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(54) **Daisy wheel typewriter.**

(57) A daisy wheel typewriter includes a keyboard circuit (12) including a plurality of character keys (12A, 12B) and at least one function key (12C, 12D), for generating printing data representing a printing type to be printed, and a control device (11, 16, 16-1, SF, TM) for setting the designated printing type to a printing position by causing rotation of a daisy wheel (DW) according to the printing data. The daisy wheel (DW) has a plurality of spokes (2) grouped in first and second spoke groups respectively including first and second reference spokes (2A and 2C). The control device (11, 16, 16-1, SF, TM) includes a flag area (SF) for storing a flag representing which one of the first and second spoke groups is designated, and when detecting no subsequent printing data until the lapse of a predetermined period of time, sets one of the first and second reference spokes (2A or 2C) to a home position according to the flag.

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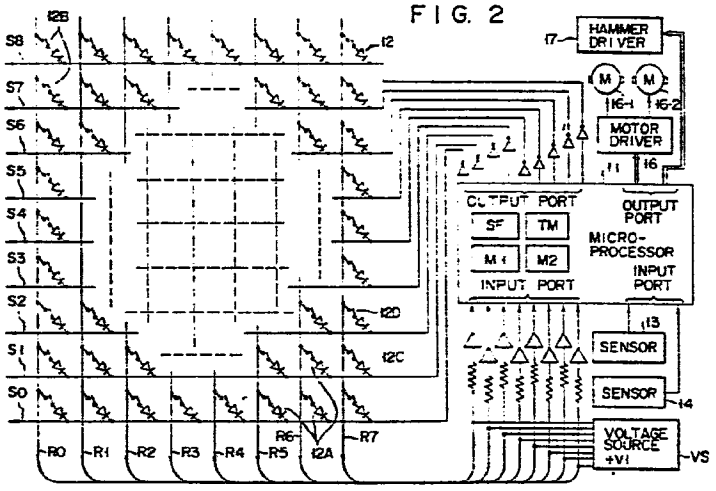
FIG. 2


S8
S7
S6
S5
S4
S3
S2
S1
S0
R0
R1
R2
R3
R4
R5
R6
R7
12
12A
12B
12C
12D
HAMMER DRIVER
17
M
M
16-1
16-2
MOTOR DRIVER
16
11
OUTPUT PORT
SF
TM
M1
M2
INPUT PORT
MICRO-PROCESSOR
OUTPUT PORT
INPUT PORT
13
SENSOR
SENSOR
14
VOLTAGE SOURCE
+V
VS

March 29, 1985

Daisy wheel typewriter

This invention relates to a daisy wheel typewriter.

An electronic typewriter for use with a daisy wheel, which has a plurality of, for instance 100, spokes arranged in a radial arrangement and having printing types of characters such as alphabet letters, numerals and symbols provided at the end, is well known in the art. In the spoke arrangement of the daisy wheel, spokes with printing types of characters which are used comparatively frequently, such as small letters and numerals, are arranged comparatively close to a reference spoke corresponding to a home position, and spokes with printing types of characters which are less frequently used such as capital letters and special characters are arranged close to a spoke remote from the reference spoke, e.g., spaced apart 180° from the reference spoke. In this kind of typewriter, the reference spoke of the daisy wheel is returned to the home position when no key is operated until the lapse of a predetermined period of time. This is done so that the last printed character may be readily confirmed, the reference spoke having a smaller length than the length of the other spokes to this end, and also that frequently used characters may be printed speedily. However, although the capital letters are thought to be used less frequently, sometimes sentences are typewritten, which are constituted by capital

letters. The prior art daisy wheel, however, is immediately returned to the home position when no key is operated until the lapse of a predetermined period of time. Therefore, when a printing key for a capital letter is subsequently operated, the daisy wheel has to be rotated a long way thus, it takes a correspondingly long time, until that character is printed. This is liable to disturb the key operation rhythm of the typist and cause mistyping.

An object of the invention is to provide a daisy wheel typewriter, with which the daisy wheel printing type characters can be printed speedily irrespective of whether the characters are used frequently or not.

To attain the above object of the invention, there is provided a daisy wheel typewriter, which comprises a daisy wheel including a center member and a plurality of spokes mounted in a radial arrangement on the center member, the spokes having characters provided at the end and being grouped into first and second spoke groups respectively including first and second reference spokes, a keyboard circuit including a plurality of character keys for generating printing data when selectively operated to select a corresponding printing type and at least one function key, a position sensor for generating an output signal when detecting that the first reference spoke is at a home position, a daisy wheel driver for causing rotation of the daisy wheel according to a drive signal, a hammer driver, data generator for generating group designation data representing the first or second designation data representing which of the first and second spoke groups is designated, and a control unit for providing a drive signal to the daisy wheel drive means according to input printing data to cause rotation of the daisy wheel to set a printing type, designated by the input printing data, to a printing position and setting one of the

first and second reference spokes to the home position according to the group designation data when detecting no subsequent printing data until the lapse of a predetermined period of time.

According to the invention, group designation data representing either the first or second spoke group, to which a spoke with a character to be printed belongs, is generated from a data generator. Unless no subsequent character key is operated within a predetermined period of time, the first or second reference spoke in the first or second spoke group designated by the group designation data is set to the home position. Thus, where printing types belonging to the same spoke group are printed successively, respective characters can be printed quickly, for each printing type is usually set to the printing position with only a short rotation of the daisy wheel.

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 view showing a daisy wheel for use in an embodiment of the daisy wheel typewriter according to the invention;

Fig. 2 is a schematic representation of the circuit of the embodiment of the daisy wheel typewriter according to the invention;

Fig. 3 is a circuit diagram showing a home position sensor in the electronic typewriter shown in Fig. 2;

Fig. 4 is a circuit diagram showing a hammer driver used for the electronic typewriter shown in Fig. 2; and

Figs. 5A and 5B constitute a flow chart for explaining the operation of the electronic typewriter shown in Fig. 2.

Fig. 1 shows the structure of a daisy wheel DW used in an embodiment of an electronic typewriter according to the invention. The daisy wheel DW has a center member or disk 1 and a plurality of, e.g., 100, spokes 2

mounted in a radial arrangement on the disk 1 and each having a printing type 3 of an individual character provided at the end.

The spokes 2 include a reference spoke 2A. The reference spoke 2A and a spoke 2B adjacent to and on the left side of the reference spoke 2A are made shorter than the neighboring spokes 2. The disk 1 has a home position hole 4 formed at a position corresponding to the reference spoke 2A. A spoke 2C which is angularly spaced apart substantially 180° from the reference spoke 2A and a spoke 2D adjacent to and on the left side of the spoke 2C are also made shorter than the neighboring spokes 2. Spokes 2 neighboring and centered on the reference spoke 2A (which constitute substantially an upper half of the illustrated daisy wheel) constitute a first spoke group, which have printing types 3 of comparatively frequently used characters such as small letters and numerals. Spokes 2 neighboring and centered on the spoke 2C (which constitute substantially a lower half of the illustrated daisy wheel) constitute a second spoke group with printing types 3 of less frequently used characters such as capital letters and special characters. The daisy wheel DW is rotated by a daisy wheel motor as drive means to be described later. When the reference spoke 2A comes to a top position, a first home position sensor to be described later detects the home position hole 4, whereby the daisy wheel is set to a first home position. When the reference spoke 2A comes to a bottom position, a second home position sensor to be described later detects the home position hole 4, whereby the daisy wheel is set at a second home position.

Fig. 2 shows an essential part of the circuitry of the embodiment of the electronic typewriter according to the invention. The circuitry illustrated includes a microprocessor 11 and a keyboard circuit 12. The microprocessor 11 has a shift flag area SF which serves

as spoke group determination means, a timer TM, a first memory M1 where position data "0" for the reference spoke 2A is preset, and a second memory M2 where position data "50" for the spoke 2C is preset. The keyboard circuit 12, although shown only schematically for the sake of simplicity of illustration, has character keys including alphabet keys 12A corresponding to alphabet letters "a" to "z" and "A" to "Z" and numeral keys 12B corresponding to numerals "0" to "9", a shift key 12C which is operated when a capital letter is to be printed, a shift lock key 12D which is operated when printing a capital letter subsequent to a small letter or printing a small letter subsequent to a capital letter, and other function keys.

The microprocessor 11 sequentially generates from its output port key scanning signals S0 to S9 which are fed to the keyboard circuit 12 via inverters. It also receives at its input port return signals R0 to R7 which are each fed back from the keyboard circuit 12 when each of the key scanning signals is generated. In this way, the microprocessor 11 detects an operated key in the keyboard circuit 12. Usually, a voltage +V1 from a voltage source VS is supplied to the input port at all times. The microprocessor 11 also receives at a different input port the output signals from the first and second home position sensors 13 and 14 noted above, thereby checking whether the home position hole 4 of the daisy wheel is at a position to be detected by the sensor 13 or 14. The microprocessor 11 further generates, from a different output port, control signals for controlling the operation of a motor driver 16, which drives a daisy wheel motor 16-1 for rotating the daisy wheel and a carriage motor 16-2 for moving a carriage (not shown) carrying the daisy wheel mounted thereon, and also the operation of a hammer driver 17, which drives a hammer to strike a printing type 3 set at the printing position.

Fig. 3 shows the circuit construction of the first home position sensor 13. The illustrated sensor 13 includes a light-emitting diode 13-1 connected between a voltage source terminal at +V1 and ground, a phototransistor 13-2 which is rendered conductive in response to light from the light-emitting diode 13-1, a diode 13-3 connected in opposite polarity between the collector and emitter of the phototransistor 13-2, a resistor 13-4 connected between the emitter of the phototransistor 13-2 and ground and an inverting amplifier 13-5 for amplifying and inverting the emitter voltage on the phototransistor 13-2 and feeding the amplified and inverted output to the microprocessor 11.

When the light from the light-emitting diode 13-1 is blocked by the disk 1, the phototransistor 13-2 is nonconductive, and a signal at a high level is fed from the amplifier 13-5 to the microprocessor 11. When the light from the light-emitting diode 13-1 is incident on the phototransistor 13-2 through the hole 4 in the disk 1, the phototransistor 13-2 is rendered conductive, so that a low level signal is provided from the amplifier 13-5. The microprocessor 11 thus can judge whether the daisy wheel is at the first home position according to the output of the sensor 13. The second home position sensor 14 has the same construction as the first home position sensor 13, and the microprocessor 11 can judge whether the daisy wheel is at the second home position according to the output signal of the sensor 14.

Fig. 4 shows an example of the hammer driver 17. The illustrated hammer driver 17 includes an npn transistor 17-1, which has its emitter grounded through a resistor and whose conduction state is controlled according to a drive control signal fed from the microprocessor 11, and a solenoid coil 17-2, which has one end connected to the collector of the transistor 17-1 and the other end connected to a voltage terminal

at +V2 through a resistor. When the microprocessor 11 generates a drive control signal at a high level, the solenoid coil 17-2 is energized, so that a hammer or actuator is driven to strike the character at the printing position.

The main routine of the microprocessor 11 will now be described with reference to Figs. 5A and 5B. In the routine, the microprocessor 11 first checks whether one of the keys is operated. When it detects that one of the keys is operated, it checks whether the operated key is a character key such as an alphabet letter key 12A or a numeral key 12B or shift lock key 12D or other key. If it detects that the operated key is a character key, the microprocessor 11 determines the extent, to which the daisy wheel is to be rotated, through comparison of the prevailing position of the daisy wheel to the position data of the printing type 3 designated by the operated character key. According to the determined extent of rotation, the microprocessor 11 drives the daisy wheel motor 16-1 to set the designated printing type 3 to the printing position. Then it supplies an energization signal to the printing hammer driver 17 to drive the hammer. Then it supplies a control signal to the motor driver 16 to drive the carriage motor 16-2 so as to move the daisy wheel in a printing direction to the next printing position. Then it sets the timer TM.

If the microcomputer 11 detects that the operated key is the shift lock key 12D, it checks whether the shift flag SF is set in STEP 1. If the shift flag SF is set, the microcomputer 11 resets this flag. If the flag is reset, on the other hand, the microcomputer 11 sets the flag. After the microprocessor 11 resets the shift flag SF, it checks whether the signal from the first home position sensor 13 is at a low level indicating that the hole 4 is being detected. If the signal of the sensor 13 is at a high level, the microprocessor 11 determines the extent of rotation of the daisy wheel

through comparison of the prevailing daisy wheel position to the reference position data "0" of the reference spoke 2A read out from the first memory M1. According to the determined extent of rotation, it drives the daisy wheel motor 16-1 to set the printing type 3 of the reference spoke 2A to the printing position. When this positioning of the daisy wheel is effected, the first home position sensor 13 detects the home position hole 4 to generate the low level signal. The operation of the positioning is omitted if it is detected that the signal of the sensor 13 is at the low level.

After the microcomputer 11 sets the shift flag SF, it checks whether the signal from the second home position sensor 12 is at a low level. If it detects that the signal of the sensor 14 is at a high level, it determines the extent of rotation of the daisy wheel by comparison of the prevailing daisy wheel position with the reference position data "50" of the spoke 2C read out from the second memory M2. According to the determined extent of rotation, it drives the daisy wheel motor 16-1 to set the printing type 3 of the spoke 2C to the printing position. When this positioning is effected, the second home position sensor 14 detects the home position hole 4 to generate a low level signal. The operation of positioning is omitted if it is detected that the signal of the sensor 14 is at the low level.

If the microprocessor 11 detects no operated key, it checks whether the preset time of the timer TM is over. If it detects that the preset time is over, it checks whether the signals from the first and second home position sensors 13 and 14 are at the low level. If it detects that the signal of one of the sensors 13 and 14 is at the low level, the routine ends. If it detects that none of the signals of the sensors 13 and 14 are at the low level, it checks whether the shift flag SF is set. If it detects that the shift flag SF is

reset, it determines the extent of rotation of the daisy wheel by comparison of the prevailing daisy wheel position with the position data "0" of the reference spoke 2A read out from the first memory M1. Then it drives the daisy wheel motor 16-1 according to the determined extent of rotation to set the printing type 3 of the reference spoke 2A to the printing position. When this positioning is effected, the first home position sensor 13 detects the home position hole 4 to generate a low level signal.

If the microprocessor 11 detects that the shift flag SF is set in STEP 2, it determines the extent of rotation of the daisy wheel by comparison of the prevailing daisy wheel position to the position data "50" of the spoke 2C read out from the second memory M1. According to the determined extent of rotation, it drives the daisy wheel motor 15 to set the printing type 3 of the spoke 2C to the printing position. When this positioning is effected, the second home position sensor 14 detects the home position hole 4 to generate a low level signal.

As has been shown, with the above embodiment of the invention in response to the operation of a character key, the extent to which the daisy wheel is to be rotated is determined by comparison of the prevailing daisy wheel position with the position data of the printing type corresponding to the operated character key to drive the daisy wheel motor 16-2 according to the determined extent of rotation, setting a corresponding printing type to the printing position. At this time the timer T is set. When no character key is subsequently operated until the preset time of the timer TM is over, either reference spoke 2A or 2C is set to the printing position depending on whether the shift flag SF is set or reset. If it is found that the shift flag SF is reset, the reference spoke 2A is set to the printing position. If the shift flag SF is set, the

spoke 2C is set to the printing position. In this way, when the preset time of the timer TM is over without any character key operated during this time, either reference spoke 2A or 2C of the daisy wheel is set to the printing position to be ready for the subsequent printing operation. Therefore, if a subsequently operated character key corresponds to a character in the same group as the character of the preceding operated character key, the character of that character key is within the semicircle arc centered on the reference spoke 2A or 2C in the printing position. Thus, the extent of rotation of the daisy wheel necessary for the subsequently operated character key can be reduced so that the subsequent character can be printed more quickly.

Further, when the shift lock key 2D is operated, the state of the shift flag SF is inverted, and the reference spoke 2A or 2C is immediately set to the printing position according to the inverted state of the shift flag SF. Thus, when the shift lock key 12D is operated for printing a capital letter after a preceding small letter or printing a small letter after a preceding capital letter, the daisy wheel is concurrently selectively set to the first or second home position that corresponds to a smaller extent of daisy wheel rotation necessary for the printing of the subsequent character. Thus, again in this case the subsequent character can be speedily printed in response to the key operation.

Further, even in the case of successively printing characters less frequently used such as capital letters and special characters which are provided on spokes compartively remote from the reference spoke 2A, a speedy printing operation can be obtained in response to the key operation because the daisy wheel is set to rotate either the first or second position, requiring a small rotation of the daisy wheel, in response to the

operation of the shift lock key 12D. Thus, it is possible to maintain a substantially constant key operation rhythm of the typist and prevent mistyping as much as possible.

While the invention has been described in conjunction with a preferred embodiment thereof, the embodiment is by no means limitative. For example, while the above embodiment has used the home position sensors 13 and 14, the sensor 14 may be omitted. In this case, the daisy wheel is set to the second home position through the calculation of the extent of rotation of the daisy wheel necessary to get from the prevailing position to the second home position thereof. Further, while in the above embodiment the spokes 2A to 2D have had a smaller length than the length of the other spokes, they may have the same length as the other spokes. Further, no printing type may be provided on the end of the spokes 2A to 2D. Moreover, the reference spoke 2C may not be provided at an angle of 180° relative to the reference spoke 2A but may be at any other suitable angle relative thereto.

Claims:

1. A daisy wheel typewriter comprising:

a daisy wheel (DW) including a center member (1) and a plurality of spokes (2) mounted in a radial arrangement on said center member (1), said spokes (2) including a first reference spoke (2A) and having respective printing types (3) provided at the end; a keyboard circuit (12), including a plurality of character keys (12A, 12B) selectively operated to generate printing data, designating a corresponding one of said printing types (3) and at least one function key (12C, 12D); daisy wheel drive means (16, 16-1) for causing the rotation of said daisy wheel (DW) according to a drive signal; hammer drive means (17); control means (11, TM, M1, M2) for providing a drive signal to said daisy wheel drive means according to input printing data to cause the rotation of said daisy wheel (DW) to set a printing type designated by said input printing data to a printing position; and supplying a printing command signal to said hammer drive means (17) and a first home position sensor means (13) for providing an output signal to said control means (11, TM, M1, M2) when detecting that said first reference spoke (2A) is at a home position;

characterized in that said plurality of spokes (2) include a second reference spoke (2C) and are grouped into first and second groups respectively including said first and second reference spokes (2A, 2C), said control means (11, TM, M1, M2) includes data generating means (SF) for generating group designation data representing which one of said first and second spoke groups is designated, and said control means (11, TM, M1, M2) sets a selected one of said first and second reference spoke to the home position according to said group designation data when it detects no subsequent printing data until the lapse of a predetermined period of time.

2. The daisy wheel typewriter according to claim 1, characterized in that said daisy wheel typewriter further comprises a second home position sensor means (14) for providing an output signal to said control means (11, TM, M1, M2) when detecting that said second reference spoke (2C) is at the home position.

3. The daisy wheel typewriter according to claim 1 or 2, characterized in that said first and second reference spokes (2A and 2C) have a smaller length than the length of the other spokes (2).

4. The daisy wheel typewriter according to claim 1 or 2, characterized in that said first and second reference spokes (2A and 2C) and spokes (2B and 2C) each adjacent to each of said first and second reference spokes (2B and 2C) have a length smaller than the length of the other spokes (2).

5. The daisy wheel typewriter according to any one of claims 1 to 4, characterized in that said control means (11, TM, M1, M2) includes first and second memories (M1 and M2) storing position data representing the angular positions of said first and second reference spokes (2A and 2C) and, when detecting no subsequent printing data until the lapse of a predetermined period of time, compares the prevailing position of said first or second reference spoke (2A or 2C) with position data in said first or second memory (M1 or M2) according to said group designation data and sets one of said first and second reference spokes (2A or 2C) to the home position according to the result of the comparison.

6. The daisy wheel typewriter according to any one of claims 1 to 5, characterized in that said data generating means is a flag memory (SF), said control means (11, TM, M1, M2) sets in said flag memory (SF) a flag representing which one of said first and second spoke groups is designated.

FIG. 1

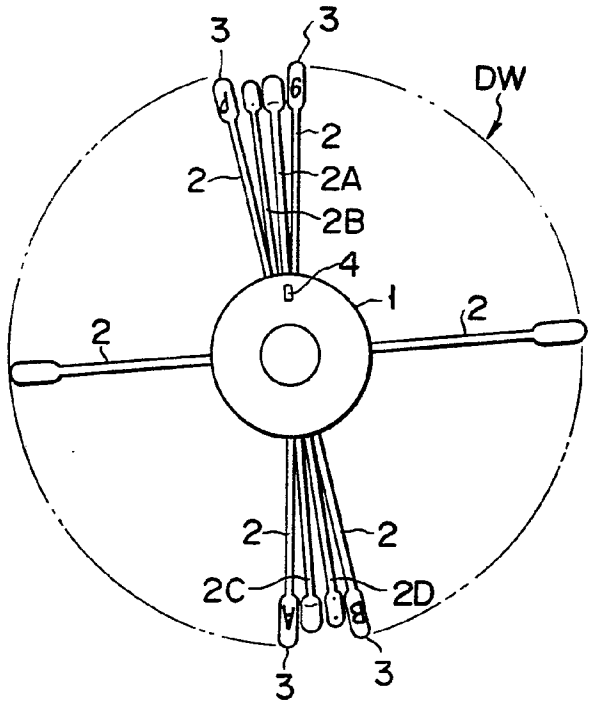


FIG. 3

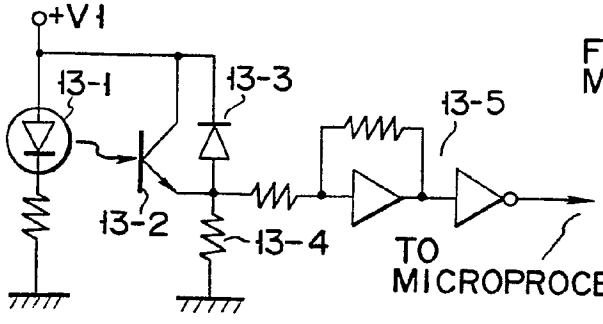


FIG. 4

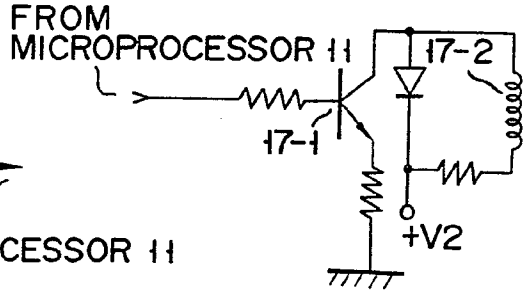


FIG. 2

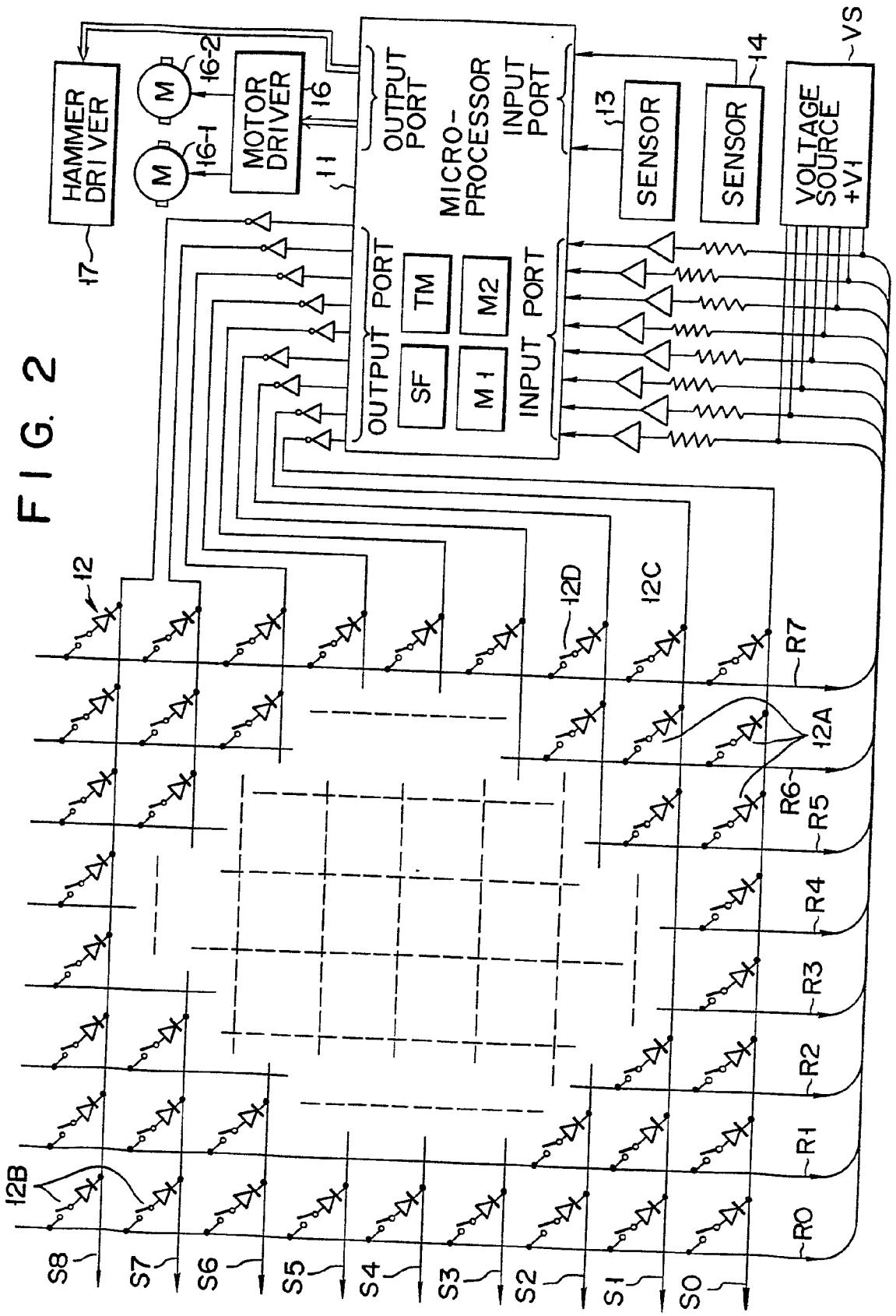

HAMMER DRIVER
17
M
16-1
16-2
MOTOR DRIVER
16
11
OUTPUT PORT
MICRO-PROCESSOR
INPUT PORT
13
SENSOR
14
SENSOR
VOLTAGE SOURCE +V1
VS
OUTPUT PORT
SF
TM
M1
M2
INPUT PORT
12
12D
12C
12A
12B
R7
R6
R5
R4
R3
R2
R1
R0
S8
S7
S6
S5
S4
S3
S2
S1
S0

FIG. 5A

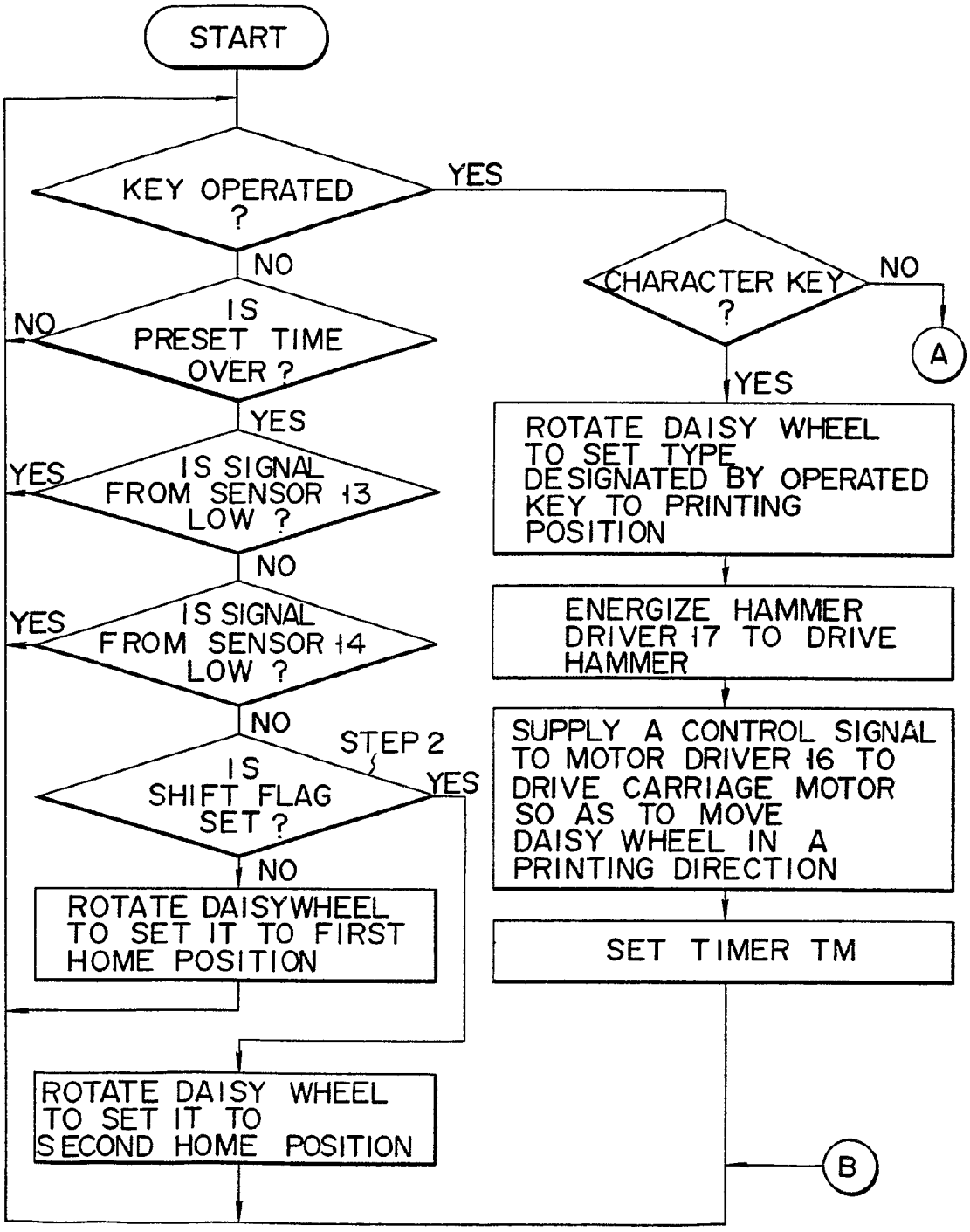
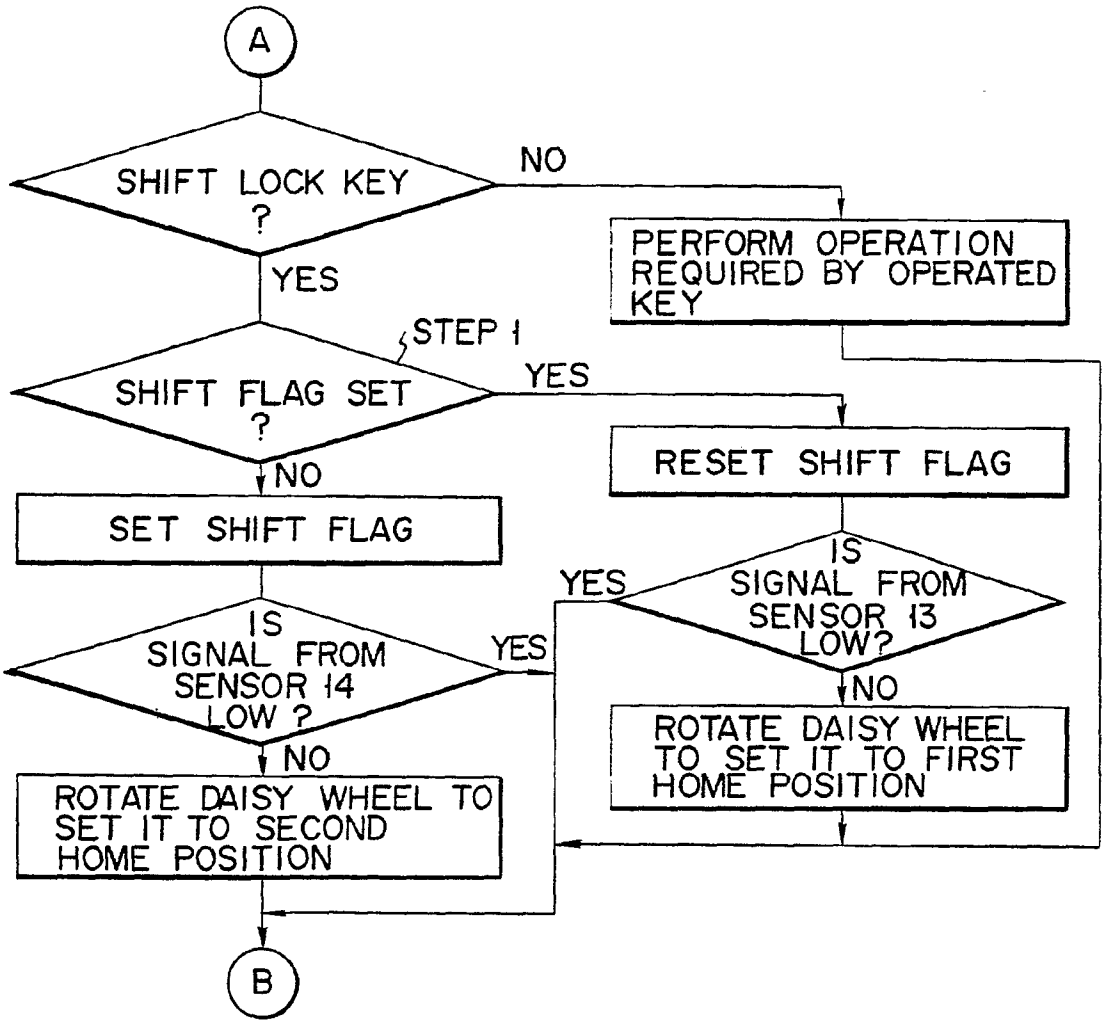

START
KEY OPERATED ?
YES
NO
IS PRESET TIME OVER ?
NO
YES
IS SIGNAL FROM SENSOR 13 LOW ?
YES
NO
IS SIGNAL FROM SENSOR 14 LOW ?
YES
NO
STEP 2
IS SHIFT FLAG SET ?
YES
NO
ROTATE DAISYWHEEL TO SET IT TO FIRST HOME POSITION
ROTATE DAISY WHEEL TO SET IT TO SECOND HOME POSITION
CHARACTER KEY ?
NO
A
YES
ROTATE DAISY WHEEL TO SET TYPE DESIGNATED BY OPERATED KEY TO PRINTING POSITION
ENERGIZE HAMMER DRIVER 17 TO DRIVE HAMMER
SUPPLY A CONTROL SIGNAL TO MOTOR DRIVER 16 TO DRIVE CARRIAGE MOTOR SO AS TO MOVE DAISY WHEEL IN A PRINTING DIRECTION
SET TIMER TM
B

FIG. 5B


A
SHIFT LOCK KEY ?
NO
PERFORM OPERATION REQUIRED BY OPERATED KEY
YES
STEP 1
SHIFT FLAG SET ?
YES
RESET SHIFT FLAG
NO
SET SHIFT FLAG
IS SIGNAL FROM SENSOR 13 LOW?
YES
IS SIGNAL FROM SENSOR 14 LOW ?
YES
NO
ROTATE DAISY WHEEL TO SET IT TO FIRST HOME POSITION
NO
ROTATE DAISY WHEEL TO SET IT TO SECOND HOME POSITION
B

European Patent Office

EUROPEAN SEARCH REPORT

0156391
Application number

EP 85 10 3802

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-3 924 725 (R.F. KUHN et al.) * Figure 3; column 2, line 61 - column 3, line 10 *	1	B 41 J 1/30
A	US-A-4 044 880 (B.R. MARTIN) * Abstract; figure 2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 41 J 1/30

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	18-06-1985	ZOPF K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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