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[54] **ELECTRONIC TABULATION CONTROL SYSTEM FOR RECORDER**

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[52] **U.S. Cl.** **197/176**

[51] **Int. Cl.** **B41j 25/18**

[58] **Field of Search** 197/19, 20, 65, 66, 197/82, 84, 84.1, 84.3, 176, 177, 178, 179, 187, 188, 190, 191, 107, 108, 110, 111, 1

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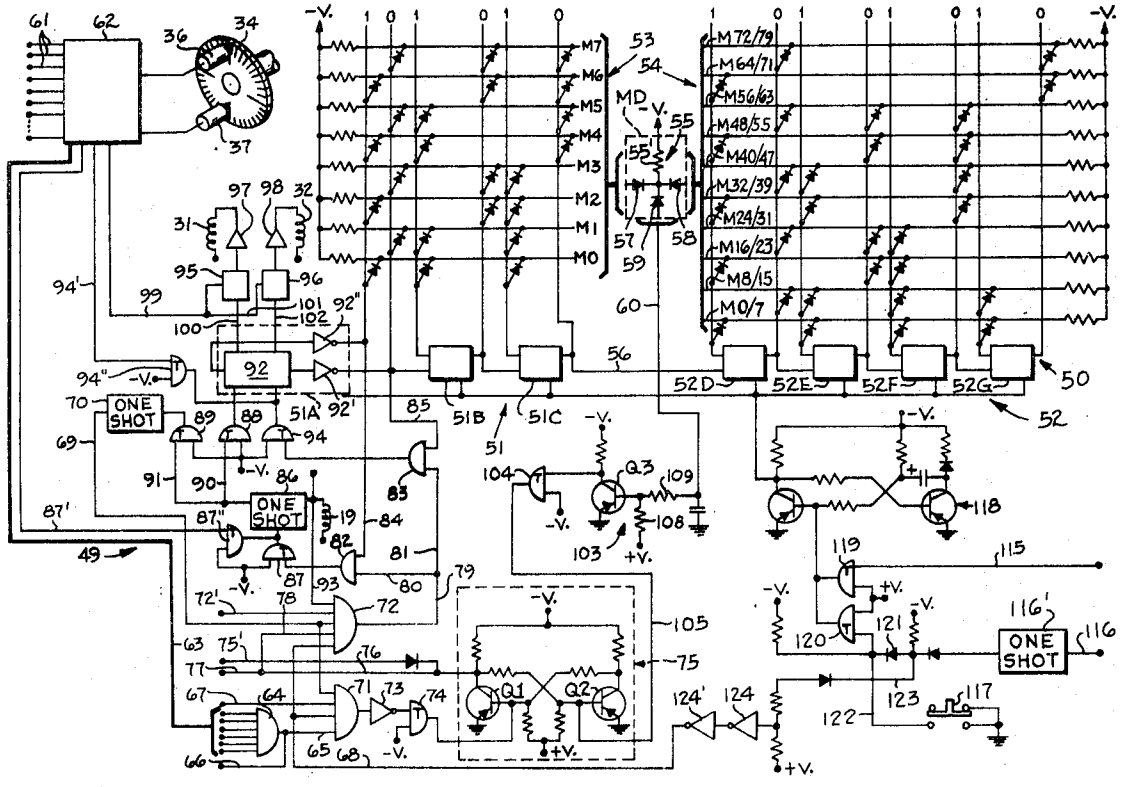
[57] **ABSTRACT**

There is disclosed a control system for a recorder such as a printer by which tabulation or columnization of data on a record medium is effected electronically, without the use of mechanical tab stops. In one specific embodiment, a carriage which mounts a pair of print hammers is controlled by electronic circuitry to effect tabulation. When a tabulating signal is received printing is inhibited and the carriage is advanced stepwise until the carriage arrives at the next preselected recording position. At that preselected recording position, stepping of the carriage ceases and printing is no longer inhibited. In another specific embodiment, the carriage mounts a single print hammer. In yet another specific embodiment, the recorder is depicted as having a moving type-carrier and a bank of print hammers; tabulation is automatically effected upon receipt of a tabulating signal so that printing is enabled at the next preselected recording position.

17 Claims, 10 Drawing Figures



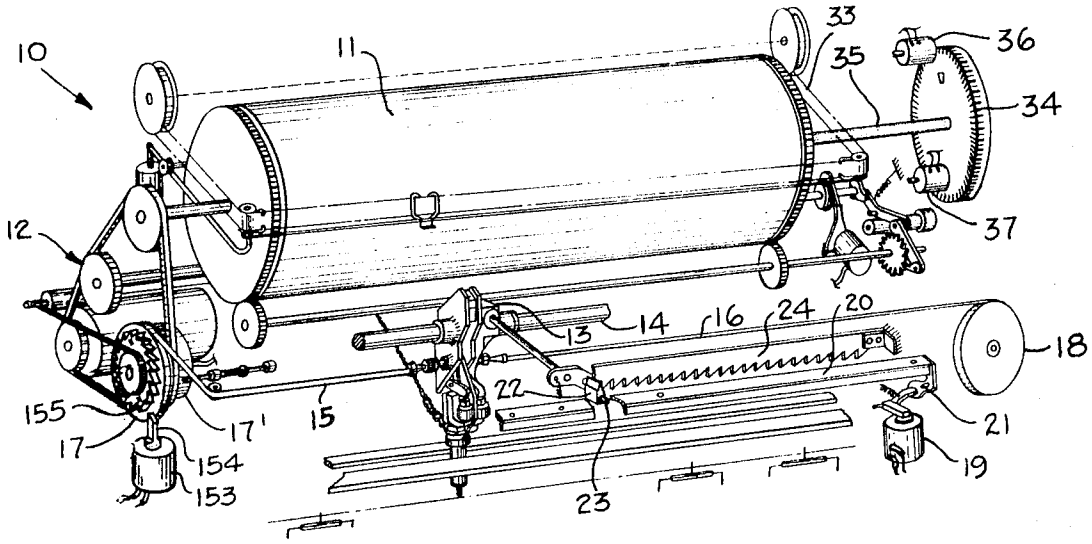


Fig. 1

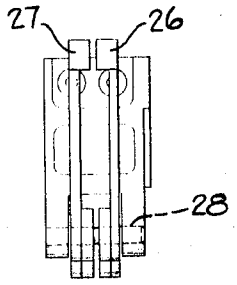
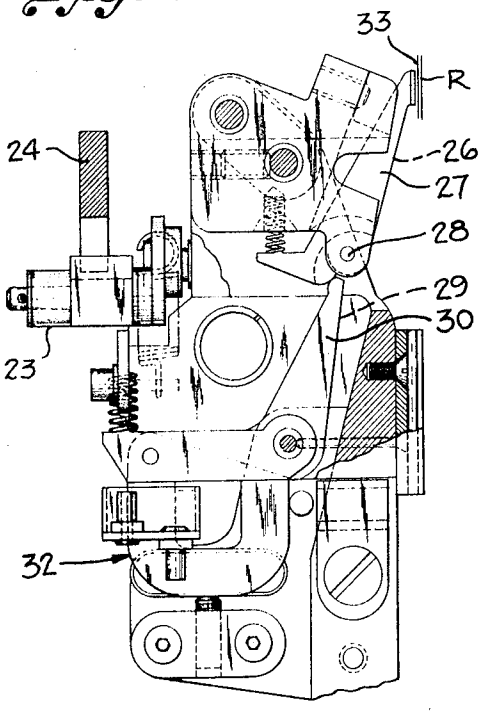


Fig. 4

Fig. 2



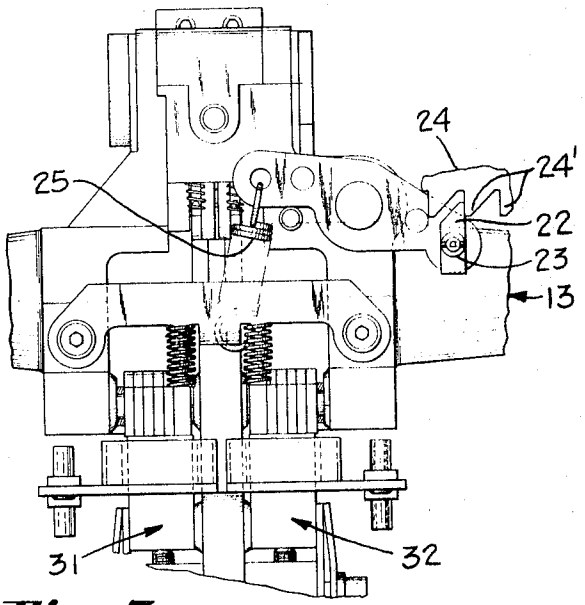


Fig. 3

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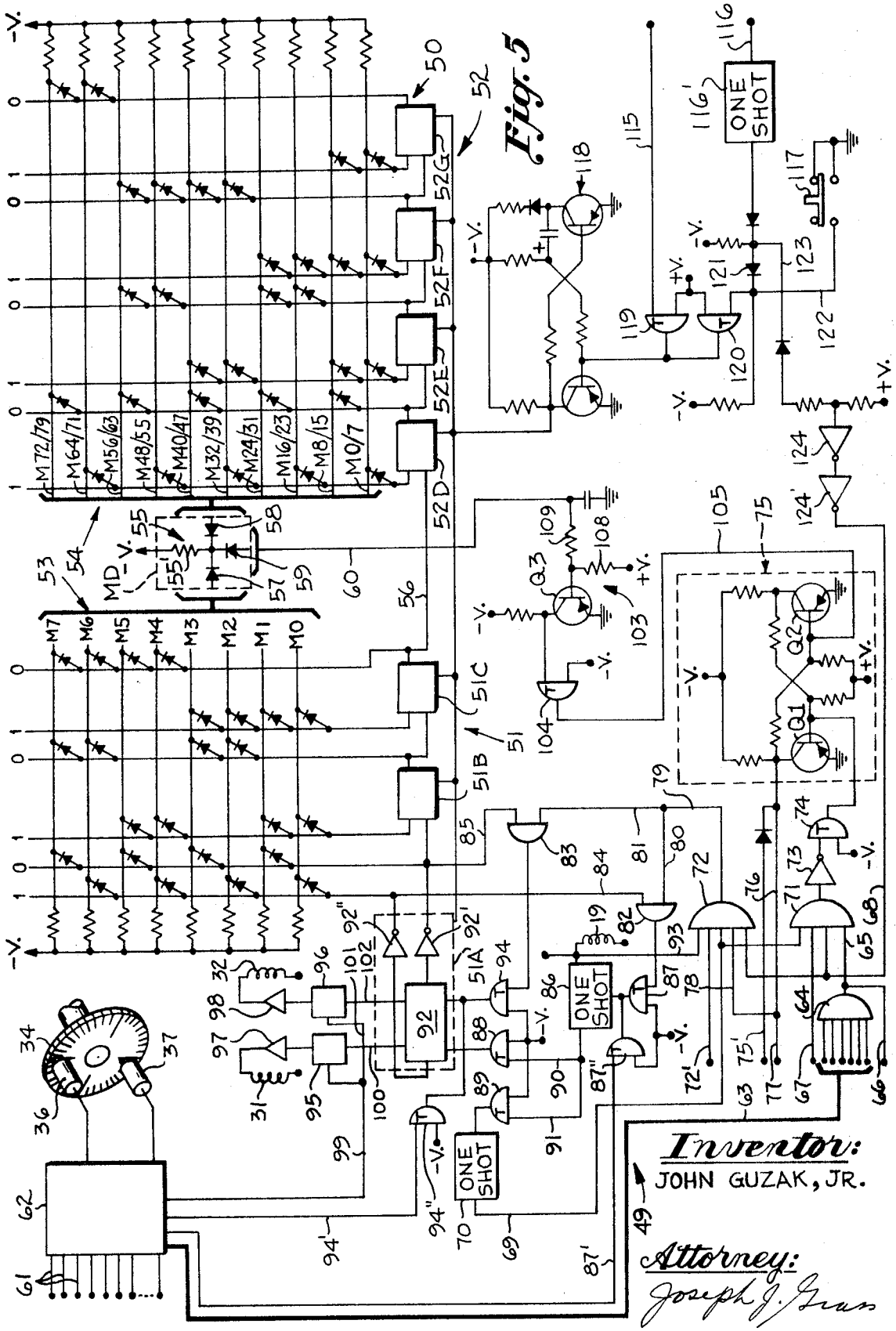
Fig. 5
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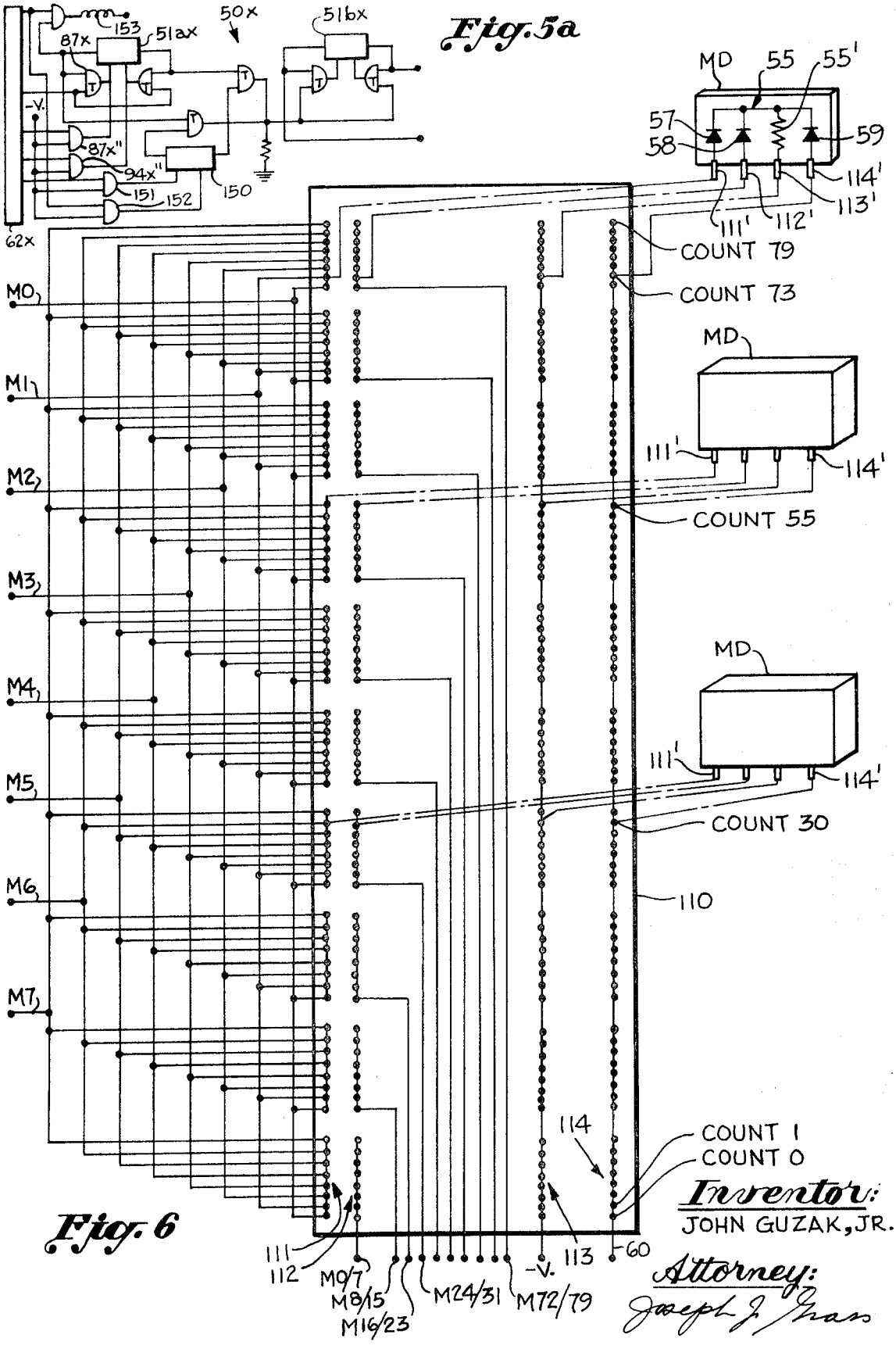

Fig. 5a

Fig. 6

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Fig. 9

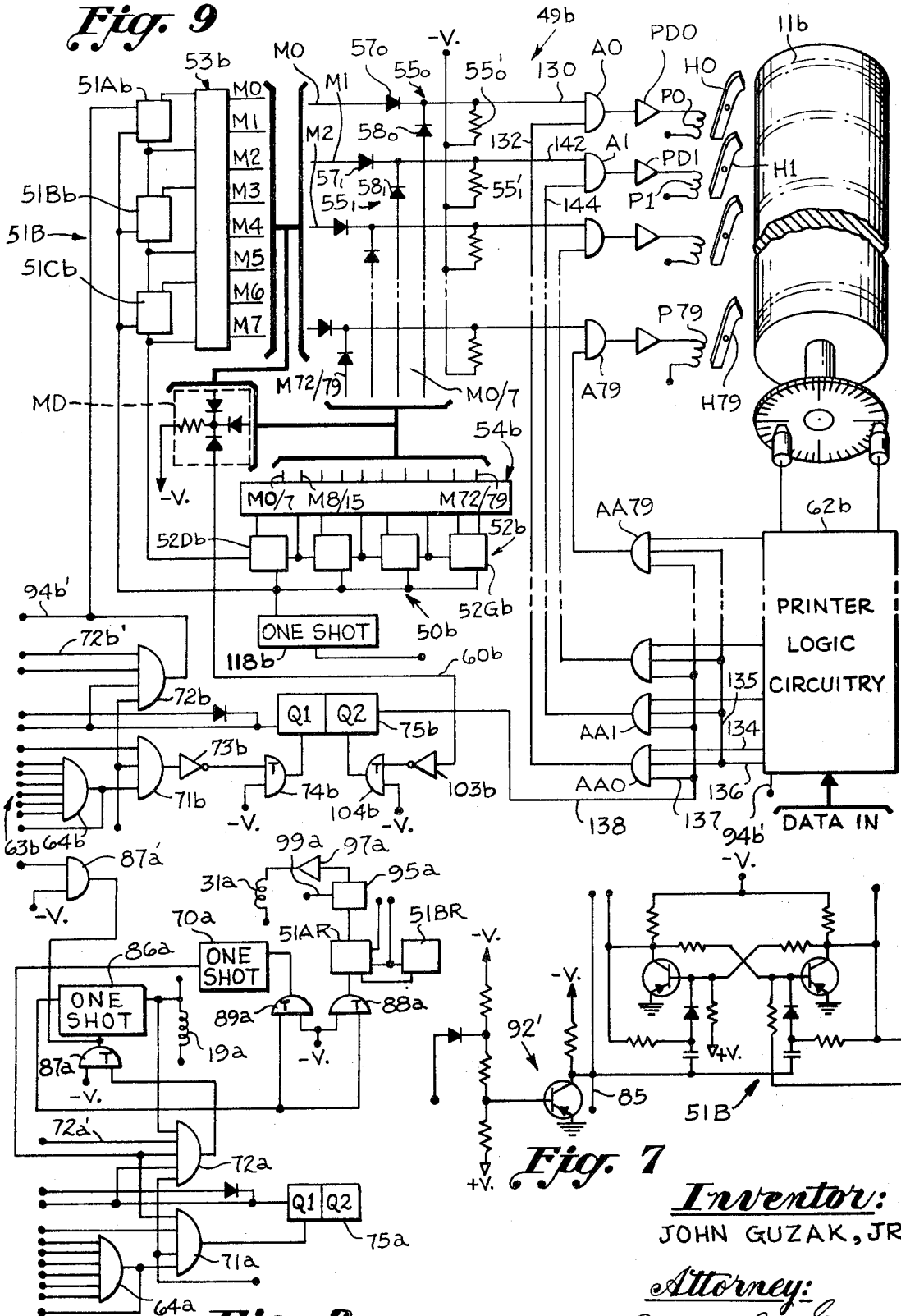

Fig. 8

Fig. 7

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ELECTRONIC TABULATION CONTROL SYSTEM FOR RECORDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a control system for a recorder, and in particular to an automatic tabulating system for a recorder.

2. Description of the Prior Art

It is commonplace in the typewriter art to provide horizontal tabulation; when the tab key is depressed or in response to a tabulating signal, the typewriter carriage is driven away from the start-of-line position until the carriage strikes a mechanical tab stop which was preset by the operator. By presetting one or more tab stops, the carriage is stopped at one or more positions so that printing occurs at preselected tabular positions or columns on the record medium.

SUMMARY OF THE INVENTION

In accordance with the invention, tabulation is automatically effected electronically, without the use of mechanical tab stops. The control system of the invention provides electronic control which automatically effects tabulation. The invention is applicable to carriage type recorders such as typewriters, or to recorders which can be either of the carriage type or of the non-carriage type such as teleprinters, and to other recorders which are adapted for tabular recording. The invention includes an electronic counter which keeps track of the last recording position of the recording mechanism. When a tabulating signal is received, the counter is advanced to the next preselected recording position while recording is inhibited. At that next preselected recording position, recording of the character corresponding to the data signal which follows the tabulating signal can commence. A plurality of selected tabular recording positions can be effected by use of the circuitry of the present invention, and, in addition, these tabular recording positions can be readily changed.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view showing a fragmentary portion of a printer having a print drum and a travelling carriage for mounting print hammers, to which the present invention is applied to effect horizontal tabulation;

FIG. 2 is an enlarged partially sectioned side elevational view of a print hammer carriage with dual hammers;

FIG. 3 is a front elevational view of the structure shown in FIG. 2;

FIG. 4 is a detailed rear view of a universal print hammer block and the two print hammers which it mounts;

FIG. 5 is a circuit diagram depicting a control system for a printer having a carriage which mounts a pair of print hammers, with various components being shown in logic form;

FIG. 5A is a fragmentary view of an alternative counter stepping arrangement;

FIG. 6 is a diagrammatic view showing a connector board having two groups of contacts to which outputs of two counters shown in FIG. 5 are connected, another group of contacts connected to a source of electrical energy, and another group of contacts connected to an output conductor, together with modules containing diode AND gates, each module having contacts connected to the AND gate in such an alignment that the modules can be connected to any set of mating contacts on the connector board to provide an output at any preselected count;

FIG. 7 is a detailed view showing an amplifier and register of one of the counters shown in FIG. 5;

FIG. 8 is a circuit diagram showing an alternative embodiment of the invention illustrating circuitry for a printer having a single print hammer; and

FIG. 9 is a circuit diagram for a recorder in the form of a drum printer having a bank of print hammers, embodying circuitry for effecting automatic horizontal tabulation electronically.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1, there is shown a recorder in the form of a drum printer generally indicated at **10**, with a moving type-carrier in the form of a print drum **11**, a power train **12**, and a carriage **13** guided slideably by a rod **14** for travel lengthwise with respect to the print drum **11**.

Belts **15** and **16** are connected to the carriage **13** and are wound about drums **17** and **18**, respectively. The drum **17** is driven by a clutch **17'** which is engaged in response to a carriage return signal, thereby returning the carriage **13** to the start-of-line position. The drum **18** contains a spring which constantly exerts tension on the belt **16** tending to urge the carriage **13** away from the start-of-line position and toward the end-of-line position (to the right as viewed in FIG. 1). Spacing of the carriage **13** is accomplished by energization of a solenoid **19** which effects pivoting of a space bail **20** about a pivot **21**, thereby causing a pawl **22** to be pulled downwardly, as viewed in FIG. **1**, due to the downward force exerted on roller **23** by the bail **20**. When the pawl **22** has moved downwardly sufficiently to clear a tooth **24'** of a space rack **24** with which it was in engagement, the belt **16** is effective to pull the carriage **13** toward the right, as viewed in FIG. **1**. As the solenoid **19** is only energized for a very short period of time, the space bail **20** is almost immediately returned to its initial position, thereby enabling a spring **25** to urge the pawl **22** upwardly to effect stoppage of the carriage **13** at the next tooth **24'** of the rack **24**. By this arrangement, the carriage **13** is stepped ahead a distance equal to the tooth-to-tooth distance between adjacent teeth **24'** of the rack **24** upon each energization of the solenoid **19**. If the carriage **13** is to be advanced two print positions for each energization of the solenoid **19**, as in the embodiment of FIGS. **1** through **7** wherein the carriage **13** carries a pair of print hammers **26** and **27** pivotally mounted on a pin **28**, the rack **24** will be constructed so that the tooth-to-tooth distance is equal to the width of two print positions. If the tooth-to-tooth distance is made equal to the width of one print position, as would be the case in the embodiment of FIG. **8** wherein the carriage **13** carries only a single hammer such as the hammer **26**, each energization of the solenoid **19** will cause advance of the carriage **13** by one print position.

The print hammers **26** and **27** are actuated by respective pivotally mounted armature operators **29** and **30**. Energization of one of the print electromagnets **31** and **32** will cause the respective print hammer **26** or **27** to be driven into printing cooperation with the desired

type element on the print drum 11, causing the desired character to be printed on a record medium R as the print hammers 26 and 27 strike a ribbon 33. A clock wheel 34 securely mounted on a print drum shaft 35 for rotation in synchronism with the print drum 11 causes transducers or monitor heads 36 and 37 to continuously signal the comparator of a printer logic circuitry 62 as to the relative position of the print drum 11.

Additional details of the recorder 10 shown in FIGS. 1 through 4 of the drawing are disclosed in U.S. Pat. No. 3,291,909.

Referring now to FIG. 5, there is shown a specific embodiment of a control system generally indicated at 49 for carrying out the invention. In particular, the control system 49 is operable to effect horizontal tabulation of the carriage 13 (FIGS. 1, 2 and 3). The control system 49 includes an electronic binary counter 50 having electronic counters 51 and 52. The counter 51 includes registers 51A, 51B and 51C, and a diode matrix generally indicated at 53. The counter 52 includes registers 52D, 52E, 52F and 52G, and a diode matrix generally indicated at 54. The diode matrix 53 is shown to have eight outputs or output conductors M0, M1, M2, M3, M4, M5, M6 and M7. The diode matrix 54 is shown to have 10 outputs or output conductors M0/7, M8/15, M16/23, M24/31, M32/39, M40/47, M48/55, M56/63, M64/71 and M72/79. One of the conductors M0 through M7 of the diode matrix 53 is always at negative potential and the others of the output conductors M0 through M7 of the diode matrix 53 are at ground potential. Similarly, one of the conductors M0/7 through M72/79 of the diode matrix 54 is always at negative potential and the others of the output conductors M0/7 through M72/79 of the diode matrix 54 are at ground potential. Any one of the output conductors M0 through M7 can be electrically connected with any one of the output conductors M0/7 through M72/79 by means of a diode AND gate generally indicated at 55 which is located in a module or coincidence gate MD. As the diode matrix 53 has eight output conductors M0 through M7 and as the diode matrix 54 has 10 output conductors M0/7 through M72/79, the diode AND gate 55 can be connected to the output conductors of the diode matrices 53 and 54 in any one of eighty possible combinations. The counters 51 and 52 are electrically connected so that the counter 51 will advance the counter 52 at every eighth count of the counter 51. Initially, the conductors M0 and M0/7 are at negative potential. As the counter 51 is advanced one step, the potential on the conductor M1 becomes negative; as the counter 51 is advanced another step, the potential on the conductor M2 becomes negative; and so on. Assuming the counter 51 has advanced so that the conductor M7 is at negative potential, when the counter 51 is advanced again the conductor M0 will again be at negative potential and the counter 52 will advance one step; the counter 52 is advanced because the register 51C changes state and ground potential is applied to the conductor 56. When the register 52D changed state, the potential on the conductor M8/15 became negative. The conductor M8/15 remains at negative potential until the counter 52 is advanced and the conductor M16/23 will be at negative potential.

Thereafter, each time the conductor M0 becomes negative, the counter 52 is advanced one step. If, for example, the diodes 57 and 58 of the diode AND gate 55 are connected to the conductors M5 and M0/7, respectively, a circuit will be completed through a diode 59 and a conductor 60 to which the diode 59 is connected when Count 5 is reached. It is at Count 5 that the diodes 57 and 58 would both have negative potential applied to them, thereby enabling the diode AND gate 55. If, for example, it were desired to complete a circuit through the conductor 60 at Count 30, the conductor M6 would be connected to the diode 57 and the conductor M24/31 would be connected to the diode 58. Thus, when the Count 30 is reached, the diode AND gate 55 is enabled to effect completion of a circuit through the conductor 60.

When a tabulating signal is received via conductors 61 by the printer logic circuitry 62, the signal is applied via a group of conductors 63 to the input of an AND gate 64, thereby enabling the AND gate 64 and effecting application of negative potential to conductors 65 and 66. A conductor 67, connected to a function detector (not shown) in the printer logic circuitry 62, is at negative potential because the printer logic circuitry 62 has detected a function, specifically a tabulating signal. A conductor 68 connected to an input of AND gates 71 and 72 is already at negative potential because a transistor (not shown) of inverting amplifier 124' is off. Likewise, a conductor 69 is maintained at negative potential by a one-shot 70 and is connected to an input of AND gates 71 and 72. Thus, when the AND gate 64 is enabled by a special or control signal, specifically a tabulating signal, the AND gate 71 is also enabled by the negative potential on the conductor 65. An amplifier 73 connected to the output of AND gate 71 will trigger a pedestal gate 74 when the AND gate 71 is enabled, thereby setting a memory device in the form of a bistable flip-flop 75. The flip-flop 75 was initially driven to the reset condition by a reset amplifier (not shown) via conductor 75'. The set condition of the flip-flop 75 can be considered to exist when its transistor Q1 is off and its transistor Q2 is on. A conductor 76, connected to the collector of the transistor Q1, is connected to an output conductor 77 and to a conductor 78 connected to the input side of the AND gate 72. When the flip-flop 75 is set, the AND gate 72 will be enabled each time a strobe or clock pulse is applied to a conductor 72'connected to an input of the AND gate 72. A conductor 79, connected to the output of the AND gate 72, is connected to conductors 80 and 81. AND gates 82 and 83 have their inputs connected to conductors 80 and 84, and 81 and 85, respectively. The conductors 84 and 85 are connected to the complementary outputs of the register 51A, so that one of the conductors 84 and 85 is at negative potential while the other is at ground potential. Therefore, when the AND gate 72 is enabled, the AND gate 82 will be enabled if the conductor 84 is at negative potential, or the AND gate 83 will be enabled if the conductor 85 is at negative potential. The AND gate 82 will be enabled every other time the AND gate 72 is enabled, and the AND gate 83 will be enabled every other time the AND gate 72 is enabled. When the AND gate 82 is enabled, its output operates a one-shot 86 via a pedestal gate 87.

The embodiment of FIGS. 1 through 7 of the drawing has a carriage 13 which mounts two print hammers 26 and 27, with the carriage 13 being advanced two print positions each time the solenoid 19 is energized. It is apparent that because the AND gate 82 is enabled every other time the AND gate 72 is enabled, the solenoid 19 will likewise be energized every other time the

AND gate 72 is enabled. At the end of the time delay effected by the one-shot 86, pedestal gates 88 and 89 are triggered via conductors 90 and 91. Each time the pedestal gate 88 is triggered it clears (or resets) bistable flip-flop 92 which with inventing amplifiers 92' and 92'', forms part of the register 51A. Triggering of the pedestal gate 89 operates a one-shot 70 which applies ground potential to the conductor 69 subsequent in time to the application of ground potential by the one-shot 86 to the AND gate 72 via a conductor 93 and to the solenoid 19. Thus, the AND gate 72 cannot be enabled until sufficient time has elapsed following energization of the solenoid 19. When the AND gate 83 is enabled, it triggers a pedestal gate 94 to change the state of the flip-flop 92. The state of the flip-flop 92 determines which print detector 95 or 96 will be operable.

It is only during the tabulating function that the flip-flop 92 is under the control of pedestal gates 88 and 94. While the printer is in the printing mode of operation, the one-shot 86 and the flip-flop 92 are under control of the printer logic circuitry 62 via a conductor 87' and a pedestal gate 87'' and the flip-flop 92 is also under the control of the printer logic circuitry 62 via a conductor 94' and a pedestal gate 94''. Assuming the printer logic circuitry 62 indicated that a character is ready to be printed, appropriate print detector 95 or 96 will be operated. An output from print detector 95 will cause print hammer driver 97 to energize print electromagnet 31. Similarly, operation of the print detector 96 will cause print driver 98 to effect energization of print electromagnet 32. The electromagnet 31 will not be energized until a signal from the printer logic circuitry 62 indicates that a character is to be printed and that comparison exists between the incoming character signal on conductors 61 and the position of the print drum 11.

Assuming the carriage 13 is at the start-of-line position, and assuming that a printable character is to be printed on the record medium R, the electromagnet 31 will be energized when coincidence is found and because the print detector 95 has been conditioned via conductors 99 and 100. Thereafter, assuming that a printable character is to be printed on the record medium R at the second print position, the electromagnet 32 will be energized when coincidence is found and because the print detector 96 has been conditioned via conductors 101 and 102. The print detector 96 is enabled, and thereafter the carriage 13 will also be spaced two positions by energization of the solenoid 19 when the one-shot 86 times out.

Assuming the AND gate 64 is enabled by a tabulating signal to effect setting of the flip-flop 75 as previously indicated, the flip-flop 75 will remain in its set condition until the next preselected count at which a diode AND gate 55 is connected, thereby completing the circuit through the conductor 60 and causing the transistor Q3 of an inverting amplifier 103 to turn on. When the transistor Q3 turns on, a pedestal gate 104 is triggered and the flip-flop 75 is reset via a conductor 105. Resetting of the flip-flop 75 disables the AND gate 72 via the conductors 76 and 78. The printer logic circuitry 62 is signalled by the ground potential applied to the conductor 77 that printing can commence.

Referring now to FIG. 6 of the drawing, there is indicated a connector board 110 having a plurality of groups of contacts 111, 112, 113 and 114. The output conductors M0 through M7 are connected to predetermined ones of the contacts of the group 111, and the output conductors M0/7 through M72/79 are connected to predetermined ones of the contacts of the group 112. All the contacts of the group 113 are connected to each other and to a source of negative potential. The contacts of the group 114 are connected to each other and to the conductor 60.

The connector board 110 has eighty sets of contacts, each set having one contact from each of the groups 111, 112, 113 and 114. Each set extends laterally and the contacts of each set are in alignment.

Each module MD includes the diode AND gate 55 and the diode 59 and mating contacts 111', 112', 113' and 114'. The diode 57 is connected to the contact 111', the diode 58 is connected to the contact 112', the resistor 55' is connected to the contact 113', and the diode 59 is connected to the contact 114'. For the sake of clarity, the contact groups 111, 112, 113 and 114 are illustrated as spread apart wider than the corresponding module contacts 111', 112', 113' and 114'; however, they are actually in alignment so that one of the modules MD can be plugged into the connector board 110 at any preselected count from Count 0 through Count 79.

For example, at Count 30 a contact of group 111 is connected to the conductor M6, and a contact of group 112 is connected to the conductor M24/31. Thus, when one of the modules MD is plugged into the connector board 110 at the Count 30 position, as shown in FIG. 6, there will be an output via conductor 60 when Count 30 is reached, that is, when both conductors M6 and M24/31 are at negative potential. Likewise, when one of the modules MD is plugged into the connector board 110 at the Count 55 position, as also shown in FIG. 6, there will be an output via conductor 60 when Count 55 is reached, and when one of the modules MD is plugged into the connector board 110 at the Count 73 position, as also shown in FIG. 6, there will be an output when Count 73 is reached. With the three modules MD shown in FIG. 6, a circuit through the conductor 60 is completed when each of Counts 30, 55 and 73 are reached. One or more modules MD can be plugged into the connector board 110 at preselected locations.

Assume that three modules MD are connected to the connector board 110 at positions shown in FIG. 6, that the carriage 13 has been advanced so that the hammer 26 is at the twentieth print position, that the counter 50 has also been advanced to the nineteenth count, and that a tabulating signal is received; the AND gate 71 will be enabled, the flip-flop 75 will be set, and each pulse via conductor 72' will enable the AND gate 72. Every other time the AND gate 72 is enabled, the one-shot 86 will operate to energize the solenoid 19. Each time the solenoid 19 is operated the carriage 13 is stepped a distance equal to two print positions. Pedestal gates 88 and 94 effect change of state of the flip-flop 92 each time the AND gate 72 is enabled, thereby advancing the counter 51 one count each time the flip-flop 92 changes state. The carriage 13 will be repeatedly advanced stepwise and the counter 50 will be advanced until Count 30 is reached. The module MD which is plugged into the connector board 110 at the Count 30 position will complete an output circuit at Count 30 of the counter 50, thereby completing a circuit from a source of positive potential, through resistors 108 and 109, the conductor 60, the diode 59, the resistor 55' to a source of negative potential; completion of this circuit causes the transistor Q3 to turn on

and causes triggering of the pedestal gate **104** to reset the flip-flop **75**. Resetting of the flip-flop **75**, disables the AND gate **72** because ground potential then exists on conductors **76** and **78**, so that the pulses on the conductor **72'** cannot enable the AND gate **72** to effect advance of either the counter **50** or the carriage **13**. Thus, the carriage **13** stops when the hammer **27** is at the thirty-first print position. While the carriage **13** was being stepped from the twentieth print position to the thirtieth print position, printing was inhibited by an inhibit signal in the form of negative potential on the conductor **66**. As long as negative potential is applied to printer logic circuitry **62** by the conductor **66**, conductors **99** and **101** will not enable either of the print detectors **95** and **96**. When the flip-flop **75** was reset at Count **30**, the ground potential placed on the conductors **76** and **77** signaled the printer logic circuitry **62** that tabulating has been completed. Assume now that printing and stepwise advance of the carriage **13** continues until the hammer **26** is at the forty-fourth print position, at which position another tabulating signal is received by the printer logic circuitry **62**. In the manner described above, the AND gate **64** is enabled, the counter **50** will be advanced each time the condition of the flip-flop **92** is changed, and the carriage **13** will be advanced stepwise every other time the AND gate **72** is enabled until Count **55** is reached. Because a module MD is plugged into the connector board **110** at the Count **55** position, when the counter **50** reaches Count **55** a circuit will again be completed through the conductor **60**, causing the flip-flop **75** to be reset. Resetting the flip-flop **75** interrupts advance of the counter **50** and advance of the carriage **13**. Printing and advance of the carriage **13** is now able to continue under the control of the printer logic circuitry **62**. Assuming the next tabulating signal is received when the hammer **26** is at the seventieth print position, thereby enabling the AND gate **64** and setting the flip-flop **75**; the counter **50** will be advanced and the carriage **13** will be advanced stepwise until Count **73** is reached. As a module MD is plugged into the connector board **110** at the Count **73** position, when the counter **50** reaches Count **73**, a circuit will again be completed through the conductor **60** to reset the flip-flop **75**. Resetting of the flip-flop **75** will again enable printing and advance of carriage **13** to the end-of-line position.

The carriage **13** can be returned to the start-of-line position while the carriage **13** is in any position which is advanced from the start-of-line position, for example, if the signal received at the forty-fourth print position were a carriage-return signal rather than a tabulating signal, the solenoid **19** would be continuously energized until the carriage **13** has been returned to the start-of-line position by means of the force applied to the carriage **13** by the belt **15** upon energization of the clutch **17'**. A carriage-return function can be initiated either by a signal applied to a conductor **115** by a carriage-return function detector (not shown) in the circuitry **62**, or by a code signal received on conductor **116** or by closure of a manual switch **117**. A signal on either of conductors **115** or **116** will initiate operation of a one-shot **118** via pedestal gate **119**, and one-shot **116'** and pedestal gate **120**,respectively. The one-shot **118** will effect resetting of the registers **51A**, **51B**, **51C**, **52D**, **52E**, **52F**, **52G** of the counter **50**, and when the counter **50** is reset the output conductors **M0** and **M0/7** of the diode matrices **53** and **54**, respectively, will be at negative potential. Depression of the switch **117** will trigger the pedestal gate **120**. Because of the diode **121** between the conductors **122** and **123**, depression of the switch **117** will not effect change of voltage condition upon the conductor **123**. Therefore, the amplifier **124'** will not be turned on, and consequently the negative potential on the conductor **68** will not be affected. However, a signal on the conductor **116** will trigger the one-shot **116'**. One-shot **116'** will, via conductor **123** and amplifiers **124** and **124'**, apply ground potential to AND gates **71** and **72**, thus inhibiting the setting of the flip-flop **75** by AND gate **71** during the duration of operation of the one-shot **116'**. The one-shot **116'** operates long enough to allow the carriage **13** to be returned to the start-of-line position. At the termination of operation of the one-shot **116'**, negative potential is again placed on the conductor **68**.

Referring now to the embodiment of FIG. **8**, there is shown a fragmentary portion of the circuitry shown in FIG. **5**, modified for a printer having a single print hammer such as the hammer **26** rather than two print hammers **26** and **27**. Components which are the same in construction and function as the components shown in FIG. **5** are designated by the same reference characters, with the addition of the letter "a." As in the embodiment of FIGS. **1** through **7**, AND gate **64*a*** when enabled enables AND gate **71*a*** provided the other inputs to the AND gate **71*a*** are at negative potential. When the bistable flip-flop **75*a*** has been set, AND gate **72*a*** will be enabled upon each strobe pulse on conductor **72*a'***. Each time the AND gate **72*a*** is enabled, a pedestal gate **87*a*** will operate the one-shot **86*a***, thereby effecting energization of the solenoid **19*a***. In the embodiment of FIG. **8**, the distance between adjacent teeth **24'** of the rack **24**, that is, the tooth-to-tooth distance, is equal to the width of one print position. Therefore, the carriage **13** is advanced stepwise each time a printable character has been printed by the single print hammer such as hammer **26** or a space signal is received by operation of a pedestal gate **87*a*** '. The one-shot **86*a*** is also operated to energize solenoid **19*a*** each time the pedestal gate **87*a*** is triggered. After the one-shot **86*a*** times out, pedestal gates **88*a*** and **89*a*** will be triggered to change the state of the register **51AR** and to initiate operation of the one-shot **70*a***, respectively. Register **51AR** which is coupled to a register **51BR** comprises a bistable flip-flop which changes state each time the pedestal gate **88*a*** is triggered, and in this respect this flip-flop differs in construction from the flip-flop **92**. Each time the register **51AR**, changes state, it signals the print detector **95*a***. The print detector **95*a***, upon receipt of a signal via conductor **99*a*** which is connected to the printer logic circuitry **62**, operates the print driver **97*a*** to energize the print electromagnet **31*a*** to drive the single print hammer such as hammer **26** into printing cooperation with the print drum **11**.

Referring now to the embodiment of FIG. **9** of the drawing, there is shown a fragmentary portion of a recorder in the form of a print drum **11*b*** having a bank of print hammers **H0** through **H79**. The printer shown in FIG. **9** does not have a carriage as in the embodiment of FIGS. **1** through **7** and the embodiment of FIG. **8**, and yet horizontal tabulation can be effected electronically. Components which are the same in construction and function as the components shown in FIGS. **1** through **7**, are designated by the same reference char-

acters, with the addition of letter "b." In the embodiment of FIG. 9, the counter 50*b* includes binary counters 51*b* and 52*b*. The eight outputs of the diode matrix 53*b* and the ten outputs of the diode matrix 54*b* are usable not only to effect horizontal tabulation through means of one or more modules or coincidence gates MD, but these outputs are connected to enable successive actuation of the print hammers H0 through H79. Assuming that the counter 50*b* is at its initial or reset condition so that negative potential exists on output conductors M0 and M0/7, thereby enabling an AND gate 55*o* formed by diodes 57*o* and 58*o* and a resistor 55*o'*. The output of the AND gate 55*o* on a conductor 130 will cause one of the inputs to AND gate A0 to be at negative potential. A conductor 132 is connected to the other input of the AND gate A0 and to the output of an AND gate AA0. When coincidence is found in the printer logic circuitry 62*b*, it will cause negative potential to be applied to a conductor 134 which forms one input to the AND gate AA0. A conductor 135, connected to a conductor 136, is at negative potential whenever the printer is not busy carrying out a typical machine function such as line feed. A conductor 137 is connected to a conductor 138 which is connected to the collector of the transistor Q2 of the bistable flip-flop 75*b*. Whenever the collector of the transistor Q2 is at ground potential, namely, when the flip-flop 75*b* is in its set condition, ground potential will be applied to the conductor 138, thereby preventing enablement of the AND gate AA0. Assuming there is coincidence, as evidenced by a negative potential on conductor 134 that the printer has completed machine functions as indicated by negative potential on the conductor 136, and that the flip-flop 75*b* is in its reset condition as evidenced by negative voltage potential on the conductor 137, the AND gate AA0 is thereby enabled to place negative potential on the conductor 132. As negative potential now exists on conductors 130 and 132, AND gate A0 is enabled to cause a print driver PD0 to energize a print coil P0, thereby driving the print hammer H0 into printing cooperation with the print drum 11*b*. Accordingly, a character is printed at the first print position on the record medium (not shown in FIG. 9). When the character has been printed at the first print position, the next character can be printed at the second print position by a print hammer H1 under the control of the printer logic circuitry 62*b*. The counter 50*b* has now advanced so that an AND gate 55_1 formed by diodes 57, and 58_1, and a resistor 55_1, which is connected to the source of negative potential, is enabled. The diode 57_1 is connected to the output conductor M1 and the diode 58_1 is connected to the conductor M0/7. When the AND gate 55_1 is enabled, negative potential will be supplied to one input of an AND gate A1 via a conductor 142. As soon as the printer logic circuitry 62*b* finds coincidence, the printer is not busy performing a nonprinting function such as line feed, and the flip-flop 75*b* is not in the set condition, an AND gate AA1 is enabled, thereby placing negative potential on a conductor 144 which is connected to another input of the AND gate A1. As both inputs 142 and 144 are at negative potential, the AND gate A1 will be enabled, causing print driver PD1 to energize print electromagnet P1 to drive the print hammer H1 into printing cooperation with the print drum 11*b*.

Assuming no tabulating signal is received by AND gate 64*b*, printing and character spacing will occur at successive print positions upon successive actuation of print hammers H0 through H79 under the control of the printer logic circuitry 62*b* and the counter 50*b*, even though modules MD are plugged into the connector board 110 at positions as shown in FIG. 6.

Assuming that a tabulating signal is received by AND gate 64*b*, AND gate 71*b* will be enabled to trigger the pedestal gate 74*b*, thereby setting the flip-flop 75*b*. Setting the flip-flop 75*b* will inhibit all AND gates AA0 through AA79 because ground potential is placed on the conductor 138. The AND gates AA0 through AA79 cannot be enabled until such time as the flip-flop 75*b* is reset. Resetting will occur at the next predetermined count of the counter 50*b* and will cause establishment of a circuit through the conductor 60*b*. Thus, the flip-flop 75*b* will be set whenever a tabulating signal is received and will be reset at the next higher count at which a module MD is plugged in.

Assume the diode matrices 53*b* and 54*b* are connected by three modules MD, as shown in FIG. 6, at the Count 30 position, the Count 55 position, and the Count 73 position, respectively. Assume also that printing has occurred at the first 10 print positions, that is, the last print hammer to be actuated having been print hammer H9, and that a tabulating signal is received. Reception of the tabulating signal by the AND gate 64*b* will set the flip-flop 75*b* and disable all AND gates AA0 through AA79; therefore, printing cannot occur at any position. When the counter 50*b* has been advanced to Count 30, the flip-flop 75*b* will be reset, thereby enabling the next printable character to be printed at the thirty-first print position by print hammer H30. Printing at successive print positions can occur until the next tabulating signal is received, at which time the flip-flop 75*b* is again set and all the AND gates AA0 through AA79 are disabled. Assuming the next tabulating signal was received at Count 50, the next print position at which printing would occur would be the fifty-sixth print position. Under the control of the printer logic circuitry 62*b* and the counter 50*b*, if no other tabulating signal is received printing can occur at successive print positions until the eightieth print position corresponding to count 79 of the counter 50*b*. If, however, a tabulating signal were received at Count 70, printing at all print positions from the seventy-first print position to the seventy-fourth print position would be inhibited. The module MD at the Count 73 position will reset the flip-flop 75*b* and printing and character spacing can continue through the eightieth print position. At the eightieth print position at which print hammer H79 is adapted to print, the print hammer H79 will be actuated when AND gates AA79 and A79 are enabled, thereby energizing print electromagnet P79. Immediately thereafter, the printer logic circuitry 62*b* operates the one-shot 118*b* to reset the counter 50*b*. Also, the record medium will be line fed so that the next line can be printed across the record medium. The next line will be printed by successive actuation of print hammers H0 through H79 and printing will be inhibited between the count at which the tabulating signals are received and next higher respective Counts 30, 55 and 73, thereby effecting horizontal tabulation electronically.

Typical printer logic circuitry to which the control system of the invention is adapted, is depicted in above-mentioned U.S. Pat. No. 3,291,909 particularly the dual hammer electronics shown in its FIGS. 42A, 42B, 42C and 42D, and the single hammer electronics

shown in its FIGS. 26A and 26B, and described in its printed specification. With respect to the dual hammer electronics conductor 72' of the present application is adapted to be connected to output Go of comparator counter 600 of that patent; the conductor 66 of the present application is adapted to be connected to an input to gate NOR–1 of that patent; the conductor 77 of the present application is adapted to be connected to an input to gate SOR1 of that patent; and so on.

In the foregoing embodiments, the counters 50 and 50*b* keep track of the last recording position. FIG. 5A represents a fragmentary portion of a counter 50*x* and counter control circuits which enable the counter 50*x* to be stepped in either forward or reverse directions so that the counter 50*x* does not lose count in response to a backspacing signal. Only registers 51*ax* and 51*bx* of the counter 50*x* are shown. An add-substract register 150 is normally in the add condition so that each printing or character spacing signal from the printer logic circuitry 62*x* will advance the counter 50*x*, alternately via pedestal gates 87*x*'' and 94*x*'', as described in connection with gates 87'' and 94'' in FIG. 5. A spacing signal from printer logic circuitry 62*x*, via pedestal gate 151, will reset the register 150 if it is in the subtract condition. A backspace signal from the circuitry 62*x* will set the register 150 to the substract condition via pedestal gate 152. A pedestal gate 87*x* will advance the counter 50*x* while the system is in the tabulating mode of operation. A space solenoid 153 operates a pawl plunger 154 to drive the drum 17 via ratchet 155 to backspace the carriage 13.

Other embodiments and modifications of this invention will suggest themselves to those skilled in the art, and all such of these as come within the spirit of this invention are included within its scope as best defined by the appended claims.

What is claimed and desired to be secured by Letters Patent of the United States is:

I claim:

1. A control system for a recorder, comprising: recording means, and means for controlling said recording means to provide recording at selected positions including a first electronic counter having a plurality of outputs, a second electronic counter having a plurality of outputs, said first and second counters being operatively associated to effect advancement of said second counter by said first counter, an AND gate having a pair of inputs for connecting a selected output of said first counter and a selected output of said second counter, said AND gate providing an output when said first and second counters enable said AND gate, memory means settable by a special control signal and resettable by an output from said AND gate, a connector board having sets of contacts to which said outputs of said first and second counters are connected, each set of connector board contacts corresponding to a different counter position, a module containing said AND gate and having a set of contacts to which said AND gate is connected, said set of contacts of said module being connectable with said sets of contacts of said connector board, and means providing for ready removal and connection of said module at any selected position on said connector board to control resetting of said memory means at any preselected count.

2. The invention defined in claim 1, wherein a plurality of said modules are provided, and means electrically connecting each of said modules to said memory means to control resetting of said memory means by said module associated with the next higher preselected count.

3. In a recorder for recording characters in response to input data along a line of horizontally spaced positions,

recording means operable to record said characters at each of said spaced positions,

enabling means for sequentially enabling recording of said characters at said spaced positions by said recording means,

an operating means for operating said recording means at each enabled spaced position in response to said input data,

indicating means operable to distinct settings each representing one of said spaced positions and operated incident to the operation of said enabling means to provide a continuous indication of the spaced position,

tabulation control means for controlling the enabling means and operable to operate the enabling means to enable recording at a sequence of said spaced positions with a corresponding advance in the setting of the indicating means, said tabulation control means inhibiting said operating means from operating said recording means at each of said enabled spaced positions,

tabulation start means for placing the tabulation control means in operation,

and tabulation stop means coupled to and controlled by the indicating means and effective in at least one of said settings of the indicating means to arrest operation of the tabulation control means.

4. The recorder as set forth in claim 3 wherein said recording means includes

a movable type carrier,

and printing means mounted in printing cooperation with said type carrier.

5. The recorder as set forth in claim 4 wherein said printing means includes

a plurality of printing hammers each disposed at one of said spaced positions.

6. The recorder as set forth in claim 3 wherein said indicating means is a counter having separate counting portions.

7. In a recorder for recording characters in response to input data along a line of horizontally spaced positions,

a movably mounted recorder carriage,

drive means coupled to the recorder carriage for moving said recorder carriage along said line and operated to advance the recorder carriage in response to said input data,

indicating means operable to distinct settings each representing one of said spaced positions and operated in response to said input data to provide a continuous indication of the spaced position,

tabulation control means for controlling the drive means and operable to operate the drive means to advance the recorder carriage without recording and to produce a corresponding advance in the setting of the indicating means,

tabulation start means for placing the tabulation control means in operation,

and tabulation stop means coupled to and controlled by the indicating means and effective in at least one of said settings of the indicating means to arrest operation of the tabulation control means.

8. In a recorder as set forth in claim 7,
a return means connected to said recorder carriage to return said recorder carriage to a start-of-line position,
a carriage return control means for controlling said return means and operable to operate said return means to return the recorder carriage to said start-of-line position and to reset said indicating means to the distinct setting representing said start-of-line position,
and a carriage return start means for placing said carriage return control means in operation.

9. The recorder as set forth in claim 7 including
at least one printing hammer mounted on said recorder carriage.

10. The recorder as set forth in claim 7 wherein said tabulation stop means includes
gating means coupled to and controlled by said indicating means to supply a stop control signal whenever said indicating means is in at least one of said settings,
and a bistable memory means coupled to and controlled by said gating means to arrest operation of said tabulation control means.

11. A control system for a recorder comprising:
a recording means for recording at successive recording positions starting at a start-of-line position,
advancing means operable to advance said recording means to each of said recording positions,
a counting means having different and distinct settings, each of said settings representing one of said recording positions,
a recording control means controlling said advancing means to operate said advancing means to advance said recording means to the successive recording positions incident to recording and correspondingly sequencing said counting means to the setting representative of each of said recording positions,
and a tabulating control means controlling said advancing means incident to tabulating to operate said advancing means to sequentially advance said recording means to successive recording positions without recording and sequencing said counting means to the settings representative of each of said recording positions, said tabulating control means arresting the operation of the advancing means when said counting means is at a predetermined setting so that the recording means is arrested at a recording position represented by said predetermined setting.

12. The control system as set forth in claim 11 including
a carriage return means operable to return said recording means to said start-of-line position and to reset said counting means to the setting representing said start-of-line position.

13. The control system as set forth in claim 11 including
a tabulating start means for placing said tabulating control means in operation.

14. The control system as set forth in claim 11 including
a gating means coupled to said counting means for selecting said predetermined setting.

15. The recorder as set forth in claim 11 wherein said recording means includes
a movably mounted recorder carriage,
and a printing means mounted on said recorder carriage.

16. The recorder as set forth in claim 15 including
a movable type carrier in printing cooperation with said printing means.

17. A printer for selecting at least one of a plurality of column positions in which a symbol is to be printed including:
a plurality of printing means, each printing means individual to at least one of a plurality of column positions for causing the printing of any one of a plurality of symbols at its associated column positions;
a binary counter having a plurality of outputs; means for normally advancing the counter a predetermined amount in response to the printing of a symbol by the printing means;
means responsive to the output of the counter for causing different printing means to be rendered operative for different counter outputs;
means for supplying a tabulation signal to the printer;
means responsive to the tabulation signal for advancing the counter at a rate which is substantially faster than the rate at which symbols are received;
a coincidence gate individual to a predetermined column position and having an output and a plurality of inputs, each of the inputs of the coincidence gate being connected to different ones of the outputs of the binary counter; and
means responsive to the output of the coincidence gate for disabling the fast counter advancing means.

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