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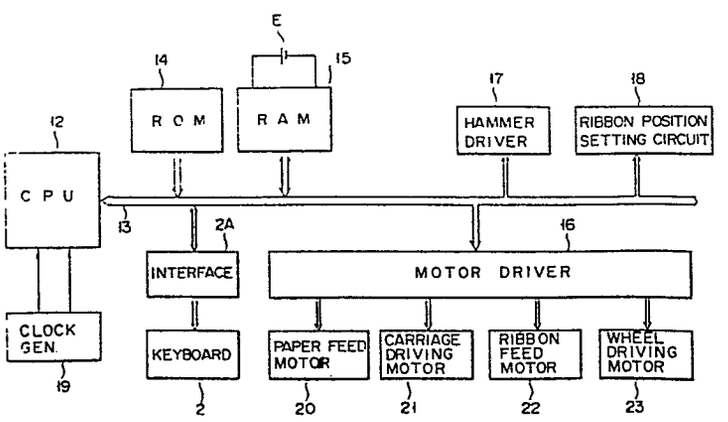
(54) Electronic typewriter.

(57) An electronic typewriter has a keyboard (2) including a plurality of character keys (8, 9), a printing wheel (5) having a plurality of types which can be designated by the character keys (8, 9), a ribbon position setting circuit (18) for selectively setting a printing ribbon (6) at either one of printing or rest positions, and a control circuit (12) which supplies a first control signal to the ribbon position setting circuit (18) so that the printing ribbon (6) is set at the printing position and thereafter the type designated by one of the operated character keys strikes a paper sheet through the printing ribbon (6) when one of the character keys (8, 9) is detected to have been operated while the printing ribbon (6) is set at the rest position, and which supplies a second control signal to the ribbon position setting circuit (18) so as to set the printing ribbon (6) at the rest position when no further key operation is detected for a preset holding time after the printing by one of the character keys is ended. The electronic typewriter further has a holding time data generator (15) for generating holding time data which is used to determine the preset holding time and can be arbitrarily changed.

F I G. 2



Croydon Printing Company Ltd

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Electronic typewriter

The present invention relates to an electronic typewriter in which a printing ribbon is held at a printing position for a preset holding time after a printing operation.

In electronic typewriters using a printing wheel as the printing mechanism, when a character key of, e.g., alphanumeric characters, symbols, and the like is pressed, a character code corresponding to the input alphanumeric character or symbol is generated and stored in a memory. The printing wheel is rotated by a printing wheel motor in accordance with the character code so that a type with the character designated by the character code is positioned to oppose printing paper set on a platen. At the same time, the printing ribbon is set at a printing position between the type of the printing wheel and the paper. A carriage mounting a printing mechanism thereon is shifted horizontally so that the type of the printing wheel is positioned at the printing position on the paper. When a hammer solenoid is driven and the type of the printing wheel strikes the paper set on the platen through the ribbon, the character designated by the input character code is printed on the paper. Note that rotation of the printing wheel, setting of the ribbon at the printing position, and shifting of the carriage are generally

performed at the same time.

In the electronic typewriter with the above arrangement, in order to shorten a response time from a key operation to a printing operation, when the key operation is continuously performed, the printing ribbon is held at the printing position, and the printing wheel does not return to a home position every time the printing operation for one character code is completed. However, when no key operation is performed within a predetermined holding time after the end of the previous printing operation, the ribbon returns to a rest position thereof and the printing wheel returns to the home position in order to allow the last character printed to be easily confirmed. Generally, the holding time is fixed at a predetermined value for each electronic typewriter.

However, the electronic typewriter with a fixed holding time has the following problems. In the electronic typewriter having a short holding time, when a beginner operates this typewriter at a low key operation speed, the printing ribbon may return to the rest position during printing of a word. Therefore, since the time for shifting the ribbon from the rest position to the printing position is added to the printing response time for the key operation, the overall printing speed is further decreased.

Meanwhile, if a skilled operator, who can operate keys at a high operation speed, uses this typewriter with a long holding time, when the printed characters are confirmed after printing a given number of words, it takes a long period of time to return the ribbon to the rest position after the key operation, thus increasing the time required for confirming the printed characters. Therefore, the typewriter with a holding time is inconvenient and the overall printing speed is decreased for a skilled operator.

It is an object of the present invention to provide

an electronic typewriter in which at least the holding time for holding a printing ribbon at a position opposite to a character printed after the end of printing operation for the character can be set at a desired value, thereby making the typewriter more suitable and providing an optimum printing speed for a beginner or a skilled operator.

In order to achieve the above object, there is provided an electronic typewriter comprising a plurality of character keys, a printing wheel having a plurality of types designated by these character keys, a holding time data generator for generating holding time data which can be arbitrarily set, a ribbon position setting circuit for selectively setting a printing ribbon at one of the printing and rest positions, and a control unit which, when detecting that one of the character keys is operated while the printing ribbon is set in the rest position, supplies a first control signal to the ribbon position setting circuit to move the printing ribbon to the printing position and then strike the type designated by the operated character key against a paper sheet through the printing ribbon, and which supplies a second control signal to the ribbon position setting circuit to return the printing ribbon to the rest position when no further key operation is detected for a predetermined period of time corresponding to the holding time data after the printing operation for the operated character key is completed.

According to the present invention, since the holding time data from the holding time data generator can be arbitrarily changed, it is possible to arbitrarily set an interval from the time at which the printing operation for the operated character key is completed to the time at which the ribbon is returned to the rest position if no further character key operation is performed. Therefore, when the holding time is set long for a beginner, the problem of the ribbon

undesirably returning to the rest position during one word printing can be effectively prevented. On the other hand, when the holding time is set short for a skilled operator, the time required for returning the ribbon to the rest position after printing can be shortened. In this manner, the electronic typewriter can be easily used, and can perform printing in accordance with the operator's skill.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a plan view of an electronic typewriter according to an embodiment of the present invention;

Fig. 2 is a block diagram of the electronic typewriter shown in Fig. 1;

Fig. 3 is a map of a RAM used in the electronic typewriter shown in Fig. 2;

Fig. 4 is a flow chart of data processing executed by a CPU used in the electronic typewriter shown in Fig. 2 in accordance with key input;

Fig. 5 is a flow chart of an interrupt operation; and

Fig. 6 is a flow chart for explaining the basic control operation of the CPU.

An embodiment of the present invention will be described hereinafter with reference to the accompanying drawings.

Fig. 1 is a plan view of an electronic typewriter according to an embodiment of the present invention. The electronic typewriter includes a housing 1, and a keyboard 2 provided on the front surface of the housing 1. A platen 3 for setting printing paper thereon is installed in an upper portion inside the housing 1. A printing mechanism is mounted on a carriage 4 which can be shifted along the platen 3. The printing mechanism includes a printing wheel 5 having types formed on distal ends of spokes thereof, a printing wheel motor

(not shown) for driving the printing wheel 5, a printing ribbon 6, a ribbon feed motor (not shown), a ribbon position setting unit (not shown) using an electromagnet for vertically shifting a ribbon position, and a hammer solenoid 7 for making the type of the wheel 5 strike the printing paper through the ribbon 6. Various function keys including a code key 11 are arranged on the keyboard 2 in addition to alphabet keys 8, numeral keys 9, and a space key 10.

Fig. 2 is a block diagram of the electronic typewriter shown in Fig. 1. The electronic typewriter includes a central processing unit (CPU) 12 for executing various calculations in accordance with key input data received from the keyboard 2 through an interface 2A, a ROM 14 connected to the CPU 12 through a data bus 13 for storing fixed data including rotational position data of the printing wheel 5 corresponding to respective character codes, and a RAM 15 backed up by a battery for temporarily storing variable data such as input character codes from the keyboard 2. The CPU 12 is connected through the data bus 13 to the keyboard 2 for inputting character codes, a motor driver 16 for driving various motors, a solenoid driver 17 for driving the hammer solenoid 7, and a ribbon position setting circuit 18. A clock signal from a clock generator 19 is supplied to a clock input terminal CK of the CPU 12. An interrupt signal generated from the generator 19 having a period TA of 1 msec is supplied to the interrupt input terminal INT of the CPU 12.

The motor driver 16 is connected to a paper feed motor 20 coupled to the platen 3 for feeding the printing paper, a carriage motor 21 for shifting the carriage 4 along the platen 3, a ribbon feed motor 22 for feeding the printing ribbon 6, and a printing wheel motor 23 for rotating the wheel 5.

As shown in Fig. 3, the RAM 15 includes a printing data buffer area RA1 for temporarily storing input

character codes from the keyboard 2; a holding time table RA2 for storing holding time data HT1 to HT9 representing a holding time during which the printing ribbon 6 and the printing wheel 5 are kept at positions opposing the printed character after the end of printing by the operation of the character key in the keyboard 2; a code flag area RA3 for storing a code flag representing that the code key 11 of the keyboard 2 is operated; an "S" flag area RA4 for storing an "S" flag representing that an "S" key of the alphabet keys 8 is operated; a time memory area RA5 for storing the present holding time TS; and a time counter RA6 for measuring time elapsed after the end of printing by operation of character keys such as the alphabet keys 8 and the numeral keys 9.

In this embodiment, nine holding time data HT1 to HT9 representing holding times 0.3 to 2.7 seconds in 0.3 second increments are stored in indexes 1 to 9 of the holding time table RA2.

When various key input signals are supplied from the keyboard 2, the CPU 12 sets the required holding time TS in the time memory area RA5 from the holding time table RA2 in accordance with a flow chart shown in Fig. 4, and stores the character codes in the printing data buffer RA1. More specifically, when a key signal is supplied from the keyboard 2, the CPU 12 checks to see if the input key signal corresponds to the code key 11 in STEP 1. If it is YES in STEP 1, the CPU 12 sets the code flag of the area RA3 in the RAM 15 at "1". If it is NO in STEP 1, the CPU 12 checks in STEP 2 if the input key signal is generated by "S" key among the alphabet keys 8. If it is YES in STEP 2 and when the code flag of the area RA3 has been already set at "1", the CPU 12 determines that the setting operation of the holding time starts, and sets the "S" flag of the area RA4 at "1". When the CPU 12 detects that the code flag is not at "1", it determines that a normal character

code has been supplied and stores a corresponding character code in the printing data buffer area RA1.

If it is NO in STEP 2, the CPU 12 determines whether or not the operated key is one of the numeral keys 9 in STEP 3. If it is YES in STEP 3, the CPU 12 executes the operation designated by the operated key. For example, when the key operated is an alphabet key other than the "S" key, the CPU 12 stores the corresponding character code in the printing data buffer area RA1. On the other hand, when the operated key is a function key, the CPU 12 executes the operation designated by this key. When the operated key is any of "1" to "9" of the numeric keys 9, the CPU 12 checks to see if the "S" flag of the area RA4 is at "1" in STEP 4. If it is YES in STEP 4, the CPU 12 determines that the input numeral represents an index in the holding time table RA2, and reads out one of the holding time data HT1 to HT9 represented by the numeral and sets the holding time data in the time memory area RA5. Thereafter, the code and "S" flags in the areas RA3 and RA4 are reset, thus ending the setting operation of the holding time. Note that in STEP 4, when the CPU 12 detects that the "S" flag in the area RA4 is not set at "1", it determines that the normal character code is supplied and stores the character code corresponding to the input numeral in the printing data buffer area RA1.

Every time an interrupt signal having the period TA (1 ms) is supplied from the clock generator 19 to the interrupt input terminal INT, the CPU 12 carries out the interrupt operation in accordance with a flow chart shown in Fig. 5. More specifically, when the interrupt signal of the period TA (1 ms) is supplied, the CPU 12 checks if the time data TC stored in the time counter RA6 in the RAM 15 is equal to or larger than the holding time data TS in the time memory area RA5. If it is NO, the CPU 12 sets the time data obtained by adding the period TA to the time data TC in the time counter RA6.

When the CPU 12 detects TC $\geq$ TS, it ends this interrupt routine without changing the time data TC in the time counter RA6.

Fig. 6 shows a main control routine of the electronic typewriter shown in Fig. 2. After power is supplied, the CPU 12 performs the initialization process. In STEP 5, the CPU 12 checks to see if the printing data buffer area RA1 stores a character code to be generated. If it is YES in STEP 5, the CPU 12 supplies drive data to the printing wheel motor 23 so as to rotate the printing wheel 5 to allow the type corresponding to the stored character code to oppose the printing paper set on the platen 3, i.e., the type is set at the printing position. The CPU 12 checks to see if the printing ribbon 6 is set at a position opposite to the character which has been printed, i.e., at the printing position. When the CPU 12 detects that the ribbon 6 is not at the printing position but at the rest position, it supplies a control signal to the ribbon position setting circuit 18 to raise the ribbon 6 to the printing position. Thereafter, the CPU 12 supplies a drive signal to the solenoid driver 17 so as to drive the hammer solenoid 7, thereby printing the character corresponding to the character code on the paper. The CPU 12 drives the carriage motor 21 so as to shift the carriage 4 by one character to the next printing position. Thereafter, the time data TC in the time counter RA6 is set at "0", i.e., the counter is reset, thus ending the printing operation with respect to one character code.

If it is NO in STEP 5, the CPU 12 determines that the next key operation has not been performed. The CPU 12 then checks in STEP 6 if the time TC in the time counter RA6 has reached the holding time TS set in the time memory area RA5. If it is YES in STEP 6, the CPU 12 checks the position of the printing ribbon 6. When the ribbon 6 is at the printing position, the CPU 12

supplies a control signal to the ribbon position setting circuit 18 so as to move the ribbon 6 downward. Thereafter, the motor 23 is driven to return the printing wheel 5 to the home position. In this state, since the ribbon 6 is at the rest position and the wheel 5 is at the home position, a user can confirm the printed character.

Note that when it is determined in STEP 6 that the time TC has not reached the holding time TS, and when the ribbon 6 is already at the rest position, STEP 5 is executed again.

In the electronic typewriter with the above arrangement, when it is required to change the holding time TS during which the ribbon 6 and the wheel 5 are kept at the printing position after the end of printing by key operation in the keyboard 2 is changed, the code key 11 of the function keys of the keyboard 2 and the "S" key in the alphabet keys 8 are depressed in this order. Thereafter, a numeral corresponding to the index of the desired holding time in the holding time table RA2 is simply inputted by a numeric key 9 of the keyboard 2. For example, a beginner can select a relatively long holding time TS, e.g., 2.1, 2.4 or 2.7 seconds by depressing the "7", "8" or "9" numeric key. On the other hand, a skilled operator can select a relatively short holding time TS, e.g., 0.3, 0.6 or 0.9 seconds by depressing the "1", "2" or "3" numeric key.

Therefore, when a long holding time TS is set for a beginner, undesirable downward movement of the ribbon 6 during one word or character printing can be prevented. When a short holding time TS is set for a skilled operator, time required for moving the ribbon 6 downward after printing can be decreased. As a result, the electronic typewriter can be easily used by any person, thus increasing printing speed.

Since the holding time can be easily changed by the

keys provided on the keyboard 2, operability of the electronic typewriter can be further improved.

Note that the present invention is not limited to the above embodiment. In the above embodiment, when the time TC between two successive key operations reaches the holding time TS, the ribbon 6 is shifted downward and the wheel 5 is returned to the home position. However, in order to achieve the object of the invention, when the time TC reaches the holding time TS, only the ribbon 6 can be moved to the rest position to provide a similar effect. Furthermore, when the time TC reaches the holding time TS, the ribbon 6 can be shifted to the rest position and thereafter the carriage 4 can be shifted to a position at which the printed characters or words can be confirmed instead of moving the ribbon 6 downward and returning the wheel 5 to the home position.

Furthermore, the holding time data set in the holding time table RA2 in the RAM 15 can be changed as needed.

In the above embodiment, in order to change the time data in the time memory area RA6, the code key 11 and the "S" key are operated and thereafter one of the numeric keys 9 for designating an index corresponding to time data to be set is operated. However, appropriate function and alphabet keys can be used in place of the code key 11 and the "S" key.

Furthermore, the holding time table RA2 can be omitted and desired holding time data can be stored in the time memory area RA5 by manually operating the numeric keys.

Claims:

1. An electronic typewriter comprising a keyboard (2) including a plurality of character keys (8, 9); a printing wheel (5) having a plurality of types designated by said character keys (8, 9); printing wheel driving means (23); ribbon position setting means (18) for selectively setting a printing ribbon (6) at either one of printing or rest positions; and a control circuit (12) which supplies a first control signal to said ribbon position setting means (18), in response to the operation of one of said character keys (8, 9) while said printing ribbon (6) is set at the rest position, to set said printing ribbon (6) at the printing position and thereafter strike the type designated by said operated character key against a paper sheet through said printing ribbon (6) and which supplies a second control signal to said ribbon position setting means (18) to set said printing ribbon (6) at the rest position when no further key operation is detected for a preset holding time after the end of printing by one of said character keys, characterized by further comprising holding time data generating means (RA2, RA5) for generating holding time data which is used to determine said preset holding time and can be arbitrarily changed.

2. An electronic typewriter according to claim 1, characterized in that said holding time data generating means comprises a first memory area (RA2) storing a plurality of holding time data and a second memory area (RA5) for selectively storing one of the plurality of holding time data as the preset holding time.

3. An electronic typewriter according to claim 2, characterized in that said keyboard (2) further includes a specified key (11), and said control circuit (12) reads out a selected one of said holding time data from said first memory area (RA2) and stores it in said second memory area (RA5) in accordance with at least one

of said character keys (8, 9) operated after the operation of said specified key (11) and a specified one of said character keys (8, 9).

4. An electronic typewriter according to claim 1, 2 or 3, characterized in that said control circuit supplies a control signal to said printing wheel driving means (23) to set said printing wheel (5) at a home position at substantially the same time when generating the second control signal.

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FIG. 1

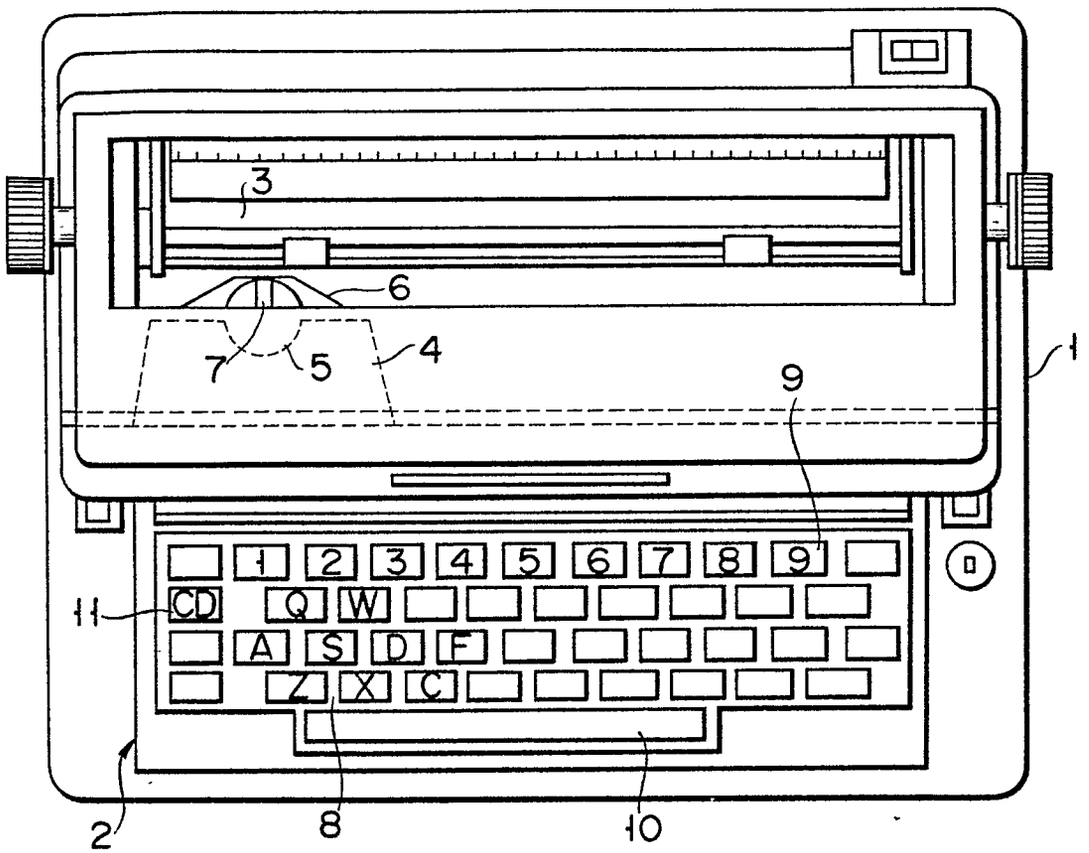

FIG. 3

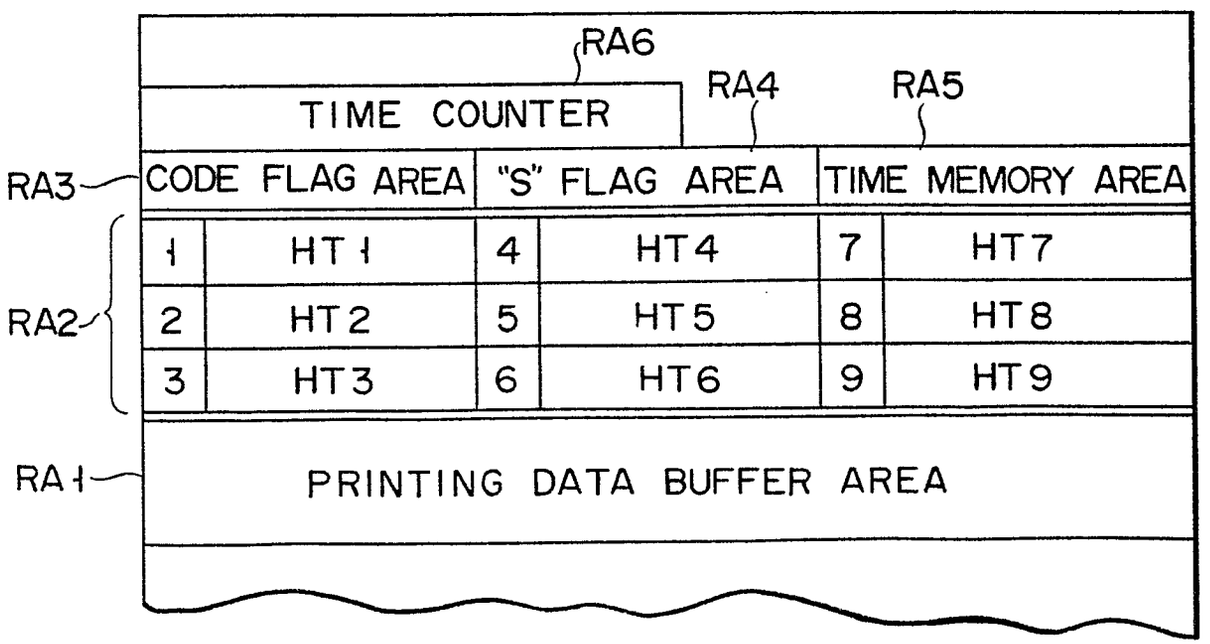

FIG. 2

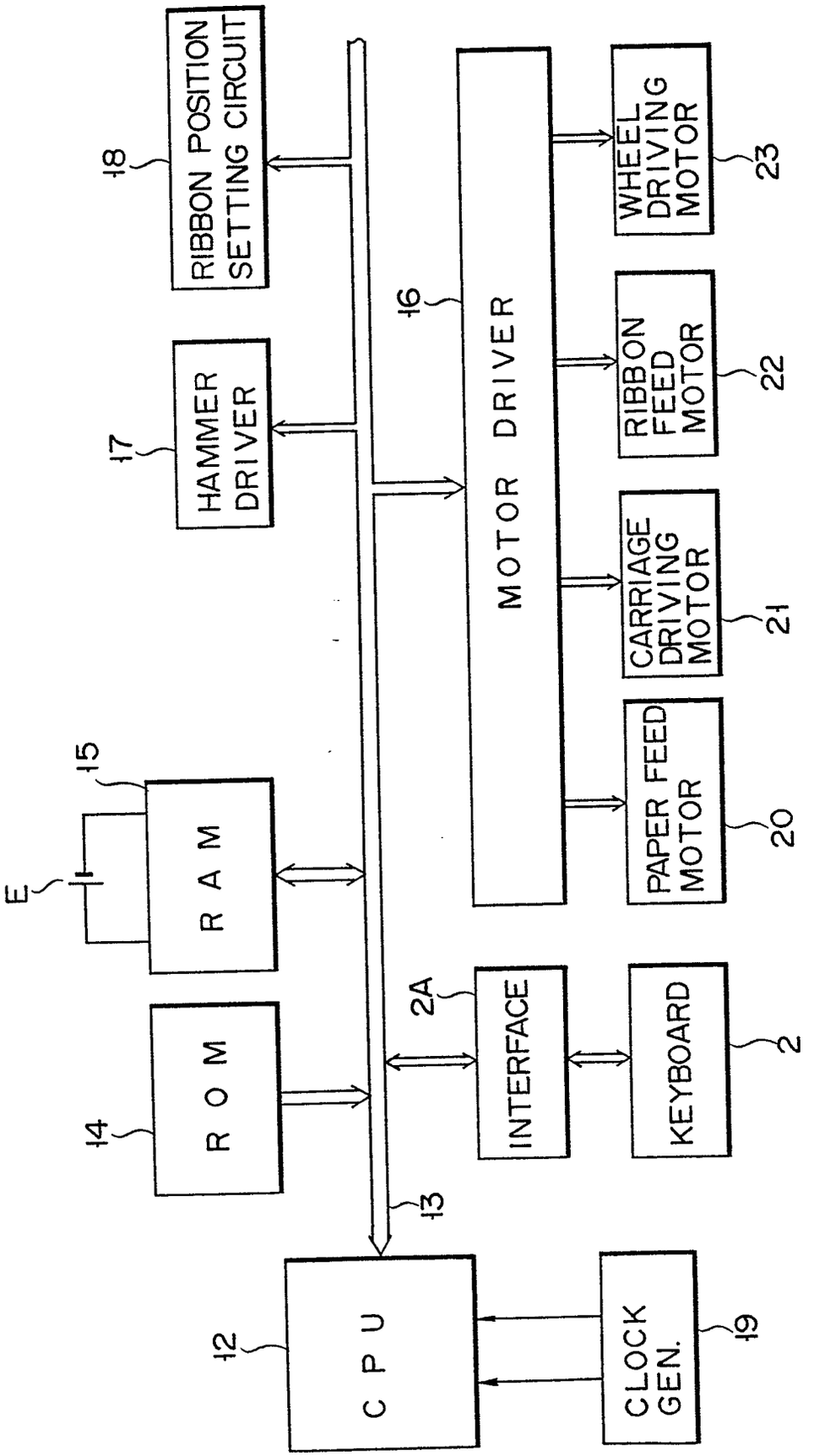
RIBBON POSITION SETTING CIRCUIT
18
HAMMER DRIVER
17
16
MOTOR DRIVER
WHEEL DRIVING MOTOR
23
RIBBON FEED MOTOR
22
CARRIAGE DRIVING MOTOR
21
PAPER FEED MOTOR
20
15
E
R A M
R O M
14
2A
INTERFACE
KEYBOARD
2
13
C P U
12
CLOCK GEN.
19

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FIG. 4

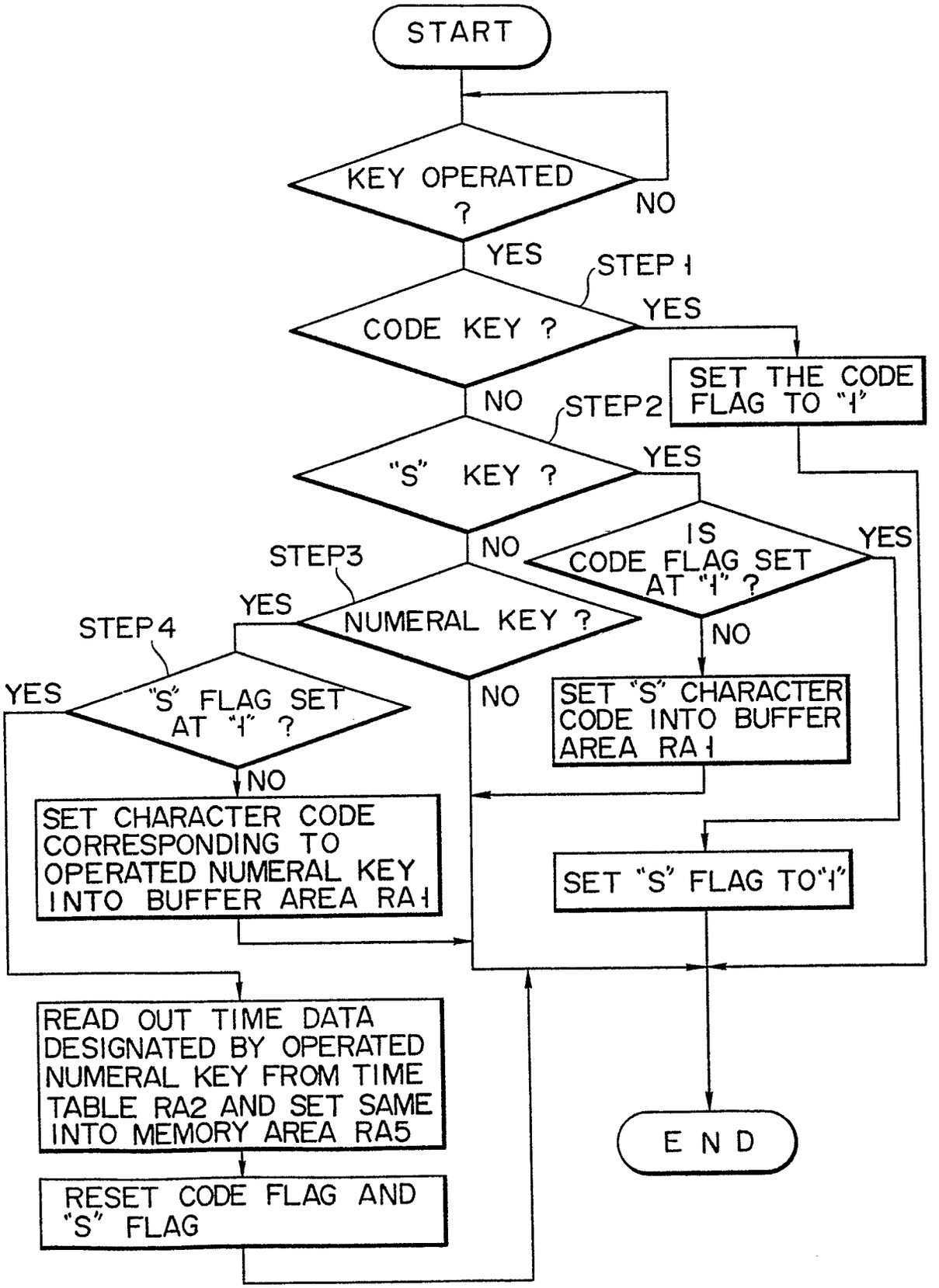

FIG. 5

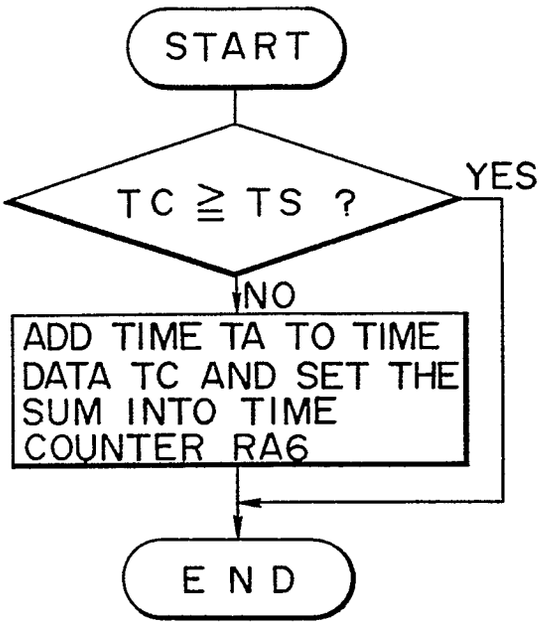
START
TC ≧ TS ?
YES
NO
ADD TIME TA TO TIME DATA TC AND SET THE SUM INTO TIME COUNTER RA6
END

FIG. 6

START
INITIALIZATION
STEP5
NO
PRINTING DATA IN RA1 ?
YES
DRIVE PRINTING WHEEL MOTOR 23
YES
RIBBON SET IN PRINTING POSITION ?
NO
SET RIBBON IN PRINTING POSITION
SUPPLY DRIVE SIGNAL TO SOLENOID DRIVE CIRCUIT 17
DRIVE CARRIAGE MOTOR 21
RESET TC TO "0"
STEP6
NO
TC ≧ TS ?
YES
NO
RIBBON SET IN PRINTING POSITION ?
YES
SET RIBBON IN REST POSITION
SET PRINTING WHEEL 5 TO HOME POSITION