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(71) Applicant: **SEIKO EPSON CORPORATION**
Shinjuku-ku, Tokyo 163-0811 (JP)

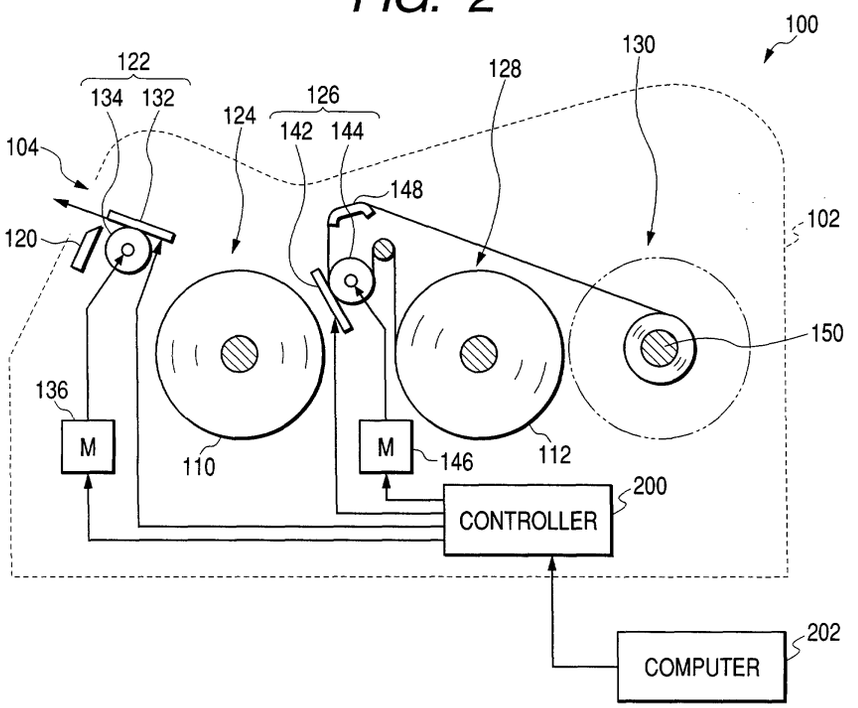
(72) Inventors:
- **Iwata, Kazunari**
  Suwa-shi, Nagano-ken 392-8502 (JP)
- **Kitabayashi, Ikuaki**
  Suwa-shi, Nagano-ken 392-8502 (JP)

(74) Representative: **Hoffmann, Eckart, Dipl.-Ing.**
Patentanwalt,
Bahnhofstrasse 103
82166 Gräfelfing (DE)

(54) Printing apparatus and method of controlling the same

(57) A first thermal head (132) is provided with at least one first heating element to perform printing on a first printing medium transported by first transporting means (134). A second thermal head (142) is provided with at least one second heating element to perform printing on a second printing medium (112) transported by second transporting means (144). A controller (200) controls the first thermal head (132) and the second thermal head (142) such that a first time period for which the first heating element is energized and a second time period for which the second heating element is energized do not overlap, while simultaneously driving a first motor (136) for driving the first transporting means and a second motor (146) for driving the second transporting means (144) at the same speed.

FIG. 2



EP 1 306 222 A2

Description

[0001] The present invention relates to a printing apparatus that is designed to print on a plurality of printing media at the same time, and a method of controlling such a printing apparatus.

[0002] For sales management for stores, point-of-sale (POS) stations have been widely employed. A POS station typically includes a personal computer, a display device, a drawer, a printing apparatus and a reader such as a barcode reader. Often the printing apparatus of such a POS station has a receipt printing function for printing a receipt to be handed to a customer (purchaser), and a journal printing function for printing a journal, which is a store transaction copy (disclosed in JP-A-9-234930A and JP-A-9-254496). A printing apparatus of this type has two thermal heads, one for printing data on a first printing medium for the receipts and another one for printing on a second printing medium as the journal.

[0003] In a printing apparatus of this type, when the two thermal heads are operated at the same time, the peak current is high causing a correspondingly high consumption of power. In order to reduce the consumption of power, the printing of a journal can be started once the printing of a receipt has been completed. In this case, however, an extended time is required to complete the printing of the receipt and the journal, and the desire of a rapid printing process cannot be met.

[0004] It is an object of the present invention to provide a printing apparatus that is capable of completing a printing process on at least two printing media within a relatively short time while keeping the peak current lower than that of comparable prior art printing apparatus. Another object of the invention is to provide a method of controlling such a printing apparatus.

[0005] These objects are achieved by a printing apparatus as claimed in claim 1 and a method as claimed in claim 8, respectively. Preferred embodiments of the invention are subject-matter of the dependent claim.

[0006] In accordance with the present invention, two thermal heads do not print concurrently but quasi-concurrently, i.e., in a time-sharing manner. Since the first and second motors are simultaneously driven at the same or nearly the same speed and the first and second thermal heads are energized in a non-overlapping interleaved manner, an increase in the peak current due to a printing on more than one printing medium can be avoided and the peak current can be reduced compared to the case where the active times of the two thermal heads overlap. Note that the term "active time" of a thermal head is used herein to denote the time period during which the thermal head is energized and consumes power as opposed to the "inactive time" during which the thermal head is not energized. Furthermore, since printing processes for which both the first and the second thermal head are used can be performed at virtually the same time, a rapid printing operation can be implemented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The above objects and advantages of the present invention will become more apparent from the following detailed description of preferred exemplary embodiments thereof with reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view of the external appearance of a printing apparatus according to a first embodiment of the present invention;

Fig. 2 is a schematic diagram showing the arrangement of the essential components of the printing apparatus;

Fig. 3 is a timing chart for explaining a method of controlling thermal heads and motors in the printing apparatus; and

Fig. 4 is a timing chart for explaining a method of controlling thermal heads and motors in a printing apparatus according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Preferred embodiments of the present invention will now be described in more detail while referring to the accompanying drawings. A printing apparatus 100 according to a first embodiment shown in Fig. 1 is adapted to print information on a receipt printing medium and a journal printing medium. As will be described in more detail later roll type printing media are used in the embodiments explained below although the invention is applicable to sheet type printing media as well. The particular material of the printing media is not important as long as it allows printing by means of a thermal print head. For convenience of description but without any limiting intention the printing medium used for receipt printing will be referred to "receipt paper" and the printing medium used for journal printing will be referred to "journal paper" hereinafter.

[0009] The printing apparatus 100 comprises an elongated case 102, in one longitudinal end face of which (the front face in Fig. 1) a discharge port 104 is formed from which a printed receipt is discharged. In the following explanation, the side on which the discharge port 104 of the printing apparatus 100 is located is defined as the "front", while the opposite side is defined as the "rear". The case 102 is formed of a lower case portion 106, which accommodates the individual mechanisms of the printing apparatus 100, and an upper case portion 108, which is provided atop the lower case portion 106. At the front of the upper case portion 108 a front cover

116 is provided that can be opened and closed, while at the top rear of the upper case portion 108 an upper cover 118 is provided that can be opened and closed. On the front of the upper case portion 108, positioned adjacent to the front cover 116, is an operation panel 114 whereupon switches, such as a power switch, are located. A roll of receipt paper 110 and a roll of journal paper 112 are loaded into the printing apparatus 100. The receipt paper and the journal paper used in this embodiment are so-called thermal sensitive printing media that are printed by the application of heat.

[0010] As is shown in Fig. 2, front and rear portions are defined inside of the case 102 of the printing apparatus 100. The front section, near the discharge port 104, is used for the printing of receipts, and in this section, beginning at the front, an auto cutter 120 for cutting a printed receipt, a receipt printing mechanism 122 for printing a receipt, and a chamber 124 for storing the receipt paper roll 110 are arranged in the named order. The rear section is used for journal printing, and in this section, beginning at the front, a journal printing mechanism 126 for printing a journal, a chamber 128 for storing the journal paper roll 112, and a journal winder 130 for winding up the printed journal paper to a roll and for holding the roll are arranged in the named order.

[0011] The receipt printing mechanism 122 includes a thermal head 132 wherein multiple heating elements are aligned in a line on a substrate; a platen roller 134 that is positioned parallel to the thermal head 132; and a motor 136 for rotating the platen roller 134 at a predetermined speed. The receipt paper is pulled from the receipt paper roll 110 and is fed to and sandwiched between the thermal head 132 and the platen roller 134. The motor 136, such as a four-phase stepping motor, produces a driving force that rotates the platen roller 134 via a transmission (not shown). As the platen roller 134 is rotated, the receipt paper is conveyed in the direction perpendicular to the direction in which the heating elements of the thermal head 132 are arranged. When the receipt paper is conveyed at a predetermined speed by the rotation of the motor 136 and the heating elements of the thermal head 132 are selectively energized to generate heat, desired characters or pictures are printed on the receipt paper. The printed portion of the receipt paper is then discharged through the discharge port 104 and is cut off the remaining receipt paper by the auto cutter 120 to be output as a receipt. As mentioned above, the auto cutter 120 is located inside the printing apparatus 100 adjacent to the discharge port 104.

[0012] The platen roller 134 is attached to the front cover 116, and the thermal head 132 is attached to a fixed portion of the upper case portion 108. When the front cover 116 (Fig. 1) is opened, the thermal head 132 and the platen roller 134 are separated from each other, and since the chamber 124 is exposed and is accessible from the front, the receipt paper roll 110 can be exchanged.

[0013] The journal printing mechanism 126, like the receipt printing mechanism 122, includes a thermal head 142 wherein multiple heating elements are aligned in a line on a support substrate; a platen roller 144 that is positioned opposite to the thermal head 142; and a motor 146 for rotating the platen roller 144 at a predetermined speed. The journal paper is pulled from the journal paper roll 112 and is fed to and sandwiched between the thermal head 142 and the platen roller 144. The motor 146 such as a four-phase stepping motor, produces a driving force that rotates the platen roller 144 via a transmission (not shown). When the receipt paper is conveyed at a predetermined speed by the rotation of the motor 146 and the heating elements of the thermal head 142 are selectively energized to generate heat, desired characters or pictures are printed on the journal paper. The printed journal paper is then conveyed to the journal winder 130, passing over a guide plate 148 that is located above the thermal head 142.

[0014] A winding reel 150 is arranged in the journal winder 130, and when the winding reel 150 is rotated by a motor (not shown), the printed journal is wound around it. When the upper cover 118 (see Fig. 1) of the upper case portion 108 is opened, the thermal head 142, the design of which provides for this, is separated from the platen roller 144 and the journal paper roll 112 can be exchanged and the roll of printed journal paper can be taken out.

[0015] A controller 200 for controlling printing apparatus 100 comprises a CPU in this embodiment. Upon receipt of a printing command from an external computer 202, the controller 200 drives the thermal heads 132 and 142 and the motors 136 and 146 to print corresponding characters or pictures on the receipt paper and the journal paper.

[0016] Fig. 3 is a timing chart for explaining a method employed by the controller 200 to control the thermal heads 132 and 142 and the motors 136 and 146. The motors 136 and 146 are stepping motors as described above, and are driven by changing, at each step, the phases (coils) of the respective motor that is to be excited. The controller 200 drives the motors 136 and 146 so that the phases of both motors are changed simultaneously. In this embodiment, the time period for each step *a*, i.e., the time period from the begin of one step to the begin of the next following step, is 1 ms. At the same time as the phase of the receipt printing motor 136 is changed (a new step starts), the controller 200 also transmits print data to the receipt printing thermal head 132 to energize selected heating elements thereof. Through this operation, data for one dot line is printed on the receipt paper. In addition, when a predetermined time interval c has elapsed since the phase of the journal printing motor 146 was changed (a new step started), the controller 200 transmits print data to the journal printing thermal head 142 to energize selected heating elements thereof. Through this operation, data for one dot line is printed on the journal paper. In this manner, the controller 200 alternately drives the receipt printing ther-

mal head 132 and the journal printing thermal head 142, so that the active times for these thermal heads do not overlap.

[0017] Preferably, the time interval c is substantially half the time period allocated for one step *a* (i.e., ½ of 1 ms = 0.5 ms, in this embodiment). The actives time *b* for the thermal heads 132 and 142 is shorter than the time interval *c* (0.35 ms, in this embodiment). With this setup, at each step data for a respective dot line can be printed by both the thermal head 132 and the thermal head 142 without the active times of the thermal heads 132 and 142 overlapping.

[0018] The operation of the thus arranged printing apparatus 100 will now be explained. Before the printing apparatus 100 is used, the front cover 116 is opened, a receipt paper roll 110 is loaded into the chamber 124, and the front cover 116 is closed. Then, the upper cover 118 is opened, a journal paper roll 112 is loaded into the chamber 128, and the upper cover 118 is closed. During this procedure, a predetermined length of the journal paper is pulled from the journal paper roll 112, and the leading edge is made to engage a predetermined portion of the winding reel 150. (It will be understood that the sequence of setting receipt paper and journal paper in the printing apparatus is irrelevant to the present invention.) Subsequently, when the power switch on the operation panel 114 is turned on, the various components of the printing apparatus 100 are activated.

[0019] Upon receipt of a print command from the external computer 202 the controller 200 synchronously drives the motors 136 and 146, and alternately energizes the thermal heads 132 and 142 between the individual steps, as is shown in Fig. 3. The receipt paper pulled from the receipt paper roll 110 is conveyed while being sandwiched between the thermal head 132 and the platen roller 134, and data is printed on the receipt paper by the heat generated by the energized heating elements of the thermal head 132. The journal paper pulled from the journal paper roll 112 is conveyed while being sandwiched between the thermal head 142 and the platen roller 144, and data is printed on the journal paper by the heat generated by the energized heating elements of the thermal head 142. The printed receipt paper is discharged through the discharge port 104 to the outside and is cut off the remaining receipt paper by the auto cutter 120 to become a receipt. The receipt is, for example, handed to a customer in a store. At the same time, the printed journal is guided to the journal winder 130 and is wound around the winding reel 150. This journal is kept, for example, as a copy for the store.

[0020] As is described above, according to this embodiment, since the motors 136 and 146 are driven stepwise at the same speed and the thermal heads 132 and 142 are energized without their active times overlapping, an increase in the peak current compared to the case of energizing only one thermal head can be avoided and the consumption of power can be reduced. Further, since the receipt and the journal can be printed substantially in parallel, the time required for the printing process can also be reduced compared to the case that the receipt and the journal are printed one after the other.

[0021] Especially, since a respective one of thermal heads 132 and 142 is energized at a time point following that, at which the respective other thermal head had been energized, after a time interval (*c*: 0.5 ms) that is longer than the period required for the printing of one dot line (the active time *b*: 0.35 ms), data for one dot line can be printed alternately on the receipt paper and the journal paper by energizing the thermal heads 132 and 142 in a time-sharing or interleaved manner.

[0022] In addition, since the motors 136 and 146 are synchronously driven and the energizing time points of the thermal heads 132 and 142 are set to be spaced by a time interval *c* that corresponds to about one half (for example, 0.5 ms) the time allocated to one step *a*, printing of the receipt and the journal can be implemented at each step, and the printing process can be rapidly performed.

[0023] A second embodiment of the present invention will now be described. In this embodiment, only the method employed by the controller 200 for controlling the thermal heads 132 and 142 and the motors 136 and 146 differs from that of the first embodiment, and the remainder of the configuration is the same as that of the first embodiment.

[0024] As is shown in Fig. 4, in this embodiment the phase changes of the motor 136 are shifted relative to those of the motor 146 by a predetermined time interval *c*. In this embodiment, each step *a* for the motors 136 and 146 is 1 ms. The thermal heads 132 and 142 are energized at the same time as the phase of the corresponding motors 136 and 146, respectively, is changed. The time interval *c* is about one half the time allocated to one step *a* of the motors 136 and 146 (0.5 ms, in this embodiment). The duration of the active time *b* of the thermal heads 132 and 142 (0.35 ms, in this embodiment) is shorter than the time interval *c* .

[0025] In this embodiment, the timings for changing the phases of the motors 136 and 146 differ, and the energization of the thermal heads 132 and 142 is started at the same time as the phases are changed, respectively, so that an overlap of the active times of the thermal heads 132 and 142 is prevented. As a result, the peak current is as low as in the first embodiment.

[0026] In this embodiment, the energization of the thermal heads 132 and 142 is started at the same time as the phases of the motors 136 and 146, respectively, are changed. However, the energization of the thermal heads 132 and 142 may be started a predetermined time after the changing of the phases of the motors 136 and 146.

[0027] Although two thermal heads have been described to be driven in a time-shared manner, one for printing receipts and another for printing a journal, the purpose of the respective printing media, such as re-

ceipt and journal, are printed for is irrelevant to the present invention. Also, three or more thermal heads could be driven in a time-shared manner.

Claims

1. A printing apparatus, comprising:

first transporting means (134) for transporting a first printing medium (110);
second transporting means (144) for transporting a second printing medium (112);
a first motor (136) for driving the first transporting means (134);
a second motor (146) for driving the second transporting means (144);
a first thermal head (132) having one or more first heating elements for printing on the first printing medium (110);
a second thermal head (142) having one or more second heating elements for printing on the second printing medium (112); and
a controller (200) for simultaneously driving the first motor (136) and the second motor (146) at substantially the same speed while controlling the first thermal head (132) by energizing selected ones of said one or more first heating elements during each of successive first time periods (b), and controlling the second thermal head (142) by energizing selected ones of said one or more second heating elements during each of successive second time periods (b),

characterized in that said controller (200) is adapted to control the first thermal head (132) and the second thermal head (142) such that none of said first time periods (b) overlaps any of said second time periods (b).

2. The printing apparatus as set forth in claim 1, wherein:

each of the first motor (136) and the second motor (146) is a stepping motor; and
said controller (200) is adapted to control said first and said second thermal heads (142) such that
a first time point at which a respective first time period (b) starts is determined based on a third time point at which an excited phase in the first motor (136) is changed; and
a second time point at which a respective second time period (b) starts is determined based on a fourth time point at which an excited phase in the second motor (146) is changed.

3. The printing apparatus as set forth in claim 2, wherein there is a first time interval (c) between a respective first time point and the next following second time point, which is longer than the first time period (b) starting at said respective first time point, and a second time interval between a respective second time point and the next following first time point, which is longer than the second time period (b) starting at the respective second time point.

4. The printing apparatus as set forth in claim 3, wherein said first and second time intervals are each substantially half the step time (a), which is defined as the time period between two successive third time points in the first motor (136) and the time between two successive fourth time points in the second motor (146).

5. The printing apparatus as set forth in claim 2, 3 or 4, wherein a respective first time point, a respective third time point and a respective fourth time point are made to coincide.

6. The printing apparatus as set forth in claim 2, 3 or 4, wherein a respective first time point and a respective third time point are made to coincide, while a respective second time point and a respective fourth time point are made to coincide.

7. The printing apparatus as set forth in claim 1, further comprising:

means (104) for discharging the first printing medium (110) to the outside after it has been printed by said first thermal head (132); and
means (130) for keeping the second printing medium (112) inside the printing apparatus after it has been printed by said second thermal head (142).

8. A method of controlling the printing apparatus as defined in any of the preceding claims, comprising the steps of:

driving the first motor (136) for transporting the first printing medium (110) and the second motor (146) for transporting the second printing medium (112) simultaneously at substantially the same speed;
energizing selected ones of said one or more first heating elements for a first time period (b) to perform printing on the first printing medium (110); and
energizing selected ones of said one or more second heating elements for a second time period (b) to perform printing on the second printing medium (112), wherein the first time period (b) and the second time period (b) do not overlap.

FIG. 1

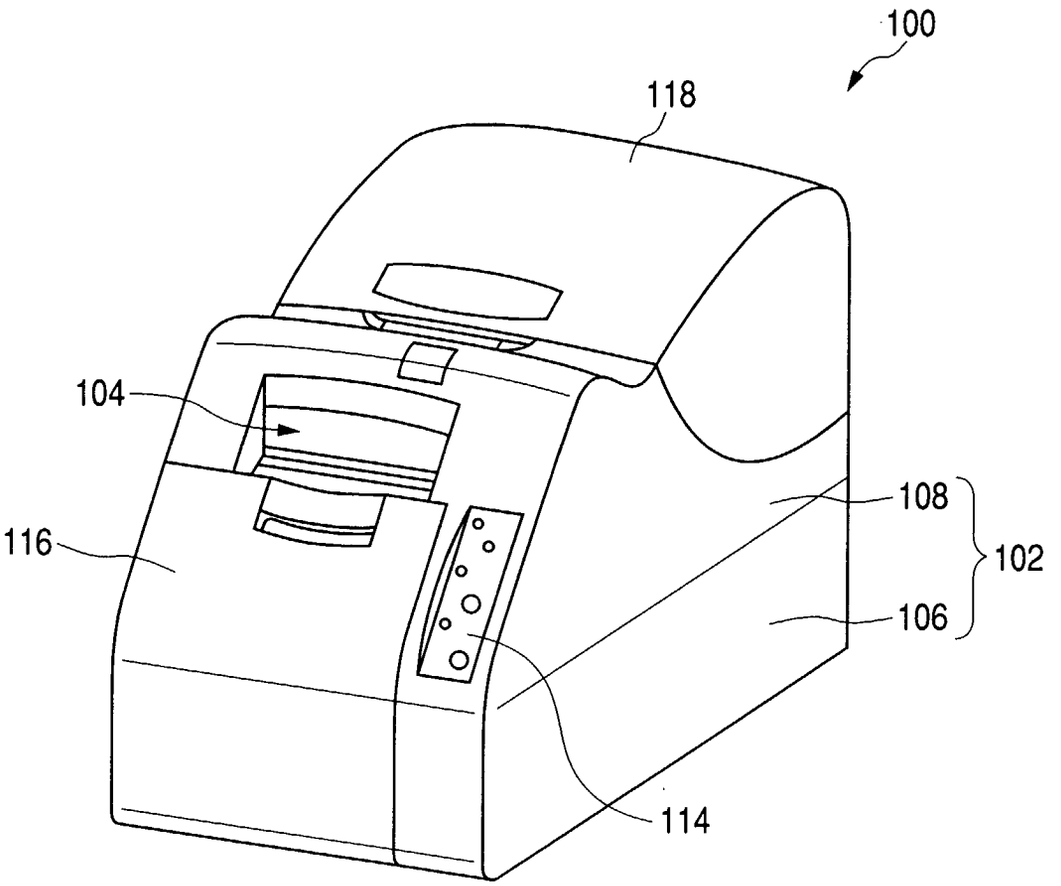


FIG. 2

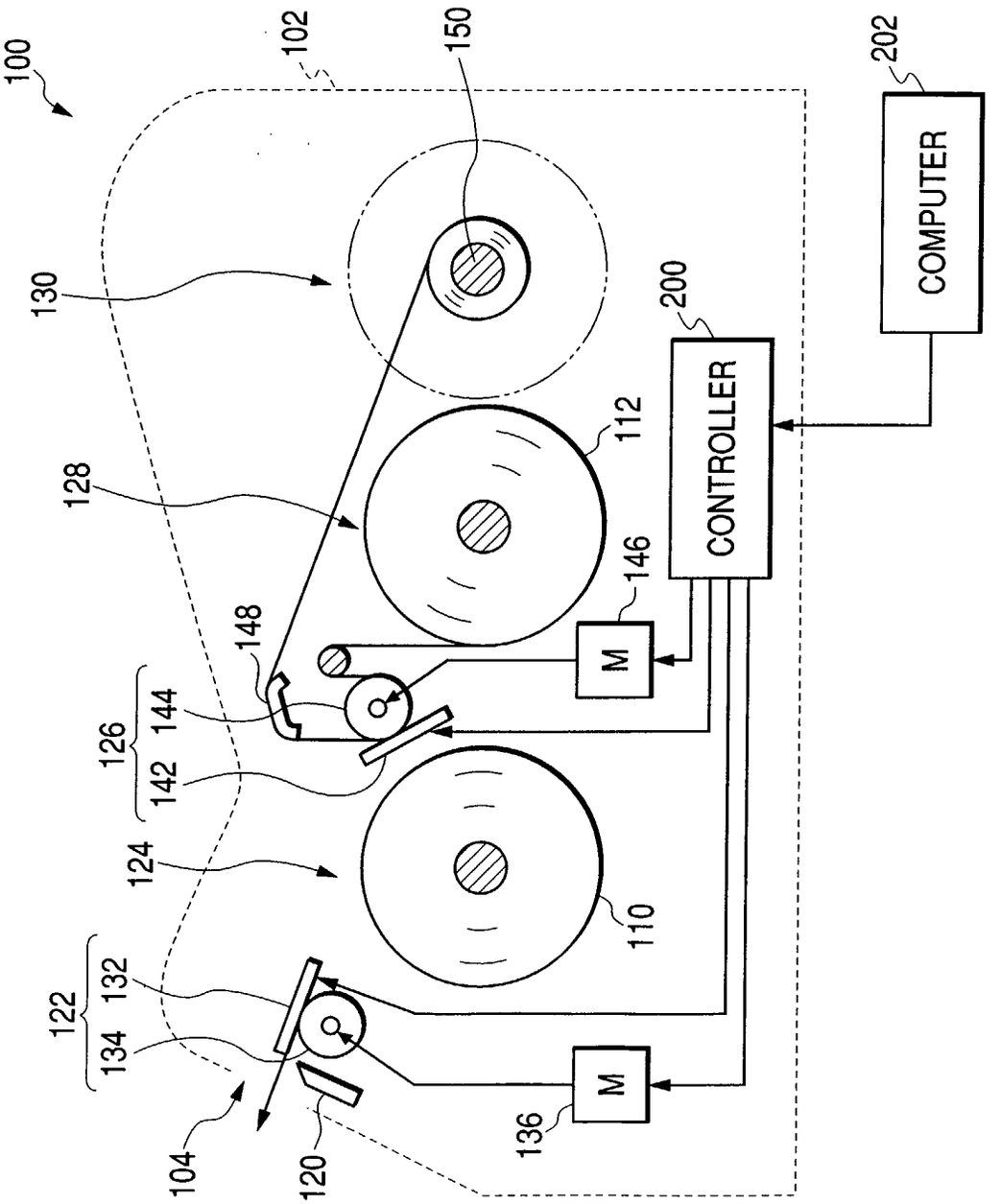

100
102
150
202
COMPUTER
130
200
CONTROLLER
112
128
146
M
148
126
144
142
124
110
122
132
134
104
120
136
M

FIG. 3

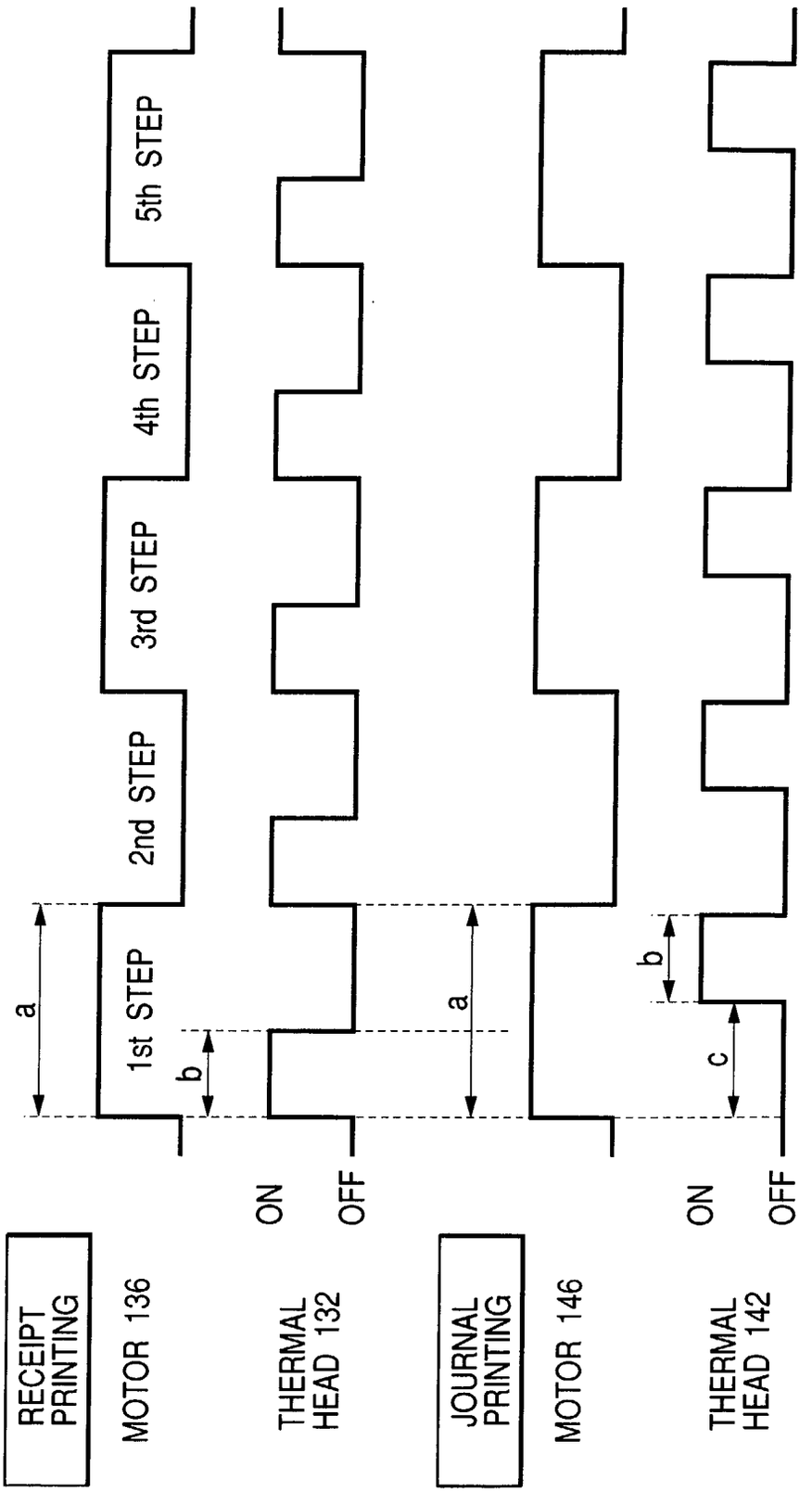
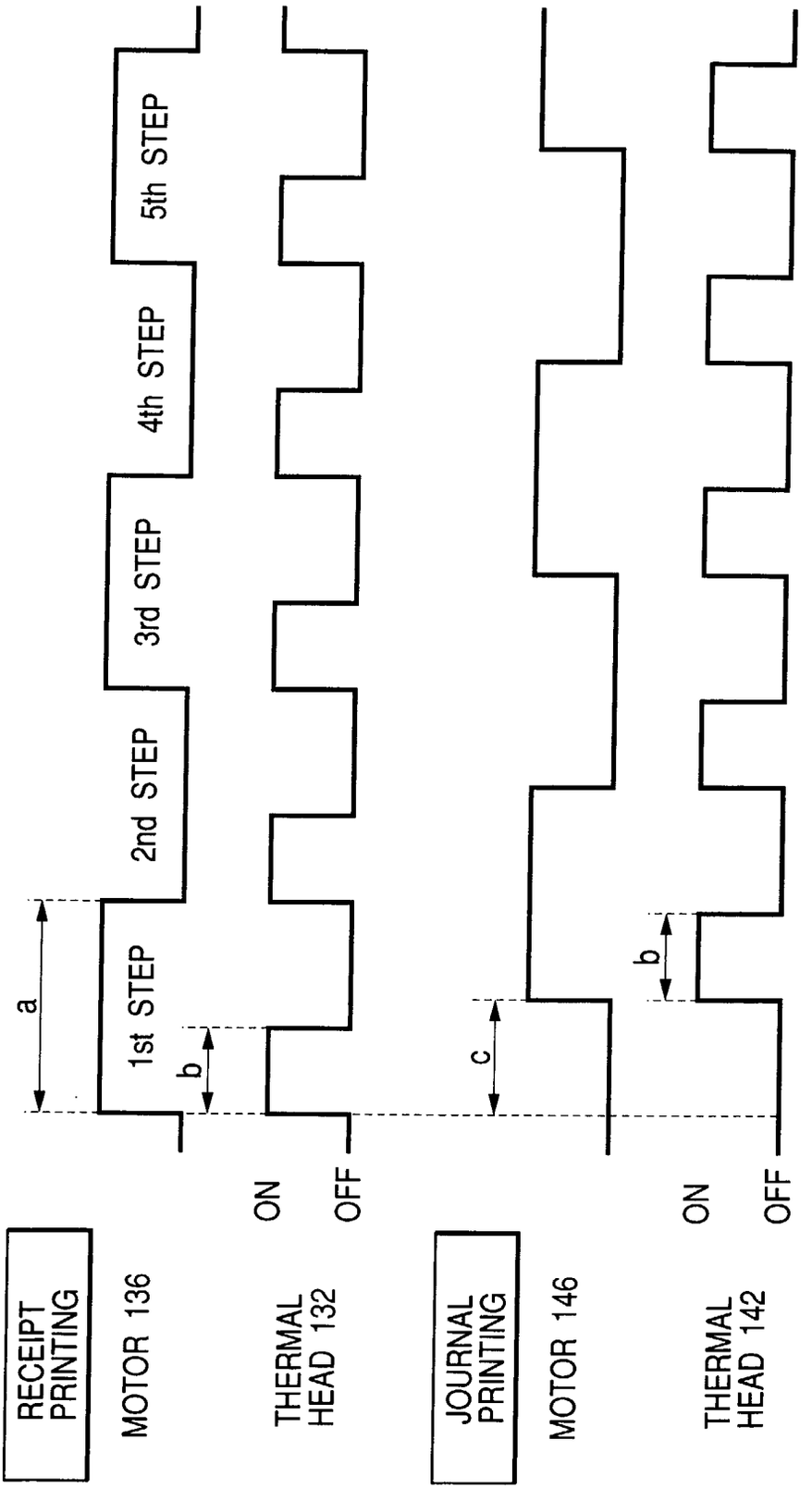

RECEIPT PRINTING
MOTOR 136
1st STEP
2nd STEP
3rd STEP
4th STEP
5th STEP
a
b
THERMAL HEAD 132
ON
OFF
JOURNAL PRINTING
MOTOR 146
a
THERMAL HEAD 142
b
c
ON
OFF

FIG. 4


RECEIPT PRINTING
MOTOR 136
1st STEP
2nd STEP
3rd STEP
4th STEP
5th STEP
a
b
THERMAL HEAD 132
ON
OFF
JOURNAL PRINTING
MOTOR 146
c
THERMAL HEAD 142
ON
OFF