

[54] **TYPING SYSTEM WITH FORM
PROGRAMMED FORMAT CONTROL**[75] Inventors: **Robert Adolph Kolpek; James
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Ky.[73] Assignee: **International Business Machines
Corporation**, Armonk, N.Y.[22] Filed: **June 20, 1973**[21] Appl. No.: **371,820**[52] U.S. Cl. **340/172.5**, 197/176[51] Int. Cl. **G06k 7/08**[58] Field of Search 340/172.5; 197/133, 176,
197/127, 18, 19, 20

[56]

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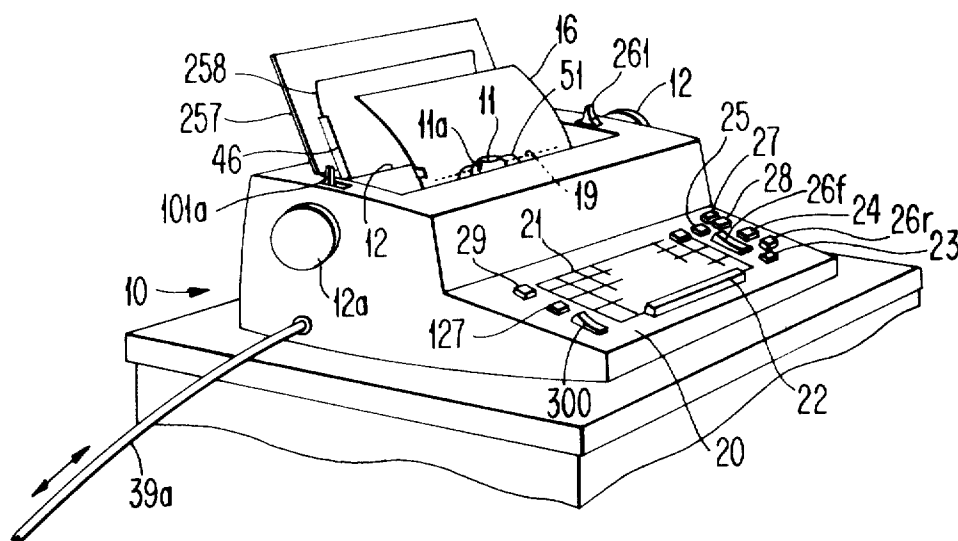
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[57]

ABSTRACT

A forms format program is read from pre-printed markings on a typing form to assist the operator in moving accurately and quickly to different typing fields. Depression of the tabulation key can select tabulation to a form selected tab stop, vertical feed and automatic line return. A field return key generates new lines within a column defined by form selected tab stops. Marks on a typing form can both initiate and terminate repeat forward or reverse indexing to provide a search for a new vertically displaced typing field. Typing status functions such as single or double line spacing are automatically selected by markings on the form.

22 Claims, 13 Drawing Figures

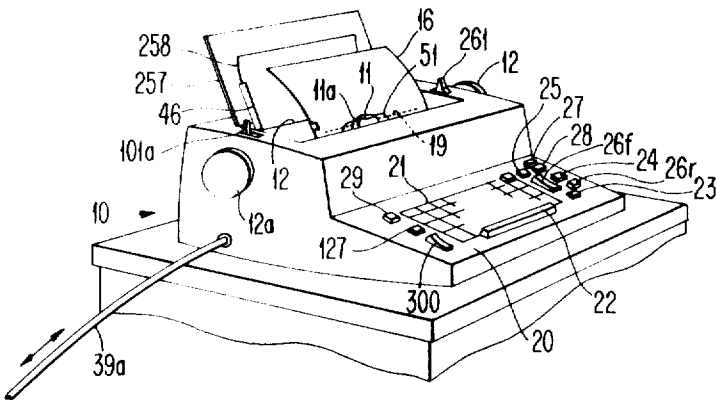


FIG. 1

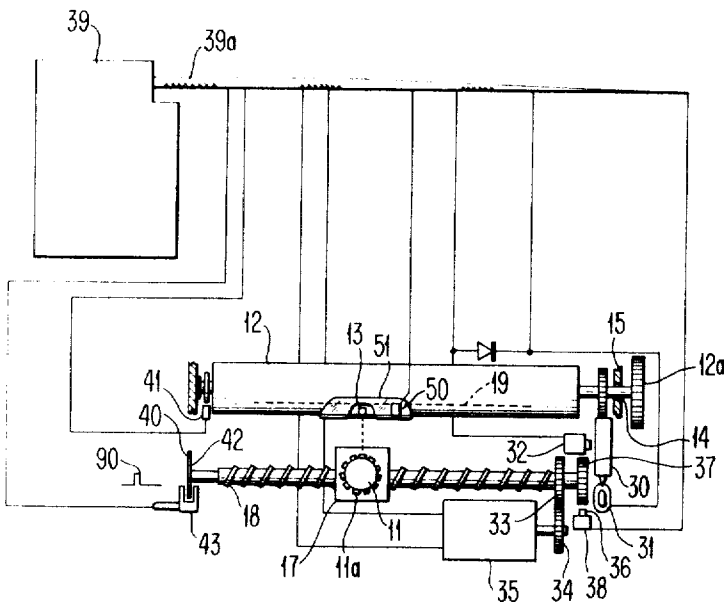


FIG. 2

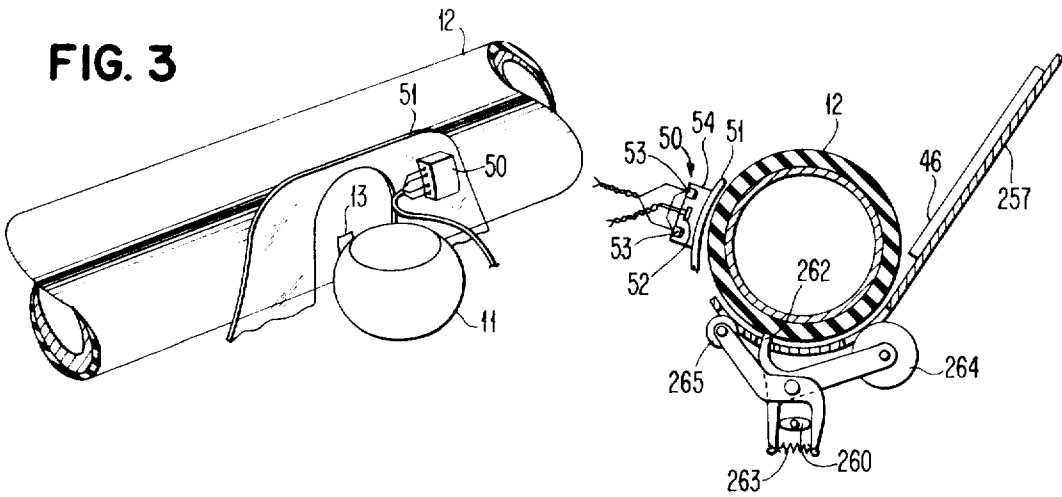


FIG. 3

FIG. 4

FIG. 5

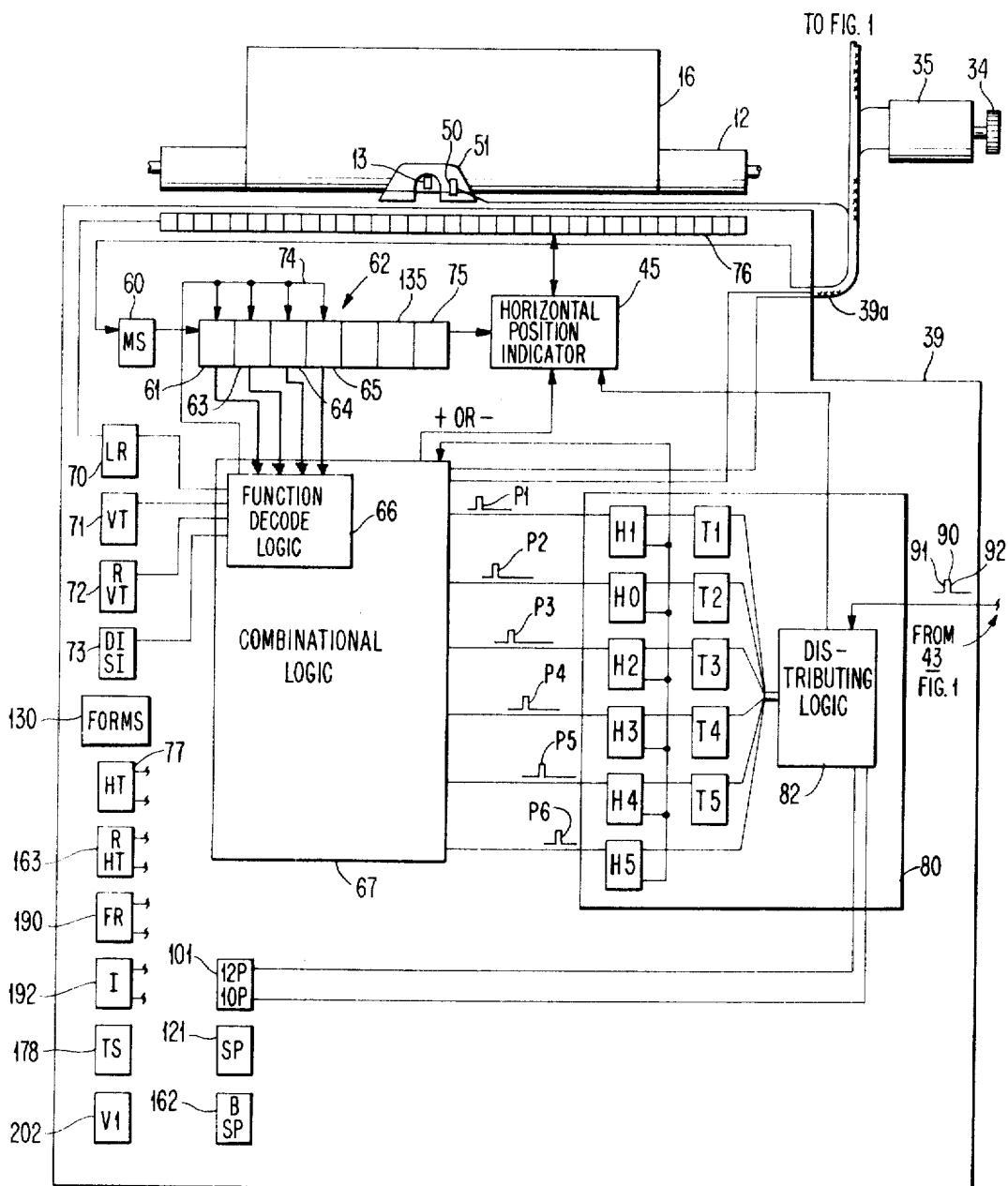
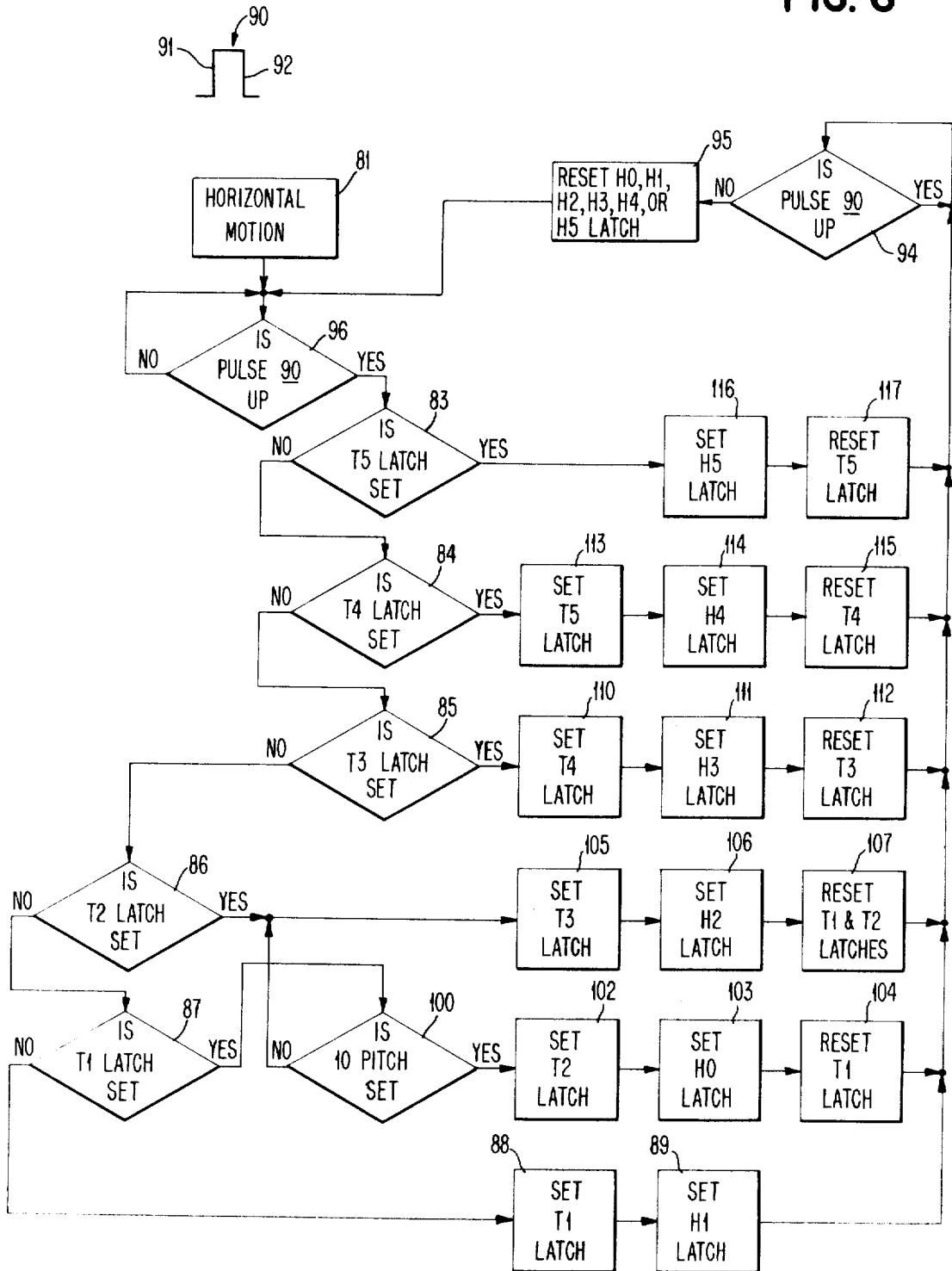
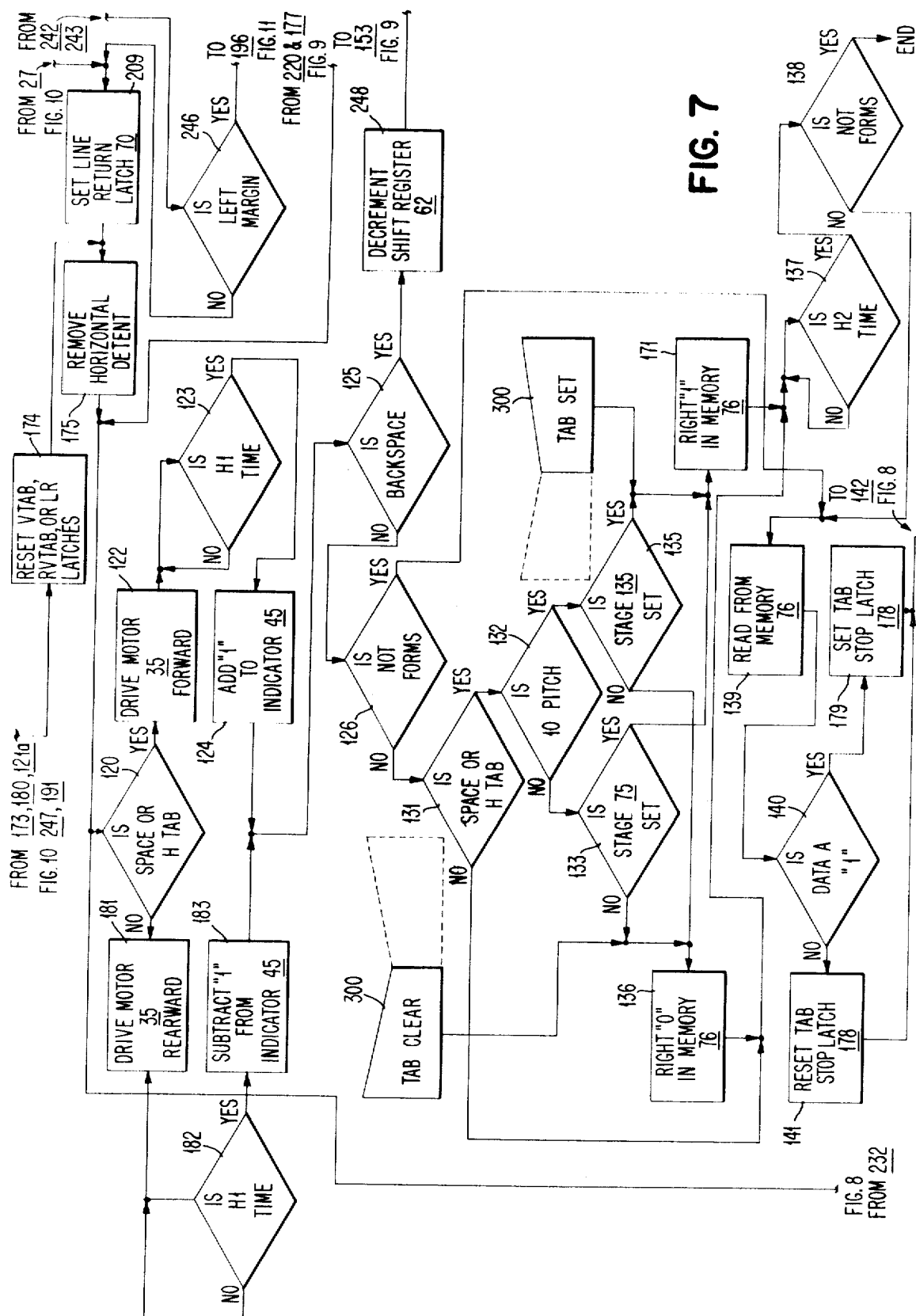


FIG. 6





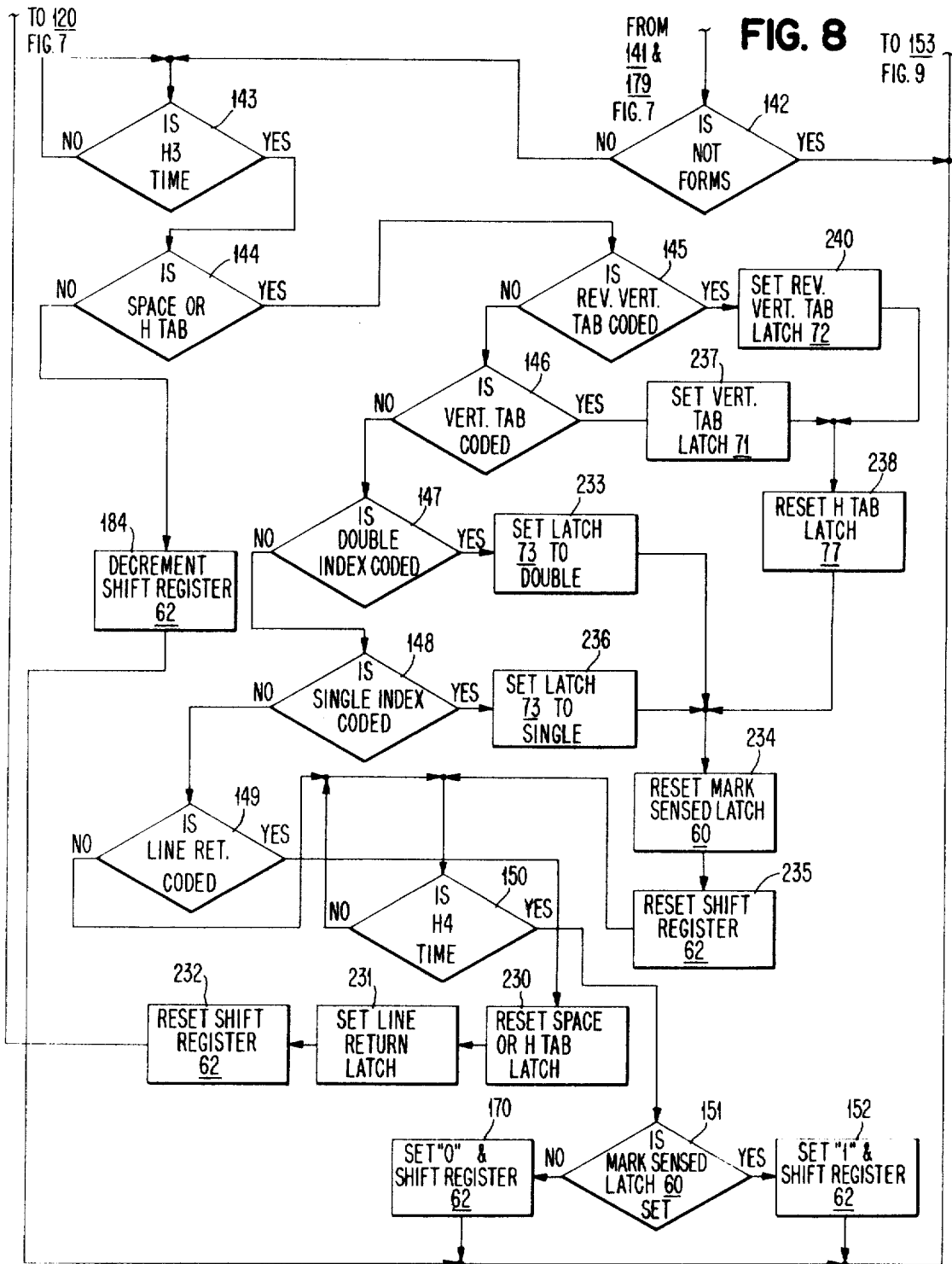
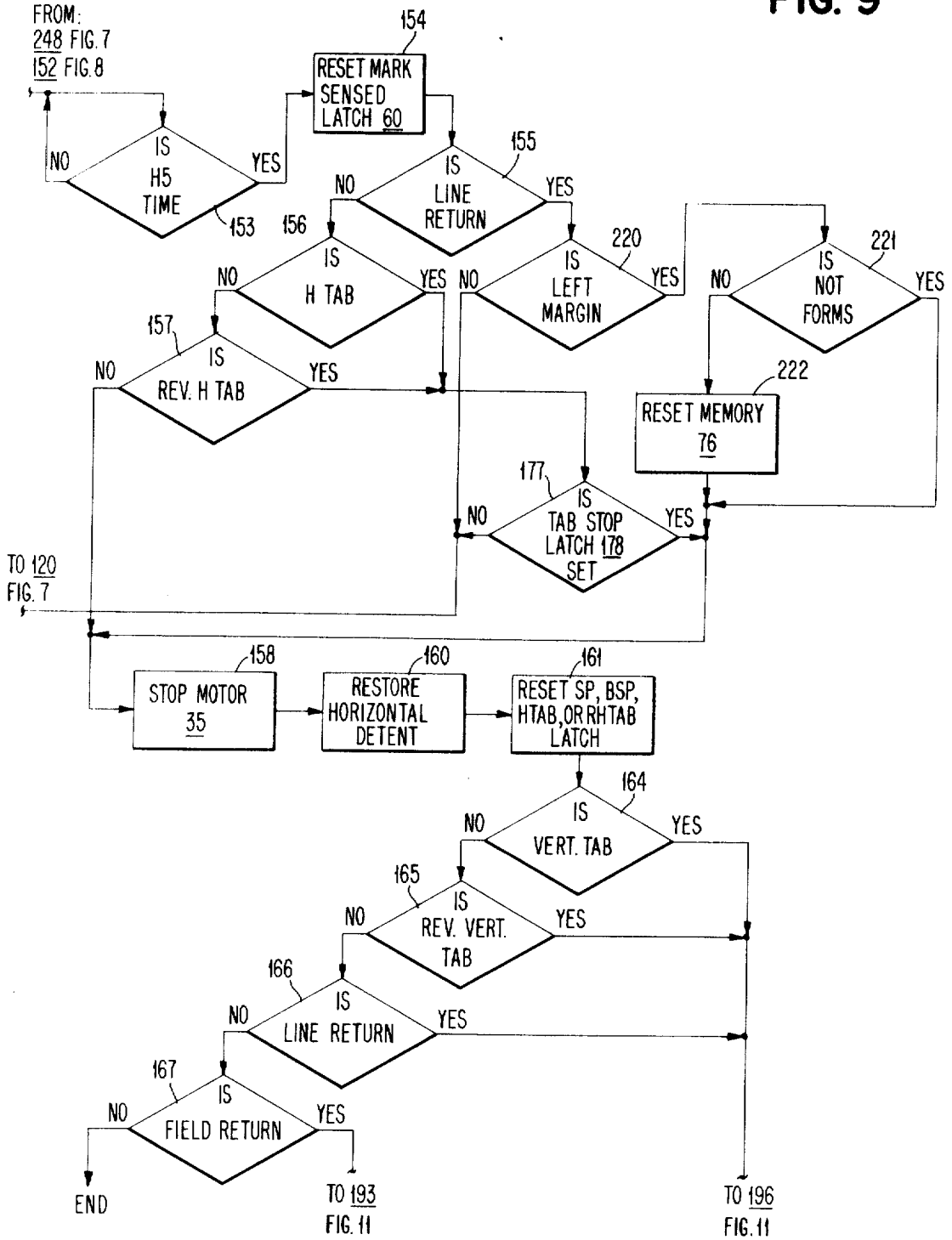


FIG. 9



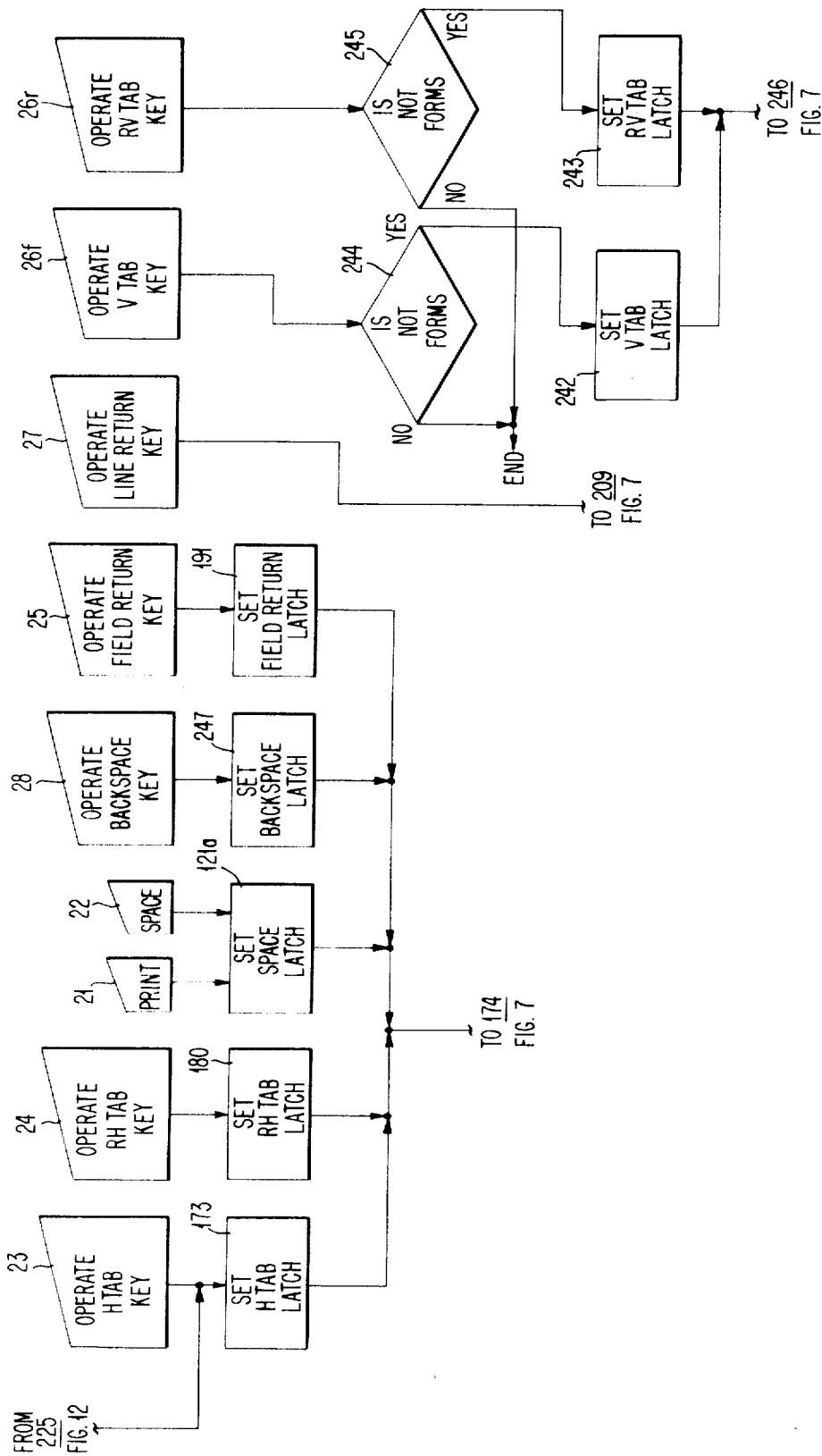


FIG. 10

FIG. 11

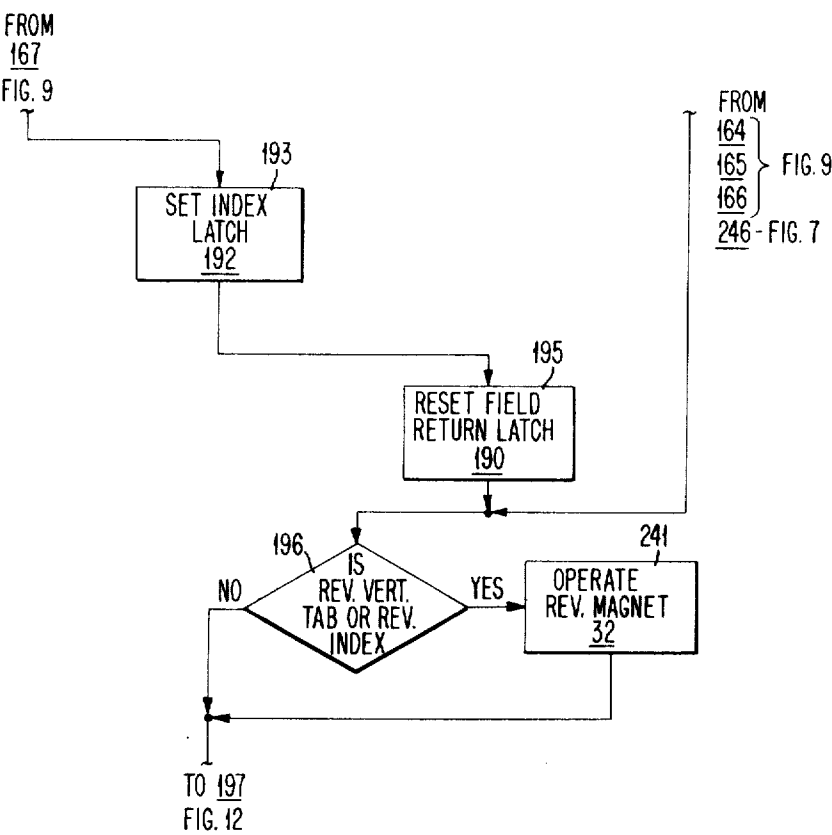
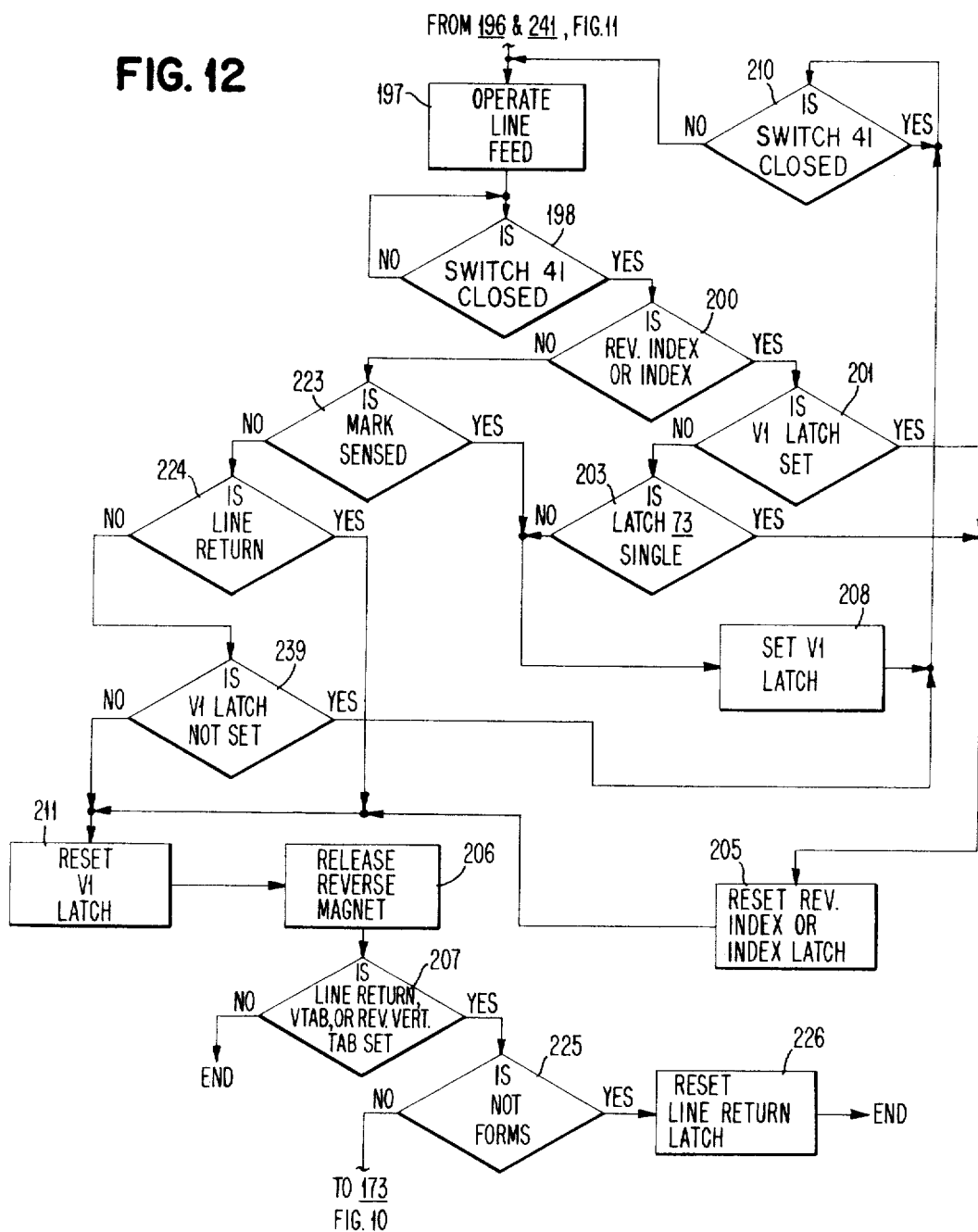


FIG. 12



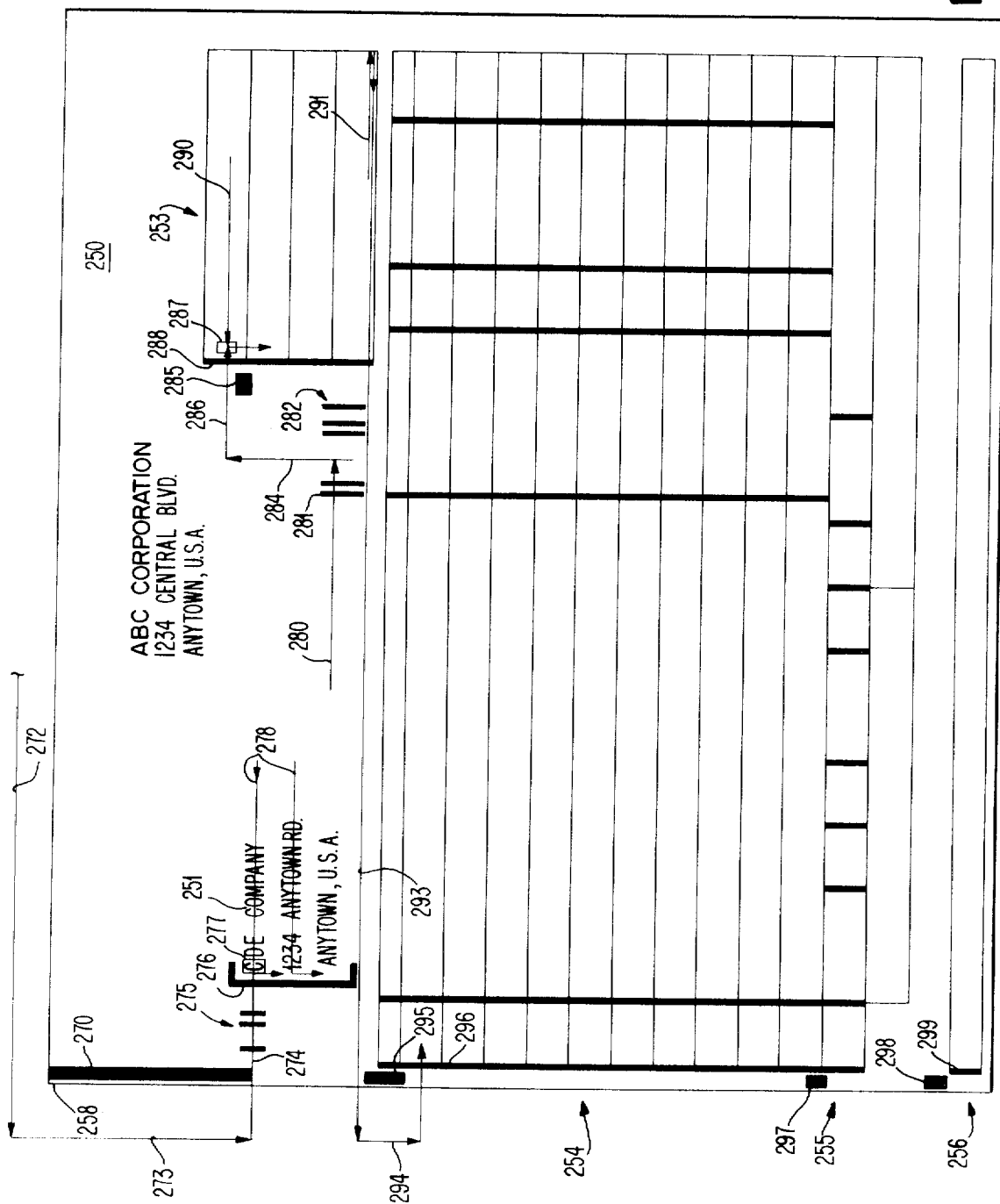


FIG. 13

TYPING SYSTEM WITH FORM PROGRAMMED FORMAT CONTROL

BACKGROUND OF THE INVENTION

Forms control employing mark sensing devices for terminating both horizontal and vertical tabulating operation at points noted by markings on a typing form have been known. It is also been known to establish predetermined format programming either by structure within a typewriter or by use of a changeable record such as paper tape. These known systems lack the combination of simplicity and versatility required for an operator to quickly and conveniently type on a variety of different forms.

DISCLOSURE OF THE INVENTION

Our invention uses lines on a form to program a format control system. Natural column lines are used to define tab stops while simple bar codes enable programming of complex positioning and typing status functions. For example, with our system a form might require movement from a typing field in the left middle of a page to a typing field at the right upper portion of the page. With our invention, a properly configured form would respond to the operator striking the tab key, by tabulating to a rightward portion of the page, reverse indexing to the first writing line, and tabulating directly to the desired start of print position. In addition, the typewriter status might be made to change if desired, from single index in one field to double index in a second field.

The results of our invention are accomplished by the provision of a black mark detector positioned to scan the writing line a predetermined number of spaces in advance of the actual printing point. A shift register temporarily electronically stores a small group of the marks last detected to enable combinations of such marks to be interpreted as the special formatting function to be preformed. Single marks are not interpreted as special functions but are understood to be tab stops for terminating a tabulating operation at a start of print position just beyond the mark itself. Thus, marks read from the page into the shift register and not otherwise interpreted as designating a special function, are passed from the shift register to a special tab stop memory. Once a "tab stop" has been recorded in the tab stop memory, it remains available to terminate both forward and reverse tabulating operations until erased by a line return operation or other specific action of the operator. Thus, the tab stop is available to create the field return function wherein depression of a field return key causes reverse movement of the print point to the first tab stop read from the tab stop memory followed by a line feed operation to advance the paper to a new writing line.

The storing and processing of information represented by the marks sensed is performed in cycles each of which is accomplished during the time that the typing element passes a character size horizontal space on the typing page. We prefer to employ a typewriter that defines horizontal spacing in terms of a basic spacing unit of 1/60 of an inch. Thus typing 10 characters to an inch requires characters that are spaced by six such incremental units, and typing 12 characters to an inch requires spacing of only five such incremental units per character. With such a spacing system, the time re-

quired for the typing element to pass an individual character space is automatically divided into at least five portions which we find convenient to employ as the timing control or clock for our processing operations.

Although the specific codes for designating specific functions are generally arbitrary, our invention employs the following preferred four bit code set:

- 1111 For automatic line return
- 0111 For vertical search
- 1011 For reverse vertical search
- 0011 For double line feed
- 1101 For single line feed

This code enables selection from several different functions as desired. Additional codes can be provided by increasing the number of permitted code bits. Additional functions that can be encoded are red-black ribbon shift, 10 pitch/12 pitch character spacing, or decimal tab per IBM Technical Disclosure Bulletin Volume 13, No. 11, published April 1971, pages 3,458 and 3,459. Our preferred code employs four successive marks to represent automatic line return since this code will automatically be sensed should a tabulation operation carry the mark sensor beyond the edge of the typing page and over the normally black platen of the typewriter.

These and other objects, features and advantages of our invention will be more apparent to those skilled in the art from reading the following description of an illustrative preferred embodiment of our invention, wherein reference is made to the appended drawings, of which:

FIG. 1 is a perspective view of a typewriter constructed in accordance with our invention.

FIG. 2 is a fragmentary plan view of those operating mechanical elements of the typewriter shown in FIG. 1 which are of primary importance to understanding of our invention.

FIG. 3 is a perspective detail view of the type element area of the typewriter shown in FIG. 1.

FIG. 4 is a side cross-sectional view of the platen area of the typewriter shown in FIG. 1.

FIG. 5 is a circuitry organization diagram of a control system for operating the mechanism of the typewriter shown in FIGS. 1 and 2.

FIG. 6 is a decision and operational sequence diagram showing the operation of clock circuitry 80 shown in FIG. 5.

FIGS. 7 and 9 are decision and operational sequence diagrams showing the operation of part of the combinational logic circuitry shown in FIG. 5 particularly as relates to horizontal movement of the typewriter printing position.

FIG. 8 is a decision and operational sequence diagram further showing the operation of a portion of the combinational logic circuitry shown in FIG. 5 and particularly showing the operation of the function decode portion of that combinational logic circuitry.

FIG. 10 is a decision and operational sequence diagram showing the operation of a further portion of the combinational logic circuitry shown in FIG. 5, particularly as relates to information entered at the keyboard of the typewriter shown in FIG. 1.

FIGS. 11 and 12 are decision and operational sequence diagrams showing the operation of combinational logic circuitry shown in FIG. 5 particularly as re-

lates to vertical movement of the typewriter printing position.

FIG. 13 is a plan of a typical exemplary typing form suitable for use in the typewriter shown in FIG. 1 in accordance with our invention.

Referring now more specifically to the drawings in FIG. 1 there is shown a serial character-by-character impact page printer or typewriter 10 that can be generally like the well known IBM SELECTRIC I/O Writer as described, for example, in IBM Customer Engineering Selectric I/O Writer Instruction Manual Form/Part No: 241-5159-1 revised Nov. 12, 1962, published by International Business Machines Corporation, Armonk, N.Y. The typewriter 10 includes well known printing mechanism comprising a type element 11 having character shaped type 11a thereon. The type element 11 together with a page or paper supporting impact resisting platen 12 defines a printing position 13. Platen 12 is rotatably supported by bearings 14 in the typewriter frame 15 (see FIG. 2) for vertically moving a page or form 16 that is carried thereby. The type element 11 is supported on a carrier 17 (see FIG. 2) that is positioned by a lead screw 18 that is different from the escapement mechanism of the SELECTRIC I/O Writer referred to above. Lead screw 18 controls relative lateral movement of the printing point 13 horizontally across the page 16 to define a writing line 19 that extends along the length of platen 12.

The typewriter 10 also includes a keyboard 20 having manually selectively operable printing control keys 21 and print position moving keys such as a space bar 22, tabulation key 23, a reverse tabulation key 24, a field return key 25, a vertical tab key 26f, a reverse vertical tab key 26r, a line return key 27, a backspace key 28, and an index key 29. Knobs 12a (see FIGS. 1 and 2) enable manually positioning of the page 16 vertically within the typewriter 10.

For moving the platen 12 between writing lines 19, a forward and reverse line feed or index mechanism 30 is provided which can be substantially like that disclosed in IBM Technical Disclosure Bulletin entitled "Forward and Reverse Indexing Mechanism" Volume 10, No. 12, May 1968 at page 1,904, published by International Business Machines Corp. Armonk, N.Y. The line feed mechanism 30 includes an activating magnet 31 like that employed in the SELECTRIC I/O Writer identified above. Ordinarily, pulsing of magnet 31 produces a single line feed operation. If magnet 31 is held active, the line feed mechanism 30 will simply operate repeatedly. The line feed mechanism 30 also includes a reverse feed select magnet 32 as disclosed in the aforesaid IBM Technical Disclosure Bulletin. When activated, reverse feed select magnet 32 changes the effective output direction of the line feed so that page 16 is fed to move the printing point 13 toward the top of the page 16.

The lead screw 18 is driven through gears 33 and 34 by a direct current, forward and reverse drive motor 35. The carrier 17 thus is positioned along the length of platen 12 by operation of the motor 35. To obtain precise positioning of the print point 13, a detent member 36 is normally engaged with a ratchet wheel 37 on the lead screw 18. During horizontal movement of the print point 13, electromagnet 38 is activated to withdraw the detent member 36 from ratchet wheel 37 and thereby free the lead screw 18 for movement prior to driving of lead screw 18 by motor 35. Termination of

lead screw rotation is followed by release of electromagnet 38 and re-entry of the detent member 36 to again precisely position and hold the lead screw 18.

Control of the foregoing mechanism is accomplished by sequences of elementary decisions and operations effected by circuitry 39 whose organization is shown in FIG. 5. The specific electronic components and the internal wiring necessary to make these decisions and effect these commands is well within the state of the art and can be constructed with only routine design effort given knowledge of the decisions to be made, the operations to be effected, and the sequence of these decisions and operations. Typewriter 10 is connected to circuitry 39 by multichannel conduit 39a.

In summary it is seen that the typewriter 10 provides mechanism capable of positioning the print point 13 horizontally and vertically both in the forward and reverse directions. While a type impact printer has been illustrated, those skilled in the art will recognize that a serial printer operating to produce visible hard copy by other techniques would be equally appropriate. For example, the printing mechanism could employ a controlled ink jet, a thermal matrix, or an optical character generator with equal facility.

The typewriter 10 is provided with a horizontal motion transducer 40 and a vertical motion transducer 41 (see FIG. 2). Vertical motion transducer 41 can simply be a normally open switch that is closed (e.g. by a cam carried by platen 12) during each increment of vertical feed motion. Horizontal motion transducer 40 can be similar in theory and operation to that disclosed in U.S. Pat. No. 3,579,195. The horizontal motion transducer 40 comprises a pulse emitting wheel 42 which generates a square wave pulse 90 for each 1/60th of an inch of motion of carrier 17 by photosensing mechanism 43. These pulses are grouped to indicate either 10 or 12 pitch character feed increments by clock circuit 80 (see FIG. 5). Character feed increment signals are delivered to add-subtract counting print position register or indicator 45. Indicator 45 stores an eight digit true binary code output that numerically represents the columnar position of print point 13 along the writing line 19. A predetermined output of device 45 denotes the left margin of a page 16 that is positioned against paper feed edge guide 46 (see FIG. 1).

For sensing marks on the typing page 16, we employ page scanning means including a simple optical detector 50, see FIGS. 3 and 4. Detector 50 is supported directly on the usual clear plastic card holder or paper guide 51 and is located in scanning alignment with writing line 19 at a position in advance of the printing point 13 by 1/2 inch which is the same as five 10 pitch character spaces or six 12 pitch character spaces. Detector 50 includes a photoelectric cell 52 positioned between two light emitting diodes 53 which are vertically aligned and encased in a transparent plastic block 54 (see FIG. 4). Light emitting diodes 53 emit light principally in the infrared frequency range. This light is normally reflected by the white page 16 to the photo-detector cell 52 to generate an output signal current. This current is terminated whenever the detector 50 overlies a black area or mark that is substantially co-extensive in size and shape with the light emitting diodes 53 and the photo-electric cell 52.

FIG. 5 shows the circuitry involved in the primary data flow for horizontal and vertical positioning according to our invention. A mark sensed by detector 50

is immediately stored in a "mark sensed" latch 60. At an appropriate time within a processing cycle the mark stored is placed in the first stage 61 of a seven stage shift register 62. Any information previously stored in shift register 62 is shifted one stage to the right. During each cycle the state of the shift register 62 as determined by the pattern of marks stored in the first four stages 61, 63, 64 and 65 is read by function decode logic 66 in combinational logic circuitry 67 to determine whether a special function code is present. The detection of a special function code causes setting of a function latch, namely latch 70 for line return, latch 71 for vertical tabulation, latch 72 for reverse vertical tabulation, and latch 73 for selecting between double and single index. Function decode logic 66 also serves to reset the first four stages 61, 63, 64 and 65 of shift register 62 after decoding a special function. Line 74 denotes this reset operation. A single mark in shift register 62 is not decoded as a special function and after seven successive cycles representing passage of seven 12 pitch character positions, the mark originally inserted in stage 61 of shift register 62 will pass from the final or 12 pitch output stage 75 thereof into a tab stop memory 76. Tab stop memory 76 provides storage for a single bit of information for each possible 12 pitch character position on a typing page. The horizontal position indicator 45 which separately encodes each horizontal position as a binary number is employed to define the read-write address for memory 76. It will be recognized that since there are more stages in shift register 62 than there are character spaces between the detector 50 and the printing point 13, that a tab stop will be recorded in memory 76 at a location associated with a position on the page 16 just beyond the position where a mark was originally sensed. This arrangement allows the start of print position following a tab operation to be separated from the marked portion of the page 16. Once a tab stop signal has been recorded in a location of memory 76, it is available to reset a tabulation latch 77 to terminate operation of horizontal motor 35 if a tabulation operation is in process. When a line return function is selected either by the operator's depression of line return key 27 or by automatic line return selected by function decode logic 66, memory 76 is reset to erase or eliminate any tab stops recorded therein thus preparing the system for different formatting in a new line.

The foregoing structural information is considered to be sufficient to enable one skilled in the art to make and use our invention. To further illustrate the preferred embodiment of our invention reference is made to the decisional sequence charts shown in FIGS. 6 through 12. As stated above, the processing cycle for our invention is preferably divided into portions that can be measured by the passage of a horizontal incremental space. The system is thus made to be self clocking by its horizontal movement. FIG. 5 shows circuitry 80 for successively generating one of six timing pulses P1, P2, P3, P4, P5, P6 that clock the processing cycle. Only some of the connections are shown within the clock circuitry 80 to assist in its understanding. Those skilled in the art will best understand the specific connections and circuitry to be employed from the decisional sequence diagram of FIG. 6. Each pulse generated by sensor 43 (FIG. 2) indicates a 1/60th inch horizontal increment and initiates an operation of the clock circuit 80 at operation 81. Simultaneous decisions by

distributing logic 82 are then made at decisions 83, 84, 85, 86 and 87 to determine which, if any, of the input latches T-1, T-2, T-3, T-4, or T-5 if any is set. If none are set, then input latch T-1 will be set at operation 88. Simultaneously, counting latch H-1 will be set at operation 89.

Sensor 43 generates a square wave signal or pulse 90 (FIGS. 2 and 6) having a defined beginning 91 and a defined ending 92. Operation 81 begins with the signal beginning 91. Decision 94 waits ending 92 of the pulse 90 and thereupon passes the sequence to operation 95 to reset any of the counting latches H-0 through H-5 that may have been set. The sequence awaits a positive response at decision 96 indicating that a subsequent signal 90 has been received.

At the signal beginning 91 of the next signal 90, the initial scan of decisions 83 through 87 will find at decision 87 that latch T-1 is set. Therefore the operation will be directed to decision 100 to determine if the typing system is in 10 or 12 pitch. This status is registered in a latch 101 that has previously been selected by the operator positioned switch lever 101a. If ten pitch has been selected, the sequence is passed to operation 102 to set input latch T-2, to operation 103 to set counting latch H-0 and to operation 104 to reset input latch T-1. The sequence then proceeds to decision 94 to await the termination 92 of the signal 90. At this occurrence, operation 95 resets all counting latches H-0 through H-5. The sequence again awaits a subsequent signal 90 at decision 96. The subsequent signal 90 will result in an affirmative decision 86 indicating that latch T-2 was set to effect operation 105 setting latch T-3, operation 106 setting latch H-2, and operation 107 resetting latches T-1 and T-2. Note that if the 10 pitch setting of latch 101 had not been detected in the previous cycle, a negative decision at 100 would have immediately produced the operations 105, 106 and 107. The sequence proceeds to decision 94 and operation 95, as before, and awaits a further signal 90 at decision 96.

Upon receipt of the further signal 90 an affirmative decision will be noted at decision 85 thereby effecting operations 110, 111 and 112 to respectively set input latch T-4, set counting latch H-3, and reset input latch T-3. Upon the following receipt of a signal 90 an affirmative decision will be detected at decision 84 to effect respectively operations 113, 114 and 115 to set latch T-5, set latch H-4 and reset latch T-4. The following signal 90 results in an affirmative decision at 83 to set latch H-5 at operation 116, reset latch T-5 at operation 117, and the sequence is passed to decision 94 to await termination of the pulse 90. As the pulse terminates, operation 95 again resets any of the H-0 through H-5 latches that had been set. This completes traversal of one ten pitch character signal. If the printing point 13 is moving continuously as in a tabulation operation, a further pulse 90 will be immediately received which will behave as the first described pulse above wherein an affirmative decision is reached at decision 87 to again effect operations 88 and 89. Thus, it will be seen that the counting latches H-1, H-0, H-2, H-3, H-4 and H-5 will reproduce pulses P1 through P6 in the shape of input pulse 90 at different successive times during the passage of the printing point 13 through the space of a single character. These timing signals are employed in the control system to properly sequence the decisions and operations required for our format control. The detailed inter-connections and operation of

the data flow circuitry shown in FIG. 5 can now be understood by reference to sequence diagram of FIG. 7. If, during any forward spacing operation of the print point 13, a mark is detected by detector 50, during the times denoted, H-1, H-0, H-2, H-3, H-4 but not H-5, mark sensed latch 60 will be set to take note of the detection.

Any horizontal movement of carrier 17 begins at decision 120 (FIG. 7) which determines the direction in which motor 35 is to be driven. If a forward space operation is selected by depression of a keyboard character key 21 of space key 22, (See FIGS. 1, 5 and 10) a spacing latch 121 would be set and decision 120 selects forward drive of motor 35 at operation 122. The printing operation, if selected, will occur prior to initiation of drive of motor 35. The resultant motion of lead screw 18 will cause H-1 time to be generated by clock circuitry 80. This time is recognized at decision 123 which directs the sequence to operation 124 which increments position indicating register 45 by one. Decision 125 determines that the operation is not a backspace and decision 126 determines by a negative response that the machine is in the "forms format" mode. Since automatic forms formatting had been selected by depression of key 127 (FIG. 1) for purpose of this illustration, and this status is stored in a "forms select" latch 130 (FIG. 5), decision 126 will be negative.

The sequence thus will be passed to decision 131 to determine whether either a space or horizontal tab operation has been selected. Since "space" latch 121 is set, the affirmative response to decision 131 passes the sequence to decision 132 where the "10 pitch" status latch 101 produces a negative response. The negative answer passes the sequence to decision 133 which reads the status of the seventh or 12 pitch output stage 75 of shift register 62 to determine whether a mark has previously been recorded therein. It will be recalled that a mark in stage 75 was originally sensed seven character positions earlier. Had the 10 pitch latch 101 been set, decision 132 would have directed the sequence the decision 134 which determines if a "one" is recorded in the six or 10 pitch output stage 135 of shift register 62. In the present example it will be assumed that no mark is sensed in 12 pitch output stage 75 and the sequence proceeds to operation 136 where "0" is written into memory 76 at the address currently designed by the horizontal position indicator 45. The sequence proceeds to decision 137 where it awaits H-2 time to direct decision 138 to determine again whether the automatic forms format mode had not been selected. The negative answer to the "not forms" decision directs the sequence to operation 139 where memory 76 is read from the address designated by horizontal position indicator 45 which happens to be the same address as that into which the "0" was written in operation 136.

The data read is evaluated at decision 140 and, being a "0," would result in operation 141 resetting tab stop control latch 178 had the latch 178 been set. Moving now to FIG. 8, a negative response to "not forms" decision 142 passes the sequence to decision 143. At H-3 time decision 144 determines that the operation is a "space" and passes the sequence to decisions 145, 146, 147, 148, and 149 which are performed by function decode logic 66 to determine whether any of the typewriter function codes "reverse vertical tab," "vertical tab," double index, signal index, or carrier return are

represented by the state of the bit pattern in the first four stages 61, 63, 64 of the shift register 62. Since no code was recorded previously, the answer to each of these decisions is in the negative and the sequence proceeds to decision 150 to await the occurrence of H-4 time.

At H-4 time, decision 151 determines whether the "mark sensed" latch 60 has been set and if affirmative sets a "1" into the first stage 61 of shift register 62 in operation 152. This operation inherently shifts the pre-recorded data in shift register 62 one stage to the right. It will be recalled that at operation 136, the information previously contained in the output stage 75 of shift register 62 was written into the tab stop memory 76. The sequence proceeds to decision 153 (FIG. 9) to await H-5 time at which operation 154 resets the "marked sensed" latch 60. Also at H-5 time, decisions 155, 156 and 157 determine respectively whether the operation being performed is a "line return," a "horizontal tab," or a "reverse horizontal tab."

Since the operation is forward space, the sequence proceeds to operation 158 which terminates operation of motor 35 to operation 160 wherein the horizontal detent 36 is restored, and to operation 161 wherein operating set operating mode latches such as spacing latch 121, backspace latch 162, horizontal tab latch 77, or reverse horizontal tab latch 163 are reset. Decisions 164, 165, 166 and 167 are answered negatively since the operation being performed is not vertical tab, is not reverse vertical tab, is not line return, and is not field return. The processing thus is complete.

As a result of this processing, the print point 13 has been advanced by one character space which incidentally was measured as five 1/60ths of an inch due to the assumed selection of 12 or 10 pitch status of latch 101. Had 10 pitch been selected all six pulses P1 - P6 will be required to attain H-5 time to enable the stop motor operation 158 (FIG. 9).

Subsequent operations of the character print keys 21 and space key 22 result in similar operations with the exception that as no mark is sensed by detector 50, "mark sensed" latch 60 is not set and decision 151 directs the sequence to operation 170 to set "0" into the first stage 61 of shift register 62 at H-4 time. The seventh such operation, decision 133 will recognize the presence of a "1" in output stage 75 of shift register 62. This "1" or mark is the "1" recorded originally in stage 61 as previously described. Decision 133 now directs the sequence to operation 171 which writes a "1" as a "tab stop" into tab stop memory 76 at the address therein currently designated by the horizontal position indicator 45. Thus the mark originating on page 16 has now been recorded as a tab stop in memory 76. Since the space between the detector 50 and the printing position 13 is only six 12 pitch spaces ($\frac{1}{2}$ inch), the address of the recorded tab stop is associated with a print position on page 16 that is located one character space just beyond the original mark on the page 16 to define the start of print position.

Substantially the same events would have occurred had the mark on page 16 been sensed originally during a forward horizontal tabulation operation. Specifically, a forward tabulation operation is initiated by depression of tab key 23 which sets horizontal tab latch 77 at operation 173, resets vertical tab latch 71, reverse vertical tab latch 72, or line return latch 70 at operation 174, if any of these latches had previously been set. At

operation 175, horizontal detent 36 is removed and decision 120 directs the sequence to initiate forward motion of motor 35 at operation 122. The sequence waits at decision 123 for H-1 time to occur. At H-1 time, horizontal position indicator 45 is advanced one unit by operation 124. It is then determined at decision 125 that the operation is not backspace, at decision 126 that the "forms format" mode has been selected, at decision 131 that a horizontal tab operation is in process as denoted by the set state of tab latch 77, at decision 132 that the typewriter is in 12 pitch as recognized by the state of pitch selection latch 101, and at decision 133 the information in shift register 12 pitch output stage 75 is read to record the desired information at operation 136 or 171 into memory 76. The sequence waits at decision 137 for H-2 time and through a negative response to the "not forms" decision 138, proceeds to operation 139 to read from the addressed portion of memory 76. The operation continues as in the case of a forward space operation with the mark that was read initially into "mark sensed" latch 60 being set into the first stage 61 of shift register 62 at operation 152. At decision 156, the horizontal tab latch 77 will indicate that the operation is a horizontal tab and the sequence will proceed to decision 177 to determine if the tab stop latch 178 has been set. Since decision 140 recognized no tab stop in memory 76, operation 141 had reset the tab stop latch 178 so that decision 177 will be negative. This returns the sequence to decision 120 for a repeat operation. At this time, the print point 13 has traversed one character space during which time a mark has been read from the page 16 and recorded in the first stage 61 of the shift register 62. The type element will continue in this tabulating motion with the processing circuitry making a complete cycle as each character space is passed. During the seventh such processing cycle, decision 133 will recognize the presence of a "1" in the 12 pitch output stage 75 of the shift register 62 and thus a "1" will be recorded in the memory 76 at the address designated by the horizontal position indicator 45. This same "1" will be read at operation 139 so that decision 140 will be affirmative and tab stop latch 178 will be set at operation 179. Now at H-5 time, decision 177 will recognize that tab stop latch 178 has been set resulting in an affirmative response that directs the sequence to operation 158 thus stopping the motor 35, to operation 160 to restore horizontal detent 36, and to operation 161 to reset the horizontal tab latch 77 and thereby end the tabulating operation. The printing point 13 now will be positioned just to the right of the mark that was originally sensed by detector 50. Having thus recorded a tab stop in the memory 76, it is possible to reposition the print point 13 so that tab stop as desired. For example, if the printing point 13 has been positioned by typing or otherwise rightwardly beyond the thus set tab stop, a reverse tab operation can be performed by depression of reverse tab key 24. This operation sets reverse horizontal tab latch 163 at operation 180 and proceeds to decision 120 just as did the forward horizontal tab operation previously described. At decision 120 it will be determined that the operation is neither a "space" nor a "forward horizontal tab" and motor 35 will be thus energized at operation 181 to rotate in the reverse direction. Decision 182 passes the sequence to operation 183 to decrement the horizontal position indicator 45. The sequence passes through decisions 125 and 126 to

decision 131 where it is recognized that the operation is neither a space nor a forward horizontal tab and the sequence is directed to decision 137 to await H-2 time. At H-2 time, the memory 76 is read at operation 139 at the address indicated by the horizontal position indicator 45 to determine whether a tab stop had been stored. In the absence of a tab stop, the tab stop latch 178 is reset at operation 141. At H-3 time (FIG. 8), decision 144 recognizes that the operation is neither a forward horizontal tab nor a forward space and effects operation 184 to decrement shift register 62. The sequence then awaits H-5 time (FIG. 9) at decision 153 and then moves to decision 157 where the reverse horizontal tab operation is recognized. Since tab stop latch 178 is not set, decision 177 will return the operation to decision 120 for repeating. If during the reverse travel of the printing point 13, operation 139 reads a tab stop from the then addressed portion of memory 76. This will be recognized by decision 140 to set the tab stop latch 178 at operation 179. During the same processing cycle, decision 177 will recognize the thus set tab stop latch and direct the sequence to motion terminating operations 158, 160 and 161 previously described.

A similar operation is accomplished in response to depression of field return key 25 which sets field return latch 190 at operation 191 thereby initiating reverse motion at operation 181 in response to decision 120. A normal reverse tab operation is performed until decision 167 recognizes that a field return is in process and directs the sequence to an index sub sequence which is shown in FIGS. 11 and 12. This sequence begins with the setting of index latch 192 at operation 193. Field return latch 194 is reset at operation 195. Decision 196 determines that the index is forward by a negative response and at operation 197 directs a cycle of forward indexing through magnet 31 (FIG. 2) in the line feed mechanism 30. The resultant line feed motion closes the vertical motion transducer switch 41 to allow the sequence to pass decision 198.

Decision 200 recognizes that the index latch 192 has been set and passes the sequence to decision 201 which provides a negative response since V-1 latch 202 has not been set. Decision 203 negatively determines that the double index mode of latch 73 has not been set to provide an affirmative response that effects operation 205 to reset the index latch 192. If the reverse line feed magnet 32 had been activated it would be deactivated by operation 206. The negative response to decision 207 indicating that the operation is not line return, vertical tab or reverse vertical tab ends the operation. The printing point 13 is now positioned just rightwardly beyond the mark that originally set the tab stop into memory 76 but on a new horizontal line due to the index operation. Had the typewriter been set into a double index mode by the state of latch 73, this would have been recognized by decision 203 to direct the sequence to operation 208 which sets V-1 latch 202.

At decision 210 the sequence awaits opening of vertical motion transducer switch 41 to allow the sequence to return to operation 197 which generates a further indexing operation through electromagnet 31 and line feed mechanism 30. Decision 201, when reached, affirmatively recognizes that V-1 latch 202 is set to direct the sequence through operation 211 to reset V-1 latch 202 and to decision 207 to terminate the operation.

The tab stop memory 76 is cleared or erased whenever the operator selects a line return operation as by

depression of line return key 27. The resulting sequence commences at operation 209 by setting line return latch 70. The remaining sequence of events is substantially identical to the field return operation described above except that at decision 155, (FIG. 9) which occurs at H-5 time, the sequence is diverted to decision 220 to determine if the print position 13 is at the leftmost margin. This determination is made by comparing the horizontal position indicator 45 with a present margin address which could simply be zero. Until the print position 13 reaches the left margin, decision 220 causes repeat cycling by returning the operation to decision 120. Decision 177 which is part of the operation with either horizontal tab or reverse horizontal tab is thus by-passed. When decision 220 determines that the print position 13 is at the left margin, negative decision 221 indicating the "forms format" mode, passes the sequence to operation 222 to reset the memory 76 and thereby clear all previously set tab stops.

The remaining part of the line return sequence proceeds through decision 166 which diverts the sequence to the vertical feed sequence shown in FIG. 12. A line feed operation is performed at 197 to advance the page 16 to a new writing line. Decision 200 recognizes that the operation is neither an index nor reverse index and directs the sequence to decision 223 to determine whether the detector 50 is currently sensing a black mark on the page 16. As will be later explained, a black mark is employed to control vertical tabulation. There being no black mark in the example being described, the sequence proceeds to decision 224 where it is recognized that a line return operation is being performed. The sequence then proceeds through operation 206 to decision 207 which recognizes that a line return operation is being performed and through decision 225 which recognizes the "forms format" mode to return the sequence to a horizontal tab operation by setting horizontal tab latch 77 at operation 173 (FIG. 10). The printing point 20 thereupon is moved rightwardly as part of a horizontal tab sequence previously described until the sequence is terminated by a tab stop mark encountered during the tabulating motion. Decisions 207 and 225 thus provide an implicit instruction for the functions line return, vertical tab and reverse vertical tab to perform an automatic horizontal tabulation at their termination when the typewriter is in the "forms format" mode. This tabulation allows the printing point to be displaced beyond any control markings that might have been employed to control the vertical feeding of the forms. When not in the "forms format" mode, decision 225 terminates line return by operation 226 resetting line return latch 70.

Up to this point the sequences have been described only in regard to the sensing of a single mark from the page. The single mark is detected as a tab stop. Part of our invention involves the detection of combinations of marks or different states of bit patterns to indicate format changing functions and to automatically control the initiation of these functions. For example, four consecutive marks in adjacent print positions preferably is encoded to denote an automatic line return operation. Thus where four sequential ones have been loaded at operation 152 into the shift register 62, the subsequent cycle will result in an affirmative response to decision 149 at H-3 time. The space or forward tab operations in process are interrupted by operation 230 which re-

sets the horizontal tab latch 77 or space latch 121 is set, operation 231 which sets the line return latch 70 and operation 232 which resets all states of shift register 62 to "0". The sequence is then returned to decision 120 which indicates by its negative response that the motor 35 is to be driven in the reverse direction. A line return operation is thus performed as previously described. While there may be occasions to encode the line return code onto a form, the selection of four successive black marks for this code enables the detector 50 to automatically initiate the line return operation whenever it is passed beyond the edge of the page 16 being typed upon. In a similar manner, combinations of marks in the stages 61, 63, 64 and 65 of shift register 62 are detected by decisions 145, 146, 147 and 148 at H-3 time during each processing cycle. Thus if the code pattern "0011" is detected by decision 147, latch 73 will be set to the double index mode by operation 233, a mark sensed latch 60 will be reset at operation 234, shift register 62 will be reset to all zeros at operation 235 and the status of the typewriter will thus have been changed from single index to double index. Similarly, the code "1101" will be recognized at decision 148 to cause resetting of latch 73 to the single index mode at operation 236. Operations 234 and 235 respectively reset the mark sensed latch 60 and the shift register 62.

The code "0111" will be recognized at decision 146 as a vertical tabulation which sets a vertical tab latch 71 at operation 238. Operation 238 resets the horizontal tab latch 77 and diverts the sequence to operations 234 and 235 to reset the "mark sensed" latch 60 and the shift register 62. At H-5 time, decision 164 will recognize that vertical tab latch 71 has been set and will divert the sequence to the vertical tab sub sequence shown in FIGS. 11 and 12. The vertical tab operation is accomplished through use of the line feed mechanism 30 operating with repeated cycles. Thus, line feed mechanism 30 is operated at operation 197. Decision 200 indicates by a negative response that the operation is neither reverse index nor index, passing the sequence to decision 223. If the detector 50 is not currently detecting a black mark on the page 16, a negative response will pass the sequence to decision 224 which recognizes that an operation other than line return is being performed. The sequence proceeds to decision 239 which determines by an affirmative response that the V-1 latch 202 has not been set. This response returns the sequence to operation 197 for a further line feed operation of mechanism 30. This sequence will repeat until the detector 50 senses a black mark on the page 16 thus causing an affirmative decision 223 to result in setting V-1 latch 202 at operation 208. At least one additional line feed will occur by operation 197, however, if the mark sensed during the previous operation is no longer sensed by detector 50, decision 223 passes the sequence through decision 224 to decision 239 which now recognizes by a negative response that the V-1 latch 202 has been set. This directs the sequence through operation 206 and 211 to decision 207 which determines that a vertical tab operation, is in progress. The sequence is thus directed to a horizontal tab operation as described above which begins by setting horizontal tab latch 77 at operation 173. The vertical tab latch 71 is reset at operation 174.

Sensing of the code 1011 at decision 145 causes operation 240 to set reverse vertical tab latch 72 which initiates a reverse vertical tab operation beginning at

decision 165 and continuing in a manner similar to the vertical tab operation described above. Differences exist at decision 196 where the reverse vertical tab is recognized thus causing operation 241 to actuate reverse index magnet 32 prior to operation of index mechanism 30 at operation 197. As part of the termination of a reverse vertical tab operation, operation 206 releases reverse select magnet 32.

It will be recognized that vertical tab and reverse vertical tab operations can be selected by respective operator depression of keys 26f and 26r, if desired. These operations result from direct setting of vertical tab latch 71 at operation 242 or setting of reverse vertical tab latch 72 at operation 243 if permitted by decisions 244 and 245 that determine whether the machine is in the "forms format" control mode. The sequence proceeds initially to decision 246 to determine whether the printing point 13 is at the leftmost margin by comparing the output of horizontal position indicator 45 with a preset margin address. If the print position 13 is at the left margin, the vertical tab is carried out as previously described. If the print position 13 is not at the left margin, decision 246 directs first of all that a line return operation be performed by setting the line return latch 70 at operation 209. This allows a vertical tab control stripe to be located adjacent to the left margin of a form to thus permit the left margin locating mechanism to locate accurately the indicator 50 over the region where a control stripe or spot will be located.

Other functions that can be performed automatically can also be performed manually. For example, a tab stop set and clear key 300 can be provided for the manual setting or clearing of individual tab stops into the memory 76. Key 300 is the usual self-centering rocking key which is depressed forwardly for tab stop setting and rearwardly for tab stop clearing. Forward depression of key 300 directly initiates operation 171 to write a "1" into memory 76 at the address designated by horizontal position indicator 45. Rearward depression of key 300 directly results in writing a "0" in memory 76 at the address designated by horizontal position indicator 45. 9n 0247

The space measuring control described initially in conjunction with the normal keyboarding operation functions equally to control backspace operations upon depression of a backspace key 28 (FIGS. 1 and 10). This operator action sets backspace latch 162 (FIG. 5) at operation 247 and initiates a sequence similar to the forward space sequence except that decision 120 responds negatively to cause operation 181 to drive motor 35 in the reverse direction. At H-1 time, operation 183 decrements the horizontal position indicator 45 and decision 125 diverts the sequence to operation 248 which decrements the shift register 62 to keep it effectively aligned with the current print position. At H-5 time (FIG. 9) the operation is terminated as previously described.

FIG. 13 illustrates an example of a typical typing form 250 coded to program its own format control in accordance with our invention. In form 250 there is a mailing address field 251 that normally is single spaced to accommodate a window envelope; an identification field 253 that is normally double spaced for clarity; an order field 254 that is normally double spaced for clarity; a reference field 255 that is but a single line, and a source field 256 that also is a single line. With a typing system constructed in accordance with our inven-

tion the typist places form 250 on paper feed tray 257 (FIGS. 1 and 4) with its leftmost edge 258 abutting page guide member 46. Paper feed roll release torque bar 260 (FIG. 4) is positioned by release lever 261 (FIG. 1) to project alignment stop 262 against platen 12. When the form is aligned the operator restores release lever 261 to allow spring 263 to press rolls 264 and 265 against platen 12. This motion also retracts alignment stop 262.

The operator now may strike either the carrier return key 27 or a vertical tab key 26f to initially position the form 250. Either operation will result in first a determination at decision 246, FIG. 7, of whether the point 13 is at the left margin. Actually, when the print point 13 is at the left margin set into the typewriter 10, detector 50 will be directly over the broad stripe 270 at the left edge of form 250. Leftward movement of the print point 13 continues until terminated by an affirmative decision at 220 (FIG. 9) which automatically institutes the vertical tab sequence at decision 164. The detector 50 (FIGS. 1-5) will sense the black platen 12 and cause setting of V-1 latch 202 at operation 208 so that the form 250 will be fed vertically until the detector 50 has passed the lower edge of bar 270. Decision 223 upon this occurrence will result in a negative response to direct the sequence through decision 224 to decision 239. A negative response from decision 239 results from the fact that V-1 latch 202 has been set and the sequence proceeds through decisions 207 and 225 to the horizontal tab sequence beginning with operation 173, see FIG. 10. The movement of the printing point 13 thus far described is shown by line 272 and line 273. The horizontal tab operation will carry the printing point 13 along line 274. During this travel, single index code marking 275 will be detected at decision 148 to set latch 73 to the single index mode if it had previously been set otherwise. Note that code marking 275 is printed as the mirror image of the code to be recognized at decision 148 since the code bars / the marking are loaded into shift register 62 serially such that the leftmost bar will appear in stage 65. Tabulation motion along line 274 is terminated in response to decision 140 detecting a tab stop that is written in memory 76 in response to the sensing of vertical bar 276. The printing position 13 is now located at position 277 just beyond the bar 276. After each line of the address is keyed by the operator, field return key 25 is depressed to initiate a field return operation with the motion following line 278. This leftward motion is terminated by reading the tab stop initially recorded by bar 276 into memory 78 and is followed by a single space line feed.

At the end of typing the final line in the address field 251 the tab key 24 is struck to initiate a tabulating motion of the print point 13 along line 280. During the tabulating movement the double index code marking 281 is read and recognized at decision 147 to set latch 73 to the double index mode. Subsequently, reverse vertical tab code marking 282 is read and recognized at decision 145 to set the reverse vertical tab latch 72 at operation 240 and reset the horizontal tab latch 77 at operation 238. This results in termination of the horizontal motion at operation 158 and initiation of the reverse vertical feed sequence by decision 165. A reverse vertical tab operation follows the path 284 and terminates upon the vertical feed following passage of mark 285 at decision 239. Decision 207 recognizes termination of the vertical tab operation to initiate a horizontal

tab sequence beginning with operation 173 which sets the horizontal tab latch 77. The print point 13 now moves along line 286 to a rest position 287 where it is stopped by the tab stop set in memory 76 by bar 288.

Since the double index mode of latch 73 was set in response to reading of code 281, field return operation following typing of each line in identification field 253 includes a double index operation under the control of decision 203. Field return operations thus follow typical path 290. After typing the date in the reference field 253 the operator may either strike the tab key 23 or the line return key 27. If the tab key 23 is struck, a horizontal tab operation will proceed along line 291 to the point that detector 50 passes the right edge 292 of the form 250 and is exposed to the continuous black platen 12 (FIG. 3). The black platen 12 will have the effect of registering four successive marks in shift register 62 which will be interpreted at decision 149 as an automatic line return operation. Motion of the print point 13 now is reversed and continues along line 293 until decision 220 determines that the printing point 13 is at the left margin. The tab memory 76 is cleared at operation 222 and a repeat line feed is produced moving the print point 13 along path 294 until detector 50 passes mark 295. Decision 207 then initiates a horizontal tab operation to bring the printing point 13 just beyond tab stop line 296. Typing within the order field 254 is enhanced by the ability to tabulate directly to successive columns. New lines within the order field 254 are reached by depression of line return key 27. Within any given column, multiple lines may be typed by the use of the field return key 25 rather than line return key 27. When the final line has been typed in the order field 254, the operator may strike the vertical tab key 26f. The ensuing sequence first restores the print point 13 to the left margin as determined by decision 220 and then institutes repeated forward line feed until detector 50 passes mark 297. The sequence terminates by a horizontal tab to a position just inside bar 296 in reference field 255. Note that the tab stops required for the reference field 255 are more complex and are different than the tab stops required for the order field 254. In a similar manner, after completion of typing the reference field 255, the vertical tab key 26f is struck, the print point 13 is returned to the left margin and repeated line feeds are performed until the bar 298 has been passed by detector 50. A horizontal tabulation brings the printing point just beyond the bar 299.

From the foregoing description, it will be recognized that the operator has advanced through a relatively complex form automatically by the use of a vertical tabulating key 26f, a horizontal tabulating key 23, a field return key 25, and a line return key 27. These keys each fundamentally represent the operator's basic choice of field changing. Thus, to arrive at the first vertical typing field 251 the vertical tab key 26f was struck. After completing the address typing field 251, it is recognized that a different horizontal typing field 253 is desired and the horizontal tab key 23 is struck. After typing the reference field 253, it is recognized that the order field 254 is a different vertical field and the vertical tab key 26f is again struck. Within any of the different fields the operator returns to a new line position through the use of the field return key 25 which avoids the usual necessity of returning to the margin and performing multiple tabulation.

Having thus described our inventive concepts, the structure necessary for implementation of our inventive concepts in a preferred embodiment, and some illustrative examples of particular applications of our invention, it will be recognized that various modifications, deletions and additions to the particular embodiment herein disclosed can be made without departing from the scope and spirit of our invention. Accordingly, it is to be understood that our invention is to be limited only by the terms of the following claims.

We claim:

1. A system including a typewriter having mutually adjacent character print and paper support mechanisms defining a printing position therebetween and supported for relative lateral movement to enable displacement of said printing position along a horizontal writing line, and means for displacing a page supported by said paper support mechanism to different writing line positions, and manually selectively operable line return means for returning said printing position to a preset left margin position and for advancing the page to a new writing line, wherein the improvement comprises:

a memory that is capable of storing information at addresses therein which are individually associatable with predetermined relative horizontal positions of said character print and paper support mechanisms,

scanning means positioned adjacent said horizontal writing line,

means for relatively moving said horizontal writing line and said scanning means to present said predetermined relative horizontal positions on said horizontal writing line successively to said scanning means, said scanning means including a detector that is operatively connected with said memory for detecting marks having a predetermined characteristic on a page supported in said typewriter, and for storing "tab stop" information in said memory at addresses associated with the relative horizontal position at which said marks are detected,

tabulating means for displacing said printing position horizontally to traverse random numbers of said horizontal positions, said tabulating means including means operative during a tabulating displacement for reading from addresses of said memory corresponding to the printing positions thereby traversed,

means responsive to the reading of "tab stop" information in said memory for terminating tabulating displacement, and

means responsive to selected operation of said line return means operation for erasing all "tab stop" information from said memory.

2. As system as defined in claim 1 wherein said tabulating means comprises first and second key controlled means for respectively displacing said printing position forwardly along said writing line and reversely along said writing line.

3. A system as defined in claim 2 wherein said second key controlled means comprises field return means, that is operable upon selection to cause advance of a page supported by said paper support mechanism to a new writing line.

4. A system including a typewriter having mutually adjacent character print and paper support mechanisms defining a printing position therebetween and

supported for relative lateral movement to enable displacement of said printing position along a horizontal writing line, wherein the improvement comprises:

register means having a series of discrete states, scanning means positioned adjacent said horizontal writing line,

means for relatively moving said horizontal writing line and said scanning means to present successive predetermined horizontal positions on said writing line successively to said scanning means, said scanning means including a mark detector that is operatively connected with said register means for registering mark sensed information detected from a predetermined number of successive horizontal positions

a manually depressible key,

control means responsive to depression of said key for normally selecting a first typewriter function and conditionable to select an alternate typewriter function, and

interpretative means operating cyclically upon each advance of said printing position to a new horizontal position for responding to a predetermined state of said register means to condition said control means to select said alternate typewriter function.

5. A system as defined in claim 4 wherein said first typewriter function is a line feed of a first predetermined amount and said alternate typewriter function is a line feed of an amount different from said first predetermined amount.

6. A system as defined in claim 4 further including tabulating means for displacing said printing position horizontally to traverse random numbers of said horizontal positions, and wherein said first typewriter function is operation of said tabulating means and wherein said alternate typewriter function is repeating line feed.

7. A system as defined in claim 4 further including tabulating means for displacing said printing position horizontally to traverse random numbers of said horizontal positions, and wherein said first typewriter function is operation of said tabulating means and wherein said alternate typewriter function is repeating reverse line feed.

8. A system as defined in claim 4 further including tabulating means for displacing said printing position horizontally to traverse random numbers of said horizontal positions, and wherein the improvement further comprises:

a memory that is capable of storing information at addresses therein which are individually associatable with predetermined relative horizontal positions of said character print and paper support mechanisms,

said interpretative means further responding to a second predetermined state of said register means to store "tab stop" information in said memory at an address associated with the relative horizontal position at which registered sensed mark information was detected,

tabulating means for displacing said printing position horizontally to traverse random numbers of horizontal positions, said tabulating means including means operative during a tabulating displacement for reading from addresses of said memory corre-

sponding to print positions thereby traversed, and

means responsive to the reading of "tab stop" information in said memory for terminating tabulating displacement.

9. A system as defined in claim 8 wherein said register means comprises:

a shift register having a series of stages interposed in the operative connection between said detector and said memory for storing information as to the detection of marks at a printing position by said detector in the first of said series of stages, advancing said information through said series of stages upon advance of said printing position along said writing line, and delivering said information from the last of said series of stages to said memory at the address associated with the relative horizontal position at which the mark was detected which originally stored information in the first of said series of stages, and

wherein said discrete states of said register means comprise ordered combinations of said information in the stages of said shift register.

10. A system including a typewriter having mutually adjacent character print and paper support mechanisms defining a printing position therebetween and supported for relative lateral movement to enable displacement of said printing position along a horizontal writing line, tabulating means for displacing said printing position horizontally, and selectively operable means for displacing said printing position vertically relatively to a page supported by said paper support mechanism, wherein the improvement comprises:

register means having a series of discrete states, scanning means positioned adjacent said horizontal writing line,

means for relatively moving said writing line and said scanning means to present successive predetermined horizontal positions on said writing line successively to said scanning means, said scanning means including a mark detector that is operatively connected with said register means for registering "mark sensed" information detected from a predetermined number of successive horizontal positions adjacent said detector, and interpretative means operating cyclically upon each advance of said printing position to a new horizontal position for responding to a predetermined state of said register means to automatically initiate operation of said selectively operable means following operation of said tabulating means.

11. A system as defined in claim 10 wherein said selectively operable means comprise line return mechanism for displacing said printing position vertically to a new writing line and displacing said printing position horizontally to a start-of-line margin position.

12. A system as defined in claim 11 wherein said predetermined state of said register means is indicative of detection of a predetermined plurality of successive adjacent marks by said detector.

13. A system as defined in claim 10 wherein said selectively operable means includes means for effecting a variable plurality of line feed displacements of said printing position relative to said page.

14. A system as defined in claim 10 wherein said selectively operable means includes means for effecting

a variable plurality of reverse line feed displacements of said printing position relative to said page.

15. A system as defined in claim 10 wherein the improvement further comprises:

a memory that is capable of storing information at addresses therein which are individually associatable with predetermined relative horizontal positions of said character print and paper support mechanisms,

said interpretative means further responding to a second predetermined state of said register means to store "tab stop" information in said memory at an address associated with the relative horizontal position at which registered mark marked information was detected,

tabulating means for displacing said printing position horizontally to traverse random numbers of horizontal positions, said tabulating means including means operative during a tabulating displacement for reading from addresses of said memory corresponding to print positions thereby traversed, and

means responsive to the reading of "tab stop" information in said memory for terminating tabulating displacement.

16. A system as defined in claim 15 wherein said selectively operable means comprised line return mechanism for displacing said printing position vertically to a new writing line and displacing said printing position horizontally to a start-of-line margin position.

17. A system as defined in claim 16 further comprising means automatically operative following operation of said selectively operable means for effecting operation of said tabulating means.

18. A system as defined in claim 15 wherein said se-

lectively operable means includes means for effecting a variable plurality of line feed displacements of said printing position relative to said page.

19. A system as defined in claim 18 further comprising means automatically operative following operation of said selectively operable means for effecting operation of said tabulating means.

20. A system as defined in claim 15 wherein said selectively operable means includes means for effecting a variable plurality of reverse line feed displacements of said printing position relative to said page.

21. A system as defined in claim 20 further comprising means automatically operative following operation of said selectively operable means for effecting operation of said tabulating means.

22. A system as defined in claim 15 wherein said register means comprises:

a shift register having a series of stages interposed in the operative connection between said detector and said memory for storing information as to the detection of marks at a printing position by said detector in the first of said series of stages, advancing said information through said series of stages upon advance of said printing position along said writing line, and delivering said information from the last of said series of stages to said memory at the address associated with the relative horizontal position at which the mark was detected which originally stored information in the first of said series of stages, and

wherein said discrete stages of said register means comprises ordered combinations of "mark sensed" information in the stages of said shift register.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,829,855
DATED : August 13, 1974
INVENTOR(S) : Robert A. Kolpek and James T. Loisel

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7	line 20	After "indicating" insert --counting--
Column 8	line 2	After "64" insert --and 65--
Column 11	line 10	Delete "present" insert --preset--
Column 12	line 29	Delete first "238" insert --237--
Column 13	line 42	Delete "9n 0247" after --45--
Column 14	line 13	After "the" insert --print--
Column 14	line 50	Delete "78" insert --76--

Signed and Sealed this

second Day of March 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks