, each

magnet unit controlling eight printing lines of the moving imprinting medium 54. Further, as evidenced in FIG. 3, each horizontally extending carrier support 22 is provided with vertical reed sections 36 supporting preferably identical type fonts 45 on the sloped or inclined faces 44 of type carriers 40. The endless chain 12 carries a circumferential array of 64 different characters in the embodiment shown with the eight magnet units 72 each controlling eight lines of imprint to the paper. The number of horizontally extending columns may be any predetermined number, depending upon the lateral width of the print impression media such as paper web 54. Of course, there is provided a similar number of magnet unit arrays in the horizontal direction, that is, at right angles to the plane of the paper, FIG. 1. The stationary magnetic drive unit 68 includes a plurality of horizontally extending, fixed latch support members 74 carrying grooves 76 therein, the members 74 being vertically spaced. Hollow, H-shaped latch armatures or members 78 are supported by members 74 such that the grooves 76 limit the lateral displacement of the latch armatures 78 with respect to the longitudinally moving type carriers 40. The latch armatures 78 are formed of magnetic material and, as such, act as armatures with respect to the electromagnetic drivers for the impact printer. The latch armatures 78 carry rectangular openings 80, within which are positioned individual continuously driven restore cams 82 which are triangular in cross sectional configuration. The restore cams 82, which extend horizontally through the complete columnar array of side-by-side latch armatures 78, mechanically return all of the latch armatures of the complete unit 68 for each cycle of operation of the printer. As indicated in FIG. 1, cams 82 are driven by a common drive mechanism emanating from drive unit 18 and in synchronism with the other components of the high speed impact printer. As mentioned previously, fixed magnetic cores 70 of U-shaped configuration, define in conjunction with latch armatures 78, a complete magnetic circuit. The cores 70 along with the latches are formed of laminated magnetic material, if desired. For electromagnetic energization of the latch armatures 78, each magnetic core 70 for the eight units is provided with individual buck out coils 84 on the individual legs of the magnetic cores 70 while only four hold coils 86 are provided, one for every two units. The hold coils 86 are continuously energized to normally maintain all of the latch armatures to the left, that is, away from latch position with respect to the type carriers 40. However, energization of an associated pair of buck out coils 84 results in the creation of a magnetic force in opposition to that of the hold coil thus releasing the latch armature 78. A spring 103 allows the latch member to go from left to right and into latch position with respect to the type carriers moving at high speed past the same. The outer leg 88 of each H-shaped latch armature is serrated, that is, it is provided with a series of longitudinally spaced notches or latches 90, one for eight different positions of the type carriers.

Associated with the moving chain 14 and specifically the laterally extending type carrier supports 22, is an impression control member 92 in the form of a coated rod or the like which is shiftable as indicated by arrow 94, so as to variably restrict flexing of the type carrier reeds, since the large projection 50 impacts the same during imprinting the type carrier, rebounding therefrom upon return movement of the latch armature and release of the latching projection 48 of the carrier.

Lateral shifting of the latch armature 78 with respect to the longitudinally moving type carrier is achieved electromagnetically by selective energization of the buckcoils, also under control of computer 20 through a coil energizing circuit 96. The computer is coupled to the coil energizing circuit 96 via leads 98 and the coils directly connected thereto through leads 100 and 102 respectively. In general, although the latch armatures 78 of the vertical array of magnet units for multiple closely positioned columns are held by respective hold coils 86, and selectively dropped out by energization of selected buck coils through leads 102, all of the latches are simultaneously reset by the series of cams 80 carried internally therein.

Preferably, the drive unit 18 drives the type at a speed seven times faster than that of the paper speed; with eight magnet units and 144 columns per line with eight lines, 10,000 lines a minute may be printed and multiple copies if desired. Printing may be achieved at 6 microsecond intervals on all eight latches per column and the number of columns may be of any predetermined number, depending upon the lines energized. Preferably, the impression control rod 92 for each type carrier can be controlled by a cam on the frame or support for the horizontal stack of type carriers associated therewith. Type rebound, as mentioned previously, is arrested by the V-notches 28 of carrier stops 26, such that the V-notch absorbs the energy of return, since the sides of the carrier slide inwardly within the V-notches when they return to home position with respect to the carriers when unlatched.

As the line to be printed, that is a designated line on the paper or impression medium, moves by the latch and the magnet units, all 64 characters will pass the line at some latch so that any character may be printed. The paper in the illustrated embodiment moves one line in 6 milliseconds, or 1.66 lines per second or 10,000 lines per minute. The number of characters does not effect output but necessarily requires more magnet and latch units to accommodate them. In the description shown, the columnar array, as evidenced by FIG. 3, has the same type carrier across the line but, if necessary, could be positioned slightly out of line for ripple firing.

Operation of the high speed chain printer in terms of a single type carrier and release of a latch armature may be seen best by reference to FIGS. 4 and 5. In FIG. 4, the type carrier 40, carrying type character L, for instance, is caused to imprint by synchronized energization of a buck out coil associated with armature latch 78 of the second magnet unit from the bottom of the vertical array with the buck out magnet nullifying the field of the hold coil, the release of the sliding armature and latch allows the latch or notch 90, associated with imprinting the character, to act as an abutment and momentarily spring out into the path of the V-shaped projection 48 of the type carrier causing the type carrier 40 to flex about its support shaft or bar 24 resulting in the opposite end of the type carrier carrying the font to impact the ribbon 56 and paper 54 to print the character L on the same at the designated line thereon. Immediately, the cyclic rotation of all of the restore cams 82 results in the particular cam associated with the released latch armature pulling the latch armature back to the magnet core, thus releasing the type carrier 40, FIG. 5. The "V" notch 28 in the carrier stop 26 keeps the hammer from rebounding as the type is restored to its normal position. Pivoting of the type carrier due to its own energy is resisted after limited clockwise movement due to the presence of the impression control rod 92, as projection 50 of the type carrier 40 impacts the same.

Because the train of type is moving at a speed seven times as fast as the moving paper, it is seen that eight different type characters will move very quickly relative to a given print line on the paper so that any one of eight characters may be imprinted thereon. This aids immeasurably in achieving the extremely high print speed. For instance, as the first line of the paper 54 arrives at the lower latch 78 in the magnet unit, some character of the train of type will line up with the lower latch and could be printed anywhere in the line by an electrical pulse to the buck out coils 84 in that column. Regardless of synchronization between the position of the individual type carrier for the chain and the vertical array of eight magnet units, energization with a type carrier notch 48 aligned with the first or lowermost notch 90 causes the type carrier to flex about the hollow shaft 24 such that the type strikes the ribbon and the paper to print. If the paper then continues on to the next latch, that is, to the notch immediately thereabove, the type carrier that was previously aligned with lowermost latch position of magnet unit 2, will now be opposite the lower or first magnet unit but aligned with the latch defined by the second lowest notch and, if desired, this character could be printed in any given column (assuming the same characters

across the line). The same thing happens at all eight latches for the lower most magnet unit, in other words, it has had a chance to print a choice of eight characters.

As the paper line number 1 reaches the lowermost latch of the second lowermost magnet unit, paper line number 9 is at the lowermost latch of the lowermost magnet unit, and both lines may be printed if desired. The same thing is repeated as the paper continues to move, synchronized with the type and latches. When the paper line number 1 arrives at the third lowermost magnet unit and opposite its lowermost latch, paper line number 9 will be at the second lowermost magnet unit and opposite its lowermost latch, paper line 17 will be at the lowermost magnet unit opposite the same corresponding latch, etc. Again, the particular character at its respective latch position can be printed on these three lines.

Each line the paper advances, a new character is presented to fill in the line. This continues until all eight magnet units are printing in the same manner and at every line space, a completed line comes out from the upper most magnet unit, and the uppermost latch of that particular unit, at a rate of 10,000 lines per minute and more than one copy if desired.

Instead of a latch pivoting the type carrier, a straight transfer of energy, like a hammer blow, could be used, that is direct impact by the armature.

Also the cams could be replaced by a strong magnet used to restore the latches. Of course, more electrical power would be needed for the magnets since, in the impact printer of the present invention, it is the energy of the moving hammer or type carrier that achieves self flexing and thus imprinting due to momentary abutment of one end of the type carrier with an associated latch notch.

What is claimed is

1. A printer for imprinting a print medium lying adjacent a backing member, said printer comprising: at least one type carrier, said type carrier comprising an arcuate element, means for moving said carrier along a path parallel to the plane of said print medium on the side opposite said backing member, flexible reed means for pivotably supporting said type carrier on said carrier moving means for pivotable movement about an axis orthogonal to the path of carrier movement, with said flexible reed means defining said pivot axis for said arcuate element, a type on one end of said arcuate element for contact with said print medium, and at least one laterally shiftable latch means to the side of said carrier opposite that of said print medium for selected movement into the path of the other end of said arcuate element to pivot said moving carrier under impact toward said print medium for type contact therewith, said flexible reed means acting to return said carrier into non-contact position following printing.

2. The printer as claimed in claim 1 wherein said means for pivotably supporting said carrier on said carrier moving means comprises angularly disposed, flexible reeds having intersecting ends defining the pivot axis with their outer ends connected respectively to the ends of the arcuate element.

3. The printer as claimed in claim number 2 wherein said latch means comprises a laterally shiftable latch member having a longitudinally notched surface facing said moving carrier for selectively receiving within the one of said latch notches the end of said arcuate element remote from print medium to effect imprinting on different lines of said print medium depending upon the longitudinal position of said type carrier when lateral shifting of said latch member occurs.

4. The printer as claimed in claim 3 further comprising: electromagnetic means for causing lateral shifting of said latch member towards said type carrier and cyclically operable cam means for restoring said latch member to non-imprint position.

5. The printer as claimed in claim 4 further comprising: means for moving said print medium parallel to the path of movement of said type carrier, in the opposite direction to the movement of the type carrier moving means, and at a speed generally inversely proportional to the number of notches on said latch member.

6. The printer as claimed in claim 5, wherein a plurality of type carriers comprise segments of an endless chain and said printer further includes means for rotating said endless chain in synchronism with said means for moving said print medium, a plurality of latch members are provided at distinct longitudinal positions along the path of said type carrier each having electromagnetic actuating means and means for selectively actuating the electromagnetic means associated with a given latch member when a selected carrier is in imprint position with respect to said laterally shiftable latch member.

7. A printer for selectively printing a plurality of characters simultaneously along multiple imprint lines in multiple columnar fashion parallel to a print medium comprising: a plurality of transversely abutting, flexibly supported type carriers forming segments of an endless chain, means for driving said endless chain to move type carriers along longitudinal, parallel paths, each type carrier comprising an arcuate member having a type on the end facing said print medium and right angle flexible reeds for supporting respective ends of said arcuate carrier element for pivotable movement about an axis orthogonal to the direction of movement of said type carriers to allow said type to move into contact with said print medium, an imprint surface of said print media lying adjacent to and parallel to the paths of said flexible type carriers, a plurality of transversely abutting, laterally shiftable latch members in a longitudinally fixed array on the side of said type carriers opposite that of said imprint surface, and means for selectively shifting individual latch members at various columnar and line positions into contact with a type carrier to print said type carriers into contact with said print medium.

8. The printer as claimed in claim 7, wherein said laterally shiftable latch members are movable into the path of said type carriers such that the end of said carrier opposite that carrying said type momentarily impacts a latch member to pivot said type carrier about a pivot axis defined by the intersection of said flexible reeds into contact with said print medium.

9. The printer as claimed in claim 8 wherein said laterally shiftable latch members comprise integral armatures, and said printer further includes a continuously energizable electromagnetic hold coil for each latch armature for normally maintaining each latch armature out of the path of said moving type carrier, means spring biasing said latch members toward said moving type carrier, and at least one selectively energizable electromagnetic buck coil for each armature to magnetically cancel the effect of said hold coil and to thereby allow the spring biasing means to shift the latch member into the path of the moving type carrier.

10. The printer as claimed in claim 9 wherein said latch armature comprises a surface, notched in the direction of carrier movement, whereby the line of imprint for a given type carrier depends upon which notch is opposite said movable carrier when said buck coil associated therewith is energized.

11. The printer as claimed in claim 10 wherein each arcuate type carrier includes a radial projection intermediate of its end and said printer further includes a laterally shiftable impression control rod positioned in the path of movement of said radial projection to limit pivoting of said reeds about said pivot axis.

12. The printer as claimed in claim 11 where each print carrier is supported in transversely abutting fashion upon a common transversely extending shaft member, and said shaft member has coupled thereto, a fixed carrier stop including V-shaped notches facing the print medium for controlling rebound of respective type carriers as they move away from said print medium after imprinting.

13. The printer as claimed in claim 12 further comprising means for moving said print medium along a parallel longitudinal path to that of said type carriers and in a direction opposite thereto and at a speed generally inversely proportional to the number of notches on columnarily aligned latch armatures.

14. The printer as claimed in claim 13 wherein each latch armature is hollow and each group of transversely abutting type carriers includes a rotatable restore cam carried within

the same and means for commonly rotating said restore cams of said longitudinal array to mechanically restore all of said latch armatures during each cycle of operation of said printer.

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