

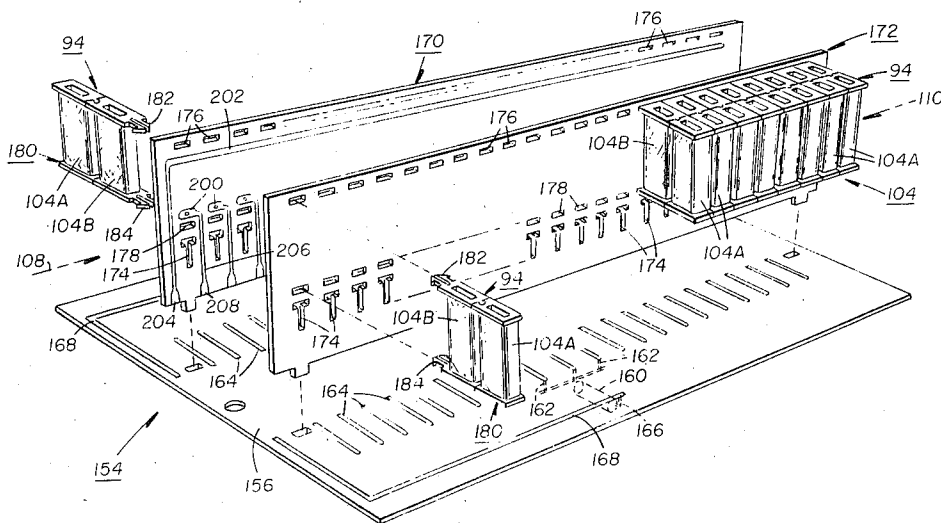
- [54] TELEPRINTER ASSEMBLY
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[73] Assignee: Teletype Corporation, Skokie, Ill.
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[51] Int. Cl. B41j 23/14, H02b 1/04, H05k 1/07
[58] Field of Search 101/93 C; 339/17 C; 317/101 CW, 113

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[57] **ABSTRACT**
Each of a plurality of self-restoring horizontally spaced apart print hammers selectively is driven linearly toward a printing position in response to movement of the armature of an electromagnet. The electromagnets are disposed in a pair of spaced apart banks, their armatures extending inwardly and providing a plurality of aligned working inner ends as agents for application of electromagnetic energy. A circuit card is physically secured and electrically connected to the coil assembly of each of the electromagnets of each bank and has a plurality of aligned apertures enabling passage and rocking movement of the corresponding armatures. The circuit cards are vertical and are disposed in horizontally extending parallelism, the working inner ends of said armatures being disposed therebetween. A circuit board is physically secured and electrically connected to said cards with which it is orthogonally disposed.

3 Claims, 5 Drawing Figures



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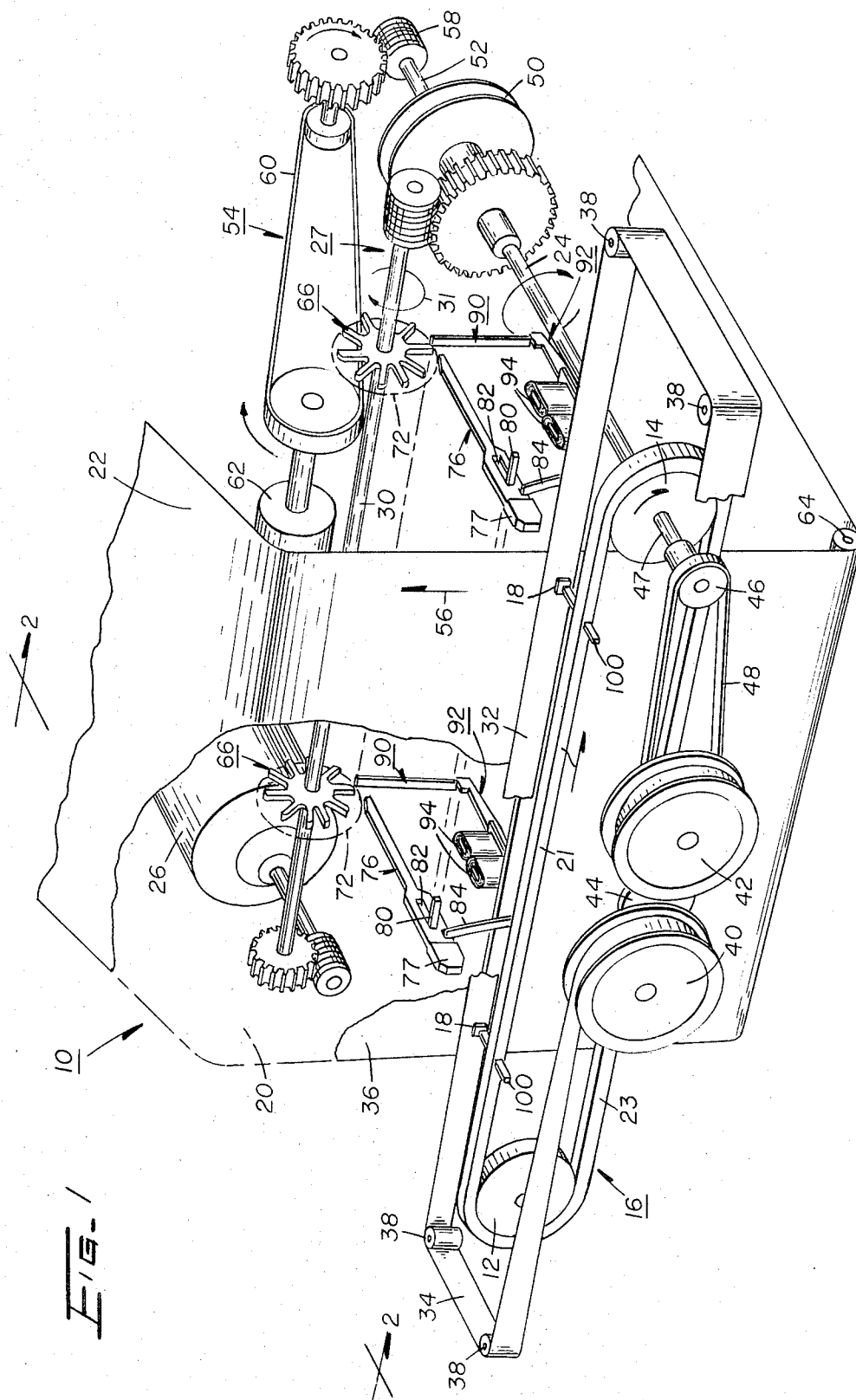
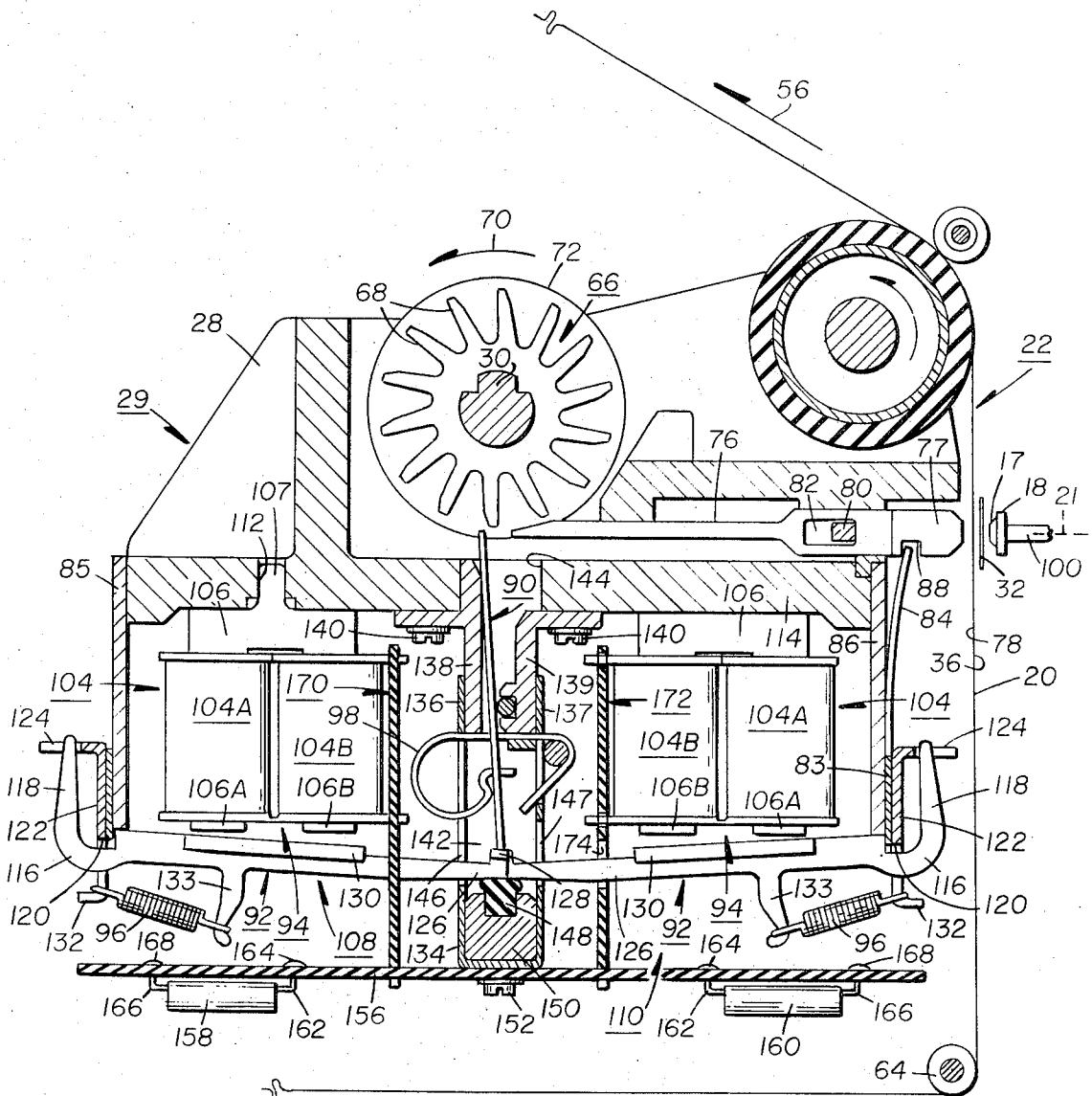
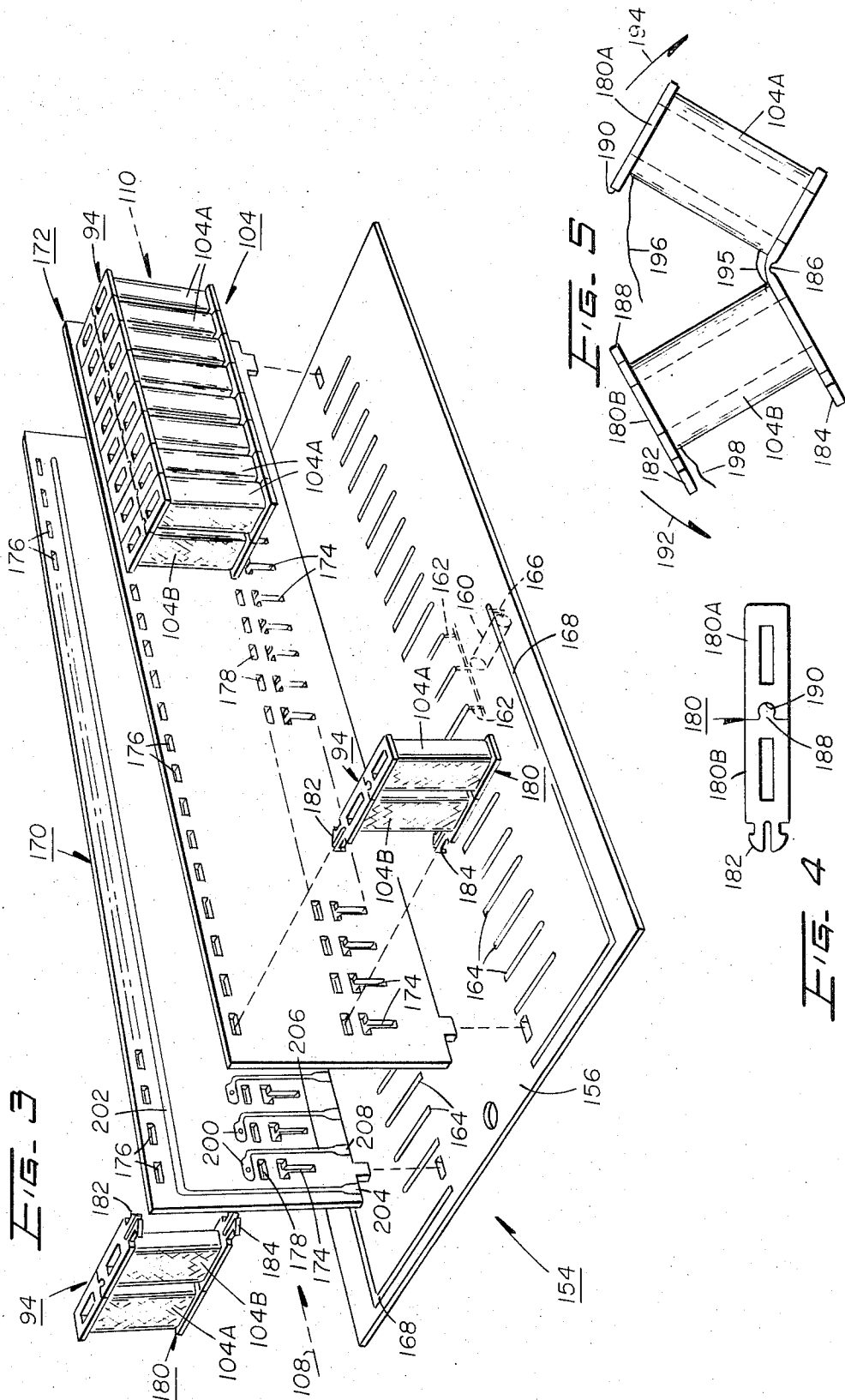


FIG. 2





TELEPRINTER ASSEMBLY

BACKGROUND of the INVENTION

The present invention relates to signal responsive impact printers. More particularly, the invention relates to electromagnetic assemblies for controlling print hammers in teleprinters.

In a class of printer with which the present invention is concerned, a plurality of print hammers corresponding to the number of printing stations in a line of copy are responsive to selectively actuated electromagnets for printing. The application Ser. No. 292-003 of Egon S. Babler, contemporaneously filed herewith, and assigned to the assignee of the present application, is directed to printers in said class. This aforesaid contemporaneously filed application is incorporated herein by reference.

In the printer shown in said application, impelling means for print hammer control is of the type disclosed in U. S. Pat. No. 2,927,960, issued to W. P. Byrnes, Mar. 8, 1960. However, the patented apparatus has been improved according to said application and others referred to therein to lower the mechanical inertia of the impelling means as well as of its print hammers. Resultantly, the speed of printing response can be increased to a level which is compatible with handling, at an optimum rate, the output from a buffer storage, for example, between incoming data and a printing mechanism. Moreover, printer costs have been minimized in the printer shown in said application by providing the electromagnets having armatures with inner working end portions aligned in a single straight array. On the other hand, the electromagnets themselves are arranged in a pair of banks disposed on opposed sides of the aligned working ends of the armatures.

Further improvement for minimizing costs in printers of the indicated class can be directed to simplifying the means for transferring logic generated signals to the electromagnets for effecting armature control.

It is an object of the invention to simplify the imposition of logic in a high speed signal responsive printer having simultaneously actuatable print hammers responsive to electromagnets, particularly by providing an improved assembly of electromagnets and armatures for operating impact printers of the type described.

SUMMARY of the INVENTION

The foregoing, and other objects of the invention which will become apparent from the ensuing detailed description, are attained in an impact printer having a lineal array of print hammers which are responsive, respectively, to electromagnetically controlled armatures. The armatures are disposed in opposed banks and have inner portions, aligned, each with the other, for control of said hammers. This application particularly concerns an improved assembly of electromagnets and armatures for such printers, wherein operating electromagnets for the printer are arranged vertically beneath a printer frame in two horizontal rows, and the armatures comprise pivoted arms mounted vertically beneath the electromagnets and having interleaved inner operating ends terminating in a common vertical plane. The electromagnets include vertically arranged magnet cores having bobbin assemblies slideably received thereon, and electrical operating coils wound on the bobbin assemblies.

The mounting assembly includes a pair of printed circuit cards mounted vertically in the frame between the cores and the operating ends of the armatures. One card is associated with each row of electromagnets and armatures, and the cards extend downward from positions above the tops of the bobbins to positions below the armatures. The cards have elongated vertically disposed slots therethrough, through which the armatures extend and which permit pivoting movement of the armatures when the coils are operated. A snap-in connecting device is provided for physically connecting each bobbin assembly to its associated circuit card in the required position in its row, the cards serving to vertically position the bobbin assemblies on the cores at the desired altitude. Each card has a plurality of printed conductors having portions extending vertically downward to the bottom of the card and terminating in terminal pads along the bottom of the card, and the conductors are arranged on the cards opposite to the bobbins and are electrically connected to the leads of the coils. Individual operating circuit components for the electromagnets are connected to the terminal pads at the bottom of the cards.

BRIEF DESCRIPTION of the DRAWINGS

In the ensuing detailed description of the invention, reference is had to the accompanying drawings on which:

FIG. 1 is a perspective view of an impact printer embodying an operating assembly according to one form of the invention, parts being broken away and parts omitted for the purpose of illustration;

FIG. 2 is a vertical sectional view of said printer according to the line 2-2 of FIG. 1;

FIG. 3 is a perspective view, partially exploded, and parts omitted, of means for connecting electromagnets of said printer to its hammer controlling logic;

FIG. 4 is a plan view of a bobbin assembly for windings member of one of said electromagnets; and

FIG. 5 is an elevational view of a windings member with its bobbin alternately conditioned from the condition of FIG. 4.

DETAILED DESCRIPTION of the INVENTION

Referring now to FIG. 1 of the drawings, the impact printer shown in generally designated 10. It has a pair of spaced apart pulleys 12 and 14 about which an endless carrier 16 is trained for translocating a plurality of pallets 18 by movement in a circuitous path. A plurality of dies 17 (FIG. 2) are carried on the front faces of the pallets. The pallets, except for possibly the terminal pallets in a font, are uniformly dimensioned and uniformly and equally spaced apart axially of the carrier. When dies 17 comprise alphanumeric characters, two or more successive fonts axially of carrier 16 may enable longer line output.

Carrier 16 and pallets 18, together with attendant elements (omitted from the drawings) may be substantially as shown and described in the copending application of Francis E. Huntoon and James F. Kearney, Ser. No. 208,198, filed Dec. 15, 1971, and assigned to the assignee of the present application now U.S. Patent 3,742,848, issued July 3, 1973. In accordance with said last named copending application, which is incorporated herein by reference, the plane in which parallel axes of pulleys 12 and 14 are disposed and the vertical

section 20 of web 22 on which printing is about to occur are orthogonally disposed. Such arrangement generates a loop in the carrier with an upper or printing course 21 and a lower or return course 23 which are disposed in a plane which is substantially parallel to web section 20.

In the exemplary printer 10, pulley 12 is an idler sheave while pulley 14 is a drive sheave secured to a shaft 24. Driving torque continuously is transmitted to said shaft from an operating prime mover means, herein shown as a motor 26, through a drive train generally designated 27. The latter herein includes an impeller shaft 30. This shaft has opposed end portions journaled in opposed side walls 28 of the chassis or frame 29 (FIG. 2) of printer 10, and it is continuously driven in the direction indicated by arrow 31 during printer operation.

A segment 32 of ribbon 34 is disposed in a plane substantially parallel to carrier course 21 between and spaced slightly from face 36 to web section 20 and the pallets 18 supported from said last course. The ribbon is trained about a plurality of ribbon guides 38 which are spaced apart such that the ribbon assumes a generally rectangular configuration in a horizontal plane. Opposed end portions of the ribbon are secured to a pair of adjoining ribbon spools 40 and 42 which alternately function for ribbon supply and accumulation. They alternately are driven in opposite angular directions, by a spool control mechanism 44, the details of construction of which form no part of the present invention. Mechanism 44 is connected to motor 26 through a pulley wheel 46 which is secured on an end portion 47 of shaft 24 for driving the spool control mechanism through a pulley belt 48.

A clutch 50, which may be conventional, is mounted for releaseably securing a split shaft section 52 to the shaft 24 from which said section extends axially. Selective actuation of the clutch may be effected through logic which may be conventional and the details of construction of which form no part of the invention. Thereupon, operating means, being a drive train generally designated 54, advances web 22, in the direction shown by arrow 56, a line-at-a-time. Such advancement results from incremental rotation of a worm gear 58 for driving a pulley belt 60 intermittently angularly to move a cylindrical roller 62. Roller 62 is disposed transversely of and adjacent to the path of web movement for frictionally engaging web 22 and in cooperation with other components (not shown), intermittently drawing said web from its supply source (not shown) about a guiding cylinder 64, as said web is advanced.

Impelling means comprises an array of radially symmetrical impellers 66 (only representative ones of which are shown in FIG. 1). The impelling means herein are substantially as shown and described in two commonly assigned copending applications of Egon S. Babler, Ser. Nos. 268,236 and 268,238, filed July 3, 1972, which are incorporated herein by reference. Accordingly, each impeller is comprised of a plurality of radial, equiangularly spaced arms or impelling elements 68, (FIG. 2), the impellers being concentrically secured to shaft 30 for rotation therewith in the direction shown by arrow 70 in the exemplary embodiment. The impellers are axially or horizontally spaced such that each is disposed in substantially horizontal alignment with a printing station on an imaginary line extending horizontally across web section 20. A plurality

of circular shims 72 are disposed between impellers 66 and define a plurality of horizontally aligned annular chambers, as more particularly defined in said application Ser. No. 268,238.

Impacter means for printing comprise a plurality of equally spaced apart print hammers 76 (only some of which are shown in FIG. 1) disposed behind back face 78 (FIG. 2) of web section 20. The impacter means herein may be substantially as shown and described in said copending Babler applications Ser. Nos. 268,236 and 268,238, as well as in an additional commonly assigned Babler application Ser. No. 268,237 filed July 3, 1972, which is incorporated herein by reference. Accordingly, each hammer is aligned with the others in a horizontal array parallel to the alignment of impellers 66. Each hammer also is aligned with, though spaced from, and disposed out of the path of movement of an associated impeller by which it can be selectively driven in a lineal path, perpendicularly to web section 20, between a normal or non-printing position (FIG. 1) and a printing position (not shown) against said back face 78 (FIG. 2).

The dies 17 on pallets 18 in course 21 and hammers 76 are disposed at a common horizontal level; and said pallets and their dies when translocated move in a path parallel to the hammer array for printing. Thereby, each pallet 18 and groups thereof can be moved successively into printing positions in horizontal alignment with successive hammers 76 and groups thereof. The force generated by each impeller 66 for urging web section 20, ribbon segment 32 and any aligned dies 17 into contact is of sufficient magnitude for printing by forming an image of each such die on web face 36. In the exemplary embodiment of the invention herein, the hammers are associated with and reciprocally arranged in the chassis or framework 29 by means and in the manner disclosed in said copending application Ser. No. 268,238.

A horizontal bumper, in the form of a rod 80 (FIGS. 1 and 2), is disposed parallel to shaft 30 has opposed ends secured in the chassis side walls 28. Said rod extends through horizontally aligned slots 82 in the hammers 76 for limiting horizontal hammer movement.

A leaf spring 84 (FIGS. 1 and 2) of general vertical orientation and associated with each hammer 76, is included in hammer driving means. The lower end portion of all of springs 84 are integrally fashioned with a horizontal front wear plate 83 which is rigidly secured to a front chassis plate 86. An upper end portion of each spring 84 is engaged in a downwardly opening slot 88 in the printing head 77 of each hammer 76. Each spring 84 has a slightly tensioned condition (FIG. 2) during which its hammer is in its rearward or most remote non-printing position, and a most tensioned condition (not shown) during printing for urging or restoring its hammer to non-printing position.

Each impeller 66 is adapted to move a printingly associated and aligned hammer 76 through the agency of an interponent 90. In the preferred embodiment of the invention, printing is effected and the assemblies of the interponents as well as the other parts of printer 10, including means for controlling and liberating the interponents are, as shown and described in said application Ser. No. 268,238. In accordance therewith, the interponents are disposed in general horizontal alignment and each has: (1) a first or upper position in which it is in a projected condition, with its upper free end por-

tion disposed in the path of movement of associated impeller arms 68 for transmitting force from its impeller 66 to an aligned hammer 76 in consequence of which printing occurs, and (2) a lower, non-printing, or second position in which said interponent has fallen and is removed from the impeller path.

As shown and described in said last named application, each interponent 90 intermittently is controlled by an assembly comprised of a magnetically elevatable armature 92 and an electromagnet 94 (FIG. 2). Any suitable logic, (forming no part of the present invention) which may be conventional, may be employed for energizing selected electromagnets 94. In consequence of energization of any electromagnet its armature will be rocked, magnetomotively, against the restoring bias of its contractile spring 96, from its position shown (FIG. 2) upwardly to a latched position (not shown).

Correspondingly, an affected interponent 90 will be thrust upwardly (from its FIG. 2 position) into its first position or projected condition (not shown) between a pair of adjoining impeller arms 68 against the lowering bias of an associated spring 98 (FIG. 2) which becomes tensioned upon upward movement of its interponent. Ensuingly, an upwardly thrust interponent will be engaged by one of the circuitously travelling impeller arm 68 of its impeller; and said interponent then will be rocked into engagement with an associated hammer 76 to effect momentum transfer and translation of impeller torque into a lineal force for printing. Both momentum transfer and restoration of each interponent 90 to its second position (FIG. 2) following momentum transfer, as well as the conditioning of interponents for repeat cycles are as shown and described in said last named copending application.

In the exemplary printer 10, though the spacing between the centers of the hammers 76 need not be the same as the spacing between the centers of pallets 18 in course 21, the spacing of said hammers as well as their dimensions, mode and sequence of operations, and printing with printer 10 is as shown and described in said copending application Ser. Nos. 268,236 and 268,238. Moreover, adjustment of impact of the hammers preferably is as shown and described in said copending application Ser. No. 268,237. Therefore, pallets 18 are mounted on the inner ends of shanks 100 (FIG. 2) whose outer ends are disposed against a backup bar (not shown); and said shanks are disposed in a horizontal plane and are removably mounted in carrier 16, extending transversely therethrough.

The assembly of the electromagnets 94 are as shown and described in said contemporaneously filed application Ser. No. 292,003. In the exemplary embodiment, each electromagnet 94 comprises a pair of electrically interconnected wire coils 104A and 104B of a windings member 104 (FIGS. 2 and 5). The coils, respectively, of each pair are circumposed about legs 106A and 106B of a pair thereof comprising a corresponding magnetic core 106. The electromagnets 94, which is to say, the cores, and their windings members, are uniformly horizontally spaced apart and disposed in a pair of straight parallel arrays, sets or banks 108 and 110. Bank 110 is aligned adjacent and parallel to the front chassis plate 86 and bank 108 is aligned along and parallel to a rear chassis plate 85 (FIG. 2), the latter being parallel to front chassis plate 86, though each bank is horizontally offset from the other, as will be ensuingly apparent.

Each core 106 has an upwardly projecting anchoring lug or shank 107 (only one is shown in FIG. 2) which is firmly secured in a respective one of a plurality of holes 112 formed in a horizontal wall 114 of chassis 29. Said holes (only one of which is shown) are aligned in said banks 108 and 110, the alignment of the holes in each bank being parallel to the hole alignment in the other bank and extending along and parallel to a respective one of the chassis plates 85 and 86. Herein, and as disclosed in at least one of my aforesaid copending applications, each core and its hole 112 in one of the banks 108 and 110, though equally spaced from adjoining cores member and holes in the same bank, are offset horizontally from the corresponding core and hole in the opposed bank by a distance equal to half the spacing between adjacent cores and their holes.

Each armature 92 has an outer portion 116 (FIG. 2) with an upwardly projected extension 118. Each outer portion passes below the chassis 29 and extends outwardly therefrom through one of a plurality of slots 120 in a chassis supported bracket 122, each outer portion being guidingly disposed in one of the slots 124 in said bracket. Each armature also has an inner portion 126 which terminates in a flat stand 128. The arrangement of the armatures in offset banks 108 and 110 is such that all of the stands 128 are disposed in general alignment, horizontally, with each armature being vertically aligned with an associated one of said impellers 66.

A flat broad latching section 130 of magnetic material on each armature 92 is disposed below and in alignment with the lower ends of a pair of core legs 106A and 106B of a corresponding core 106 to which such latching section is drawn upon energization of an associated windings member 104. Accordingly, each armature has a first or latched condition (not shown) in which the latching section 130 of such armature is magnetically held against its core 106 and a second, non-printing or released condition (FIG. 2) in which a corresponding spring 96 biases its armature away from a magnetically attracted or latched position. To effect the latter condition each contractile spring 96 has an end anchored about one of the lugs 132 formed by slots 120 in bracket 122 and an opposite end connected to an extension 133 from its corresponding armature 92; and each spring 96 is tensioned for armature return when its armature is disposed in its first or latched condition.

A horizontally elongated channel 134 U-shaped in cross-section, has upper end portions of its opposed sides 136 and 137 suitably secured to the outside surfaces of a pair of spaced apart horizontally extending hanger plates 138 and 139 which are parallel to chassis plates 85 and 86. Plates 138 and 139 depend from chassis wall 114 to which they are secured by a plurality of fasteners 140. Plates 138 and 139 generate a chamber 142 therebetween longitudinally of the alignment of impellers 66 and of interponents 90, said chamber 142 being coextensive with an elongated opening or slot 144 in wall 114 through which the interponents extend upwardly toward said impellers. The closed end portion of channel 134 is spaced from the lower ends of said hanger plates 138 and 139 and closes chamber 142 from below.

Channel 134 is disposed medially of the electromagnets 94 of banks 108 and 110. Its sides 136 and 137 are slotted, the slots 146 in side 136 and the slots 147 in side 137 being spaced apart in horizontal alignment longitudinally of their respective sides, though the slots

in one side are offset horizontally from the slots in the other side.

Stands 128 are disposed in the lower end portion of chamber 142 with the armatures in bank 108 passing through slots 146 and the armatures in bank 110 passing through slots 147. A bumper 148 extends along the bottom of channel 134 and provides a support toward which stands 128 are urged by springs 96 and against which said stands repose (as in FIG. 2) when said armatures are in their second or unlatched condition. The bumper is held in a retainer 150 which is secured along the bottom of channel 134 by means of a plurality of fasteners 152 (only one of which is shown).

Operation of the exemplary embodiment is described in at least one of my aforesaid copending and contemporaneously filed applications. The distinctive features of the present invention repose in the combination of means, generally designated 154 (FIG. 3), for connecting electromagnets 94 to a logic assembly, whereby the electromagnets can be selectively energized for operating printer 10.

Means 154 comprises a mounting board 156 (FIGS. 2 and 3) which is disposed in a horizontal plane below chassis 29 and perpendicular to chassis plates 85 and 86. Board 156 is secured to the bottom of channel 134 by the fasteners 152. From its lower surface, board 156 supports a pair of component assemblies 158 and 160 (FIG. 2) of a logic system for energizing electromagnets 94 in a meaningful succession for printing. Said component assemblies are shown schematically, the assembly for energizing the bank 108 electromagnets being designated 158 and the assembly for energizing the bank 110 electromagnets being designated 160. The components of the assemblies 158 and 160 may be integrated circuits or miniature circuit elements. These components may include decoders, signal amplifiers, and counting means which may be assembled in a conventional manner for converting intelligence signals from a remote station into signals which can be utilized by the printer, and imposing such signals on the windings member 104 of selected electromagnets 94. The details of the logic system forms no part of the present invention.

Each of the component assemblies 158 and 160 has a plurality of output leads 162 (only one such lead from each assembly is shown in FIG. 2). Each lead 162 extends through circuit board 156 and is electrically connected to a terminal pad 164 formed on the upper surface of board 156 for providing input intelligence to a corresponding one of the electromagnets 94. Each of the component assembly also has a common return 166 which projects through the circuit board 156 and is electrically connected to a common ground land 168 formed on the upper surface of the circuit board 156.

Circuit cards 170 and 172 are substantially identical, each being a mirror image of the other. Circuit card 170 is connected to the electromagnets 94 in bank 108 and circuit card 172 is connected to the electromagnets 94 in bank 110. The circuit cards and the circuit board 156 are orthogonally disposed, the circuit cards being parallel to each other and spaced apart on opposed sides of stands 128 and outside of the channel 134. Circuit cards 170 and 172 are physically secured by any suitable means to circuit board 156, and each has a plurality of apertures to only some of which reference numerals 174 (FIG. 3) have been applied. The armatures 92 of bank 108 extend through apertures 174 in card

170 and the armatures 92 of bank 110 extend through apertures 174 in card 172. The apertures are fashioned for accommodating rocking movement of armatures 92.

Each of the circuit cards 170 and 172 extends longitudinally of its array of electromagnets 94; and for each electromagnet in its bank there is a pair of vertically aligned slots 176 and 178. The slots are disposed such that the slots 176 in each of the circuit cards are aligned horizontally and the slots in 178 in each of the circuit cards are aligned horizontally below the alignment of slots 176.

A bobbin assembly 180 (FIG. 4) comprises coupled bobbins 180A and 180B and which supports each windings member 104. The inner bobbin 180A of each bobbin assembly has an upper pair of spring legs 182 and a lower pair of spring legs 184. The spring legs of each bobbin assembly 180 are fashioned for snap-fit into a vertically aligned pair of slots 176 and 178 for releasably mounting the windings members 104 on circuit cards 170 and 172.

Bobbin 180A and outer bobbin 180B of each bobbin assembly are connected together by a living or elastic hinge 186 (FIG. 5) fashioned integrally with their lower parts. The top side of each bobbin 180B is fashioned with a snap-in male element 188; and each bobbin 180A is fashioned with a cooperative female snap-in component 190 which is proportioned for releasably receiving a male component. In consequence of the foregoing, the bobbins 180A and 180B of a coupled assembly may be mounted on the spindle (not shown) of a winding assembly by bending the bobbins at the hinge 186 into coaxial alignment in the direction of arrows 192 and 194 (FIG. 5). Thereafter, in a single winding to form windings member 104, each pair of coupled coils 104A and 104B can be wound on the bobbins 180A and 180B in a single continuous operation, thereby generating a connecting wire segment 195 between each pair of coils 104A and 104B, and an input wire end portion 196 and an output wire end portion 198 on each windings member. The bobbins are restored, after winding, to their operable configuration (FIG. 4) by bending the hinge 186 to move the bobbin opposite to the direction of arrows 192 and 194.

In such last named condition each windings member 104 is easily mounted on one of the circuit cards 170 and 172 by engaging legs 182 and 184 in slots 176 and 178. Thereafter, each circuit card then is mounted in a generally vertical aspect (FIG. 2) by slipping the bobbins 180A and 180B of each member 180 over the core arms 106A and 106B of a corresponding cores 106. This results in a disposition of circuit cards 170 and 172 longitudinally of the alignment of the cores 106 and perpendicular to the extension of their electromagnets.

Subsequently, the circuit cards 170 and 172 can be physically and electrically connected to circuit board 156 and the latter secured in its position with fasteners 152. To attain electrical connection, each input end portion 196 is electrically connected to corresponding one of the electrically conductive input lands 200 which may be fashioned in any known manner on one of the circuit cards 170 and 172. Each output end portion 198 (FIG. 5) is electrically connected to a respective common return conductor 202 fashioned in any known manner longitudinally of each of the circuit boards 170 and 172. Lands 200 on each circuit card

are horizontally aligned longitudinally of the card and parallel to the common return conductor 202.

A common return pad 204 at the terminal end of conductor 202 and adjacent the end of each of the circuit cards 170 and 172 is electrically connected by known means to one of the common return conductors 168. Each land 200 is electrically connected by a conductor 206 on its circuit card to a corresponding input pad 208. The input pads 208 on each circuit card are aligned along the lower edge of such card adjacent their juncture with circuit board 156 and are connected by means which may be known to a corresponding one of the terminals 164.

It is observed that circuit board 156 could be obviated by mounting the component assemblies 158 and 160 of the logic system in the form of integrated circuitry on respective circuit cards 170 and 172. This would entail enlargement of the printer 10, because known components could not be accommodated within the areas of cards 170 and 172 as presently designed. The exemplary assembly has minimum printer size requirements within the framework of presently known technology.

As many modifications in the described construction could be conceived, and as many widely different embodiments could be made without departing from the spirit and scope of the claims, it is intended that all matter contained in the accompanying specification shall be considered as illustrative only and not in a limiting sense.

I claim:

1. In combination with a teleprinter of the type having a frame; a plurality of electromagnets mounted in the frame and arranged in two spaced parallel rows; an equal plurality of armatures pivotably mounted in the frame in two spaced parallel rows, each armature being associated with a corresponding electromagnet and individually movable from a non-printing position to a printing position in response to energization of the corresponding electromagnet; an equal plurality of print hammers arranged in a single row, one corresponding to each print position in a line, one print hammer being associated with each armature; and means responsive to movement of each individual armature for firing the associated print hammer; and improved assembly of electromagnets and armatures characterized by:

A. the electromagnets being arranged vertically beneath the printer frame in two horizontal rows, the electromagnets in the two rows being staggered so that the electromagnets in one row operate odd numbered print hammers in the row of hammers and the electromagnets in the other row operate even numbered print hammers;

B. the armatures comprising pivoted arms mounted in the frame generally horizontally in two spaced parallel rows, each armature being mounted vertically beneath the associated electromagnet and having an operating end extending inwardly toward

the center of the printer, the operating ends terminating in a common vertical plane midway between the two rows of electromagnets, the operating ends of the armatures in one row being interleaved with those of the other row;

C. the electromagnets comprising a plurality of vertically arranged magnet cores secured to the frame and depending therefrom in the two parallel rows, a plurality of bobbin assemblies slidably received on the cores in vertical positions, and electrical operating coils wound on the bobbin assemblies;

D. a pair of printed circuit cards mounted vertically in the frame between the cores and the operating ends of the armatures, one card being associated with each row of electromagnets and armatures, the cards extending downward from positions above the tops of the bobbins to positions below the armatures, the cards having elongated vertically disposed slots therethrough, through which the armatures extend and which permit pivoting movement of the armatures when the coils are operated;

E. snap-in connecting means for physically connecting each bobbin assembly to its associated circuit card in the required position in its row, the cards serving to vertically position the bobbin assemblies on the cores at the desired altitude, each card having a plurality of printed conductors having portions extending vertically downward to the bottom of the card and terminating in terminal pads along the bottom of the card, the conductors being arranged on the cards opposite to the bobbins and being electrically connected to the leads of the coils; and

F. means for connecting individual operating circuit components for the electromagnets to the terminal pads at the bottom of the cards.

2. An assembly as recited in claim 1, wherein the connecting means (F) comprises a horizontal circuit board extending beneath the printer and fastened to the frame in a position below and engaging the bottoms of the two circuit cards, the board and lower edges of the cards having aligning means to locate the cards with respect to the board, the board having printed circuit conductors along its upper surface engaging and electrically connecting with the terminal pads on the cards, the operating circuit components being electrically connected to the printed conductors on the circuit board and being mechanically fastened to the board beneath the board.

3. A combination as recited in claim 2, wherein each bobbin assembly comprises a pair of coupled together bobbins, each operating coil comprises a pair of electrically connected coils wound on the bobbins, and each magnetic core comprises a pair of arms depending from the frame, each bobbin being positioned on one of said arms of said core.

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