

[54] **EMBOSSING AND ENCODING SYSTEM**

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[51] Int. Cl. **B41j 23/00**

[58] Field of Search 101/93 C, 18, 19, 93 R; 197/6, 6.1, 6.2, 20; 340/172.5; 346/79, 83; 235/154, 61 A; 178/42

[56] **References Cited**

UNITED STATES PATENTS

2,596,721	5/1952	Pentecost et al.	101/18
2,890,651	6/1959	Hosken	101/93
2,918,658	12/1959	Hoberg et al.	101/93 C X

3,107,292	10/1963	Daly et al.	101/19 X
3,185,818	5/1965	Furman et al.	101/93 C X
3,358,804	12/1967	Feldman	197/20
3,401,877	9/1968	Brett et al.	346/83 X
3,414,103	12/1968	Knudsen et al.	197/20
3,502,187	3/1970	Becking et al.	197/20
3,638,563	2/1972	Drillick	101/18
3,651,487	3/1972	Washington	101/93 C X
3,656,601	4/1972	Abell, Jr.	197/20
3,726,380	4/1973	Beers et al.	197/84 R X

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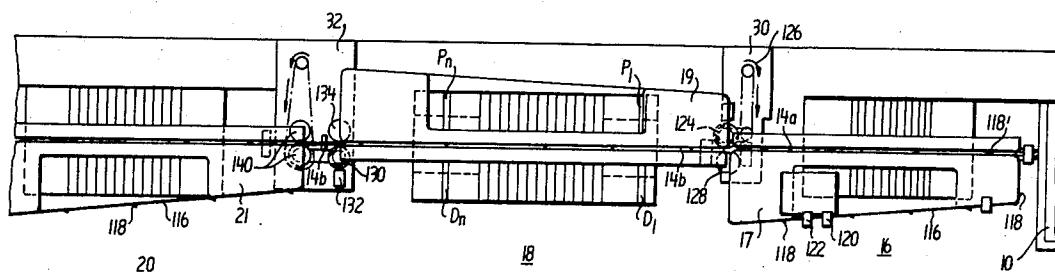
Attorney, Agent, or Firm—Staas, Halsey & Gable

[57]

ABSTRACT

A machine for embossing numeric and alphabetic data on plastic cards. The embosser is selectively controlled by computer and has a single set of OCR and alphanumeric embossing fonts past which each card is indexed. As the card passes the single alphanumeric font, it is vertically oscillated and may be selectively embossed with several lines of data.

17 Claims, 30 Drawing Figures



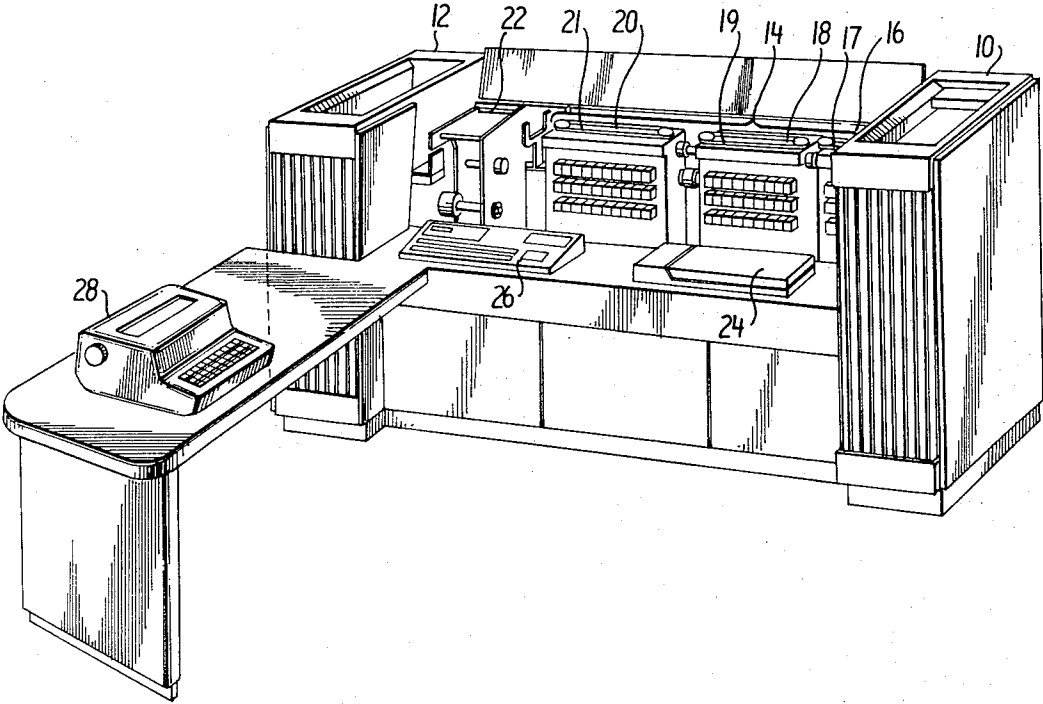


FIG. 1

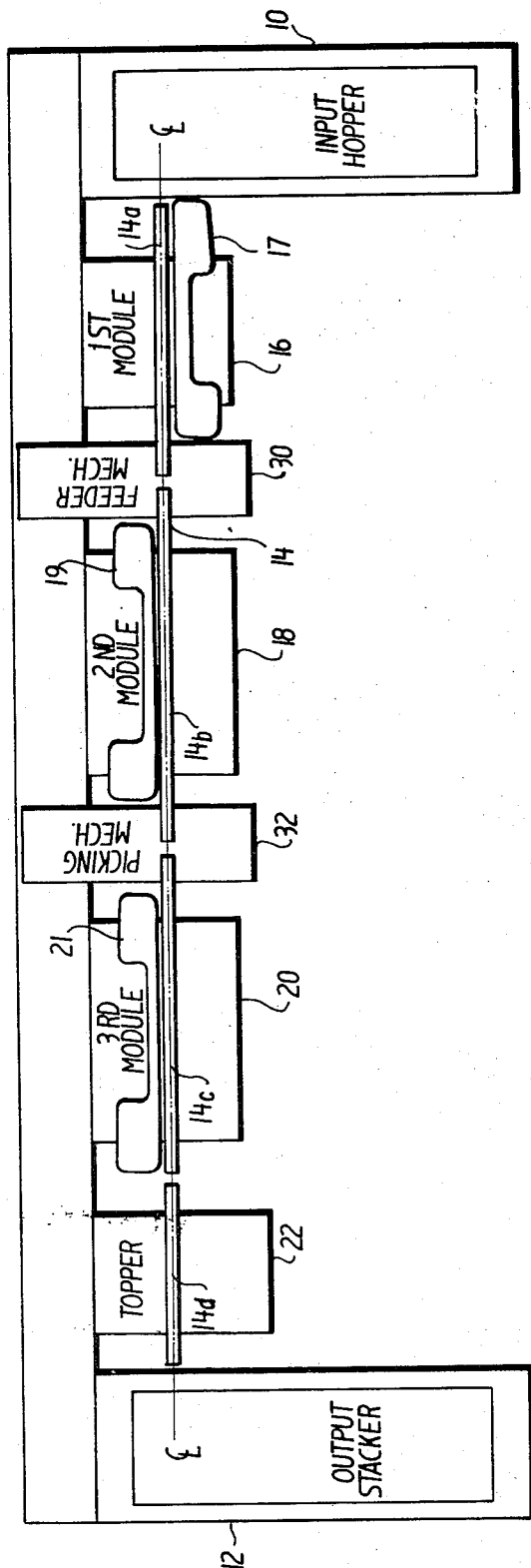


FIG. 2

FIG. 3

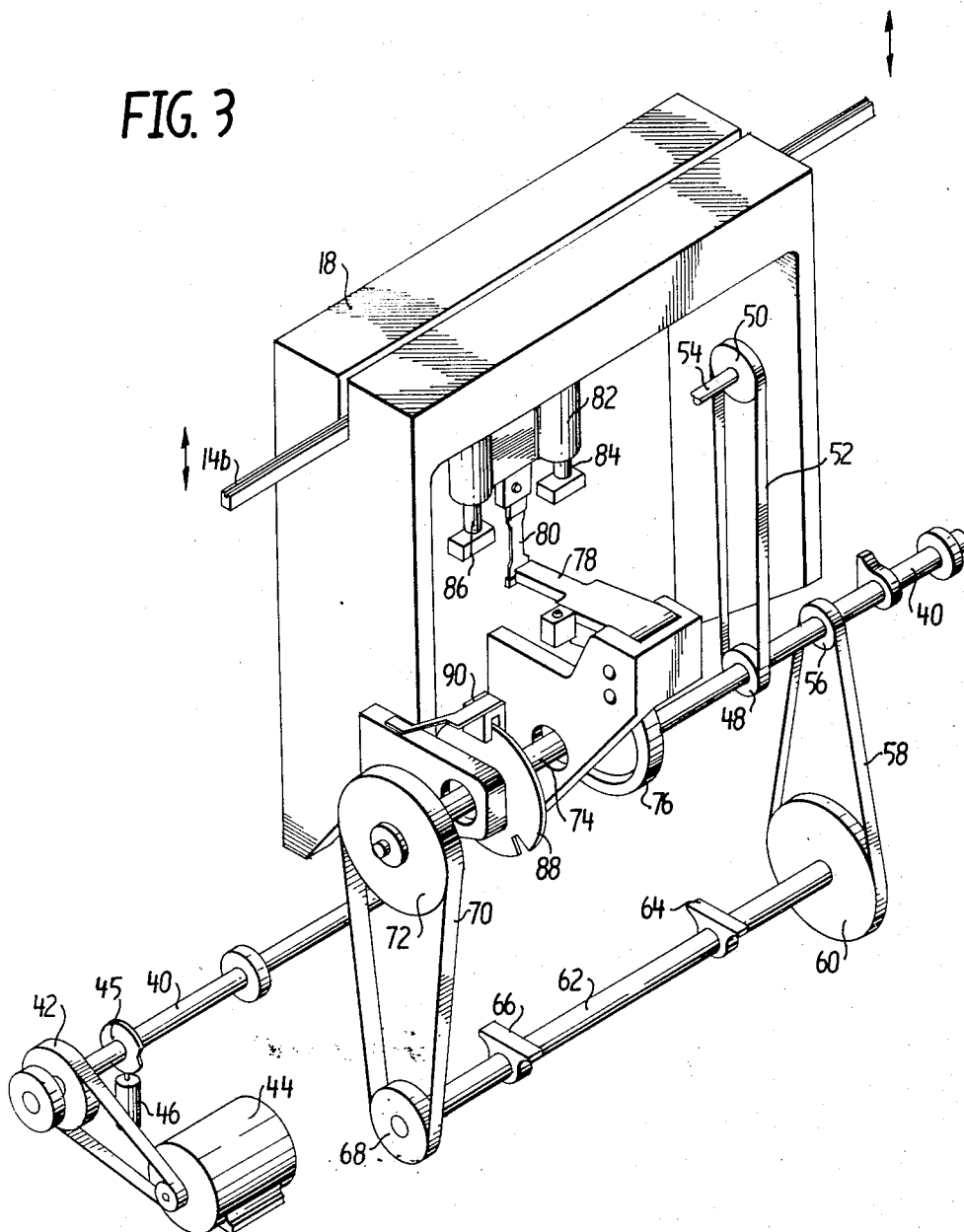
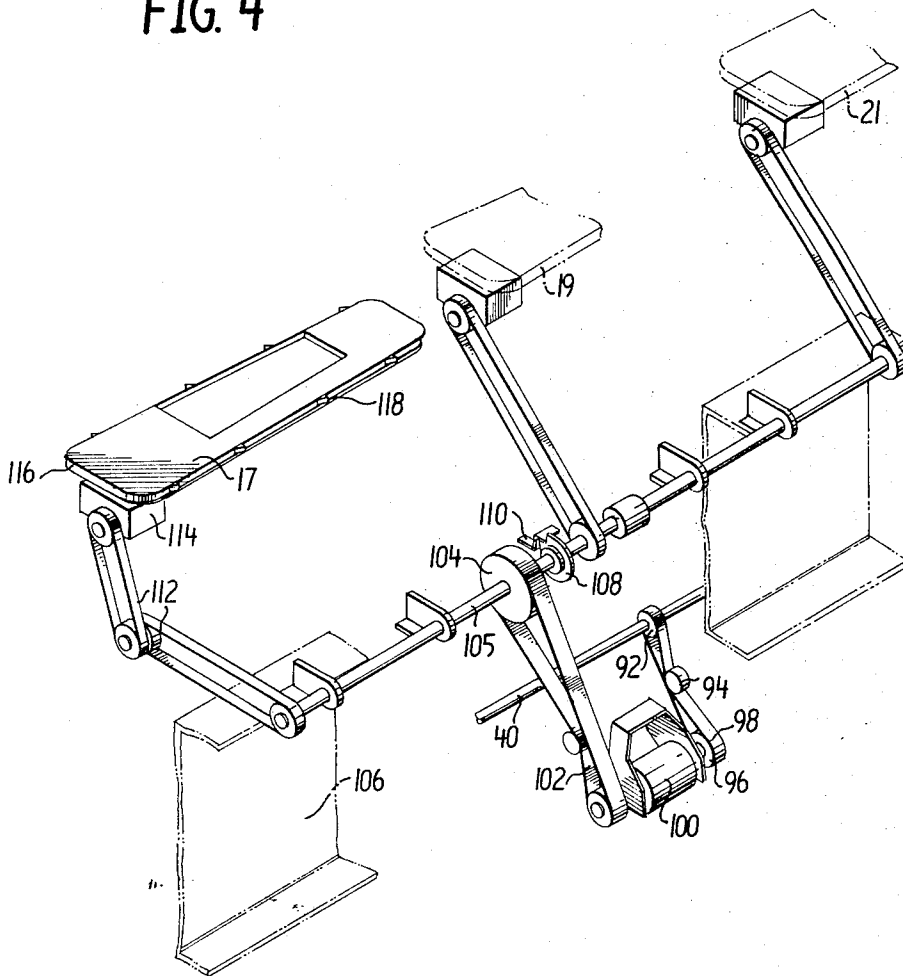


FIG. 4



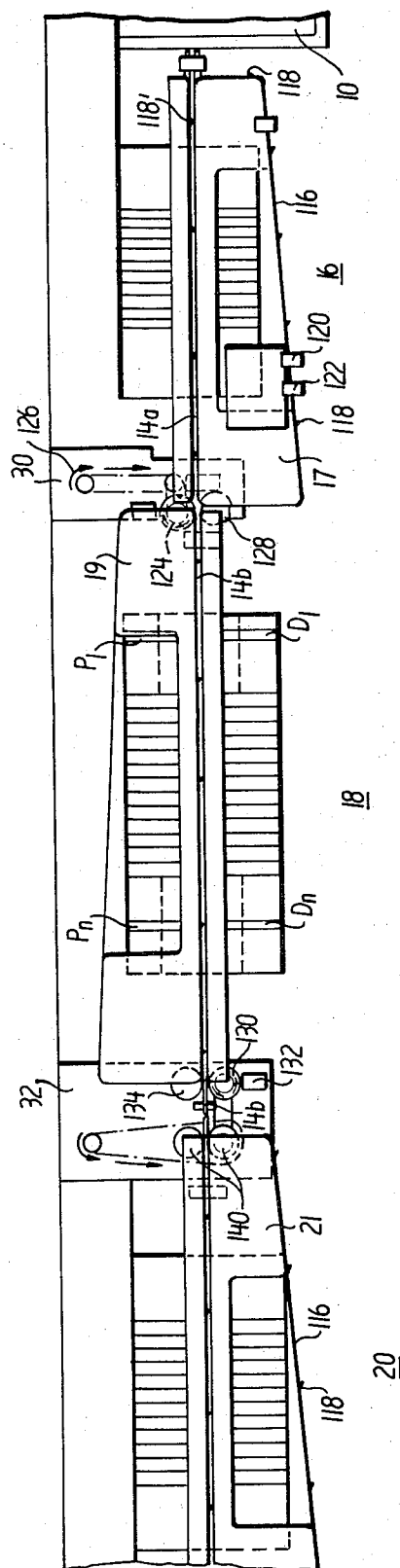


FIG. 5

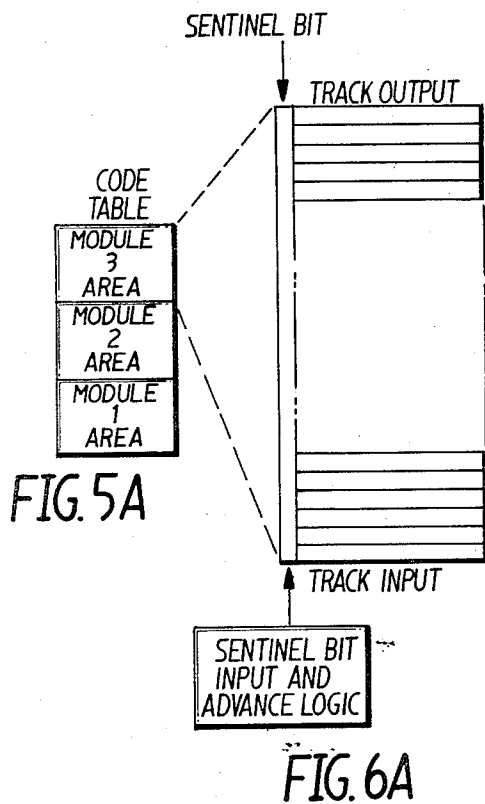
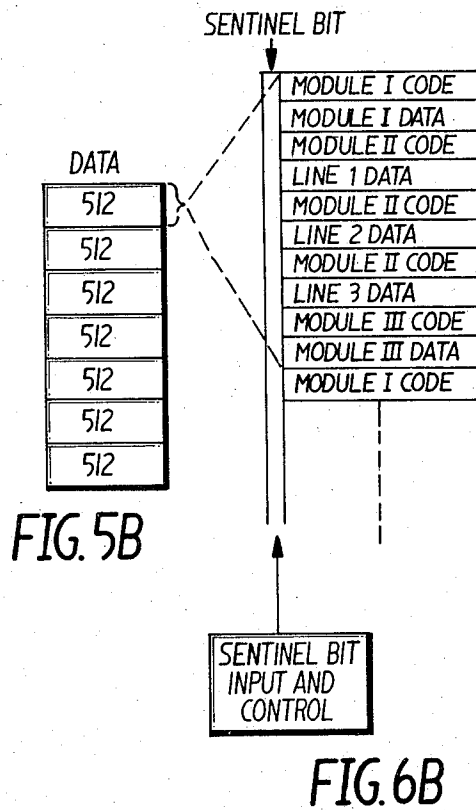
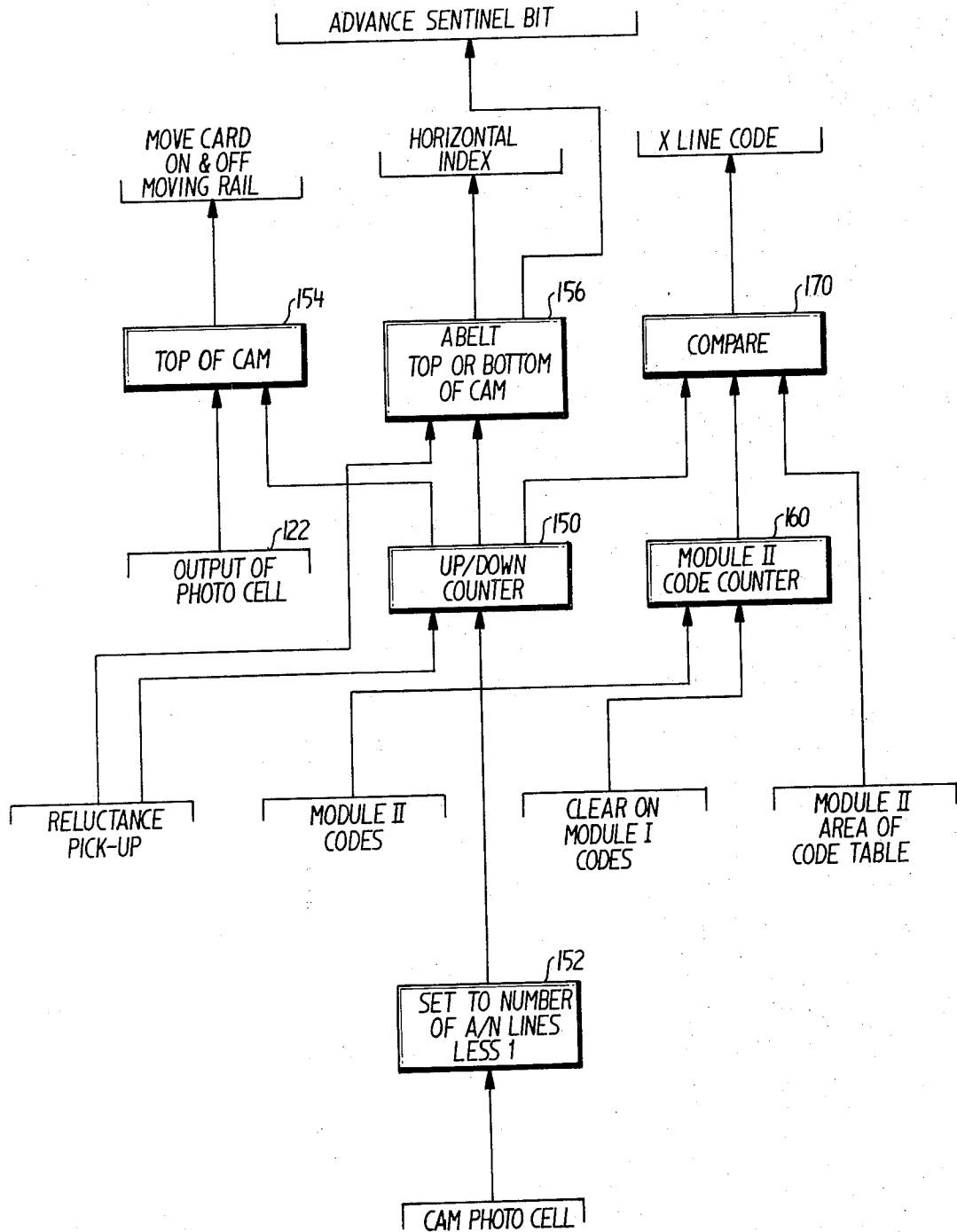
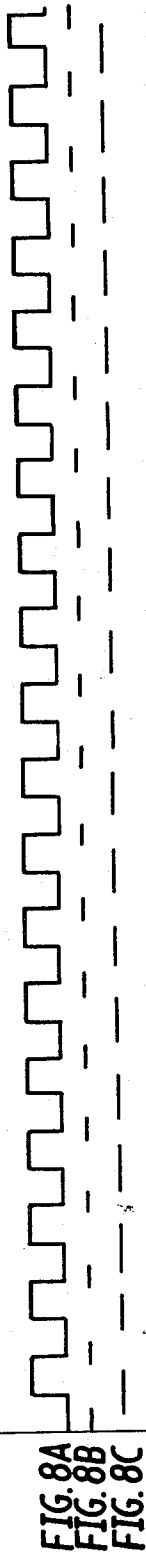
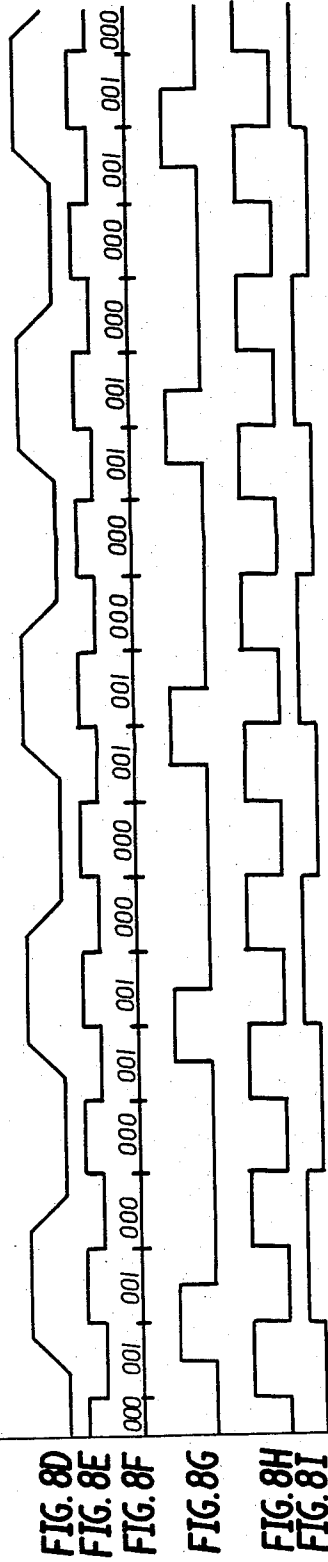
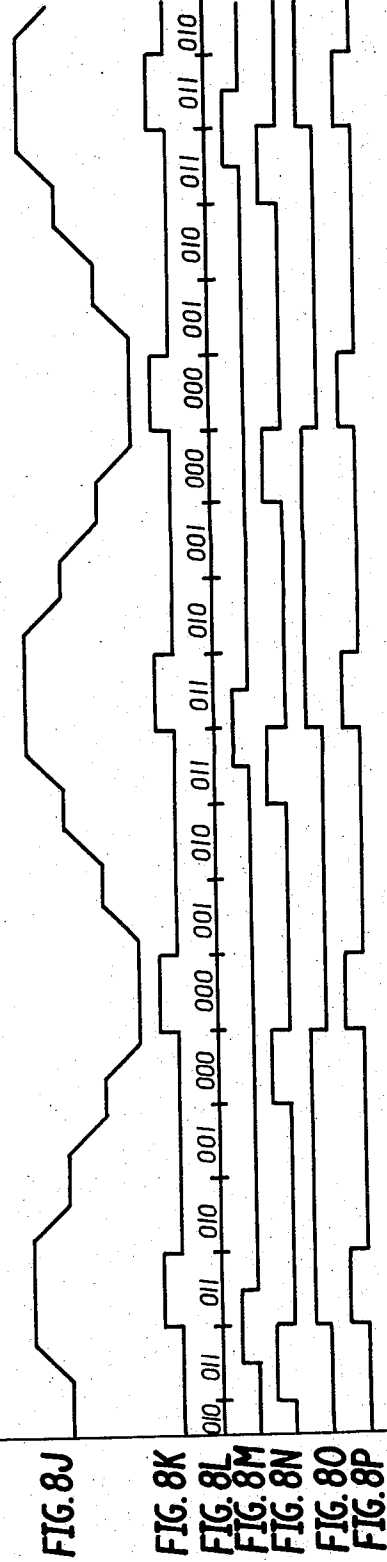


FIG. 7



60MS



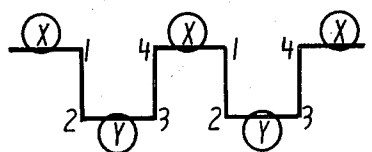


FIG. 9A

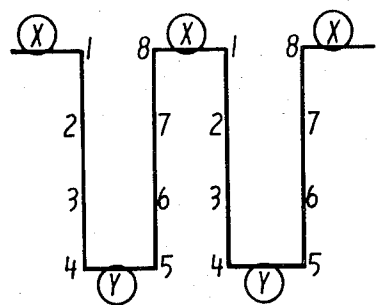
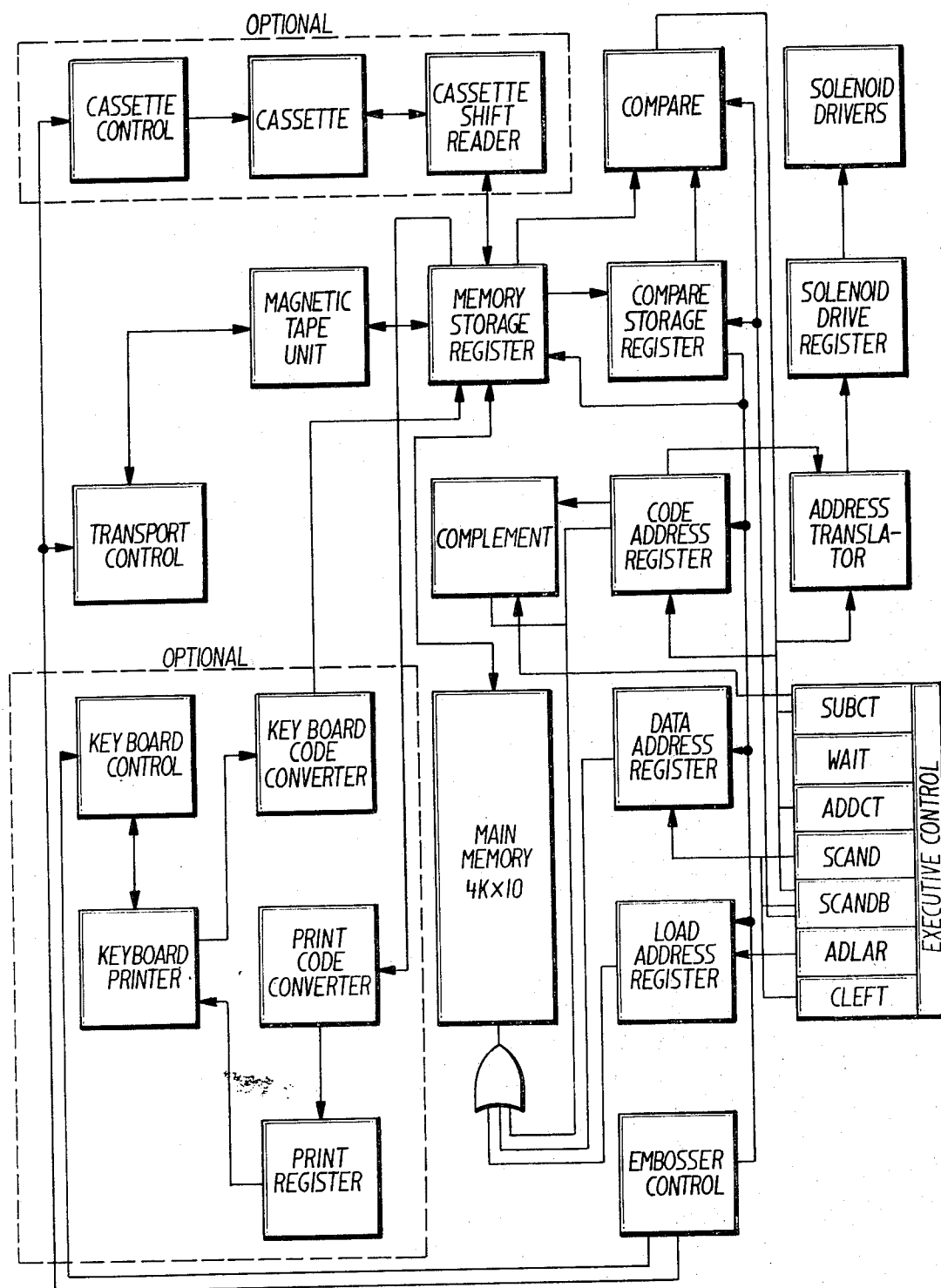


FIG. 9B

FIG. 10



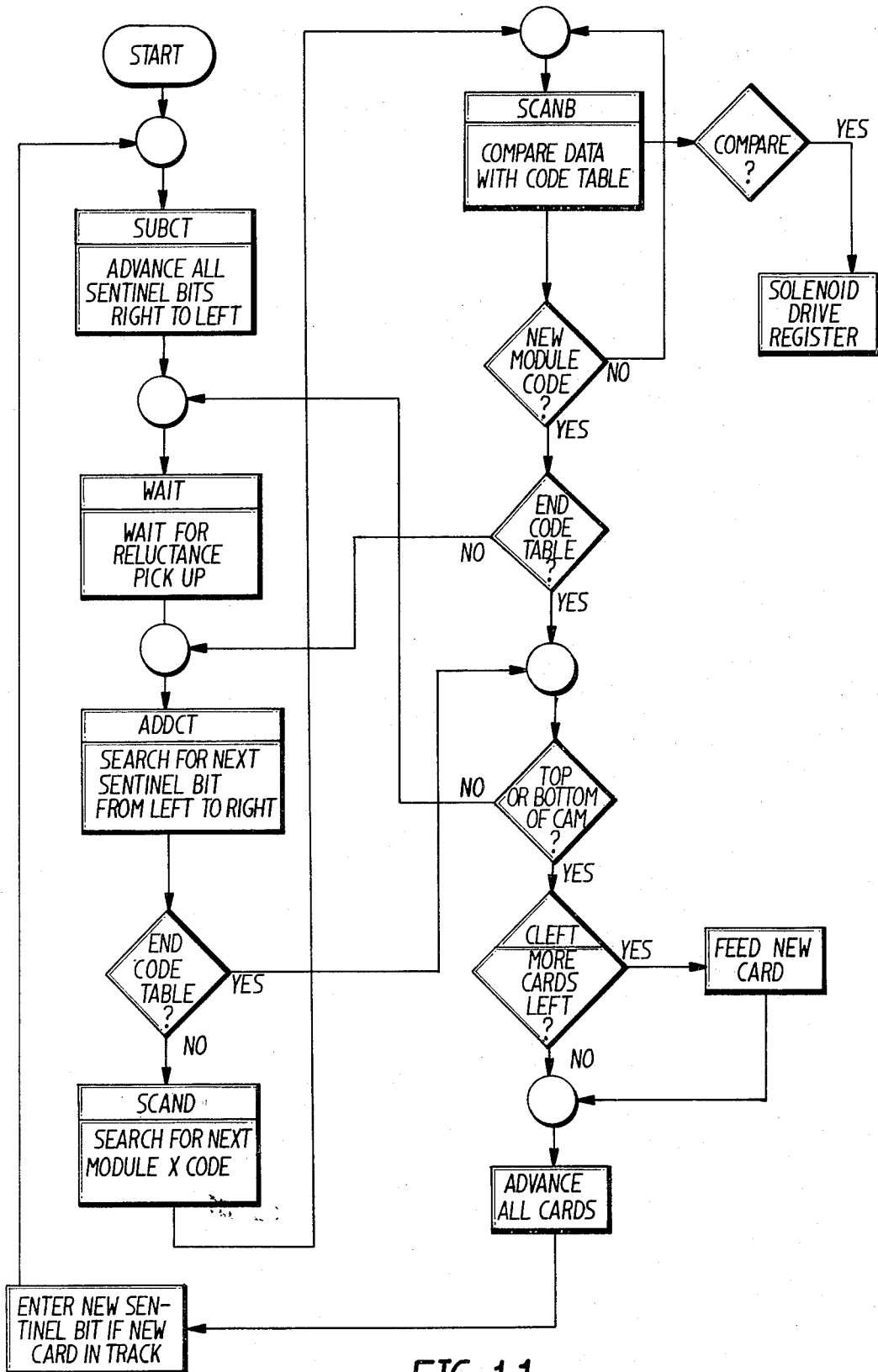


FIG. 11 750 SYSTEM FLOW DIAGRAM

EMBOSSING AND ENCODING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application discloses in part an embossing mechanism which is also disclosed in the co-pending application of the assignee, Ser. No. 57,906, filed July 24, 1970, now U.S. Pat. No. 3,638,563 entitled High Speed Automatic Card Embosser. This application incorporates the disclosure of that application for the explanation of certain features of the present embosser.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an automatic embossing system and, more particularly, to such a system which may provide for embossing multiple lines of characters on a medium such as a common credit card, for encoding information on a magnetic stripe provided on the card, and for automatically affording the embossing, encoding and other related functions under control of a computer control system responding to data input thereto from an external source.

2. Description of the Prior Art

The system disclosed and claimed in the above mentioned patent application, Ser. No. 57,960 and assigned to a common assignee, provides for automated embossing and encoding of credit cards under computer control and in accordance with data as presented thereto from any of the number of different desired input sources and specifically including magnetic tape input. In that system, the card proceeds along a track past one or more, as desired, modules which variously may provide for embossing the card in the respectively corresponding, vertically displaced embossing lines on the card, or encoding a magnetic stripe on the card. In that system, when plural lines of embossing are to be provided, a corresponding module for each such line is employed. Each embossing module includes a fixed row or font of embossing elements and thus for plural lines of embossing positions, a corresponding number of modules are employed with their respective rows of embossing elements suitably vertically displaced for alignment with the corresponding embossing lines of the card.

A typical credit card may have a card format including a single line of OCR font suitable for optical character recognition and one or more lines of alphanumeric (A/N) characters, such as for the name and address of the card holder. The aforescribed system therefore requires a separate embossing module for each separate line of the embossing to be provided on the card.

In accordance with the present invention, two or more lines of embossing of a given A/N font style of characters may be afforded by a single embossing module having a fixed row of embossing elements of the desired font style. The present system therefore permits reducing the number of embossing modules required and thus affords a more compact and lower cost system affording the same amount of data embossing on each card to be processed.

SUMMARY OF THE INVENTION

In accordance with the invention, two or more lines of embossed characters of a single font style may be

provided on a credit card or other medium to be embossed by a single embossing module having a fixed row of embossing elements. The fixed row of embossing elements furthermore need include only a single punch and die pair for each character to be embossed. Plural lines and, in fact, from one up to as many lines as are desired, typically five or six lines maximum, are embossed on the card by subjecting the card to a square wave movement as it is transported past the row of embossing elements. The movement is characterized as that of a square wave in that the card is indexed or transported in increments, in a horizontal direction and, in each horizontal index or embossing position, it is furthermore vertically displaced to present each embossing line of the card to the fixed row of embossing elements. Initially, the card is in the extreme upper vertical position and then incremented downwardly such that all horizontal embossing lines of the card are presented to the fixed row of embossing elements. At the lower extreme position, the card is indexed function to the next horizontal embossing position and then displaced vertically through the number of horizontal embossing lines back to the upper extreme position. The alternating sequence of horizontal and vertical displacement or indexing of the card thus defines a square wave direction of travel of the card past the fixed row embossing elements of the embossing module.

Control means provide for synchronization of the horizontal and vertical indexing of the card in accordance with the time requirements of the mechanical embossing operations and, as well, provides for deriving from an internal operating memory of the system the data necessary for activating the embossing elements when the card is presented at the appropriate embossing positions with respect to the fixed positions of the embossing elements. For this purpose, the operating memory includes a code table in which is stored coded information identifying the operating functions present throughout the entire length of the track through which the card travels, from an input hopper through to an output hopper, into which the completed, embossed card is fed. The code table of the memory thus provides a digital picture of the track. A data portion of the memory then receives and stores in a suitable, encoded form, the data supplied thereto from an input device to the system. Said data identifies the characters to be embossed on the card, as well as data to be encoded on the card where an encoding module is employed. Logic means provide for scanning with memory for each new index position of the card — with respect both to the vertical and the horizontal indexing directions of movement — for determining the possible operating functions as are then available by the modules of the system, e.g. the particular embossing dies between which the card is presently presented. The data required to be embossed (or encoded, etc.) on the card for the particular position of the card at that time is also derived from memory. More specifically, the position of the card is intended to mean its position within a specific module and, as to the multiple line A/N embossing module, the particular vertical position and thus the embossed line position of the card then presented to the A/N embossing elements. Furthermore, the system provides for transport of plural successive cards simultaneously through the system whereby numerous embossing, encoding and other operations may be performed simultaneously on two or more cards within a

given module and, as well, on several cards as variously presented to a plurality of modules of the systems.

Control means as well provide for various interfacing and operating functions as between exterior or peripheral apparatus and the operating memory of the system. For example, a keyboard or other input device may be utilized for entering data into the internal operating memory. If desired, data as entered into the operating memory may be read out for preparing a print out as well as for embossing and encoding of cards being transported through the system.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 is shown a perspective view of the system of the invention, incorporated in a suitable housing with portions of the housing removed to reveal certain primary operating components mounted in the interior thereof. Units 10 and 12 comprise input and output hoppers for the blank cards to be embossed, and for receiving the completed cards, respectively, the cards being transported from the input hopper 10 under suitable feed control means through a track 14 to the output hopper 12. Modules 16, 18 and 20 may comprise modules operative to afford either single or plural lines of embossing on a card and another, typically the last module 20, may be a magnetic encoder. A topping unit 22 may be provided at the end of the track, from which the cards are deposited into output hopper 12.

The track 14 is segmented into portions corresponding to each of the modules. Respectively associated with each module are indexing transport mechanisms 17, 19 and 21. These mechanisms are arranged for synchronized operation with respect to each other and with respect to the general system operation, to assure that the cards are advanced at the proper rate through the modules and at a proper position. This position must be known at all times for all cards, for the data retrieval from memory, as later described. Several cards typically are transported through a given module at one time, and thus a large number of cards are transported simultaneously through the plurality of modules along the track 14, at any given time.

Component 24 represents a magnetic tape input containing data to be embossed and/or encoded on the cards and from which the data is requested at periodic intervals for temporary storage in the internal operating memory of the system. Unit 26 represents a general control panel to establish the mode of operation of the system. Finally, a typewriter 28 may be utilized as a keyboard input or, in another mode of operation, as a printer output.

FIG. 2 is a plan view of the system, illustrating more clearly the card transport path from the input hopper 10 to the output hopper 12, along the segmented track 14. (C/L illustrates that path of travel). Suitable picker means (not shown) initially introduce each card from the input hopper into the first module under timing controls afforded by the control system to be described.

As described in more detail hereinafter, in any module providing plural lines of embossing while utilizing only a single row of embossing characters, the cards being transported through the module are caused to undergo a square-wave movement pattern. For example, the module 18 may provide multiple line embossing. Accordingly, the track 14b is displaced transversely of the path of travel in incremental steps, for

each horizontal index position of the card — i.e., at each horizontal index position, the card is displaced in vertical index steps to one extreme transverse position and then advanced by one horizontal index step and then again displaced by the same number of vertical index steps, but in the reverse direction. Thus, the card is indexed vertically in a reciprocating manner as well as being indexed horizontally. Track 14b thus moves out of vertical alignment with the tracks 14a and 14c. Accordingly, mechanisms 30 and 32 are provided for assuring that proper feeding between these segmented tracks is accomplished.

Specifically, the feeder mechanism 30 receives each card from the segmented track 14a associated with module 16, for transporting each card from that track to the track section 14b. The timing of that advance is determined in a manner to be described. Similarly, pick-up mechanism 32 receives each card from track 14b for transport to track 14c.

In FIG. 3, the multiple line embossing module 18 is shown in more detail for explaining the vertical indexing operation. Main drive shaft 40 is suitably supported for being driven in constant rotation at pulley 42 by motor 44. Cam plate 45 on shaft 40 operates a reluctance switch 46 to produce an electrical pulse for each revolution thereof, and which establishes a basic control and synchronization clock for the system. Pulleys 48 and 50, joined by belt 52 rotates shaft 54 for driving of the mechanics (not shown) associated with the embossing elements. The embossing operations thereby are synchronized, as well, with the system clock rate. A suitable such embossing apparatus is disclosed and claimed in the pending application above noted.

Pulley 56, through belt 58, drives pulley 60 and, in turn, shaft 62, suitably supported to the housing by brackets 64 and 66. Pulley 68 is attached to shaft 62 and, through belt 70, drives pulley 72 and, in turn, shaft 74 to rotate cam 76. Cam 76 preferably is a conjugate cam and serves to transform the rotary motion of shaft 74 to vertical intermittent reciprocating movement of track 14b. This action is accomplished through pivot arm 78 which operates through linkage 80 to drive carriage 82 on which track 14b is mounted in intermittent, reciprocating movement along the guide shafts 84 and 86.

The belts such as 58 and 70 are conventional types of timing belts which assure precise synchronization between the driving and driven pulleys with which they are associated. As better illustrated in timing charts, subsequently described, the conjugate cam 76 defines a number of vertical index positions to which the track 14b is displaced, corresponding to the number of lines of embossing to be provided by the module 18. As likewise illustrated in the timing charts, in each horizontal index position of a card in track 14b, at which embossing is to occur, the track 14b is incrementally displaced through the entire vertical distance encompassed by the total number of embossed lines. At each extreme of the vertical displacement, the card is indexed to the next horizontal embossing position and thus a second embossing operation at the extreme vertical position is performed. The cam then acts to displace the track 14b in successive vertical indexing steps to the opposite extreme of the vertical reciprocating travel. The drive ratio of pulleys 68 and 72 is selected in accordance with the number of horizontal lines to be embossed by the module 18. Again, it will be recalled that each revo-

lution of the shaft 40 defines one embossing operation, or cycle.

Slotted disc 88 and associated photo cell 90 serve to produce an electrical output pulse for each complete revolution of the cam 76 and thus define each complete cycle of vertical reciprocation of the track 14b. As later described, the initial positioning of the disc 88 is such that the slot passes through the photo sensor 90 approximately as the track 14b is displaced to its uppermost position. It is at this time that the track 14b is aligned vertically with the associated tracks 14a and 14c.

In Fig. 4 is shown an exploded perspective view of the mechanism providing for horizontal indexing of the cards through the various modules. As will be recalled, a transport and indexing mechanism is provided for each module and one such mechanism is shown at 17, which is associated with the first module 16. Mechanisms 19 and 21 may be identical in construction and thus only the mechanism 17 is shown in detail.

In FIG. 4, the main drive shaft 40 is shown connected through pulley 92, belt idler 94 and drive pulley 96 by belt 98 for driving a selectively operable intermittent horizontal index clutch device 100. An electrical pulse is generated in a manner to be described to engage clutch 100 and thereby, through belt 102, to drive pulley 104 and its associated shaft 105. Shaft 105 is mounted to a main beam support 106 of the housing by suitable brackets there indicated.

Clutch 100, when engaged, translates the rotational movement from pulley 96 through belt 102 to pulley 104, for driving shaft 105. Shaft 105 drives a slotted disc 108, the slot of which is sensed by a photo cell sensor 110. The output of sensor 110 activates a control circuit which serves to brake the further rotation of the output shaft of clutch 100, and thus of pulley 104 and its associated shaft 105 upon completing one full revolution. The intermittent rotational movement of the shaft 105 is transmitted by belts and pulleys 112 to indexing box 114. Box 114 responds to each complete rotational input thereto intermittently to advance, or index, the transport and indexing belt 116.

Belt 116 carries equally spaced teeth 118 which engage the trailing edge of each card in the associated track and thereby intermittently advance all such cards along the length of the track. The teeth, such as 118, of each belt are spaced apart by identical amounts, although the spacing of the corresponding teeth for the belts of the transport mechanisms associated with other modules may be different, although again equal as to each such other belt.

In FIG. 5 is shown a detailed plan view of the track, modules, and the associated transport mechanisms and furthermore the feeder mechanisms 30 and picking mechanisms 32 referenced previously in FIG. 2. The segmented track in which the cards ride during transport is hidden from view but will be understood to be beneath the open space within which are seen the teeth 118 of the related indexing belts for the various modules. The modules 16, 18 and 20 are illustrated and within each there is diagrammatically shown the associated punch and die pairs for each character. For example, as to module 18, P1 and D1 are the punch and die pair for the first character embossing position of the module 18. A number of these pairs are provided, through the last such pair Pn and Dn. In a typical A/N module, 42 such punch and die pairs are provided.

Blank cards from the input hopper 10 are advanced into the first module 16 by a suitable picker, details of which are not shown since it may be conventional. The timing of the picking function is defined by photo cell 120 which senses, in succession, the teeth 118 on the belt 116. The photo cell output indicates to the system any tooth 118 which has advanced sufficiently to permit a card to be introduced into the track from the hopper 10. The next occurring tooth 118 then engages the trailing edge of that card to initiate its transport along the track 14a.

Upon reaching the end of track 14a of the module 16, the card must be advanced by the mechanism 30 to track 14b. For this purpose, photocell 122 senses the teeth 118, and, by the relative spacings employed, provides an output to the control system indicating that a card in the track has reached the end of the fixed track 14a and is ready to be advanced onto the moveable track 14b of the module 18. The specific actuation of feed mechanism 30 occurs at a time as defined both by recognition of each successive tooth 118 by photo cell 122 and as well by an electronic counting technique, to be described, which slightly anticipates the movement of the cam 76 for raising the track 14b to its extreme upper vertical position at which time it is in alignment with track 14a. At that time, a pinch roller 124 is advanced by solenoid 126 toward idler roller 128 thereby engaging the card and rapidly transporting it into the track 14b.

As before noted, the transport unit 19 of module 18 includes an indexing belt advanced in synchronization with the belt of transport 17 of module 16, and thus the associated tooth on the belt of transport 19 engages on the trailing edge of the card and forwards it through the module 18. The length of track 14b is selected with respect to the displacement of cards transported along there such that as a card is fed onto track 14b, a previously fed card has reached the end of that track and is ready to be advanced onto track 14c. Accordingly, the same timing control signal as aforescribed for the feed operation serve to activate solenoid 132 for engaging pinch roller 130 with idler 134 to advance the card rapidly to a constant rotating pinch roller transport system 140 for transport to the succeeding module 20.

In FIG. 5A is a representation of a code table comprising a part of the internal operating memory of the system of the invention. As there indicated, the code table is broken down into three areas respectively labeled Module I Area, Module II Area and Module III Area. In the related FIG. 5B is illustrated the portion of the memory containing the data identifying the characters to be embossed on the cards, data to be encoded thereon, or other such data.

In the system herein disclosed, Module I may imprint or emboss a single line of OCR type font as where Module II may emboss one, two or more lines in A/N font. Module III then may comprise a magnetic encoder for recording data on a magnetic stripe afforded on a credit card, or any other encoding device.

The code table may better be understood as containing therein a digital picture or representation of the entire track, from the input hopper to the output hopper. The card travel along that track, as will be appreciated, may be defined as a number of indexing steps and, in general, includes "space" or "blank" words therein for the positions of card travel from the input hopper to the first module, words identifying the specific embossing

element at each step of the indexed movement of the card through Module 1, and so forth.

The data to be embossed on the cards is recorded in the data portion of the memory which in FIG. 5B, is illustrated as including seven sections, or blocks, each storing 512 characters. In a conventional manner, a request is made at each cross-over point between successive blocks for loading data therein directly from an input device such as a magnetic tape. Likewise in conventional fashion, it will be understood that the maximum length of each block from tape is 512 characters although the data block may contain fewer characters. Each block of data on tape may represent the characters to be embossed on one or more credit cards. The loading and readout of data proceeds in a cyclical fashion with the data of a given card being cleared from memory when the card associated with that data has been properly processed by the system, i.e. embossed, encoded and the like, and is deposited in the output hopper. When a 512 area of memory relating to all such completed cards is cleared, an appropriate request is made to the input tape system to load in another block (or blocks) of data. Such loading functions from exterior memory are well known to those skilled in the art and thus further description is not deemed necessary.

It is noted, however, that the source of input data may be other than tape and that the memory may be utilized for purposes other than supply of data to the embossing system, in a manner to be described.

In FIGS. 6A and 6B are shown enlarged, more detailed representations of the code table and data portions of the memory. Considering first FIG. 6A, the code table includes a number of positions corresponding to each index position throughout the track. Each position in the code table comprises a coded word identifying a function or condition existing at the corresponding indexing position along the track. Thus, the coded word may comprise merely a blank as where the card is simply being transported through a section such as from the input hopper through the first module. Each embossing position for each module, or each encoding position or the like, is represented in the code table by a coded word identifying that function. As a specific example, a given punch and die pair for embossing a specific character is identified at its indexing position in the code table by a coded word. In a manner to be described, a so-called sentinel bit is advanced through the code table by sentinel bit input and advance logic, to identify the position of each card along the track of the system.

In FIG. 6B is shown in enlarged form a representation of the data stored in the data portion of the memory. Herein, the data for each module of the system is identified by a corresponding code stored in the data memory and, for a multiple line embossing module shown as Module II, a Module II code is provided identifying each successive line of data stored in memory, and to be embossed by that module on a given card in corresponding, predetermined embossing line positions on the card. Conveniently, the Module II code may be a carriage return coded word or any other suitable word. A sentinel bit input and control is also associated with the data portion of the memory for controlling the portion of that data section which is permitted to be read out and supplied to the embossing modules of the system at any given time. More generally the sentinel bit

control of the data memory provides for efficient and convenient control of input and output of data to and from the memory.

FIG. 7 comprises a block diagram of certain logic components and functions utilized in the system of the invention, FIG. 8 comprises a timing chart of mechanical operations and electrical signals and conditions developed in the operation of the system and which charts serve as well to illustrate the synchronization of the mechanical and electrical portions of the system. Reference is made concurrently to these figures in the following discussion.

FIG. 8A represents the basic clock generated by the reluctance cam previously described. In FIG. 7, up-down counter 150 receives the output of the photo cell associated with the slotted disc driven on a common shaft with the cam, the photo cell output presetting the counter 150 to its highest count. The counter 150 receives the cam photo cell output (FIG. 86) through a control 152 which sets the count capacity of counter 150 maximum the number of lines to be embossed by the multiple line module, less one. Counter 150 therefore counts in successive steps down to zero and back up to the maximum count as shown in FIG. 8F, in response to the successive pulses from the reluctance cam (FIG. 8A).

Block 154 serves to determine when the cam is at its top-most position and thus when the moveable track has reached its top position. In fact, the output from block 154 is slightly in advance of, or anticipates the time at which the cam reaches its upper-most position. Block 154 receives as inputs the maximum count output of counter 150, the output of the feed photo cell 122 of FIG. 4, and the reluctance cam output (FIG. 8A). Logic block 154 more particularly responds to the trailing edge and the reluctance cam clock pulse of which occurs midway of the rise time of the cam, as seen by comparison of FIGS. 8A and 8D. At that time, logic block 154 then generates a command for advancing the card onto and off of the vertically reciprocating track 14b of Module II as previously described.

The logic block 156 labeled ABELT: top-or-bottom of cam receives both the maximum and minimum count outputs of the counter 150 and as well the reluctance cam output, or basic clock pulse, of FIG. 8A to produce as its output the horizontal index control signal; more precisely, the horizontal index output is produced in response to the leading edge of the clock pulse which first occurs after the counter has attained its maximum of its minimum count. This is the equivalent of producing that output when the cam is at its extreme top or extreme bottom positions. In FIG. 8, wave form 8H is generated internally of block 156 and the trailing edge of each pulse therein defines the leading edge of the horizontal index pulses, shown in wave form 8E. The ABELT output also produces an output labeled Advance Sentinel Bit used by the logic associated with the code table of FIG. 5A.

Logic block 160, labeled Module II Code Counter, is cleared during scanning of the data memory by reading out from there a Module I code. Counter 160 furthermore receives and counts the Module II codes read from the data memory of FIG. 6B, the count thereof being advanced only after the succeeding line of data has actually been read from memory.

The count outputs of counters 150 and 160 are compared by logic block 170 when that block is enabled by

the output labeled Module II Area of Code Table. Referring to FIGS. 6A and 5A, when the sentinel bit has advanced into the Module II area of the code table, that output is provided to the compare block 170 which is enabled thereby. When the count of counters 150 and 160 is identical, the output X line code is generated. This output indicates that the data portion of memory that is currently being addressed corresponds to the position of the cam and hence the vertical position of the card, the associated sentinel bit for that card having identified in the code table that the card is in the Module II area.

Concluding as to FIG. 8, and recognizing that 8D represents the functions of a two line cam, FIG. 8E then represents the horizontal indexing advance. FIG. 8E therefore represents the energizing intervals of the magnetic clutch for advancing the horizontal indexing and transport belts. FIG. 8I merely represents the counting control function whereby counter 150 is controlled in its direction of count.

FIGS. 8B and 8C represent the alternating intervals of indexing movements and embossing operations, respectively.

FIGS. 8J through 8D represent the corresponding functions as before described but wherein four embossing lines are provided. Thus the cam wave form of FIG. 8J defines four vertical positions.

FIGS. 9A and 9B illustrate the so called square wave transport of the cards through the plural line embossing module. Particularly, FIG. 9A relates to a two line system corresponding to the cam function of FIG. 8D, one half cycle of the cam occurring between position X at the upper extreme of the cam and Y at the lower extreme. Proceeding from X to Y, the first and second embossing operations occur at the vertically displaced positions 1 and 2 for a given horizontal index position. At time Y, the card is horizontally indexed, then providing for embossing at the vertically displaced positions 3 and 4 for the new horizontal index position. At the next occurring time X, the card is indexed horizontally again and the cycle continues. FIG. 9B illustrates the same operations as to the four position cam of FIG. 8J, now providing for four vertically displaced embossing operations at each horizontal index position.

Reference is now made to FIG. 10 which comprises a block diagram of the logic and control elements of the invention. The main memory includes both the code table and the data portion of memory as above discussed and has associated therewith code, data, and load address registers. The block labelled executive control represents the central logic and synchronization control of the system, and provides a number of separate command functions. These functions are better understood with reference to FIG. 11 which comprises a logic flow diagram of the system.

Referring concurrently to FIGS. 10 and 11, and assuming data to have been entered in the memory and a card to have been advanced, the logic scans through the code table, advancing any and all sentinel bits located therein from right to left and thus from the highest to the lowest number address by one address. The system then waits for the reluctance cam pickup, i.e., the basic clock pulse to occur, thereby synchronizing the electronics of the system with the mechanics. More specifically, the system waits for the leading edge of the next occurring clock pulse from FIG. 8A. When the leading edge of that pulse is received, the system then

initiates a search through the code table from left to right and thus from the lower to the higher addresses, for the next sentinel bit. If the scan proceeds through to the end of the code table, a decision then is made whether the cam is at the top or bottom position. If it is not, i.e. the decision is no, the system then waits for the next reluctance pickup, or clock pulse, as above described for conducting another search. If the decision is yes as to the top or bottom position of the cam, a decision is then made as to whether there are more cards left to be embossed — i.e. that data for embossing another card is present in memory — if the decision is yes, a new card is fed, and all cards currently in the track are advanced by one index position in the horizontal direction. If a new card enters the track, in addition, a new sentinel bit is inserted into the code table. If no data for a further card remains, the advancing routine for horizontal indexing nevertheless proceeds, but no further cards are fed.

If the decision is that the scan in the code table has not reached the end of that table, the system proceeds in a search through the data portion of memory for the next module X code — herein, the system searches for a Module I, II, or III code and, within Module II, the particular line. When an X code is found, the next logic step is to compare the data from the data portion of memory with the words read from the code table. This comparison continues line by line until a new module code is read from the data memory. For each comparison which is obtained, a bit corresponding to that code address is stored in a solenoid drive register. A bit is stored in the register in this manner for each comparison which is obtained. the solenoid drivers associated with the punch and die pairs corresponding to those comparisons thereupon being activated for embossing or punching the card.

When a new module code is read and the scan is not at the end of the code table, the system returns to search for the next sentinel bit which thus corresponds to processing the data for the next card, if any.

In FIG. 10, the command outputs of the executive control are identified by mnemonics corresponding to the functions as set forth in the flow diagram. In general, the executive control assures the proper sequencing of functions in accordance with the flow diagram as afordescribed.

The code and data address registers operate in a conventional manner for effecting scanning of the code and data portions of memory. The memory storage register acts as a buffer for all input and output of data from and to the main memory. Thus, each code word read from memory at a given address passes through the memory storage register to the compare register wherein it is stored. The data address register then is sequenced and each data word read from memory is received and stored by the memory storage register for comparison by, the compare circuit, with the code word stored in the compare register. If a successful comparison is attained, the address translator translates the code address from the code address register to produce a one bit output which is supplied to the solenoid driver register and stored in the particular stage thereof which corresponds to that code address. This function is performed for all positions in the code table memory such that the solenoid drive register registers one bit for each position at which an embossing operation is to oc-

cur. The solenoid drivers then may be activated as each bit is set, for embossing the cards.

The complement circuit is alternately enabled and disabled in accordance with the desired opposite directions of scan of the code table, permitting the code address register to advance in the same direction. The embosser control block represents the afordescribed electrical and mechanical control and synchronization functions, and the sentinel bit controls.

The final function to be described is the control of input and output data from and to the data memory. As before noted, logic means provide for inputting a sentinel bit to the data memory and controlling its location in that data memory. In an initializing operation, therefore, a sentinel bit is entered in the first address of the data memory. The load address register is set initially to zero and this corresponds to the location of the sentinel bit. At this point in time, since data memory is empty, a request is initiated such as to mag tape to load a block of data into memory. The load address register controls this input into the memory. When the load is complete, the load address register specifies the address in data memory and the logic control inserts a sentinel bit at the next address in memory.

In a first major mode, using mag tape input, the load address register continues through all data memory addresses under the control of ADLAR from the executive control until it encounters the first sentinel bit — which in this cycle is the sentinel bit stored in the zero line position of the data memory. At this time, under control of the load address register, printout of the data proceeds until the next sentinel bit previously entered at the end of that block of data is encountered. The load address register now advances through the data memory addresses back to the zero position at which the first sentinel bit is stored and now clears that sentinel bit. The load address register, again under control of ADLAR, advances to the next sentinel bit. The previously entered block of data now may be utilized such as for an embossing operation, and a new block of data may be entered into the memory in the portion following that sentinel bit position. The insertion of the sentinel bits in the afordescribed manner then continues.

In a different mode of operation, such as from keyboard input to emboss with mag tape output, the same procedure with regard to the sentinel bit as above described is again performed.

A second major mode is that of mag tape input directly to emboss, or keyboard input directly to emboss. In these operations, the initializing functions are again performed and a sentinel bit is entered in the first line of the data memory. A block of data then may be entered into memory and, at the end of the block, a sentinel bit is stored under control of the load register. Under control of the load address register and ADLAR, the data memory is addressed or advanced through the addresses to the initial line of memory and the sentinel bit stored at that line is cleared. The load address register is now advanced to the next sentinel bit permitting a new block of data to be entered and the previously entered block of data to be read out for embossing.

It will be appreciated that whereas the invention has been disclosed in a specific environment for embossing characters on credit cards, that the control techniques of the invention as well as the embossing functions may

be utilized in any system wherein a particular character representation is to be provided at a specific location on a data receiving medium and particularly with respect to both horizontally and vertically defined character receiving positions on that medium. Thus, the character representation may be afforded by punching or printing mechanisms, as well as embossing mechanisms. Accordingly, in the appended claims, the term "card" is to be understood to include any suitable data receiving medium or document, and the term "embossing" is to be understood to include any form of embossing, printing, punching, or other recording technique whereby specific character representation may be provided on a suitable, corresponding medium. As well, the references to horizontal and vertical, such as in regard to directions of transport and displacement of the cards, are to be understood as defining relative directions and not as specified absolute directions, alternate orientations of the mechanisms and hence the card transport and displacement being obvious modifications.

It will be apparent to those skilled in the art that numerous modifications and adaptations of system of the invention may be made and thus it is intended by the appended claims to cover all such modifications and adaptations which fall in the true spirit and scope of the invention.

What is claimed is:

1. A system for embossing documents with characters in a specified character location format along each of a predetermined number of parallel, displaced embossing line locations afforded on each such document, and in accordance with particular character data to be embossed in each such line for each such document, comprising:

a plurality of embossing elements respectively corresponding to the characters of a specified data format and aligned in adjacent, successively displaced positions in a fixed row,

means for receiving and transporting, in succession, a plurality of documents to be embossed, said receiving means defining a document transport path extending parallel to the row alignment of said embossing elements and being located to dispose documents advanced along the transport path adjacent said embossing elements for embossing thereby,

means for incrementally advancing each said document received by said receiving means along said transport path of said receiving means to successive index positions, the spacing of the successive index positions corresponding to the displacement of said successive embossing elements,

means for displacing said receiving means transversely of the row alignment of said embossing elements at each of said index positions, to align, in succession, each of said predetermined number of parallel displaced embossing line locations on each document in said transport path of said receiving means with said row of embossing elements, for each such index position, in succession,

means for identifying the embossing elements of said row thereof, at which there is disposed a document in the transport path, for each said index position of each said document in said transport path and for identifying the character data to be embossed on each said document in accordance with the line

location thereof currently aligned with said row of embossing elements,
 means for comparing the thus identified character data and embossing elements, and
 means responsive to said comparing means for actuating each such identified embossing element of said row thereof as to which a comparison is obtained, for embossing said document with said element.

2. A system as recited in claim 1 wherein said actuating means actuates each of said identified embossing elements as to which a comparison is obtained in the sequence in which the comparisons are obtained.

3. A system as recited in claim 1 wherein:
 said receiving means is of a length relative to the length of documents to be embossed, to receive in succession a plurality of documents to be simultaneously incrementally advanced along said transport path and disposed to be embossed substantially simultaneously by said embossing elements,
 said identifying means identifies as to each said document in said transport path of said receiving means, in accordance with the respective index positions of said documents, the embossing elements of said row at which each said document is disposed, and the character data to be embossed on each said document in accordance with the common line location of said plurality of documents currently aligned with said row of embossing elements,
 said comparison means compares the identified embossing elements for each of said documents in said transport path of said receiving means with the identified character data as to each of said documents, for all documents in succession, and
 said actuating means actuates each of the embossing elements as to which a comparison is obtained, for all said documents in the transport path of said receiving means.

4. A system as recited in claim 1 wherein said receiving means comprises a movable track defining said transport path, said track being fixed in position in the direction parallel to the row of embossing elements and mounted for movement transversely thereof, said track being of a length greater than the length of the row of embossing elements, and

said displacing means is connected to said track and incrementally displaces said track at each index position of a document transported along said track, to align in succession, each of said displaced embossing line locations of each said document with said row of embossing elements.

5. A system as recited in claim 1 wherein there is further provided:

a memory for storing a code table identifying the operations capable of being performed by the system at each of the successive index positions along the transport path,

a memory for storing the character data to be embossed on each document, in accordance with the line locations and the character location format for each line location to be embossed, for each of a plurality of documents, and

said identifying means includes means for identifying in the code table memory, the current index position of each document in said transport path thereby to identify the embossing elements at which each said document is currently disposed,

and for scanning the data memory to identify in accordance with the said identified index position of each such document and the line location of said documents aligned with said embossing elements, the specific characters to be embossed on the document.

6. A system as recited in claim 5 wherein said data memory has a capacity for storing the data for a plurality of cards at least as great as the number of cards capable of being received and transported by said receiving means along said transport path, and wherein said identifying means comprises:

means for inserting a sentinel bit into said code table and for successively advancing said bit in accordance with the entry of each successive document into the transport path of said receiving means, thereby to identify the index position of said document along said transport path with respect to the successive indexed addresses of said code table,

means for scanning said code table to identify the first and each successive sentinel bit entered and advancing therethrough, for each indexing advance of a first and each successive document through said receiving and transporting means, and

means responsive to the recognition of a sentinel bit in said code table for effecting a scan of said data memory in the portion thereof containing data for the document corresponding to the recognized sentinel bit, for each sentinel bit in succession.

7. A system as recited in claim 6 wherein said identifying means responds to the end of the data in memory for a given document for activating said scanning means of said code table memory to scan for a successive sentinel bit, through the end of the code table, for each indexing position of the successive cards in said transport path of said receiving means.

8. A system as recited in claim 1 wherein said plurality of embossing elements aligned in a row are provided in a single embossing module and there is furthermore provided:

a further embossing module displaced from said first embossing module and aligned with said direction of transport of said documents along said transport path of said receiving means, such that each said document is transported past said modules in succession by said incremental advancing means to successive index positions with respect to each module,

said further module including a row of plural embossing elements in adjacent, displaced positions with said row of embossing elements positioned for embossing each document in a further displaced line location on a card, and wherein said receiving means comprises:

a track associated with each such module and defining a transport path for receiving and having transported therealong a succession of documents, and

said advancing means incrementally advances said succession of documents to successive index positions simultaneously and in synchronized, incremental steps along the transport paths of each of said tracks and adjacent the row of embossing elements of the respective modules.

9. A system as recited in claim 8 wherein:
 said further module receives said successive cards in the transport path of the track thereof,

said displacing means associated with the track of said module adapted for embossing a predetermined number of line locations of said document is operative to displace said track transversely to align each line location in succession, at each index position of said document, with the row of embossing elements, and there is further provided:

synchronization means for advancing each document from the track of said further module to said transversely displaceable track when the latter is positioned in alignment with said track of said further module for receiving said document.

10. A system as recited in claim 9 wherein there is further provided an additional track disposed in the path of travel of said documents for receiving each document from said transversely displaceable track, and wherein said synchronization means provide for advancing each card which has proceeded through the length of said transversely displaceable track to said additional track when said transversely displaceable track is aligned with said additional track.

11. A system as recited in claim 8 wherein said identifying means includes

a code table memory having a succession of storage positions respectively corresponding to the index positions in the transport path for identifying each such index position and the system function which can be performed at each index position, including the identification of the module and the embossing element thereof associated with each such index position,

a data memory including in successive storage positions thereof data identifying characters to be embossed on successive ones of a plurality of documents by said embossing modules, the data including identification of the module by which associated ones of the characters are to be embossed, and identification of each line of said predetermined number of lines of characters and the characters to be embossed in each identified line by said one module,

means for entering a sentinel bit in said code table memory for each successive document received by said receiving means and successively advancing said sentinel bit to each successive storage position for each successive indexing position of each of said successive documents advanced along said transport path of said receiving means by said advancing means,

means for scanning said code table memory to identify each sentinel bit therein, in succession and thereby to identify the index position and thereby the module at which the document associated with each identified sentinel bit is presented currently,

means for scanning the data memory and responsive to the identification of each such sentinel bit by said code table scanning means for scanning that portion of the data memory containing data for the document identified by the sentinel bit and including the characters to be embossed by the corresponding module on the associated line location of the card, and

said comparing means compares the character data derived from said data memory with the embossing elements of the corresponding module as identified

from the code table memory by said code table scanning means.

12. A system as recited in claim 11 wherein said data memory furthermore includes a line identification for each line of data to be embossed on a document by said module which provides for embossing a predetermined number of embossing line locations, and wherein said means for scanning said data memory is responsive to recognition of each successive line identification for the module which provides for embossing said predetermined number of line locations, to effect a repetitive scan of the code table memory for repetitive identification of the corresponding embossing elements, for comparison with the identified character data derived for each such line in succession from said data memory.

13. A system as recited in claim 1 wherein said character data identifying means comprises:

a memory containing a plurality of successive memory address locations for storing data and a sentinel bit column having positions corresponding to each data location of the memory,

a load address register,

initializing means for initiating input of data to said memory and operative to insert a sentinel bit in the first position of said column corresponding to the initial memory address location, and to set said load address register to that initial memory address location,

loading means operable under control of said load address register to load a block of data into said memory through a number of storage positions thereof in accordance with the amount of data in the block,

control means operative to activate said load address register to insert a sentinel bit in said column at the memory address location corresponding to the end of the data block loaded into memory, said control means sequencing through the memory addresses in a continuous, circulating addressing function to recognize and cancel the sentinel bit preceding the block of data previously loaded into memory, said load address register thereupon advancing through the memory location addresses of the previously loaded block of data to the address at the end of the block as identified by the sentinel bit entered at said end of the block, said control means initiating entry of a succeeding block of data in the successive addresses of said memory from that identified by the last entered sentinel bit, for each such block of data in succession,

means for reading out data from the successive address positions of said memory, and

means for disabling said readout means upon detection of a sentinel bit preceding any block of data entered in memory.

14. A system as recited in claim 1 wherein said receiving and advancing means comprise:

a track defining said transport path for said documents extending in the said parallel direction, means mounting said track for reciprocating movement in said transverse direction,

main drive means adapted to be driven in continuous rotation and defining the rate of movement of the document to successive index positions in accordance with each cycle of rotation thereof,

a cam mounted for rotating movement and coupled to said track for displacing said track in incremental steps in the transverse direction for each completed revolution thereof, each incremental displacement of said track aligning a successive one of said line locations of a document received in said track with the row of embossing elements, means coupled to said main drive means and to said cam for rotating said cam at a rate proportionately reduced from the rate of rotation of said main drive means so as to displace said track by one said incremental step in the transverse direction for each cycle of rotation of said main drive means, said cam furthermore defining a first dwell period at each step of the transverse displacement of said track produced thereby, and a second dwell period at each extreme of the transverse movement, means driven by said main drive means and operative during the second dwell of said cam for incrementally advancing the document along said track in said parallel direction to a successive index position, at each extreme of the incremental displacement in the transverse direction.

15. A system as recited in claim 14 wherein said last named means comprise:
 means for engaging said document in said track,
 means responsive to a complete cyclic input thereto for driving said engaging means to advance said document in said parallel direction to a successive index position,
 rotatable means for producing the cyclic input to said driving means,
 selectively actuatable coupling means for coupling said rotatable means to said main drive shaft to effect a complete rotation of said rotatable means, and
 means responsive to the rotation of said cam to a position producing either extreme of the transverse displacement of said track and to the indexing rate of said main drive shaft to actuate said coupling means, to effect a complete rotation of said rotatable means.

16. An automatic card embosser for embossing selected characters at predetermined character embossing positions in each of plural, predetermined line locations on a card comprising:

- a. a module of character embossing elements aligned in a fixed row in a first direction, said elements being selectively controlled to emboss the desired characters at said predetermined positions of the predetermined line locations on the card;
- b. means to incrementally advance each of a plurality of cards, in succession, to successive index positions in the said first direction thereby to present the character embossing positions of one of said line locations on a card in succession to the character embossing elements of the row thereof; and
- c. means to displace each card in a second direction transverse to said first direction, at each index position

tion of said first direction, to present to each embossing element the corresponding character embossing positions of each of said line locations of each card whereby each of the corresponding character embossing positions of each of the plurality of lines is presented to each character embossing element at each indexed embossing position of said first direction.

17. An automatic card embosser for embossing a single line of OCR type and multiple lines of AN type on each of a plurality of cards comprising:

- a. an input hopper for holding blank cards;
- b. an OCR module of character embossing elements aligned in a row in a first direction and including means for incrementally advancing cards to successive embossing index positions in said first direction past said row of elements;
- c. an AN module of character embossing elements aligned in a row in said first direction and including means for incrementally advancing cards to successive embossing index positions in said first direction past said elements;
- d. means to actuate simultaneously selected ones of the character embossing elements of either or both modules as one or more cards are advanced into an embossing index position relative to the embossing elements of either or both of said modules;
- e. a card guide rail spanning at least said AN module and mounted for reciprocatory movement in a second direction transverse to said first direction whereby at each index position in said first direction of each card, as presented for embossing by said AN module, the multiple embossing lines of each said card on said guide rail are presented in succession to said row of character embossing elements;
- f. means for moving said reciprocatory movable card guide rail to preselected index positions in said second direction for presenting said multiple embossing lines, in succession, to said row of character embossing elements, and for maintaining said guide rail at each extreme of the vertical reciprocating movement for a time interval corresponding to advancing of a card between two successive index positions in said first direction;
- g. a fixed entrance rail and a fixed exit rail associated with said reciprocatory movable guide rail, one extreme of the reciprocation of said guide rail being at a predetermined height corresponding to the height of said fixed entrance rail and said fixed exit rail; and
- h. control means responsive to said guide rail moving means to move a card from the fixed entrance rail to the movable card rail and from the reciprocatory, movable card guide rail to the fixed exit rail when said guide rail moving means maintains said reciprocatory, movable card guide rail at the predetermined height position.

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