United States Patent

[11] 3,554,347

[72] Inventor Cornelius C. Perkins Birmingham, Mich.
[21] Appl. No. 724,965
[22] Filed Apr. 29, 1968
[45] Patented Jan. 12, 1971
[73] Assignee Burroughs Corporation Detroit, Mich. a corporation of Michigan

[54] **SYSTEM FOR AUTOMATICALLY SETTING A POSITION COUNTER TO EFFECT AGREEMENT WITH THE POSITION OF A TRAVELING PRINTING ELEMENT**
1 Claim, 9 Drawing Figs.

[52] **U.S. Cl.** **197/48,** 101/93, 197/65
[51] **Int. Cl.** **B41j 1/60**
[50] **Field of Search** .... 101/93; 197/48—55, 65, 66

[56] **References Cited**

UNITED STATES PATENTS

2,831,424	4/1958	MacDonald	197/49X
3,135,195	6/1964	Potter	101/93
3,426,880	2/1969	Blodgett	197/1
3,472,352	10/1969	Kondur	197/49
3,343,482	9/1967	Scott et al.	101/93X
3,360,782	12/1967	Derc	101/93X
3,399,753	9/1968	Revelle	101/93X
3,400,213	9/1968	Hell	101/93X
3,417,690	12/1968	Clark et al.	101/93
3,420,164	1/1969	Lee	101/93
3,442,364	5/1969	Ragen	197/49

Primary Examiner—Edgar S. Burr
Attorneys—Paul W. Fish and Edwin Uren

ABSTRACT: A system for synchronizing the lateral movement of a printing element with an electronic position counter. A pulse generator is operatively connected to a printing element drive motor to generate a pulse at each printing position. The pulses from the pulse generator are supplied via an amplifier to a comparator circuit which is periodically tested for a voltage level change in the amplifier output. When the level has not changed for a predetermined time due to the arrested movement of the printing element, the electronic position counter is set to a predetermined number corresponding to the present position of the printing element.

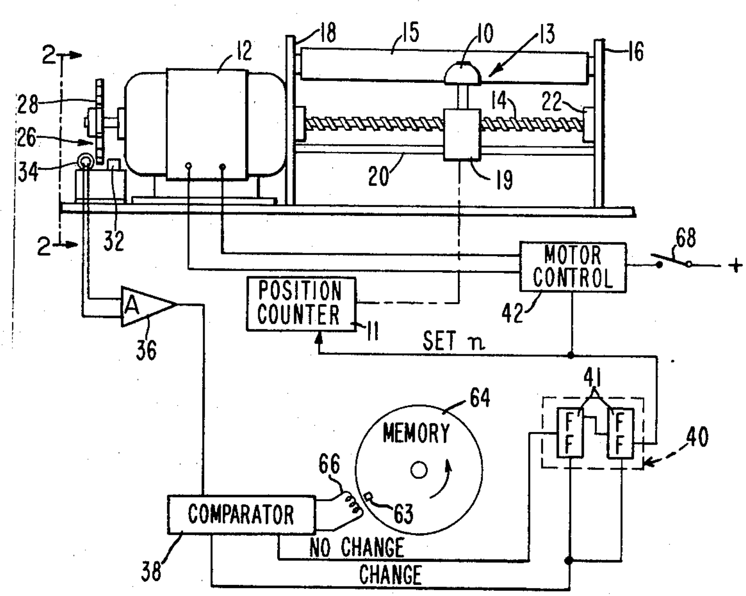


FIG. 1.

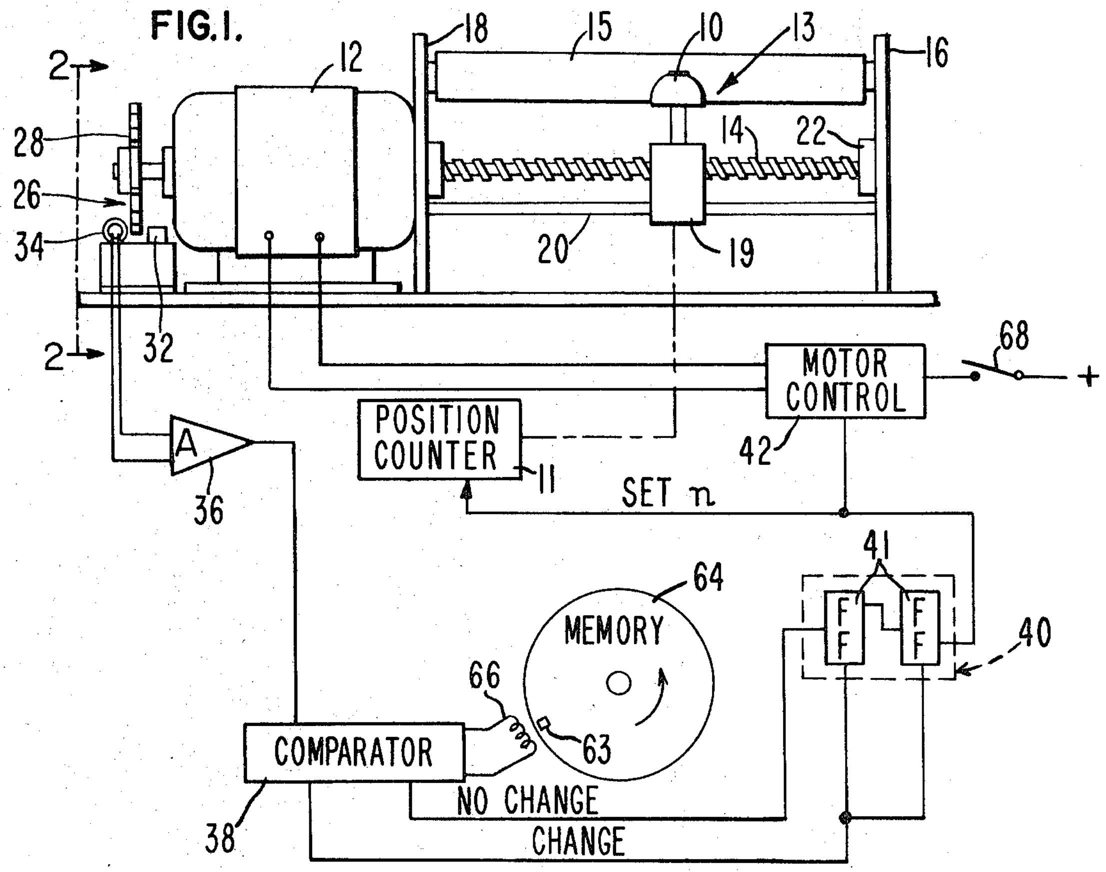


FIG. 2.

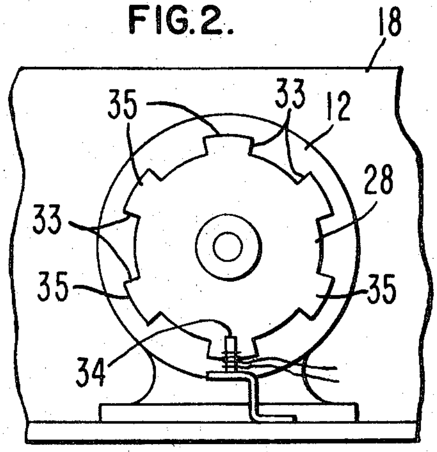
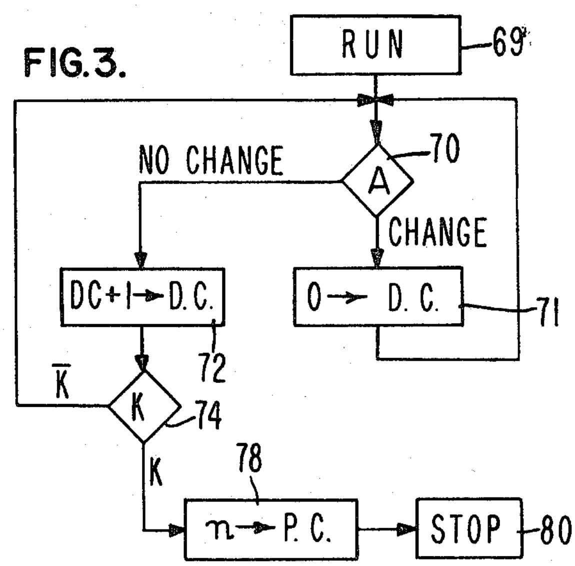


FIG. 3.



INVENTOR.
CORNELIUS C. PERKINS.
BY
Russel C. Wells
ATTORNEY.

FIG.4.

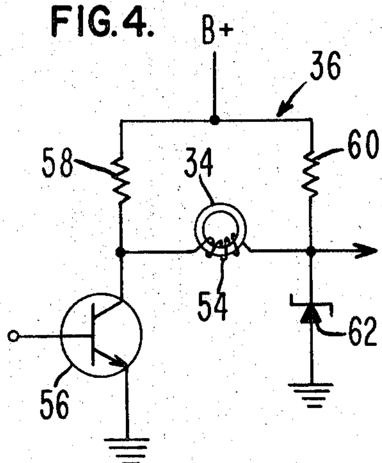


FIG.5.

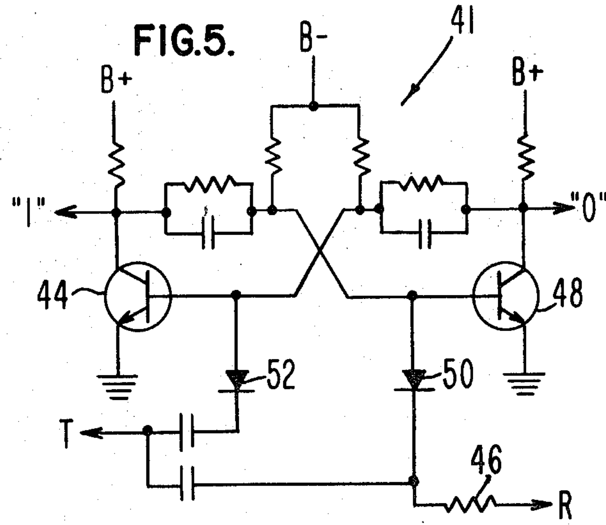


FIG.6.

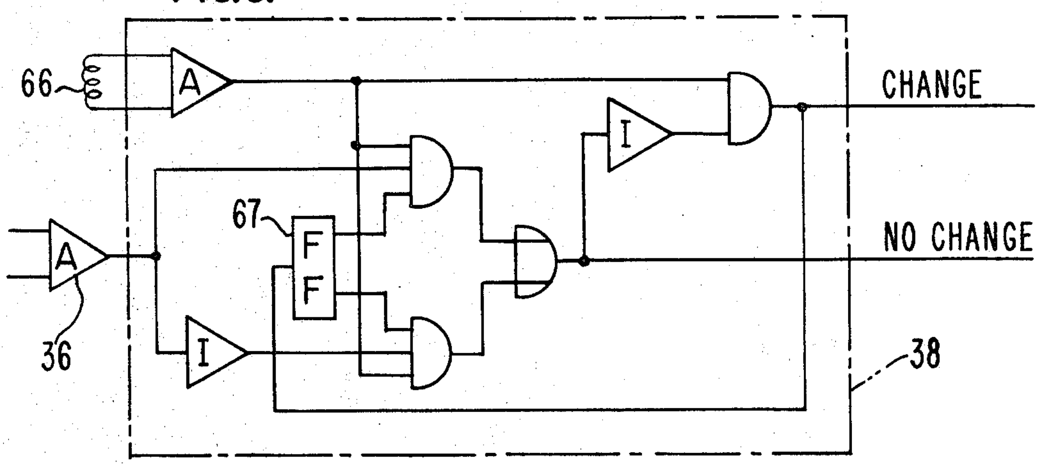


FIG.7.

FIG.8.

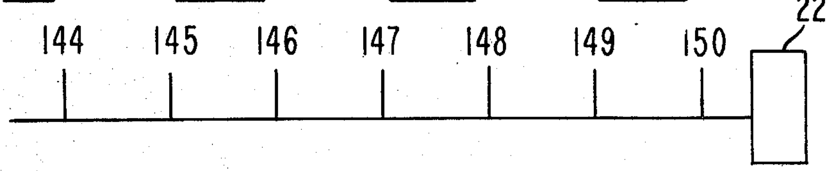
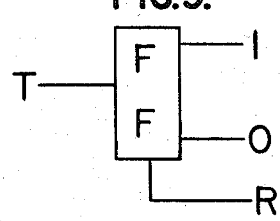


FIG.9.



INVENTOR.
CORNELIUS C. PERKINS.
BY
Russel C. Wells.
ATTORNEY.

SYSTEM FOR AUTOMATICALLY SETTING A POSITION COUNTER TO EFFECT AGREEMENT WITH THE POSITION OF A TRAVELING PRINTING ELEMENT

SUMMARY OF THE INVENTION

In computing systems having a visual printing output, wherein each printing position along the platen is represented by a number indicating the printing element's position from a reference point at one end of the platen, the location of the printer element is controlled by information stored in an electronic position counter. However, when the power to the printing element drive motor is removed, the printing element can then be manually moved to any printing position and thereby invalidating the relationship between the printing element and stored number in the position counter. It is therefore necessary, prior to the operation of the printing element to set the position counter to effect count agreement with the position of the printing element.

It is, therefore, an object of my invention to synchronize the present position of a printing element with the electronic position counter.

I have, therefore, provided a system to accomplish this synchronization and the system comprises a stop member positioned at one end of the path of travel of the printer element and a pulse generator which is operatively connected to the printing element and generates a pulse at each printing position during movement of the element. The output of the pulse generator is temporarily stored in a multivibrator and at predetermined intervals, the present output of the pulse generator is compared with the output of the multivibrator to determine whether or not the printing element has moved one printing position during the preceding time interval. When the printing element has been arrested by the stop member for a period of time, which time is greater than the time required for travel of the printer element between adjacent printing positions, a position counter is electronically set with a number representing the present position of the element.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a diagrammatic illustration of portions of a printer embodying my invention.

FIG. 2 is a view taken along the line and in the direction of the arrows 2–2 of FIG. 1;

FIG. 3 is a flow diagram;

FIG. 4 is a schematic of the amplifier shown diagrammatically in FIG. 1;

FIG. 5 is a schematic of the flip-flop circuit shown diagrammatically in FIG. 1;

FIG. 6 is a schematic of the comparator of FIG. 1;

FIG. 7 is an illustration of the output of the amplifier;

FIG. 8 is an illustration of the printing positions adjacent the stop member;

FIG. 9 is a diagrammatic illustration of the flip-flop of FIG. 5.

DETAILED DESCRIPTION

In printers of the type illustrated in FIG. 1 wherein a printing element 13 is movable along a lead screw 14 from one printing position to the next, the carrier 19 is adapted so as to allow manual movement of the printing element along the lead screw. One reason for such an adaptation is to allow qualified service personnel perform maintenance operations such as cleaning and lubricating the lead screw 14. Unfortunately this also permits nonqualified personnel to also move the printing element 13 from any one position to another. This usually occurs when the printer is not operating such as after business hours. Such manual movement, either authorized or unauthorized, usually results in the printing element 13 becoming out of synchronization with its control unit or position counter 11. It is therefore necessary, before the printer is put into use, to provide means of establishing the synchronization between the printing element 13 and the position counter 11.

Additionally, it is the nature of most electronic components or devices which are capable of storing information in the form of electrical signals, to lose all such information upon the removal of electric power. Such removal of power naturally occurs whenever the system is turned off at the close of business. Therefore, when the power is removed, the location of the printing element 13 as stored in the position counter 11 is lost. Before the printer is put in use, it is necessary to provide a system for automatically setting the position counter 11 to effect agreement with the position of a traveling printing element 13.

The position counter 11 functions to electrically retain the numerical position of the printing element 13 with respect to the platen 15 so that under control of a system such as disclosed and claimed in U.S. Pat. No. 3,403,386 entitled Format Control by C. C. Perkins et al. and assigned to the same assignee, the printing element 13 may be moved in either direction any number of print positions and, of course, a requirement of sequential printing is unnecessary. Once the printing element 13 is initially synchronized with the position counter 11 any future out of synchronization condition may be corrected according to this invention by turning the power off and on or according to another system procedure.

The printing element 13 responds through means not shown, to an input comprising the next printing position and the alpha-numeric character to be printed. In a billing system, by way of illustration only, the data to be printed may contain such information as quantity, article description, cost per unit, weight per unit, shipping charges, gross price, discount, net price and net weight. Each item of data is typically arranged in a columnar format wherein each column is spaced from the adjacent columns. In some instances, all of the above enumerated information may not be required, hence the printing element 13 must be moved along the path of travel through a column without printing. The synchronization between the printing element 13 and the position counter 11 permits selective movement between different columns in a manner as shown in the previously mentioned patent entitled Format Control.

FIG. 1 illustrates the interconnection between the printing element 13 and the electronic or position counter 11 which must be brought into synchronization. As illustrated in FIG. 1, a reversible electric motor 12 drives by means of a lead screw 14, a printing element 13 along a path parallel to the platen 15 and between right 16 and left 18 sideframes. The printing element 13 is supported by a carrier 19 which has a threaded drive connection with the lead screw 14 and is restrained against rotation by a guide rod 20. Attached to the right 16 sideframe is a fixed stop 22 to arrest the travel to the right beyond the extreme printing position as shown in FIG. 8, of the printing element 13. As illustrated, the printing element is of the well known, spheroidal type 10 which is rotatable to position a selected printing type to the print line.

Operatively connected to the motor 12 is a pulse generator 26 comprising a rotatable shunt 28 which is rotated between a permanent magnet 32 and an opposed ferromagnetic core or transducer 34. The shunt 28 has a plurality of spaced projections 35 which are rotated between the magnet 32 and the transducer 34 whenever the printing element 13 is moved along the platen by the motor 12. In the present embodiment, the radial edges 33 of each projection 35 represents a printing position as defined along the platen 15.

The transducer 34 is interconnected as shown in FIG. 4 to an amplifier 36 to supply the output voltage waveform 37 as illustrated in FIG. 7. The amplifier 36 is connected to a comparator circuit 38 wherein the output of the amplifier 36 is periodically tested to determine when the voltage level changes. Any suitable comparator circuit may be used such as the comparator circuit illustrated in FIG. 6. Each time the amplifier 36 is tested, the comparator circuit 38 generates either a "change" or "no change" signal. Both signals are supplied to a disc counter 40 wherein the "no change" signal increments the counter 40 and the "change" signal resets or clears the counter 40. The only output from the disc counter 40 occurs when there is a carry indicating that the counter has exceeded capacity. This signal, called the carry signal K is supplied to the position counter 11 to preset that counter 11 to a predetermined number and this signal is also supplied to the motor control circuit 42 to turn off the motor 12.

The disc counter 40 and the position counter 11 may be any suitable electronic counter that is well-known in the art. FIG. 5 is a schematic of a common flip-flop 41 which can be used for each counting stage of both the disc counter 40 and the position counter 11. In FIG. 1, the disc counter 40 is represented as a two-stage counter with the interconnection between each stage as is shown, while in the preferred embodiment the position counter 11 has eight stages which are similarly interconnected. Also, the position counter 11 in the preferred embodiment is a reversible counter; that is, it has the capability to be counted by incrementing or by decrementing.

In the disc counter 40, when the count exceeds the count of three, the counter setting switch or "1" output transistor 44 is driven out of conduction causing the carry signal to be generated at its collector. This signal is applied to the "R" input resistor 46 at each stage of the position counter 11 to cause its associated preset switch or output transistor 44 or 48 to be driven into conduction. In the preferred embodiment, the number to be preset in the position counter is 150, therefore the first, fourth, sixth, and seventh stages have "R" input resistor 46 connected to the base diode 50 of the "O" output transistor 48 such as shown in FIG. 5; and the other stages have the "R" input resistor 46 connected to the base diode 52 of "1" output transistor 44. In the disc counter 40, the "R" input resistor 46 is connected as shown in FIG. 5, since the disc counter is preset to zero. The position counter 11 can be adapted to permit any number from zero to 255 to be preset in that counter by merely changing the connection of the "R" input resistor 46 to the proper base diode 50 or 52 in each stage. For example, if the position counter were to be preset to zero, each stage would be as shown in FIG. 5, but if the preset number were to be 255, the "R" input resistor 46 in each stage would be connected to the base diode 52 of the "1" output transistor 44.

Referring to FIG. 4, which is the schematic of the amplifier 36, there is shown the single winding 54 on the core 34. When the transistor 56 is conducting because of a signal applied to the base of the transistor, there are two current paths from the B+ to ground. The first path is via one resistor 58 and the second path is via a second resistor 60 and the winding 5. If the shunt projection 35 is between the magnet 32 and the transducer 34, the winding 54 is essentially a high impedance and output level is essentially the magnitude of the zener diode 62. If a shunt projection 35 is not between the magnet and the transducer, the winding is essentially a short circuit and the output voltage is essentially the collector voltage of the transistor 56. For a more detailed discussion of this circuit, reference is made to U.S. Pat. application Ser. No. 521,662, filed Jan. 19, 1966, now a continuation application Ser. No. 780,308, filed Nov. 18, 1968, entitled Transducer and assigned to the same assignee.

The testing signal for the comparator circuit 38 is generated from a magnetic signal which is encoded at a predetermined location 63 on the magnetic memory disc 64. This encoded signal is read by the read head 66 every revolution of the memory disc 64 and is used in the comparator circuit 38 to determine whether or not the amplifier voltage output 37 has changed during the previous revolution of the memory disc. Since a memory disc 64 is driven at a constant speed, an extremely constant time interval between testings is provided and by counting the number of revolutions between changes an elapsed time interval may be determined.

For the purpose of illustration, if the memory disc 64 rotates at 6,000 revolutions per minute, 1 revolution equals 10 milliseconds and assuming that the carrier moves at the rate of 5.00 inches/sec., it will take the printing element 13 approximately 20 milliseconds to move 0.1 inch, which is equal to the distance between printing positions. Therefore, within 3 revolutions of the memory disc 64 the flip-flop 67 will change state if the carrier is moving.

OPERATION

To initiate synchronization between the position of the printing element 13 and the position counter 11, the switch 68 is closed to supply power to the system. In particular, power is supplied to the motor control circuit 42 to cause the motor 12 to drive the printing element 13 toward the right. As the element moves past each printing position, the transducer 26 alternatively changes from a high impedance to a low impedance depending upon the presence or absence of the projection 35 between the magnet 32 and the transducer 34. The disc counter 40, as illustrated, counts from 0 to 3 or less, then resets, but the disc counter 40 never exceeds capacity as long as the printing element 13 is moving.

When the printing element 13 is arrested by the stop member 22, the testing in the comparator circuit 38 continues because the memory disc 64 is still rotating. As the disc counter 40 counts beyond the count of 3,a carry signal is generated out of the counter 40. This carry signal is transmitted to the motor control circuit 42 to turn off the power to the motor 12 and is also transmitted to the position counter 11 to set a predetermined number into the position counter 11 which corresponds to the present position of the carrier 19 against the stop member 22. In the preferred embodiment, the stop member 22 is effectively at printing position 150 although it is physically positioned beyond that position so as not to interfere with normal movement of the printing element 13 and the number set into the carrier position counter 11 is therefore 150.

The flow diagram of FIG. 3 is entered via the box 69 labeled "Run"Run." The designation Run refers to transferring the switch 68 to supply power to the motor 12 to move the printing element 13 to the right. The next operation is to test the output of the amplifier 36 which is shown by the diamond-shaped symbol 70. If there is a change, the disc counter 40 is then cleared at the next step 71, and the program is returned to the testing of the amplifier at the next disc revolution.

If no change is detected, the disc counter 40 is incremented by one at the next step 72. The disc counter 40 is then tested 74 to determine whether or not a carry signal is present. If no carry signal ($\overline{K}$) is present, then the program returns to the amplifier testing step 70.

If a carry K is present, a number *n* is set 78 into the position counter 11 and the program is stopped 80. As previously stated, the time interval between each amplifier test 70 is equal to one revolution of the memory disc 64.

FIG. 8 illustrates the numerical identification of several juxtaposed printing positions which are adjacent the stop member of the right-hand end of the platen as viewed in FIG. 1. Each printing position is numbered in 1/10-inch increments from the left hand end of the platen. In the present embodiment, the platen is 15 inches long although this length is not a limit.

Once the printing element 10 and the position counter 11 are in synchronization, the position counter which as previously stated is an reversible counter, is responsive to bidirectional movement of the printing element. As the printing element moves to the right, the position counter is a "-count-up" counter, and as the printing element moves to the left, the position counter is a "count-down" counter.

Thus, I have shown and described a system for synchronizing the positioning of a printing element 13 with the indicated electronic position stored in a position counter 11. The printing element 13 is operatively connected to the position counter 11 and when the movement of the printing element carrier 19 is arrested by the stop member 22, a signal from the disc counter 40, sets the position counter 11 to a predetermined number indicating the present position of the printing element 13.

I claim:

1. In printing apparatus:

printing means movable along a path of travel having spaced apart printing positions including opposite end printing positions;

an electronic counter normally synchronized with and controlling the positioning of said printing means within the range of said end positions;

electrically operated means operatively connected to said printing means to move said printing means along said path of travel;

said electrically operated means also being operable to move said printing means beyond one of said end printing positions in response solely to loss of synchronization between said counter and said printing means;

a stop member to stop said movement of said printing means at a predetermined position beyond said one end printing position; and

a preset switch element responsive to the engagement of said printing means with said stop member to preset the counter at a numerical indication of the said one end printing position thereby establishing synchronization between said printing means and said counter.