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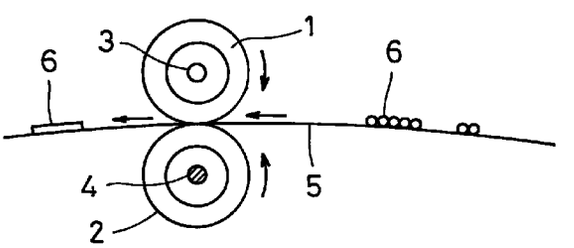
(54) Heat apparatus for use in an image forming apparatus

(57) A fusing/fixing apparatus has an upper roller 1 that is rotatable, a lower roller 2 that follows the rotation of the upper roller 1, and a heating means for heating at least one of the first and second rollers 1 and 2. When an image forming medium 5 with a toner image 6 formed thereon is passed and pressed between the upper and lower rollers 1 and 2, the toner image 6 is fused and fixed on the image forming medium 5. The heating means is constructed by combining a halogen heater 3 and a sheathed heater 4.

Fig. 1



EP 0 793 150 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a heat fusing/fixing apparatus for use in an image forming apparatus such as a photocopier, facsimile machine, printer, or the like.

Description of the Prior Art

In general, a heat fusing/fixing apparatus is provided with at least two rollers, of which the upper roller is driven to rotate and the lower roller is pressed against the upper roller so that it follows the rotation of the upper roller, as well as with an inner surface heating means for heating at least one of the rollers from inside (in some cases, an outer surface heating means is additionally provided to heat the rollers from outside). In such a heat fusing/fixing apparatus, an image forming medium with a toner image formed thereon is passed between the upper and lower rollers so that the toner image is fused and fixed on the image forming medium by direct application of heat from the rollers to the toner image. Conventionally, as the above-mentioned inner surface or outer surface heating means, halogen heaters have been used in most cases because of their quick response.

However, since halogen heaters offer only moderate heat efficiency, their use limits image processing speed to a considerably low level. Moreover, since halogen heaters have low resistances when cool, they cause a large rush current when powered, and thus cause undesired effects (such as a flicker) on other components arranged nearby.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a heat fusing/fixing apparatus that is capable of forming images at higher speed and with no more power consumption than conventional heat fusing/fixing apparatus.

To achieve the above object, according to the present invention, in a heat fusing/fixing apparatus for fusing and fixing by heat a toner image on an image forming medium, the above-mentioned heating means is constructed by combining a halogen heater and a sheathed heater.

Although sheathed heaters offer better heat efficiency than halogen heaters, they have thus far not been used widely because of their extremely slow response. However, by combining these two types of heaters, it is possible to secure satisfactorily quick response with the halogen heater and at the same time improve heat efficiency with the sheathed heater. Moreover, by restricting the power consumption of the halogen heater to a moderate level, it is possible to reduce rush currents.

BRIEF DESCRIPTION OF THE DRAWINGS

This and other objects and features of this invention will become clear from the following description, taken in conjunction with the preferred embodiments with reference to the accompanied drawings in which:

Fig. 1 is a diagram schematically showing the roller portion of an embodiment of the heat fusing/fixing apparatus according to the present invention;

Fig. 2 is a diagram schematically showing the roller portion of another embodiment of the heat fusing/fixing apparatus according to the present invention;

Fig. 3 is a diagram schematically showing the roller portion of still another embodiment of the heat fusing/fixing apparatus according to the present invention;

Fig. 4 is a diagram showing a first example of the control circuit for controlling the halogen heater and the sheathed heater;

Fig. 5 is a diagram showing a second example of the control circuit for controlling the halogen heater and the sheathed heater;

Fig. 6 is a diagram showing a third example of the control circuit for controlling the halogen heater and the sheathed heater;

Fig. 7 is a diagram showing a modified version of the third example of the control circuit of Fig. 6 with an additional phase detector or current detector; and

Fig. 8 is a diagram schematically showing the principal portion of an image forming apparatus fitted with a heat fusing/fixing apparatus according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, embodiments of the present invention will be described with reference to the drawings. Fig. 1 is a diagram schematically showing the roller portion of an embodiment of the present invention. In Fig. 1, reference numeral 1 represents an upper roller that is driven to rotate, reference numeral 2 represents a lower roller that is kept in contact with the upper roller 1 so as to follow its rotation, reference numeral 3 represents a halogen heater for heating the upper roller 1 from inside, and reference numeral 4 represents a sheathed heater for heating the lower roller 2 from inside. A sheet of transfer paper (image forming medium) 5 with a toner image 6 formed thereon is passed between the upper and lower rollers 1 and 2 so that the toner image 6 is fused and fixed on the transfer paper 5 by direct application of heat from the rollers 1 and 2 to the toner image 6.

The present invention may be embodied in many other ways than is shown in Fig. 1. For example, as

shown in Fig. 2, it is possible to heat the lower roller 2 from outside with a sheathed heater 4. Alternatively, as shown in Fig. 3, it is possible to heat the upper roller 1 from inside with a halogen heater 3 and a sheathed heater 4, and heat the lower roller 2 from outside with another sheathed heater 4. In similar ways, further variations and modifications are possible within the scope of the present invention.

Although sheathed heaters offer better heat efficiency than halogen heaters, they have thus far not been used widely because of their extremely slow response. However, the present invention, by combining these two types of heaters, makes it possible to secure satisfactorily quick response with the halogen heater 3 and at the same time improve heat efficiency with the sheathed heater 4. As a result, the heat fusing/fixing apparatus according to the present invention is capable of forming images at higher speed and with no more power consumption than conventional heat fusing/fixing apparatus. Moreover, by restricting the power consumption of the halogen heater 3 to a moderate level, it is possible to reduce rush currents, and thus to reduce undesired effects (such as a flicker) on other components arranged nearby.

Fig. 4 is a diagram showing a portion, relevant to the present invention, of a first example of the control circuit for controlling the halogen heater 3 and the sheathed heater 4. In Fig. 4, reference numeral 7 represents an AC (alternating current) power source, reference numeral 8 represents an operation section through which a user enters instructions, reference numeral 9 represents a temperature sensor for detecting the temperature of the heat fusing/fixing apparatus, and reference numeral 10 represents a microcomputer that opens and closes a switch 11 in accordance with signals fed from the operation section 8 and from the temperature sensor 9.

In this control circuit, the halogen heater 3, which has a low resistance, and the sheathed heater 4, which has a high resistance, are connected in series. Accordingly, this circuit considerably reduces rush currents that occur at the moment when the switch 11 is closed, and thus reduces undesired effects (such as a flicker) on other components arranged nearby.

Fig. 5 is a diagram showing a portion, relevant to the present invention, of a second example of the control circuit for controlling the halogen heater 3 and the sheathed heater 4. In Fig. 5, the same elements as are found in the above first example of the control circuit are identified with the same designations, and the descriptions of such elements will not be repeated.

In this control circuit, the halogen heater 3 and the sheathed heater 4 are connected in parallel. Accordingly, this circuit causes larger rush currents than the circuit with the two heaters connected in series. Nevertheless, since two heaters are used in combination to obtain a desired amount of heat by appropriately sharing the heat capacity in the present invention, and accordingly the halogen heater only needs to have lower heat producing capacity than in conventional cases where it is used independently, this circuit still reduces rush currents considerably, and thus reduces undesired effects (such as a flicker) on other components arranged nearby. Moreover, in this control circuit, the current flowing through the halogen heater 3 is not affected by the current flowing through the sheathed heater 4. Accordingly, this circuit offers better response than the circuit with the two heaters connected in series.

Fig. 6 is a diagram showing a portion, relevant to the present invention, of a third example of the control circuit for controlling the halogen heater 3 and the sheathed heater 4. In Fig. 6, the same elements as are found in the first and second examples of the control circuit are identified with the same designations, and the descriptions of such elements will not be repeated. This control circuit is provided with switches 12 and 13 for controlling the halogen heater 3 and the sheathed heater 4 individually, and these switches 12 and 13 are opened and closed by a microcomputer 10.

This control circuit not only offers the same advantages as the one described just above with the two heaters connected in parallel, but also allows simultaneous control of the halogen heater 3 and the sheathed heater 4, or independent control of the sheathed heater 4 with the halogen heater 3 turned off.

This control circuit is convenient to control the heat fusing/fixing apparatus when it is in a pre-heating or standby state, or when it is operated in a power save mode or in a mode for short-time processing. In such cases, the microcomputer 10 keeps the switch 12 open to keep the halogen heater 3 turned off, and controls only the sheathed heater 4 by opening and closing the switch 13.

Such control offers still better heat efficiency, but leads to slower response. However, since quick response is not so important in a pre-heating or standby state as during image formation whereas heat efficiency is of great importance in a power save mode, and since the amount of heat consumed in short-time processing can be compensated for with moderately quick response, it is possible to cope with these situations by using the sheathed heater alone. Note that, since the sheathed heater 4 exhibits only small variations in its resistance, independent control of the sheathed heater 4 does not cause undesired effects such as a flicker on other components arranged nearby such as the halogen heater 3.

Moreover, it is also possible, as shown in Fig. 7, to provide the control circuit of Fig. 6 with a phase detector 14 or current detector 15 so that the microcomputer 10, by monitoring signals from such a detector, can control the phase or current of each of the halogen heater 3 and the sheathed heater 4, and thus control the distribution of power to be consumed.

This makes it possible to obtain desired characteristics of the heat fusing/fixing apparatus in terms of the balance between response speed and heat efficiency. For example, when the heat fusing/fixing apparatus is

cold, priority is given to response speed by distributing more power to the halogen heater 3; when the heat fusing/fixing apparatus is hot (within a predetermined temperature range), priority is given to heat efficiency by distributing all available power to the sheathed heater 4; and otherwise, when the heat fusing/fixing apparatus is neither cold or hot, power is distributed evenly between the halogen heater 3 and the sheathed heater 4.

In a heat fusing/fixing apparatus according to the present invention, combination of a halogen heater, which is characterized by quick response, and a sheathed heater, which is characterized by good heat efficiency, makes it possible to secure satisfactorily quick response with the halogen heater and at the same time improve heat efficiency with the sheathed heater. Accordingly, the heat fusing/fixing apparatus of the present invention can process images at higher speed and with no more power consumption than conventional heat fusing/fixing apparatus. Moreover, by restricting the power consumption of the halogen heater to a moderate level, it is possible to reduce rush currents, and thus to reduce undesired effects on other components arranged nearby.

Fig. 8 is a diagram schematically showing the principal portion of an image forming apparatus fitted with a heat fusing/fixing apparatus according to the present invention as described above. In Fig. 8, reference numeral 20 represents a rotary drum having on its surface a light-sensitive layer. This light-sensitive drum 20 rotates in the direction indicated by arrow A. Reference numeral 21 represents a main charger for charging the surface of the light-sensitive drum 20, and reference numeral 22 represents an image writing means for emitting light 23 in accordance with an image to form a latent image on the surface of the light-sensitive drum 20. When the image forming apparatus is an analog photocopier, the image writing means 22 is constructed as an optical system for scanning an original. In this case, the light 23 is obtained as light reflected from the original when the original is illuminated by light. When the image forming apparatus is a digital photocopier or printer, the image writing means 22 is constructed with a laser light source that is driven in accordance with an image signal. Reference numeral 24 represents a developer for developing the latent image formed on the surface of the light-sensitive drum 20; specifically, the developer 24 supplies toner to the surface of the light-sensitive drum 20 by the use of a rotary sleeve 25. Reference numeral 26 represents a transfer charger for transferring a toner image formed on the light-sensitive drum 20 onto a sheet 5, which is fed in the direction indicated by arrow B. Reference numeral 27 represents a separation charger for separating the sheet 5 from the light-sensitive drum 20. The thus separated sheet 5 is then passed between the upper roller 1 and the lower roller 2 of the heat fusing/fixing apparatus and is fed toward the discharging side.

Claims

1. A heat apparatus (28) for fusing and fixing by heat a toner image formed on an image forming medium (5),
   wherein a halogen heater (3) and a sheathed heater (4) are used in combination as a heating means.

2. A heat apparatus as claimed in claim 1,
   wherein said halogen heater (3) and said sheathed heater (4) are connected in series.

3. A heat apparatus as claimed in claim 1,
   wherein said halogen heater (3) and said sheathed heater (4) are connected in parallel.

4. A heat apparatus as claimed in claim 1,
   wherein said halogen heater (3) and said sheathed heater (4) are controlled individually.

5. A heat apparatus as claimed in claim 4,
   wherein, when an image forming apparatus fitted with said heat apparatus is in a pre-heating or standby state, or is operating in a power save mode, said halogen heater (3) is kept turned off and only said sheathed heater (4) is controlled.

6. A heat apparatus as claimed in claim 4,
   wherein said halogen heater(3) and the sheathed heater (4) are controlled by controlling phases thereof.

7. A heat apparatus as claimed in claim 4,
   wherein said halogen heater(3) and the sheathed heater (4) are controlled by controlling currents thereof.

8. A heat apparatus as claimed in claim 1,
   wherein a first roller (1) and a second roller (2) are further provided between which a medium (5) with a toner image formed thereon is passed, the second roller (2) being pressed against the first roller (1) to be kept in contact therewith, and
   wherein said heaters heat at least one of the rollers.

9. A heat apparatus as claimed in claim 8,
   wherein said halogen heater (3) heats said first roller (1), and said sheathed heater (4) heats said second roller (2).

10. A heat apparatus as claimed in claim 8,
    wherein said halogen heater (3) and said sheathed heater (4) are connected in series to a power source (7).

11. A heat apparatus as claimed in claim 8,
    wherein said halogen heater (3) and said

sheathed heater (4) are connected in parallel to a power source (7).

Fig. 1

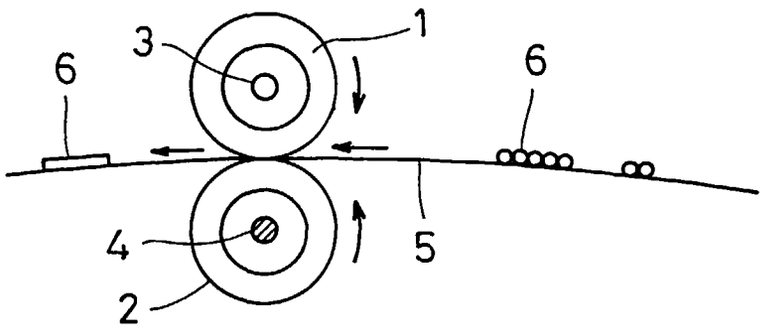


Fig. 2

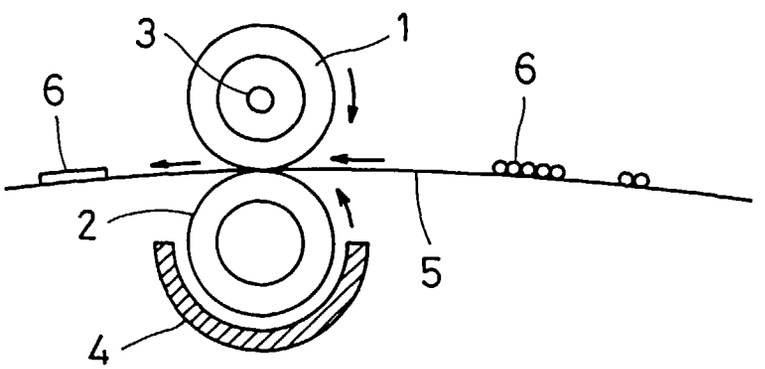


Fig. 3

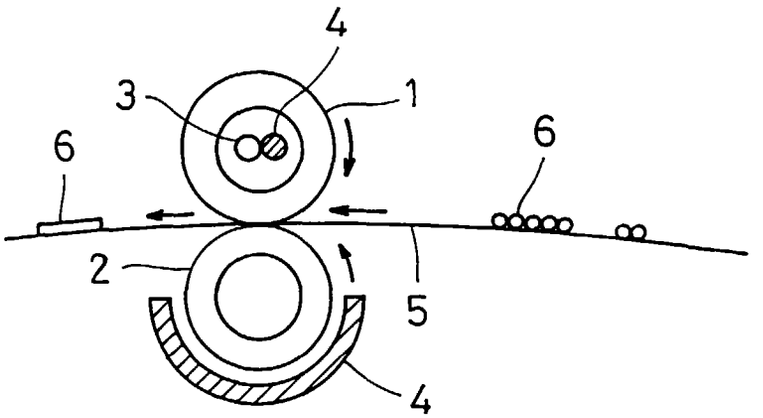

4
3
1
6
6
2
5
4

Fig. 4

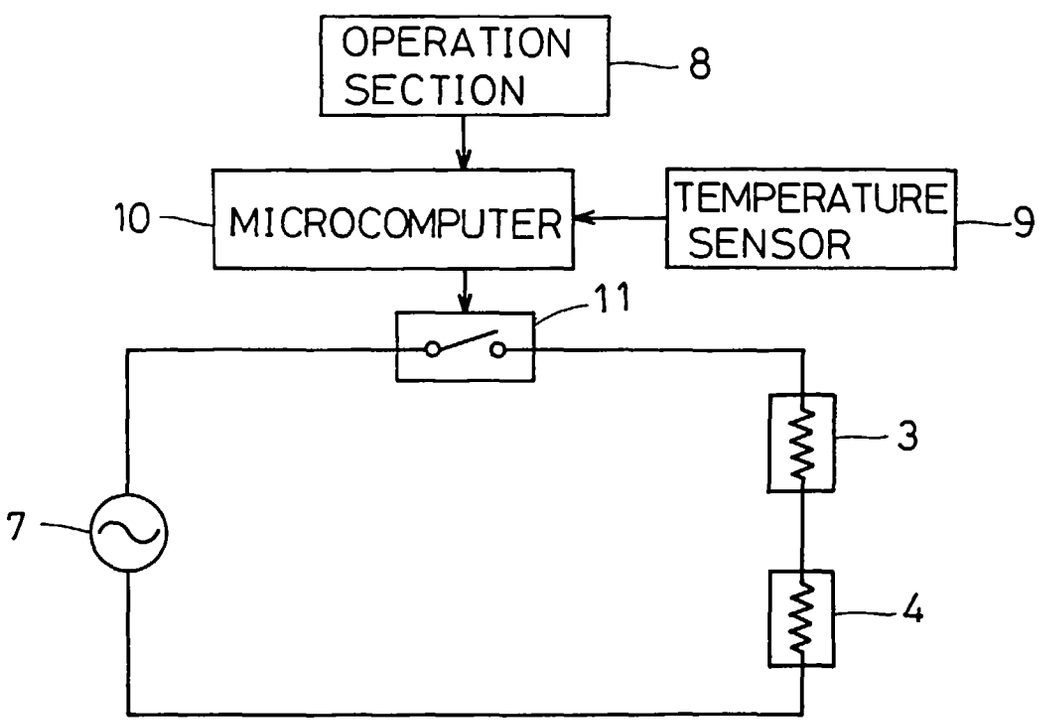
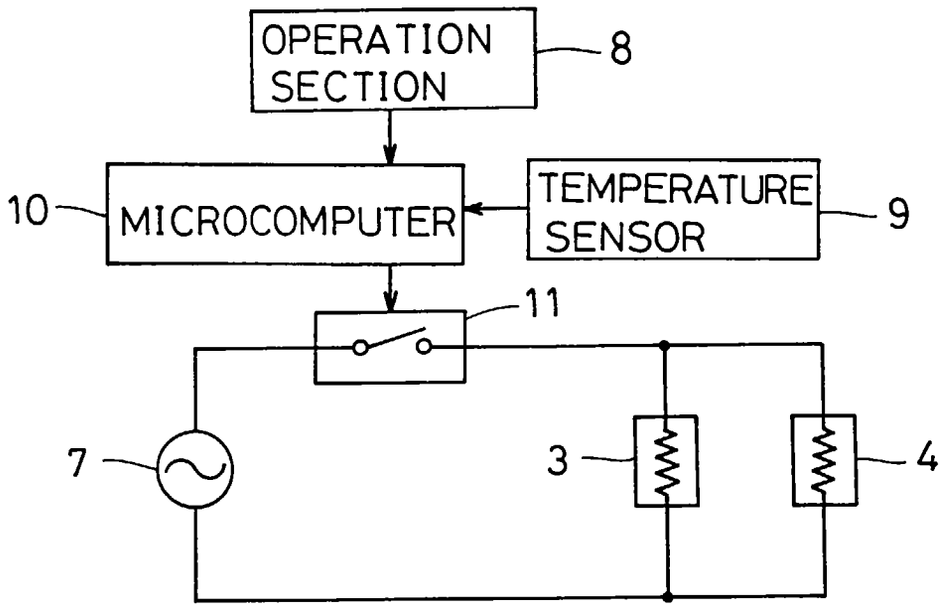

OPERATION SECTION
8
10
MICROCOMPUTER
TEMPERATURE SENSOR
9
11
3
7
4

Fig. 5


OPERATION SECTION
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MICROCOMPUTER
TEMPERATURE SENSOR
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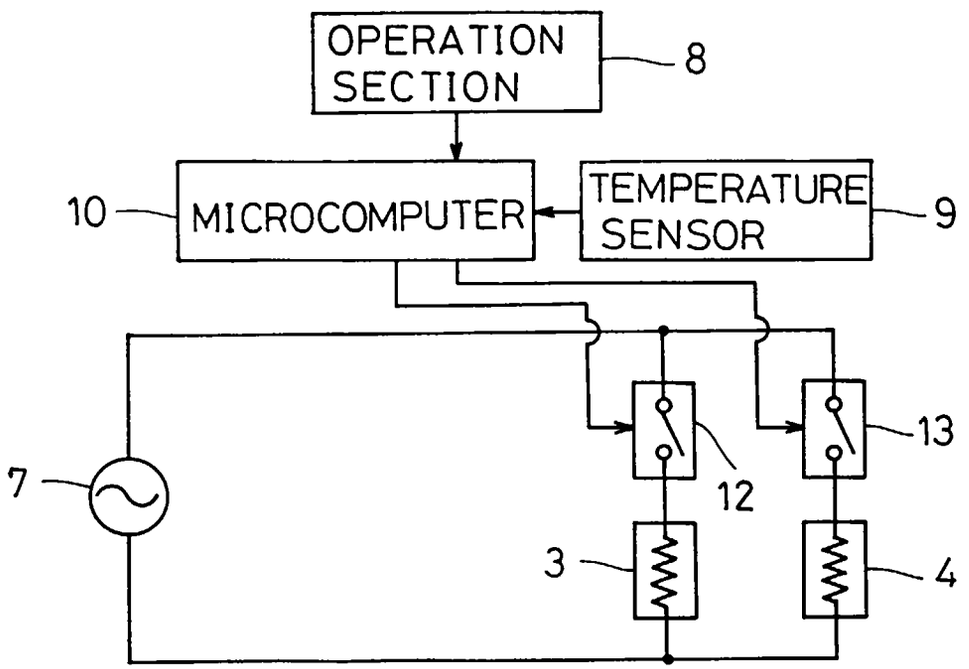
Fig. 6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MICROCOMPUTER
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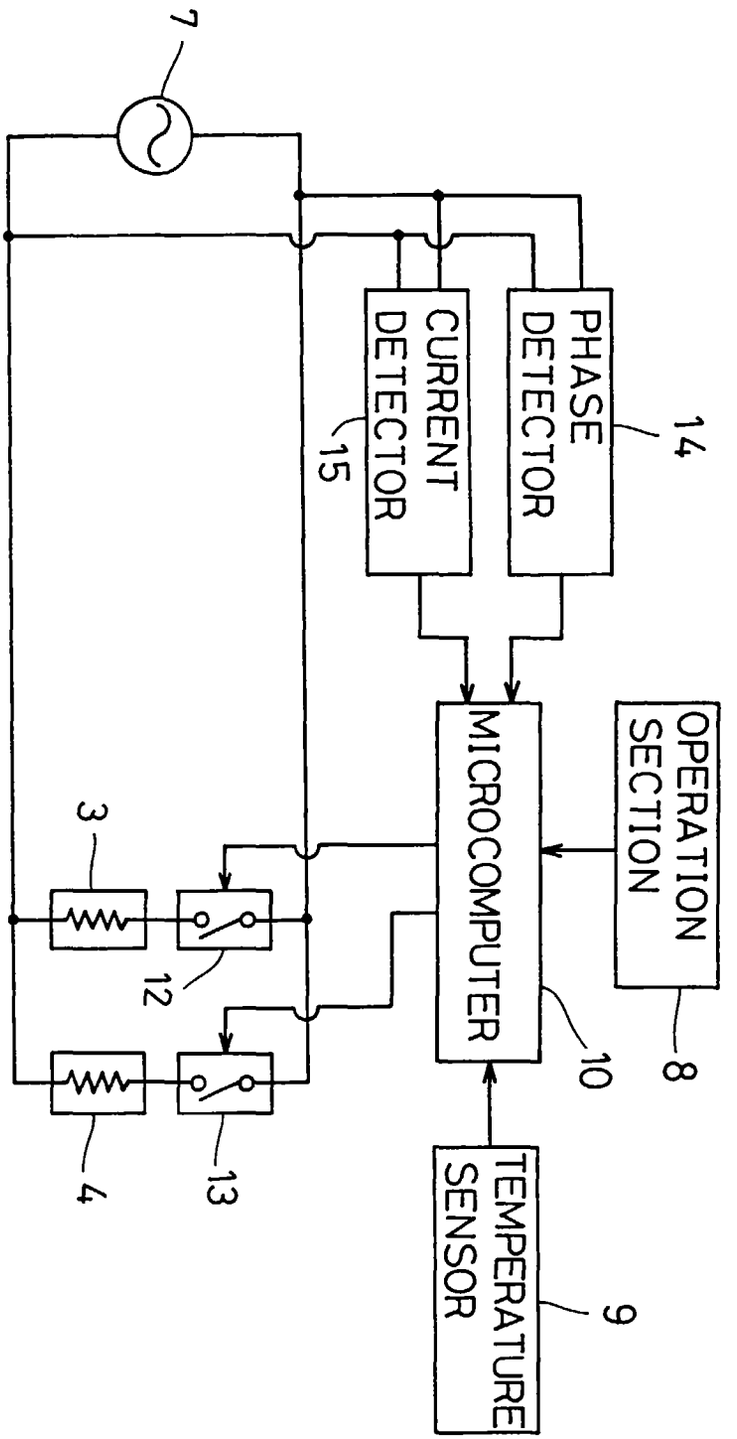
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PHASE DETECTOR
14
CURRENT DETECTOR
15
MICROCOMPUTER
10
OPERATION SECTION
8
TEMPERATURE SENSOR
9
3
12
4
13

Fig. 7

Fig. 8