May 13, 1969 H. S. SCHWARTZ 3,443,514

PRINT HAMMER TIMING AND ENERGIZING MEANS IN HIGH SPEED PRINTERS

Filed May 17, 1967

Fig.1.

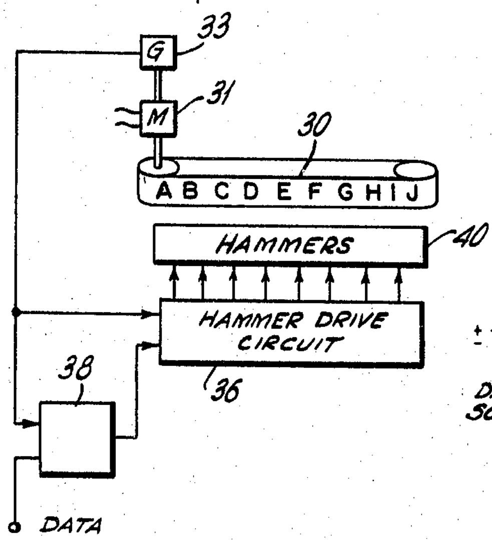
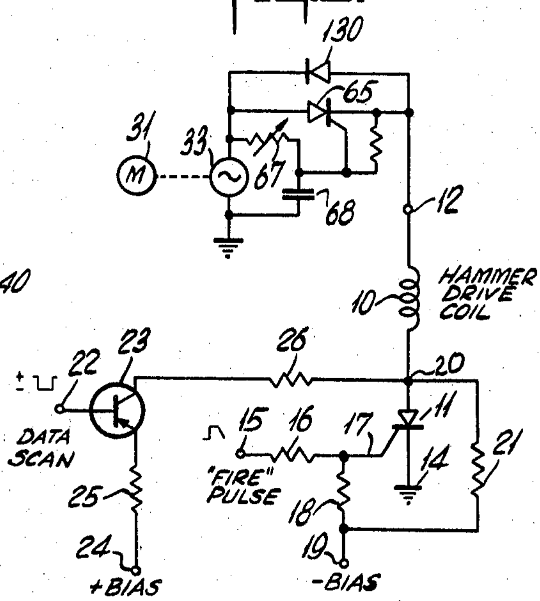


Fig.2.



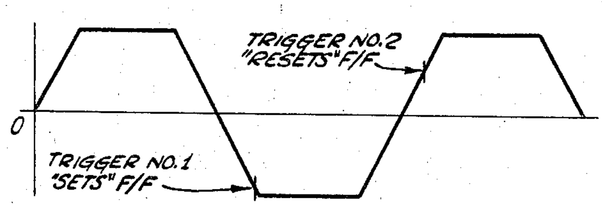


Fig.4A

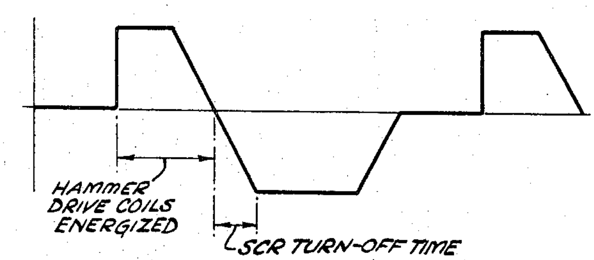


Fig.4B

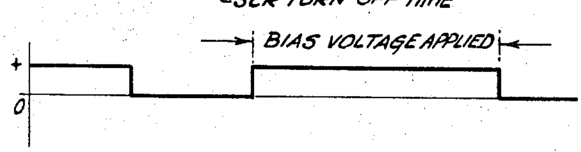


Fig.4C

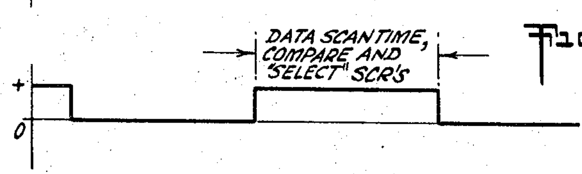
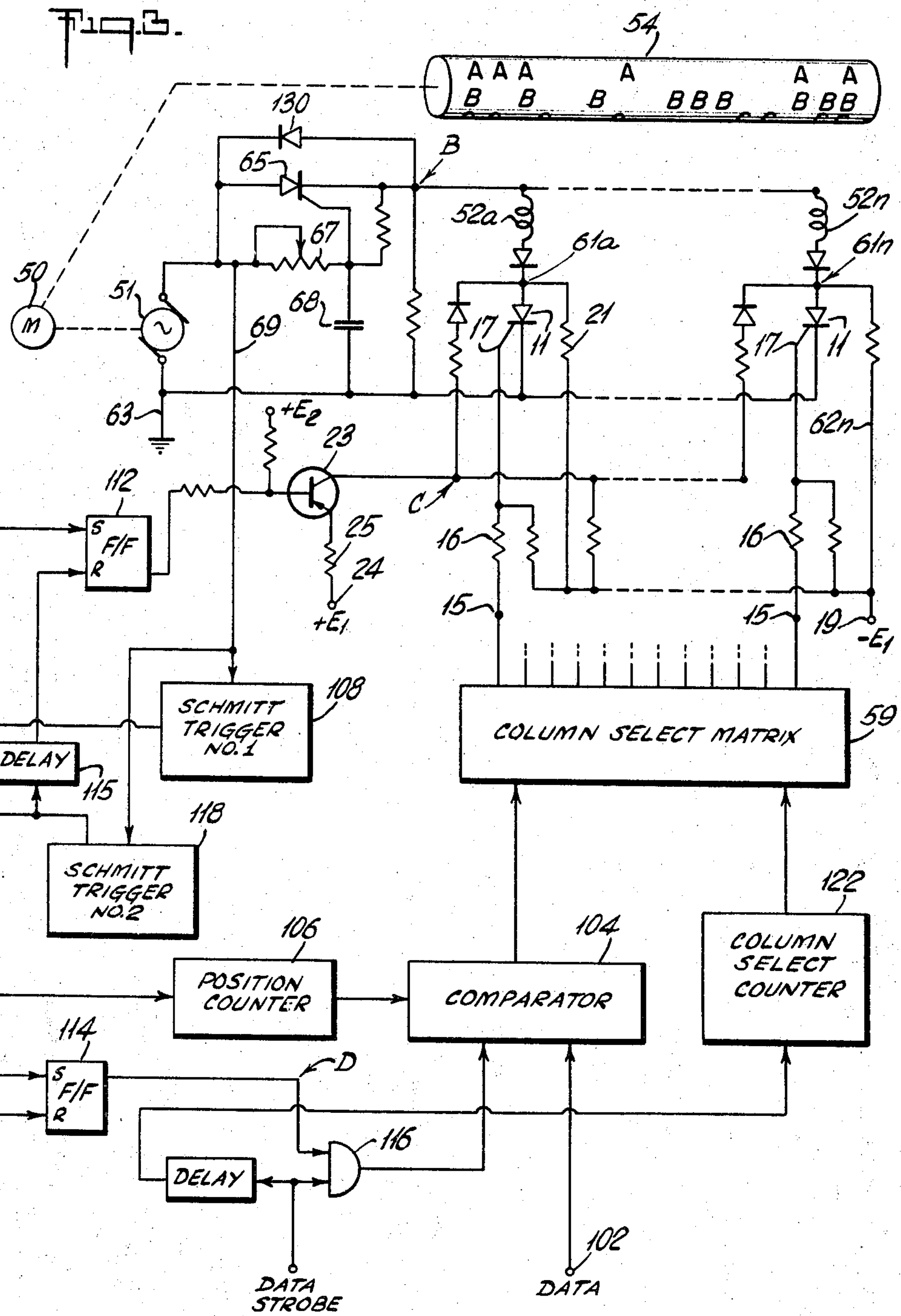


Fig.4D

INVENTOR
HAROLD S. SCHWARTZ

Fig. 3.



INVENTOR
HAROLD S. SCHWARTZ

United States Patent Office 3,443,514
Patented May 13, 1969

3,443,514

PRINT HAMMER TIMING AND ENERGIZING MEANS IN HIGH SPEED PRINTERS

Harold S. Schwartz, White Plains, N.Y., assignor to Potter Instrument Company, Inc., Plainview, N.Y., a corporation of New York

Filed May 17, 1967, Ser. No. 639,191
Int. Cl. B41j *1/16*
U.S. Cl. 101—93 8 Claims

ABSTRACT OF THE DISCLOSURE

An alternating current generator is synchronously driven with the rotating drum in a high speed drum printer, or the circulating belt in a high speed chain printer, and the output of this generator is used to provide timing signals indicative of the character positions and to provide power for energizing the printer hammers.

Background of the invention

The present invention, generally, relates to a high speed, on-the-fly impact printer for printing electronic data processing information and, more particularly, to a new and improved printer in which an alternating current generator driven synchronously with the character drum or belt provides timing signals and power for energizing the printer hammers.

One object of this invention is to provide a new and improved high speed impact printer which is relatively simple and efficient as compared with prior art printers of similar performance.

Another object of the invention is the provision of an improved power supply for printer hammers employing silicon controlled rectifiers (SCR's) in series with each drive coil, which reduces electrical noise.

Summary of the invention

Briefly, the high speed printer contemplated in this invention has a hammer drive coil for actuating each printing hammer and a SCR connected in series with each hammer drive coil for controlling the current flow through the coil. Hammer selection logic circuitry, of a suitable design known in the art, is connected to the control electrode of each SCR to select (in accordance with input data) certain hammers for impacting the continuously moving drum or belt. It will be appreciated that the printer described thus far is conventional.

An alternating current generator is driven synchronously with the rotating drum or circulating belt of the printer and its output is coupled to the hammer drive coils for energizing the selected coils and to the logic circuitry as a timing signal.

Brief description of the drawings

Further objects, features and advantages of the present invention will become more apparent from the following detailed description thereof, when taken in conjunction with the acocmpanying drawings in which like referece numerals are used for like parts in the various views, and in which:

FIGURE 1 is a block diagram of chain printer constructed in accordance with the principles of this invention;

FIGURE 2 is a schematic diagram of a circuit for selecting and energizing a hammer coil in accordance with the teachings of the present invention;

FIGURE 3 is a partial schematic diagram and partial block diagram of a drum printer constructed in accordance with the principles of the present invention; and

FIGURE 4 is a series of idealized voltage waveforms at the points indicated by the letters A through D in the circuit diagram of FIGURE 3.

Description of the preferred embodiment

Referring now to FIGURE 1 of the drawings, a motor 31 continuously circulates a type belt or chain 30 past a row of electromagnetically operated print hammers 40 in a manner known to those skilled in the high speed printer art. The print hammers are energized by a hammer drive circuit 36 which is controlled by a logic control circuit 38.

One example of an electromagnetically operated print hammer of the type that may be employed in the practice of this invention is disclosed in U.S. Patent No. 3,349,696, granted to J. T. Potter, Oct. 31, 1967.

An alternating current generator 33 driven by the motor 31 produces an output which is coupled both to the logic circuitry 38 and the hammer drive circuitry 36. This output provides a reference or timing signal which correlates the position of the type faces on chain 30 with the printing positions along the hammer print line and further provides power for energizing the electromagnetic hammers 40 in a manner which will be described more fully below. Although the output of generator 33 may be sinusoidal, it preferably has a trapezoidal waveform.

Incoming binary encode data coupled to terminal 39 is scanned in a manner known to those skilled in the art, and when there is a correspondence betwee the data to be printed in a column and the type character about to be in position at that column, the particular hammer is selected. All the selected hammers are advantageously energized simultaneously by the generator 33 during the positive half cycle of its output waveform.

Referring now to FIGURE 2, a silicon controlled rectifier 11, coupled in series with a hammer drive coil 10, controls the flow of current through the coil. During the period when the data is scanned, there is no energizing potential coupled to terminal 12 of coil 10 from generator 33. A transistor switch 23, however, is driven to saturation during this interval, coupling a positive bias 24 to the anode 20 of SCR 11 so that a positive selecting pulse applied to the control electrode terminal 15 initiates conduction through the thusly selected SCR. Current flow from bias 24 sustains conduction through the SCR during the scanning period.

Advantageously, the hammer driver coils 10 are not coupled to the generator 33 until the output of the generator has at least approximately reached its peak positive potential. To this end and to the end of providing a sufficiently long interval during which the hammers may be selected, a silicon controlled rectifier 65 controls the energization of the print hammer coils. The control electrode of SCR 65 is coupled to an R-C network comprising variable resistor 67 and capacitor 68, which delays the rise of the control electrode potential and therefore delays the firing of this SCR until after the output of generator 33 has reached its peak positive potential. When SCR 65 fires, it couples generator 33 to the coil 10, causing the hammer to fire. When the output of generator 33 goes negative, conduction through SCR 65 and the SCR 11 is extinguished, and diode 130 provides a discharge path for the hammer driver coil 10. It will be appreciated that all the selected hammer driver coils may be energized simultaneously.

While the hammer driver coils are energized, the data scan pulse terminates cutting off transistor switch 23 so that when the output of generator 33 reaches zero potential and starts to go negative, conduction through the selected SCR's 11 is extinguished.

The control electrode 17 and the anode 20 of SCR 11 are coupled via resistor 18 and 21, respectively, to a slightly negative bias source 19 in order to provide noise immunity.

Referring now to FIGURE 3, a motor 50 drives a print drum 54 and a generator 51 having a trapezoidal output waveform. A print hammer (not shown) is located at each print position or column along the print line and each hammer has associated with it a hammer driver coil designated 52*a* through 52*n*. An SCR 11 is connected in series with each of the coils 52*a* through 52*n* and acts as a switch controlling the current through the respective coils in the manner previously explained in connection with FIGURE 2.

The data to be printed may be stored and presented a line at a time to a comparator 104. A counter 106 whose output is indicative of the angular position of the print drum with respect to the print line provides the other input for comparator 104. The input for counter 106 is derived from generator 51 which is so wound that its output moves through 360 electrical degrees each time the print drum 54 advances through an angle sufficient to present a new line of characters at the print line.

The output of generator 51 triggers a bistable multivibrator 108, which may be conveniently a Schmitt trigger circuit, and its output advances the position counter 106 one count for each pulse. As will be appreciated by those skilled in the art, the overall logic system shown is similar to that shown in U.S. Patent No. 3,024,723 of Carl I. Wasserman with the exception that the generator 51 is the source of clock pulses rather than the tone wheels as in the Wasserman patent.

In addition to providing an input to position counter 106, multivibrator 108 additionally triggers a flip-flop 112 whose output in its set condition drives transistor 23 to saturation and a flip-flop 114 whose output in its set condition enables an AND gate 116. Flip-flops 112 and 114 are reset by a second bistable multivibrator 118, which conveniently may also be a Schmitt trigger. With reference to FIGURE 4, it will be understood that multivibrator 108 triggers just slightly before the output of generator 51 reaches its peak negative value and multivibrator 118 triggers before this output reaches its peak positive value. The interval during which flip-flops 112 and 114 are in their set condition determines the data scan interval. It should be noted that flip-flop 112 is reset slightly after flip-flop 114 owing to a delay circuit 115 in order to insure that conduction is initiated through the selected SCR's.

During the data scan interval, a data strobe signal from a high frequency source (not shown) causes the comparator 104 to compare the data applied to 102 with the output of counter 106. The output of a column select counter 112 controls a column select matrix 59 to the end that the output of the comparator 104 is initially steered to the control electrode 17 of the SCR in series with the hammer driver coil in the first column. It will be understood that each time the counter 112 advances one count, its output causes the matrix 59 to steer the output of comparator 104 to the control elecrode of the SCR in series with the coil of the hammer for the next column.

In operation, if the position of the print drum is such that the letter B, for example, is about to appear along the print line, the output of position counter 106 may be a binary coded letter B. It will be understood that a decade matrix may be employed if necessary. If the data coupled to terminal 102 demands a B be printed in the first column, an output from the comparator, which is coupled via the column select matrix to the control electrode 56 of the SCR 53 for the first column, causes the SCR to fire. Current flow through transistor 70 maintains conduction in SCR 53 after the select pulse on control electrode 56 terminates.

The delayed data strobe pulse causes column select counter 122 to advance one count, coupling the output from comparator 104 to the SCR in series with the hammer driver coil for the second column. If a B is to be printed in the second column also, the next data strobe pulse will cause an output from comparator 104 to fire the SCR 53 for the second column. If a letter other than B is to be printed in the second column, the comparator produces no output signal. Following the comparison for the second column, the column select counter advances another count. It will be appreciated that the frequency of the data strobe signal is high enough that all of the printer column position may be scanned during the data scan interval.

The hammers which have been selected in the manner just described are then energized simultaneously by the generator 51. An SCR 65 advantageously establishes a delay between the time when the output of generator 51 attains its peak positive value and the time when the hammer coils of the selected hammers are energized. When the control electrode 66 of SCR 65 reaches a sufficiently positive potential with respect to the potential at the anode of SCR 65, it triggers, coupling the output of generator 51 to the terminals of all of the hammer driver coils. For the selected hammers, their associated SCR's 53 are conducting and permit current flow through coils causing the associated hammers to fire. As the output of generator 51 goes negative, the anodes of the previously conducting SCR's 53 become back bias and conduction through these SCR's is extinguished. It should be noted that during this interval, conduction through SCR 65 is similarly extinguished and diode 130 couples the coils 52 to the generator 51 during the negative half cycle of the generator output.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and described.

What is claimed is:

1. A high speed printer comprising, in combination:
a moving type carrier,
a selectable electromagnetically operated print hammer disposed to impact with said type carrier,
said hammer including a hammer driver coil which actuates said hammer upon being energized,
a logic circuit for selecting said print hammer,
said logic circuit including means responsive to input data and the position of said moving type carrier for firing said print hammer when a type on said moving type carrier specified by said data is operably positioned for printing with respect to said hammer,
an alternating current electrical generator driven synchronously with said moving type carrier, and
means for coupling an output from said generator to said hammer driver coil wereby said hammer driver coil is energized by said generator when said hammer is selected.

2. A high speed printer as in claim 1 further including means for coupling an output from said generator to said logic circuitry for correlating the position of said type carrier with respect to said print hammer.

3. A high speed printer as in claim 2 wherein said moving type carrier is a continuously circulating endless belt.

4. A high speed printer as in claim 2 wherein said moving type carrier is a continuously circulating drum.

5. A high speed printer as in claim 1 wherein one end of said hammer driver coil is coupled to the output of said generator and further including a silicon controlled rectifier having an anode, a cathode and a controlled electrode, means for coupling the other end of said coil to said anode, means for coupling said control electrode to said logic circuit, and means for also coupling said anode

to a sustaining power supply whereby in selecting said hammer conduction through said rectifier is initiated by a pulse on said control electrode and sustained by said sustaining current supply until an output is coupled from said generator to said coil.

6. A high speed printer as in claim **1** wherein said means for coupling said generator to said hammer driven coil includes an electrical switch which couples said output to said one terminal of said coil a predetermined interval after the output of said generator has reached a certain amplitude during its positive half cycle.

7. A high speed printer as in claim **5** wherein said alternating electric current generator has a trapezoidal output waveform.

8. A high speed printer as in claim **6** wherein said switch is a silicon controlled rectifier and said predetermined interval is adjustable.

References Cited

UNITED STATES PATENTS

2,776,618	1/1957	Hartley	101—93
2,874,634	2/1959	Hense	101—93
2,915,966	12/1959	Jacoby	101—93
2,915,967	12/1959	Gehring et al.	101—93
2,940,385	6/1960	House	101—93
2,941,188	6/1960	Flechtner et al.	340—172.5
3,064,561	11/1962	Mauduit	101—93
3,099,206	7/1963	Hense	101—93
3,220,343	11/1965	Wasserman	101—93
3,247,788	4/1966	Wilkins et al.	101—93

WILLIAM B. PENN, *Primary Examiner.*