

Feb. 19, 1963

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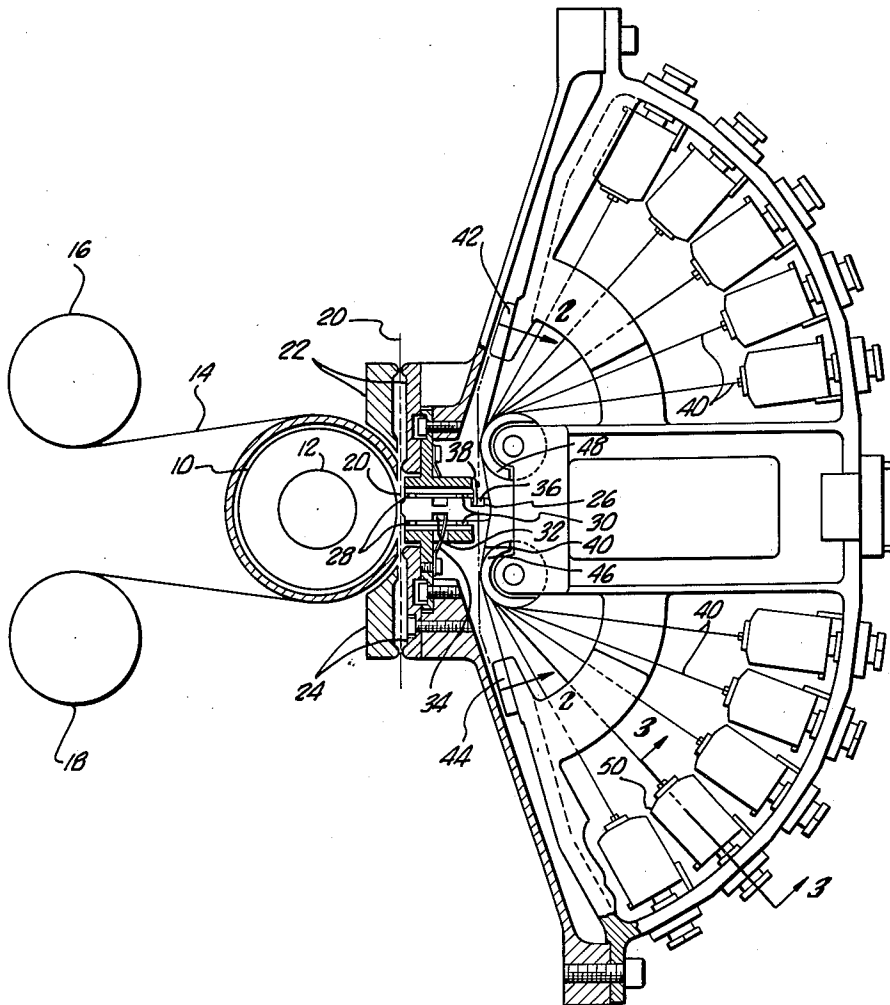
3,077,830

HIGH SPEED PRINT MECHANISM

Filed June 5, 1961

2 Sheets-Sheet 1

FIG. 1.



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2 Sheets-Sheet 2

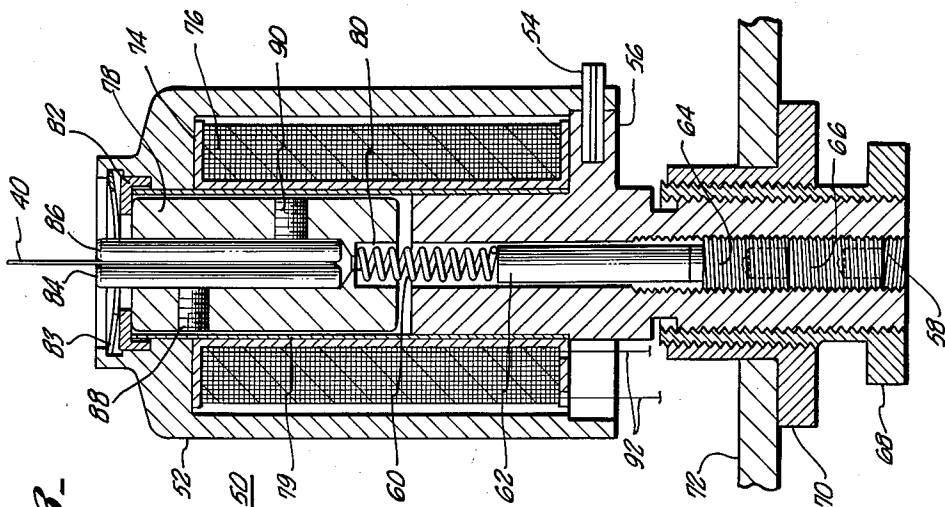


FIG. 3-

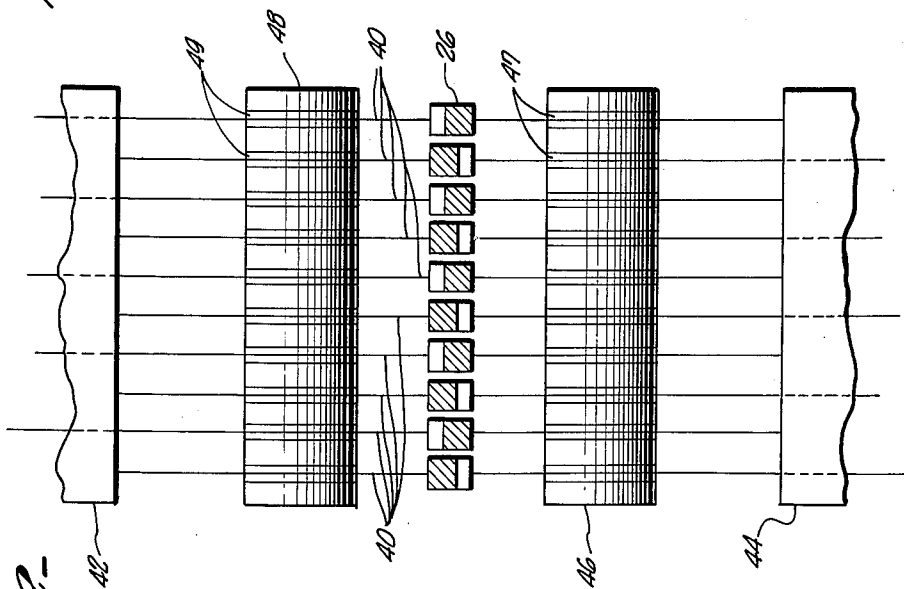


FIG. 2-

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HIGH SPEED PRINT MECHANISM

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16 Claims. (Cl. 101-93)

This invention relates to high speed printers and, more particularly, to a novel rapid-acting print mechanism for high speed printers.

Although many types of high speed printer configurations are known in the printing art, they all basically include a type surface having type characters impressed thereon in a column array, a series of print hammers each associated with a type column on the type surface, a print medium such as paper passing between the print hammers and type surface, and means for selectively actuating the print hammers to press the print medium against the type surface thereby causing the print medium to be selectively printed. Generally, the type surface, which might take the form of a type drum, is continuously moving at a high velocity relative to the print hammers. In view of the continuous movement of the type surface and since it is desired that the characters printed upon the print medium be clear and distinct, it is necessary that the print hammers be rapid acting mechanisms. In particular, if a print hammer dwells upon the print medium long enough to allow the type surface to move beneath the print hammer, the character being printed is smeared.

Further, since it is generally desired that the characters being printed by an actuation of the print hammers be accurately aligned in rows on the print medium, it is necessary that the timing of the operation of each print hammer be substantially the same and invariant from one print cycle to the next.

In the past, print mechanisms attempting to accomplish the above have in general included in their arrangement a pivot or hinge point either at the print hammer itself or at the means for actuating the print hammer. When the print hammer itself is pivoted, wear of the hinge point affects the timing of the hammer operation. Further, such print hammer arrangements generally possess a large mass and hence have a high inertia and an inherent speed limitation.

In print mechanisms wherein the actuating means includes a hinge arrangement, the pivot is usually included at the armature of an electromagnet which when actuated strikes an associated print hammer propelling it against the type surface. In this type of configuration, wear of the hinge point not only produces a change in the propelling force applied to the print hammer but also varies the air gap between the winding of the electromagnet and the armature. The variation of the air gap produces changes in the timed actuation of the print hammers thereby resulting in misalignment of the characters as printed on the print medium.

In view of the above, the present invention provides a low inertia, high-speed print mechanism having a novel hammer actuating arrangement which does not require a hinge configuration either at the hammer or at the actuating means to rapidly propel light-weight print hammers against a high speed type surface.

To accomplish this, the present invention in a basic form includes, in combination with a high speed type surface, a row of print hammers slidably mounted normal to the type surface such that a forward end of each print hammer is positioned adjacent to a type column of the type surface. Further, each hammer is normally urged away from the type surface by a spring arrangement. Positioned adjacent to the row of print hammers are first and second guide means, one disposed on either side of

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the row of print hammers in a plane which is ahead of the back end of the hammers. To provide means for selectively actuating the print hammers, the present invention includes a plurality of high strength tapes of equal length, one associated with each print hammer. In particular, each tape has one end fixedly attached to the frame of the printer and passes over the first guide means, the back end of the associated print hammer and the second guide means. The remaining end of each tape is coupled to an armature of a plunger type electromagnet the displacement of which is adjustable relative to the frame of the printer to produce equal initial tension forces on each tape.

Since the first and second guide means lie in a plane forward to the back end of the row of hammers, each tape forms a bowstring arrangement for propelling its associated hammer against a type column. In particular, by selectively actuating an electromagnet of the present invention, a longitudinal force is exerted on its associated tape which momentarily reduces the length of the tape between the guide means thereby rapidly propelling the associated print hammer against the type surface. Upon striking the type surface, the hammer rapidly rebounds. Upon rebound, the back end of the hammer is met by the tape which acts as a cushion for the hammer and with the spring arrangement maintains the hammer away from the type surface, thereby preventing rebound of the type hammer to the type surface. Further, since the initial tension of each tape is adjusted to be the same and each tape is of equal length, the time of each print cycle for each hammer is the same, thereby providing a printing of type characters upon the print medium in accurately aligned rows.

The above as well as other features of the present invention may be more clearly understood by reference to the following detailed description when considered with the drawings, in which:

FIGURE 1 is a diagrammatic representation of a high speed printer utilizing the print mechanism of the present invention;

FIGURE 2 is a sectional view along the section line 2-2 represented in FIGURE 1; and

FIGURE 3 is a cross-sectional view of the electromagnet of the present invention along section line 3-3.

Referring to FIGURE 1, there is illustrated a high speed printer utilizing the print mechanism of the present invention. As shown, the high speed printer includes a type surface illustrated as being a type drum 10 mounted for rotation with a drive shaft 12. Although not specifically shown, the type drum 10 is of the type commonly known to include a series of columns of type characters impressed in rings around the periphery of the type drum 10. Further, by means not specifically shown, the shaft 12 and the type drum 10 are rotated at a high velocity by a motor drive. By way of example, the type drum 10 may have a rotational velocity of 1,200 revolutions per minute.

As illustrated in FIGURE 1, extending around the periphery of the type drum 10 is a print ribbon 14 which is mounted on take-up spools 16 and 18, respectively. A print medium 20 such as paper passes tangentially past the print drum 10, the print ribbon passing between the medium and the drum. As illustrated, the print medium 20 is maintained in position by guides 22 and 24, respectively. To print upon the print medium 20, a plurality of print hammers, one of which is represented at 26, are positioned in a row along the surface of the type drum 10. In particular, each hammer is positioned adjacent to a type column on the type drum 10. As illustrated, the hammer 26 is elongated and is slidably mounted between hammer bearings 28 and 30 normal to the surface of the type drum 10. Further, as represented,

each hammer 26 includes a slot 32 in which there is positioned a return spring 34 which is coupled to the frame of the printer to normally urge the print hammer 26 away from the surface of the type drum 10.

As further illustrated, the print hammer 26 includes a second notch 36 in which is positioned a back-stop 38 which limits the forward movement of the print hammer 26.

To selectively actuate the print hammers of the high speed printer, a plurality of high strength tapes 40 are included. In particular, each tape is associated with a particular print hammer.

As represented in FIGURE 1, one end of each of the tapes 40 is fixedly coupled to the frame of the printer by one or the other of the groups of clamps 42 and 44, respectively. As further represented in FIGURE 1, each of the tapes passes over first and second guide means 46 and 48 and the back end of an associated print hammer. In particular, as represented in FIGURE 1, the guide means 46 and 48 are equally spaced on either side of the row of print hammers in a plane which is forward to the back end of the print hammers. Further, as illustrated in FIGURE 2, each of the guide means 46 and 48 includes a series of grooves, 47 and 49, respectively, a groove being associated with each print hammer for selectively guiding the associated tape 40. As is further represented in FIGURE 2, consecutive tapes being associated with consecutive print hammers are alternately coupled to the frame of the printer by the clamps 42 and 44, respectively. This allows a maximum tape spacing at the clamps 42 and 44 of the tapes 40 with a minimum spacing of the tapes passing over the print hammers 26. In particular, if the print hammers are spaced one-tenth of an inch apart, the spacing of the tapes at the clamps 42 and 44 is two-tenths of an inch apart.

As previously mentioned, and as represented in FIGURE 1, the guide means 46 and 48 are positioned in a plane ahead of the back end of the hammers. Thus, each tape in passing over the guide means 46, the back end of its associated hammer, and the guide means 48 creates a bowstring type arrangement for its associated hammer.

To actuate the above described bowstring arrangement thereby propelling the hammer against the type surface of the type drum 10, the remaining end of each tape 40 is connected to the armature of an electromagnet, one of which is represented at 50. In general, the electromagnet 50 is of a type which when activated imparts a linear movement to its armature. Thus, when the electromagnet 50 is actuated, the armature thereof is caused to move in a linear direction as to impart a longitudinal force upon the tape 40 associated therewith. This reduces the length of the tape 40 between the guide means 46 and 48 propelling the hammer associated therewith against the surface of the type drum 10.

Upon being propelled against the type drum 10, the particular hammer rebounds. In rebounding, the back end of the print hammer is met by the now relaxed tape 40 associated therewith which acts as a cushion for the actuated hammer. The cushioning effect produced by the tape 40 along with the normal urging of the spring 34 maintains the actuated hammer away from the surface of the type drum 10 thereby preventing any undesired rebound which would cause double printing.

As represented in FIGURE 1, the electromagnets are arranged in fan-like configuration. This is in accordance with the space-conserving design of the printer represented in FIGURE 1. In particular, such a fan-shaped arrangement allows a minimum spacing of the hammers while maintaining a direct line of connection to the hammer actuating mechanism. As is further represented at FIGURE 2, each of the tapes 40 is of equal length and, as will be described in detail in connection with FIGURE 3, is maintained in an equal initial tensioned

condition by the electromagnets. Thus, the timing of each print cycle for each print hammer will be substantially the same. Accordingly, by selectively actuating all or particular ones of the electromagnets, the print hammers will be actuated to print characters upon the print material in an accurately aligned row.

As previously mentioned, the electromagnet for use with the present invention includes an armature which when activated is moved in a linear direction to exert a longitudinal force on its associated tape. Further, as previously mentioned, the electromagnet of the present invention has a variable displacement relative to the frame of the printer such that the initial tensioning of each tape may be adjusted to an equal value. An electromagnet providing the above is represented in FIGURE 3. As illustrated, the electromagnet of the present invention includes a shell 52 which is coupled by a pin 54 to a core member 56. As represented, the core member 56 includes a partially threaded hole 58. Within the hole 58 is imposed a spring 60, a pin 62, and screws 64 and 66. As is further represented, a portion of the periphery of the core 56 is threaded at a greater pitch than that of the hole 58. In particular, as represented in FIGURE 3, an adjusting nut 68 having inner and outer threaded portions is mated with the threaded portion of the core 56. As is further represented, the inner threaded portion of the nut 68 has a greater pitch than the outer threaded portion. As represented, the outer threaded portion is mated by a bushing 70 which is positioned between the nut 68 and the frame 72 of the printer. Due to the above described differential threadings of the bushing 70 and the nut 68, the displacement of the shell 52 of the electromagnet 50 may be coarsely varied by turning of the bushing 70 and may be finely varied by turning of the nut 68.

As is further represented, the electromagnet of the present invention includes a bobbin arrangement 74 having a coil assembly 76 wound thereon. Further, the electromagnet 50 includes an armature 78 which is positioned for movement in a sleeve 79 within the bobbin 74. As represented, one end of the armature 78 includes a counterbore 80 in which is nested the spring 60. The other end of the armature 78 is held in place by a forward stop represented at 82 and a snapping 83. Thus motion of the armature 78 is limited to a longitudinal movement which causes a compression of the spring 60.

As previously mentioned, each of the tapes 40 is coupled to the armature of an electromagnet. As represented in FIGURE 3, this coupling is obtained by two half-rounded slugs 84 and 86 which are positioned to enclose the tape 40 and are mounted within the armature 78 and secured by set screws 88 and 90.

Thus, in operation, a signal is momentarily applied to the conductor lead represented at 92 which energizes the coil assembly 76. The energizing of the coil assembly 76 produces a magnetic field tending to draw the armature 78 into the bobbin assembly 74. The movement of the armature 78, in turn produces a compression of the spring 60 and exerts a longitudinal force on the tape 40. The longitudinal force exerted on the tape 40, as previously described, propels the print hammer associated with the electromagnet against the type drum causing a character to be printed upon the print medium 20. When the signal is removed from the conductor 92, the magnetic field collapses and the spring 60 forces the armature 78 to its normal position.

As previously described above, the screws 64 and 66 maintain the pin 62 against one end of the spring 60. By adjusting the longitudinal position of the screws 64 and 66 within the hole 58, the initial tension of the spring 60 may be adjusted. This in turn determines the longitudinal force transmitted by movement of the armature 78 as well as the rate of the return of the armature 78 to its

initial position upon termination of the signal applied to the conductor 92.

In view of the above description, it appears that the present invention provides a printing mechanism which includes a low inertia hammer actuating arrangement for rapidly propelling a light-weight hammer against a high speed type surface, the hammer actuating arrangement including means which prevent a rebound of the print hammer as well as means for accurately aligning the printed characters in a print row by maintaining the time of each print cycle for each print hammer substantially equal and invariant from one print cycle to the next.

What is claimed is:

1. In a high speed printer which includes a moving print surface having type characters impressed thereon and a print hammer having a print face positioned to impinge upon the print surface, a hammer actuating mechanism comprising: guide means having first and second guide surfaces positioned on either side of said hammer in a common plane adjacent to the print surface; a length of tape having a high tensile strength passing over said first and second guide surfaces and a point on said hammer which lies to a side of the common plane that is remote from said print surface; and means for shortening the length of tape passing between said first and second guide surfaces to propel said hammer against said print surface.

2. Apparatus for printing individual characters on a print medium, comprising: an elongated print element; means movably supporting the print element for movement into and out of impinging relationship to the print medium; means normally urging the print element out of contact with the print medium; an elongated flexible member having one end enclosed in fixed relation to the point of contact between the print element and the print medium; guide means for directing the flexible member in contact with the end of the print element opposite the impinging end thereof, the flexible member being bent slightly at the point of contact with the print element; and means secured to the other end of the flexible member for momentarily tensioning the flexible member to straighten out the flexible member where it passes over the print element, whereby the flexible member applies an impinging force to the print element against the action of the urging means.

3. In a high speed printer which includes a reference frame, a moving print surface having type characters impressed thereon, and a light-weight hammer slidably mounted relative to the print surface such that one end of the hammer is positioned to impinge upon said print surface, a hammer actuating mechanism comprising: first and second guide means positioned on either side of said hammer, the guide means having guide surfaces lying in a common plane adjacent to said print surface; a length of tape having one end coupled to said reference frame and passing over said first and second guide means and a point on said hammer which is to a side of said common plane remote from said print surface; and means for exerting a longitudinal force on the other end of said tape to shorten the tape length between the guides and thereby propel said hammer against said print surface.

4. In a high speed printer which includes a print surface having characters impressed thereon, said print surface being continuously moving relative to the frame of the printer, and a light-weight elongated print hammer having one end positioned to impinge upon the print surface, a hammer actuating mechanism comprising: a tape of high tensile strength material, one end of said tape being fixedly coupled to the frame of said printer; guide means for directing the tape in contact with the end of the hammer opposite the impinging end thereof, the tape being bent slightly at the point of contact with the hammer an electromagnet having an armature positioned for substantially linear movement; and means for coupling

the remaining end of said tape to said armature such that movement of said armature produces a tensioning of said tape to straighten out the tape where it passes over the hammer, thereby causing said hammer to be propelled against said print surface.

5. In a high speed printer which includes a print surface having type characters impressed thereon, said print surface being continuously moving relative to the frame of the printer, and a light-weight elongated print hammer slidably mounted relative to the print surface such that one end is positioned to impinge upon said print surface, a hammer actuating mechanism comprising: first and second guide means positioned on either side of said hammer in a plane between said print surface and a remaining end of said hammer; a length of tape having a high tensile strength passing over said first guide means, the remaining end of said hammer, and said second guide means; means for fixedly attaching one end of said tape to said frame; an electromagnet having an armature positioned for linear movement; and means for coupling the remaining end of said tape to said armature such that movement of said armature produces a tensioning of said tape causing said hammer to be propelled against said print surface.

6. In a high speed printer which includes a reference frame and a continuously moving print surface having type characters impressed thereon, a print mechanism comprising: a light-weight projectile-type hammer having one end positioned to impinge upon said print surface; means for urging said hammer away from said print surface; first and second guide means positioned on either side of said hammer in a common plane adjacent to said print surface; a length of tape having a high tensile strength passing over said first and second guide means and a point on said hammer which lies to a side of said common plane that is remote to said print surface; and means for exerting a longitudinal force on said tape to propel said hammer against said print surface.

7. The print mechanism defined in claim 6 wherein one end of said tape is attached to said frame and wherein said means for exerting a longitudinal force on said tape includes an electromagnet having an armature positioned for linear movement, the other end of said tape being attached to said armature.

8. In a high speed printer which includes a reference frame and a continuously moving print surface having type characters impressed thereon, a print mechanism including: a light-weight elongate hammer slidably mounted between two low friction guides, said hammer having a slot therein and one end positioned to impinge upon said print surface; a return spring having one end positioned in said slot to normally urge said hammer away from said print surface; first and second guide means positioned on either side of said hammer in a common plane adjacent to said print surface; a tape of high tensile strength material having one end attached to said frame and positioned to pass over said first and second guide means and a point on said hammer which lies to a side of said common plane which is remote to said print surface; an electromagnet having an armature positioned for substantially linear movement; and means for coupling the remaining end of said tape to said armature such that movement of said armature shortens the length of tape passing between said first and second guide means to propel said hammer against said print surface.

9. In a high speed printer which includes a print surface having type characters arranged in print columns thereon, the print surface continuously moving relative to the frame of the printer, and a plurality of light-weight elongated print hammers arranged in a row above the print surface, each hammer being slidably guided in a plane normal to the print surface such that a forward end of each hammer is positioned to impinge upon a print column, a hammer actuating mechanism comprising: first and second guide means positioned on either

side of the row of hammers in a common plane adjacent to said print surface; a plurality of tapes having one end attached to the frame of the printer and each passing over said first and second guide means and a point on a print hammer which lies to a side of said common plane which is remote to said print surface; and a plurality of electromagnets each having an armature coupled to the remaining end of one of said plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto such that when an electromagnet is energized a particular print hammer corresponding to the electromagnet is propelled against a print column of the print surface.

10. In a high speed printer which includes a print surface having type characters arranged in print columns thereon, the print surface being continuously moving relative to the frame of the printer, a print mechanism comprising: a plurality of light-weight elongated print hammers arranged in a row above the print surface, each hammer being slidably guided in a plane normal to the print surface, a forward end of each hammer being positioned to impinge upon a print column; means for normally urging said print hammers away from said print surface; first and second guide means positioned on either side of the row of hammers in a plane between the print surface and the back end of said hammers; a plurality of tapes having one end attached to the frame of the printer and each passing over said first guide means, the back end of a print hammer and said second guide means; a plurality of electromagnets coupled to the frame of the printer, each electromagnet having an armature coupled to the remaining end of one of said plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto such that the energizing of an electromagnet causes a print hammer to be propelled against a print column of the print surface.

11. In a high speed printer which includes a print surface having type characters imposed thereon said print surface being continuously moving relative to the frame of said printer and a light-weight hammer slidably guided in a plane normal to the print surface a forward end of the hammer being positioned to make contact with the print surface, a hammer actuating mechanism comprising: first and second guide means positioned on either side of said hammer in a common plane adjacent to said print surface; a tape having a high tensile strength coupled to the frame of said printer and passing over said first and second guide means and a point on said hammer which lies to a side of said common plane which is remote to said print surface; an electromagnet coupled to the frame of the printer said electromagnet including a bobbin, a coil wound around said bobbin, and an elongated armature positioned for longitudinal movement within said bobbin upon an excitation of said coil, said armature including means for anchoring the remaining end of said tape to said armature such that said tape is initially in a slightly tensioned condition; and means for adjusting the displacement of said electromagnet relative to said frame to vary the initial tensioning of said tape.

12. In a high speed printer which includes a rotating type drum having type characters arranged in rings around the surface of the drum, said drum being continuously rotated relative to the frame of the printer, a print mechanism comprising: a plurality of light-weight elongated hammers arranged in a row above the surface of the type drum, each hammer being slidably guided for movement in a direction normal to the surface of the type drum such that a forward end of each hammer is positioned to impinge upon a print ring of said type drum; first and second guide means each having a plurality of grooves, adjacent grooves of each guide means being associated with adjacent print hammers, said first and second guide means being positioned on either side of said row of hammers, said grooves lying in a plane which is forward to the back end of said row of hammers; a first plurality of tapes of equal length having one end attached

to the frame of the printer adjacent to said first guide means and passing through alternate grooves of said first guide means over the back end of alternate hammers associated with the grooves of said first guide means and through associated grooves of said second guide means; a first plurality of electromagnets coupled to the frame of said printer and arranged in a fan-shaped array relative to said second guide means each electromagnet having an armature coupled to the remaining end of one of said first plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto; a second plurality of tapes of equal length having one end attached to the frame of the printer adjacent to said second guide means and passing through the grooves of said second guide means which are alternate to those passing said first plurality of tapes, over the back end of alternate hammers associated with the grooves of the second guide means and through the associated grooves of said first guide means; and a second plurality of electromagnets coupled to the frame of said printer arranged in a fan-shaped array relative to said first guide means each electromagnet having an armature coupled to the remaining end of one of said second plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto; and means for selectively energizing said first and second plurality of electromagnets.

13. In a high speed printer which includes a print surface having type characters arranged in print columns thereon, said print surface being continuously moving relative to the frame of the printer and a plurality of light-weight print hammers arranged in a row above the print surface each hammer being slidably guided in a plane normal to the print surface such that a forward edge of each hammer is positioned to make contact with a print column, a hammer actuating mechanism comprising: first and second guide means positioned at equal distances on either side of said row of hammers in a plane forward to the back end of said row of hammers; a first plurality of tapes of equal length having one end attached to the frame of the printer adjacent to said first guide means and each passing over said first guide means, the back end of alternate print hammers and said second guide means; a first plurality of electromagnets arranged in a fan-shaped array relative to said second guide means, each electromagnet having an armature coupled to the remaining end of said first plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto; a second plurality of tapes of equal length having one end attached to the frame of the printer adjacent to said second guide means and each passing over said second guide means, the back end of print hammers alternate to those associated with the first plurality of tapes, and over the second guide means; and a second plurality of electromagnets arranged in a fan-shaped array relative to said first guide means each electromagnet having an armature coupled to the remaining end of one of said second plurality of tapes, said armatures being arranged to exert a longitudinal force on the tape coupled thereto.

14. Apparatus for printing on a print medium, comprising: a print element; means movably supporting the print element for movement into and out of impinging relationship with the print medium; guide means having first and second guide surfaces one positioned on either side of the print element in a common plane, the common plane lying between the print medium and rearwardly extending portion of the print element; an elongated flexible member passing over the first and second guide surfaces and a point on the print element which lies to a side of the common plane remote from the print medium; and means for shortening the length of the flexible member passing between the first and second guide surfaces to propel the print element against the print medium.

15. The apparatus defined in claim 14 wherein the means for shortening the length of the flexible member

includes means for fixing one end of the flexible member relative to the print element and means secured to the other end of the flexible member for tensioning the flexible member.

16. The apparatus defined in claim 14 including means for normally urging the print element out of contact with the print medium. 5

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