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(54) IMAGE-PROCESSING APPARATUS

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(57) **ABSTRACT**

There is provided an image-processing apparatus including: one or more heaters; a power supply unit including at least one direct current power supply, the power supply unit being configured to operate in one of a plurality of operation states having respective different total consumed powers; one or more drive circuits configured to drive the one or more heaters, respectively, using power supplied from the at least one direct current power supply; and a controller configured to control, on the basis of a driving state of the one or more heaters, the power supply unit to operate in an operation state selected such that a surplus of the total consumed power is reduced.

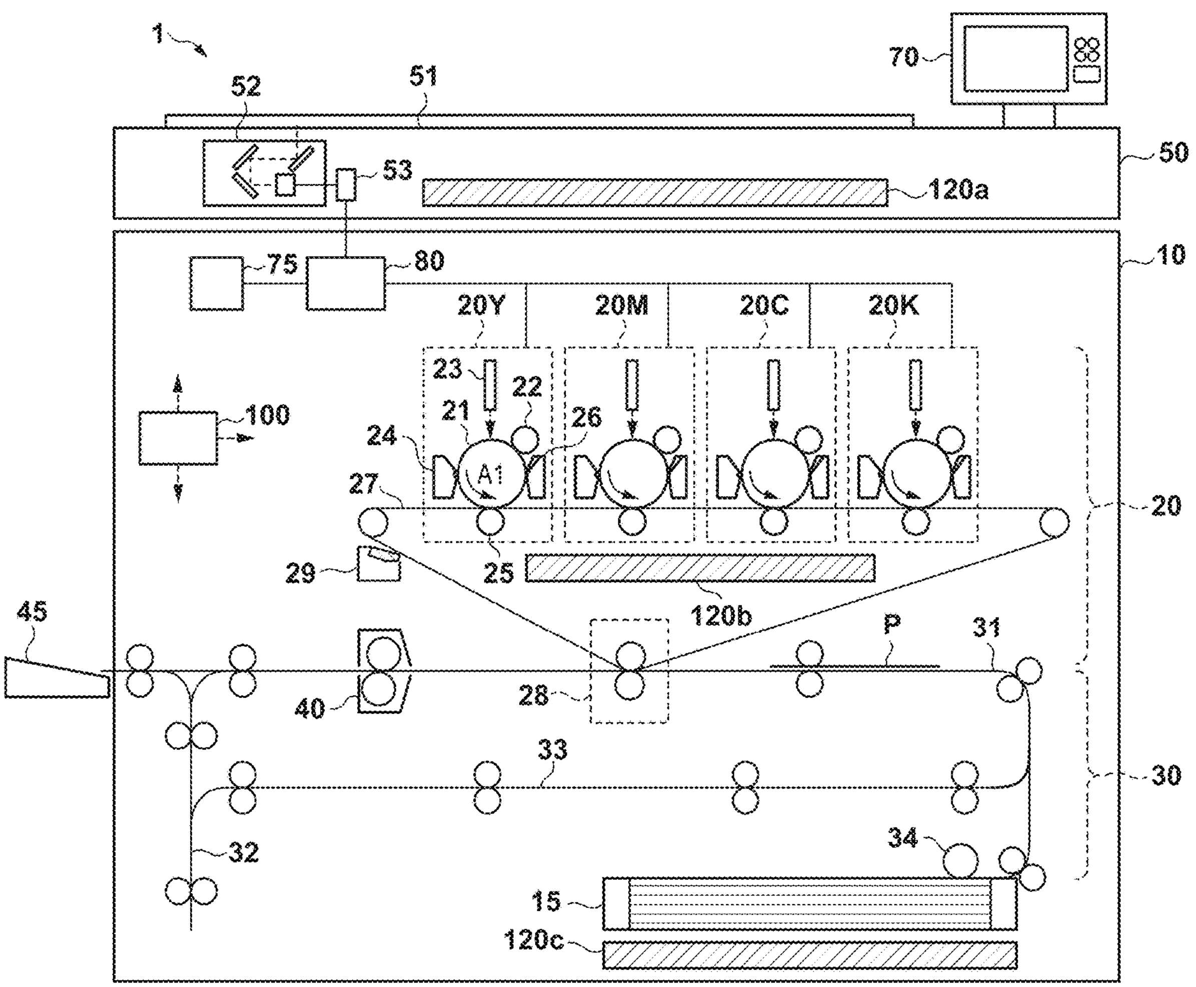


FIG. 1

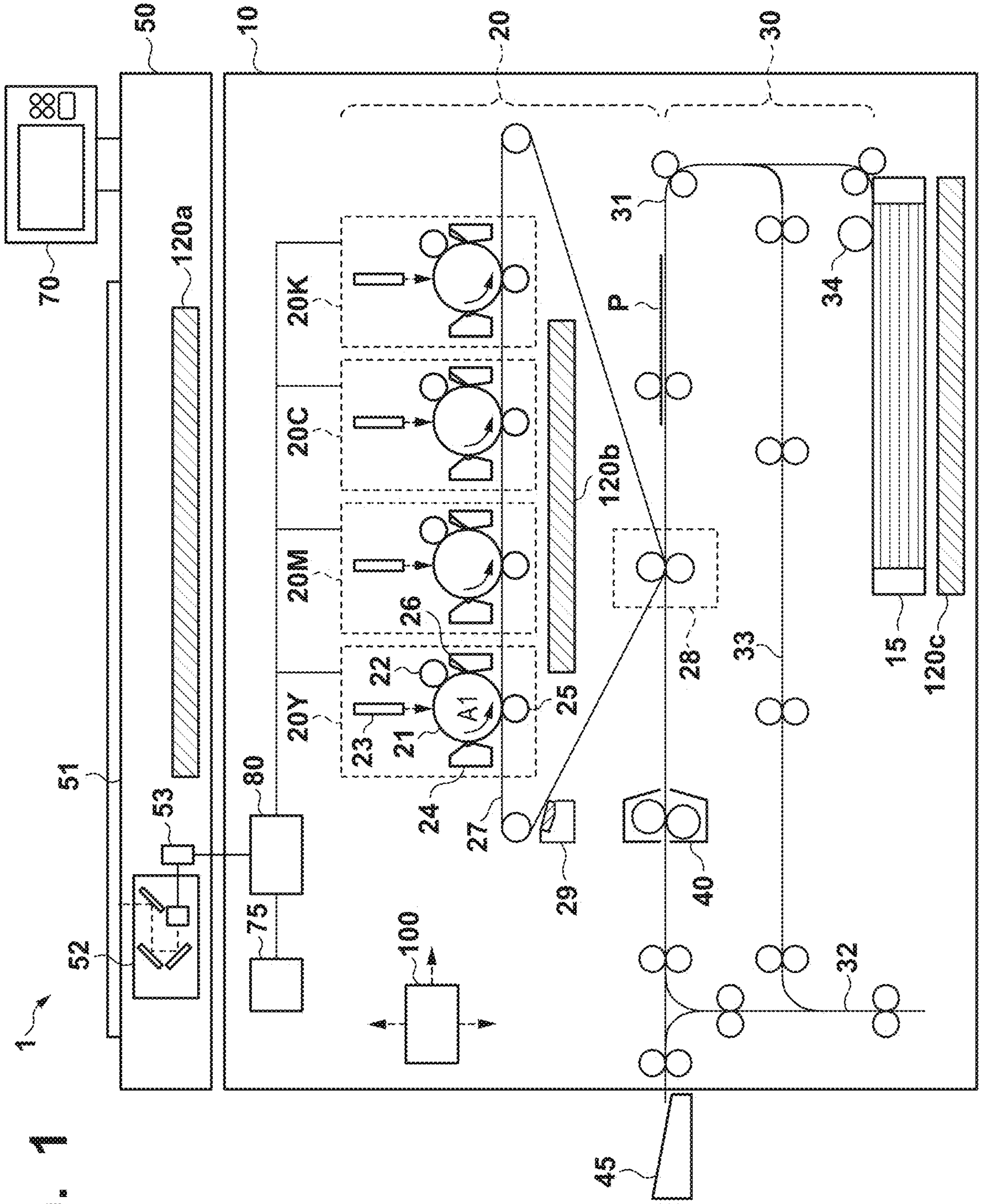
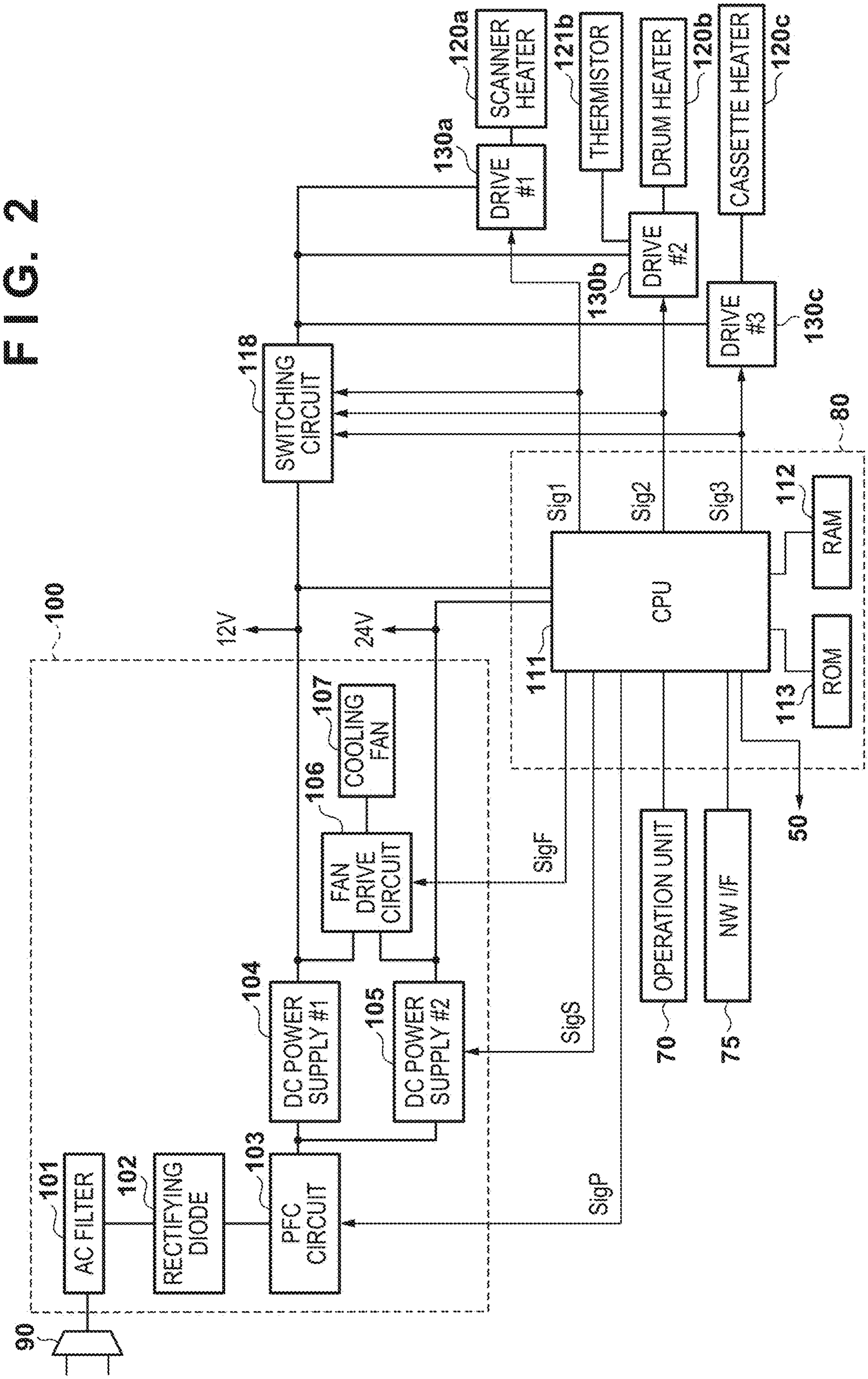
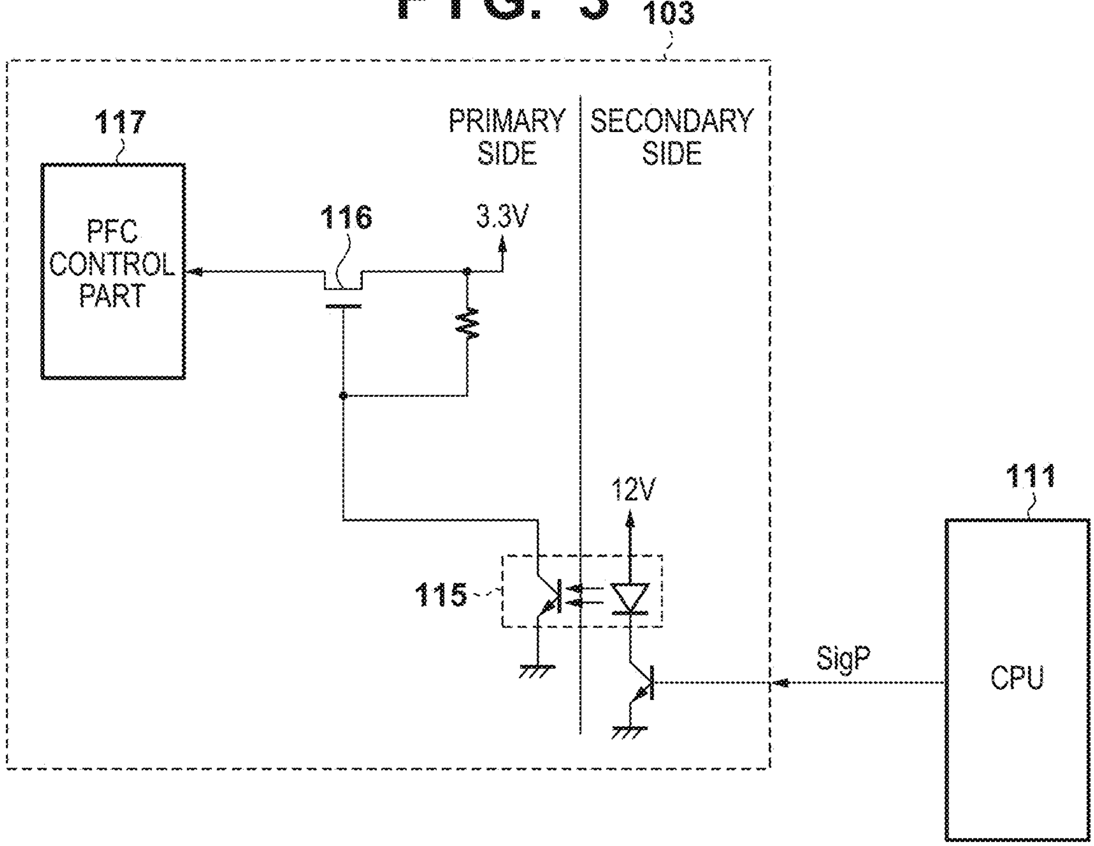

1
70
50
51
52
53
120a
10
80
75
100
20
20Y
20M
20C
20K
21
22
23
24
25
26
27
28
29
A1
120b
30
31
32
33
34
P
15
120c
40
45

FIG. 2



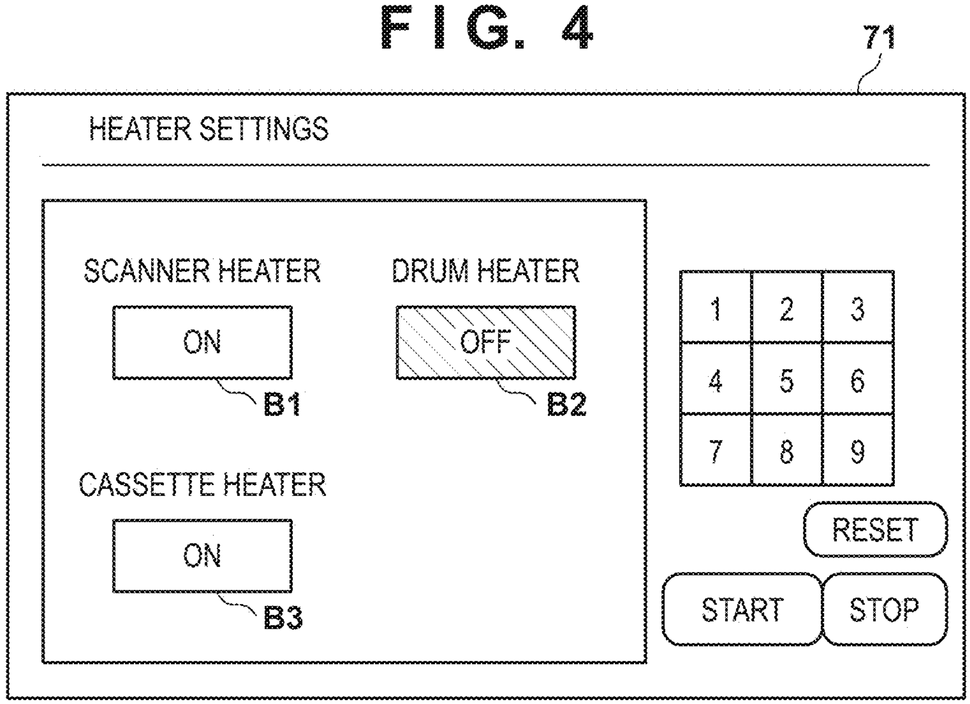
90
100
101
AC FILTER
102
RECTIFYING DIODE
103
PFC CIRCUIT
104
DC POWER SUPPLY #1
105
DC POWER SUPPLY #2
106
FAN DRIVE CIRCUIT
107
COOLING FAN
12V
24V
SigP
SigS
SigF
118
SWITCHING CIRCUIT
80
111
CPU
112
RAM
113
ROM
Sig1
Sig2
Sig3
50
70
OPERATION UNIT
75
NW I/F
130a
DRIVE #1
130b
DRIVE #2
130c
DRIVE #3
120a
SCANNER HEATER
121b
THERMISTOR
120b
DRUM HEATER
120c
CASSETTE HEATER

FIG. 3



103
117
PFC CONTROL PART
PRIMARY SIDE
SECONDARY SIDE
116
3.3V
12V
111
115
SigP
CPU

FIG. 4



71
HEATER SETTINGS
SCANNER HEATER
ON
B1
DRUM HEATER
OFF
B2
CASSETTE HEATER
ON
B3
1
2
3
4
5
6
7
8
9
RESET
START
STOP

FIG. 5

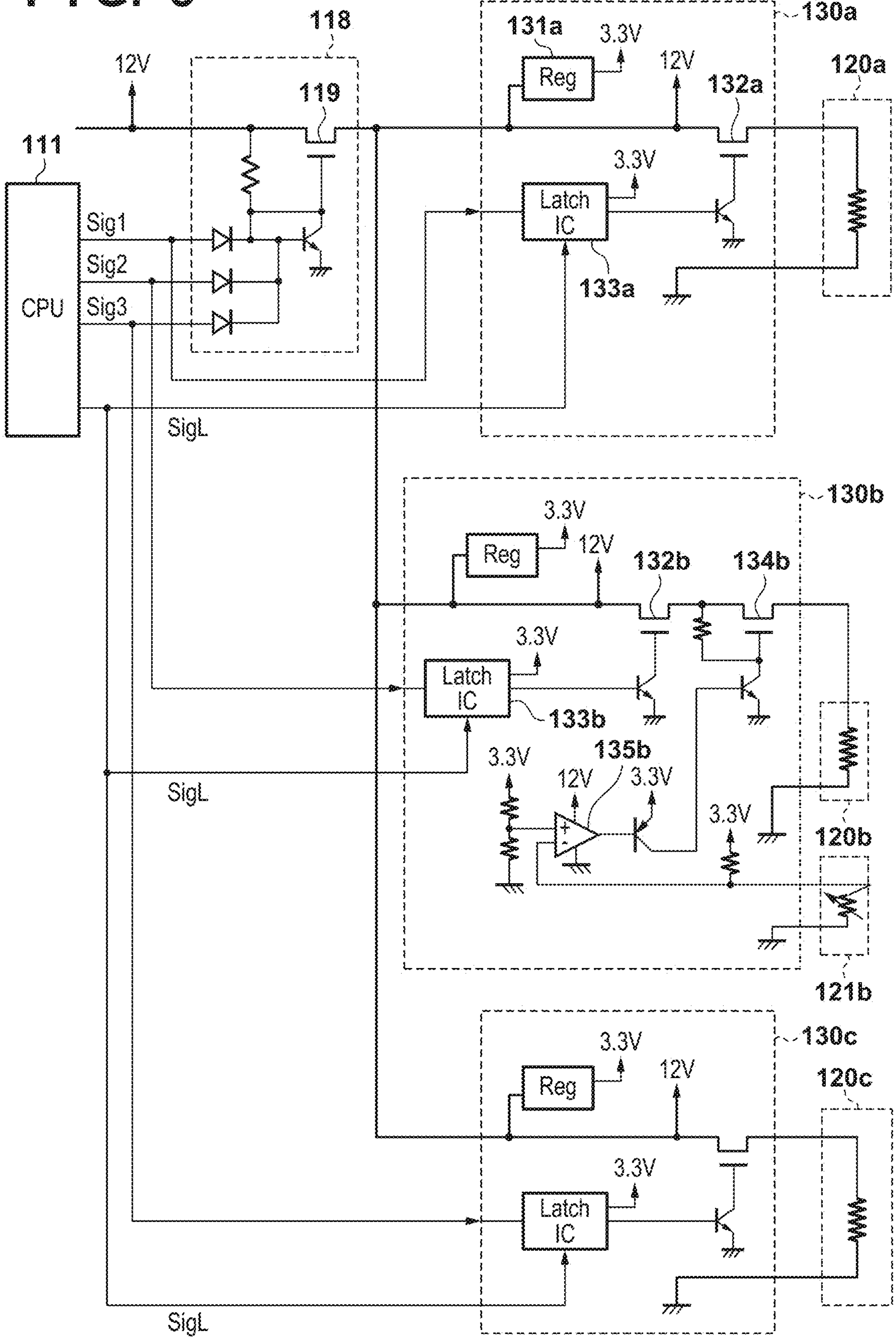

118
12V
119
111
CPU
Sig1
Sig2
Sig3
SigL
130a
131a
Reg
3.3V
12V
132a
120a
Latch IC
133a
130b
Reg
3.3V
12V
132b
134b
Latch IC
133b
135b
SigL
120b
121b
130c
Reg
3.3V
12V
120c
Latch IC
SigL

FIG. 6

APPARATUS MODE	DRIVING STATE OF HEATER			REQUIRED POWER			OPERATION STATE OF POWER SUPPLY			
				POWER SUPPLY #1		POWER SUPPLY #2 [W]				
	SCANNER H (10W)	DRUM H (20W)	CASSETTE H (10W)	HEATER TOTAL [W]	CONTROL [W]		PFC	FAN	POWER SUPPLY #1	POWER SUPPLY #2
POWER OFF /SLEEP	OFF	OFF	OFF	0	0 or 1	0	OFF	OFF	ON	OFF
	OFF	OFF	ON	10	0 or 1	0	OFF	OFF	ON	OFF
	OFF	ON	OFF	20	0 or 1	0	OFF	OFF	ON	OFF
	OFF	ON	ON	30	0 or 1	0	ON	OFF	ON	OFF
	ON	OFF	OFF	10	0 or 1	0	OFF	OFF	ON	OFF
	ON	OFF	ON	20	0 or 1	0	OFF	OFF	ON	OFF
	ON	ON	OFF	30	0 or 1	0	ON	OFF	ON	OFF
	ON	ON	ON	40	0 or 1	0	ON	ON	ON	OFF
STANDBY /PRINT	Don't Care	Don't Care	Don't Care	Don't Care	Max 30	Max 290	ON	ON	ON	ON

FIG. 7

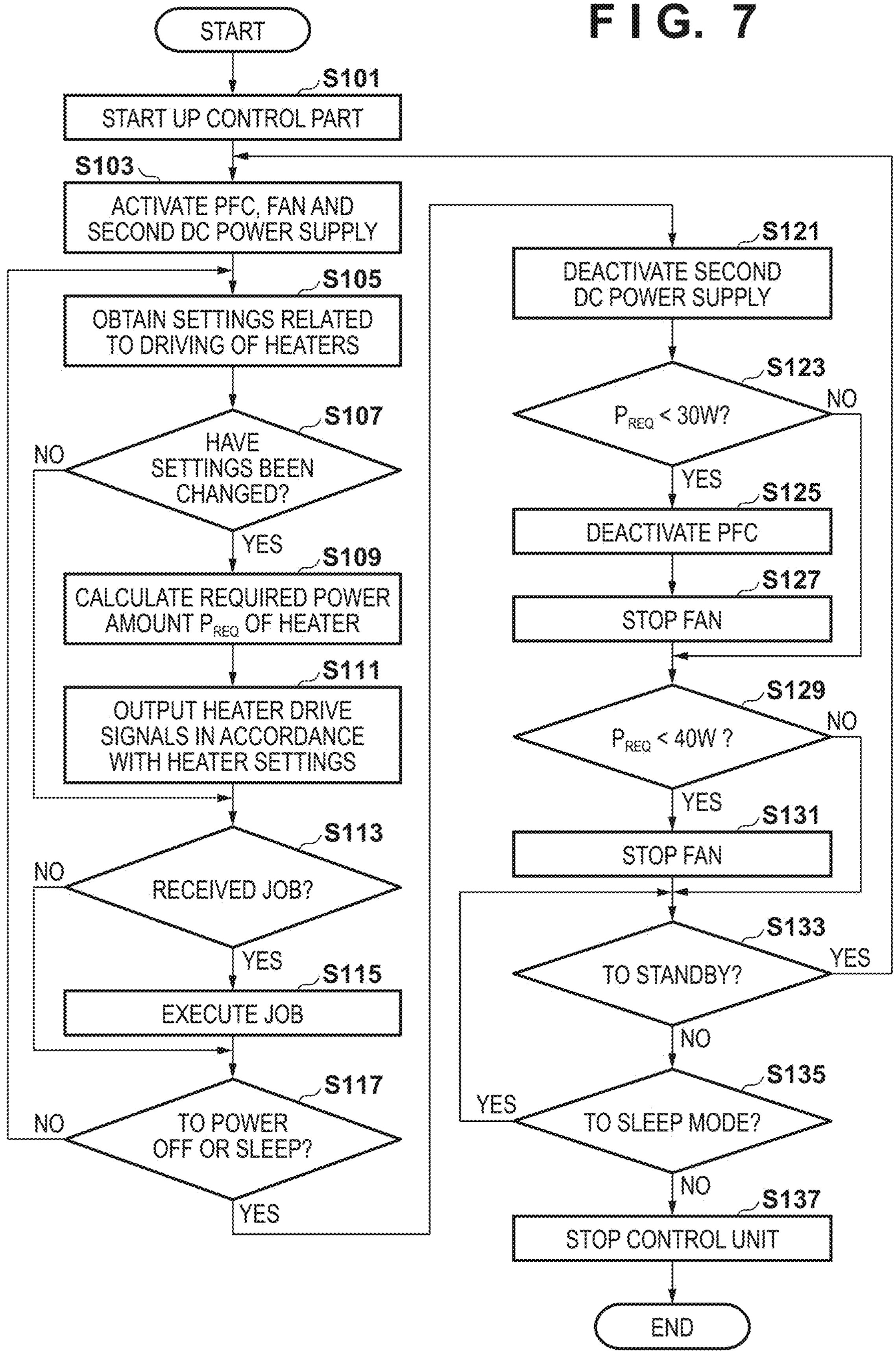
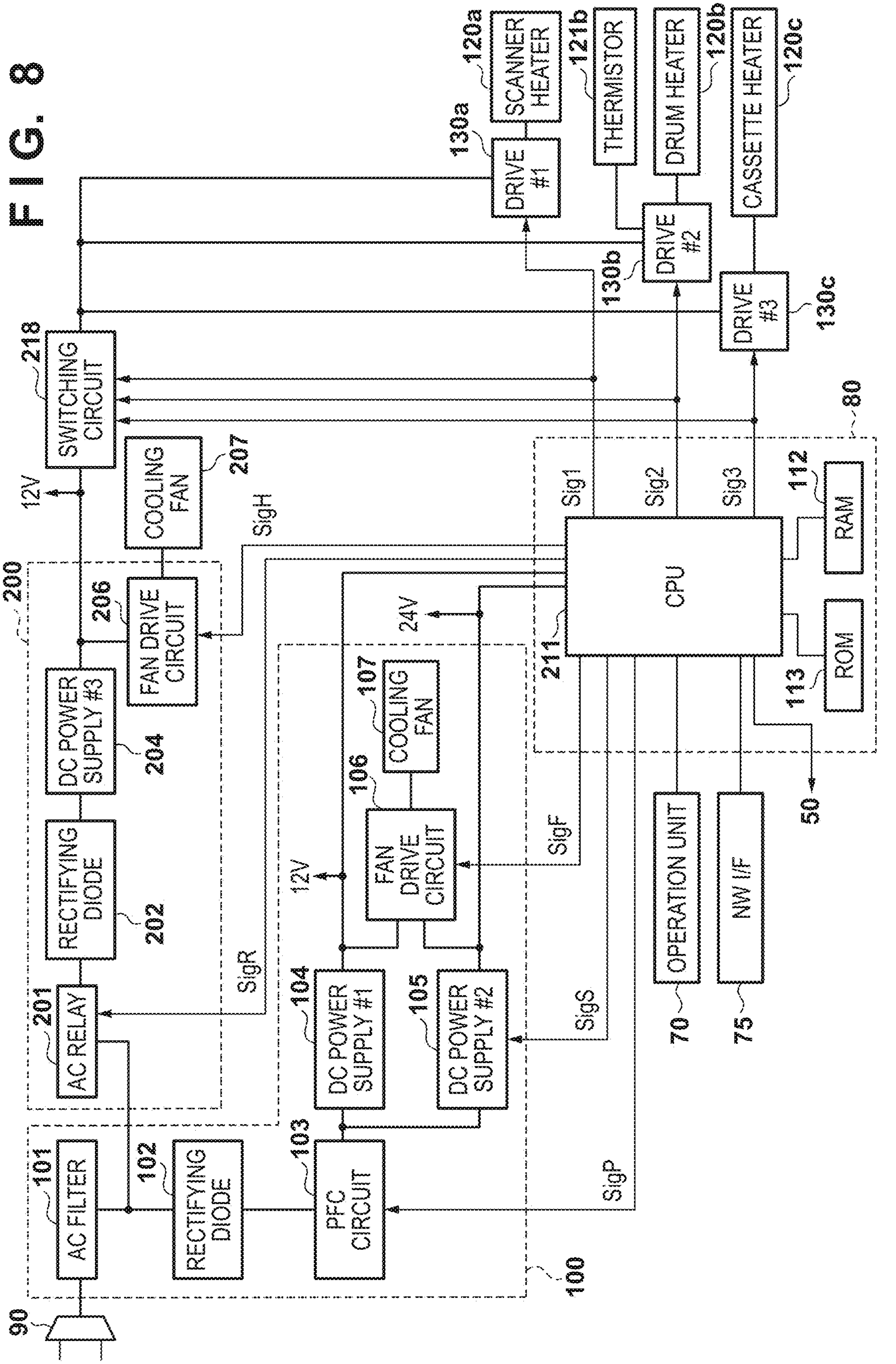

START
S101
START UP CONTROL PART
S103
ACTIVATE PFC, FAN AND SECOND DC POWER SUPPLY
S105
OBTAIN SETTINGS RELATED TO DRIVING OF HEATERS
S107
HAVE SETTINGS BEEN CHANGED?
NO
YES
S109
CALCULATE REQUIRED POWER AMOUNT P_{REQ} OF HEATER
S111
OUTPUT HEATER DRIVE SIGNALS IN ACCORDANCE WITH HEATER SETTINGS
S113
RECEIVED JOB?
NO
YES
S115
EXECUTE JOB
S117
TO POWER OFF OR SLEEP?
NO
YES
S121
DEACTIVATE SECOND DC POWER SUPPLY
S123
P_{REQ} < 30W?
NO
YES
S125
DEACTIVATE PFC
S127
STOP FAN
S129
P_{REQ} < 40W ?
NO
YES
S131
STOP FAN
S133
TO STANDBY?
YES
NO
S135
TO SLEEP MODE?
YES
NO
S137
STOP CONTROL UNIT
END

FIG. 8



90
100
101
AC FILTER
102
RECTIFYING DIODE
103
PFC CIRCUIT
104
DC POWER SUPPLY #1
105
DC POWER SUPPLY #2
106
FAN DRIVE CIRCUIT
107
COOLING FAN
12V
24V
SigP
SigS
SigF
200
201
AC RELAY
202
RECTIFYING DIODE
204
DC POWER SUPPLY #3
206
FAN DRIVE CIRCUIT
207
COOLING FAN
SigR
SigH
12V
218
SWITCHING CIRCUIT
130a
DRIVE #1
120a
SCANNER HEATER
121b
THERMISTOR
130b
DRIVE #2
120b
DRUM HEATER
130c
DRIVE #3
120c
CASSETTE HEATER
Sig1
Sig2
Sig3
80
211
CPU
112
RAM
113
ROM
70
OPERATION UNIT
75
NW I/F
50

FIG. 9

APPARATUS MODE	DRIVING STATE OF HEATER			REQUIRED POWER			OPERATION STATE OF POWER SUPPLY					
	SCANNER H (10W)	DRUM H (20W)	CASSETTE H (10W)	POWER SUPPLY #3 HEATER TOTAL [W]	POWER SUPPLY #1 [W]	POWER SUPPLY #2 [W]	PFC	FAN #1	POWER SUPPLY #1	POWER SUPPLY #2	POWER SUPPLY #3	FAN #2
POWER OFF /SLEEP	OFF	OFF	OFF	0	0 or 1	0	OFF	OFF	ON	OFF	OFF	OFF
	OFF	OFF	ON	10	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	OFF	ON	OFF	20	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	OFF	ON	ON	30	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	ON	OFF	OFF	10	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	ON	OFF	ON	20	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	ON	ON	OFF	30	0 or 1	0	OFF	OFF	ON	OFF	ON	OFF
	ON	ON	ON	40	0 or 1	0	OFF	OFF	ON	OFF	ON	ON
STANDBY /PRINT	OFF	OFF	OFF	0	Max 30	Max 290	ON	ON	ON	ON	OFF	OFF
	OFF & ON			1 to 39	Max 30	Max 290	ON	ON	ON	ON	ON	OFF
	ON	ON	ON	40	Max 30	Max 290	ON	ON	ON	ON	ON	ON

FIG. 10

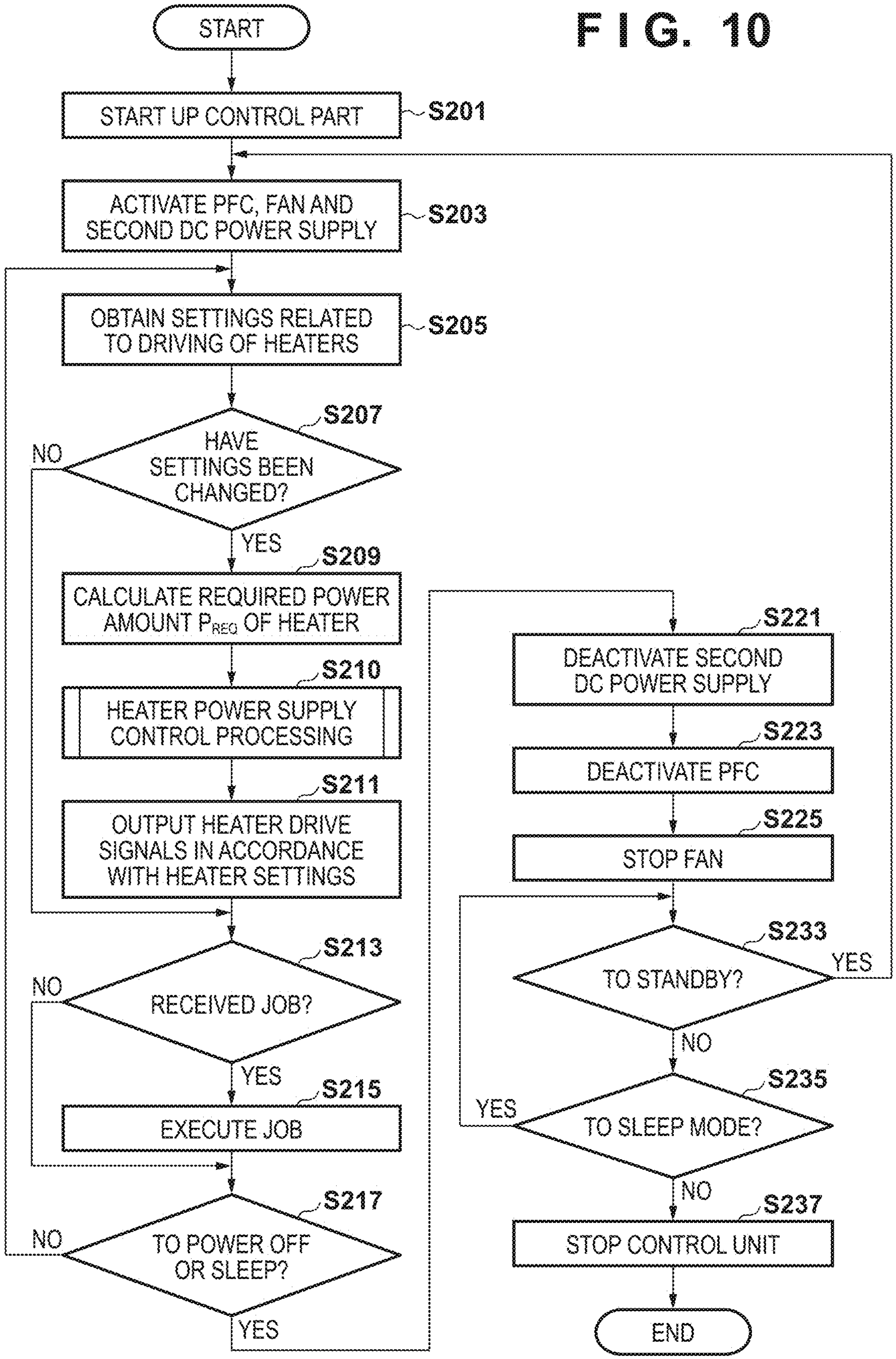

START
START UP CONTROL PART
S201
ACTIVATE PFC, FAN AND SECOND DC POWER SUPPLY
S203
OBTAIN SETTINGS RELATED TO DRIVING OF HEATERS
S205
HAVE SETTINGS BEEN CHANGED?
S207
NO
YES
CALCULATE REQUIRED POWER AMOUNT P_{REQ} OF HEATER
S209
HEATER POWER SUPPLY CONTROL PROCESSING
S210
OUTPUT HEATER DRIVE SIGNALS IN ACCORDANCE WITH HEATER SETTINGS
S211
RECEIVED JOB?
S213
NO
YES
EXECUTE JOB
S215
TO POWER OFF OR SLEEP?
S217
NO
YES
DEACTIVATE SECOND DC POWER SUPPLY
S221
DEACTIVATE PFC
S223
STOP FAN
S225
TO STANDBY?
S233
YES
NO
TO SLEEP MODE?
S235
YES
NO
STOP CONTROL UNIT
S237
END

FIG. 11

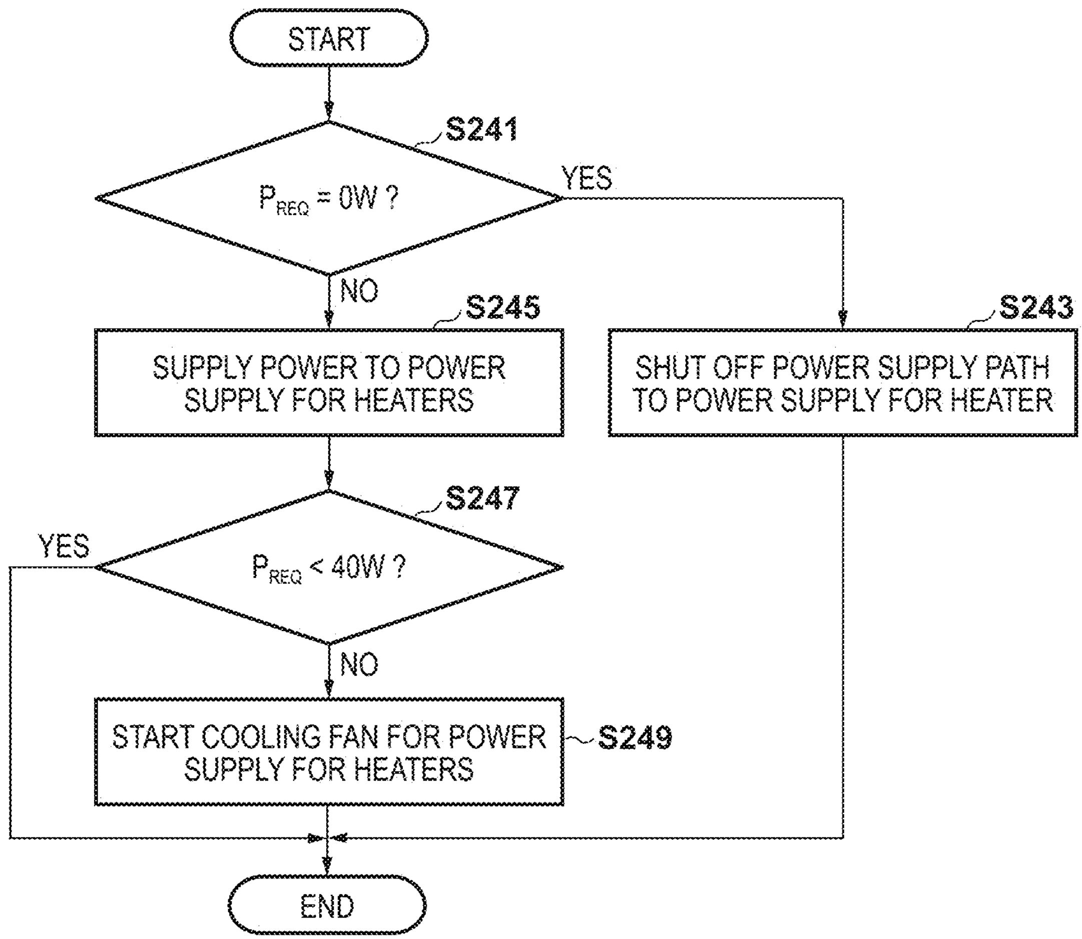
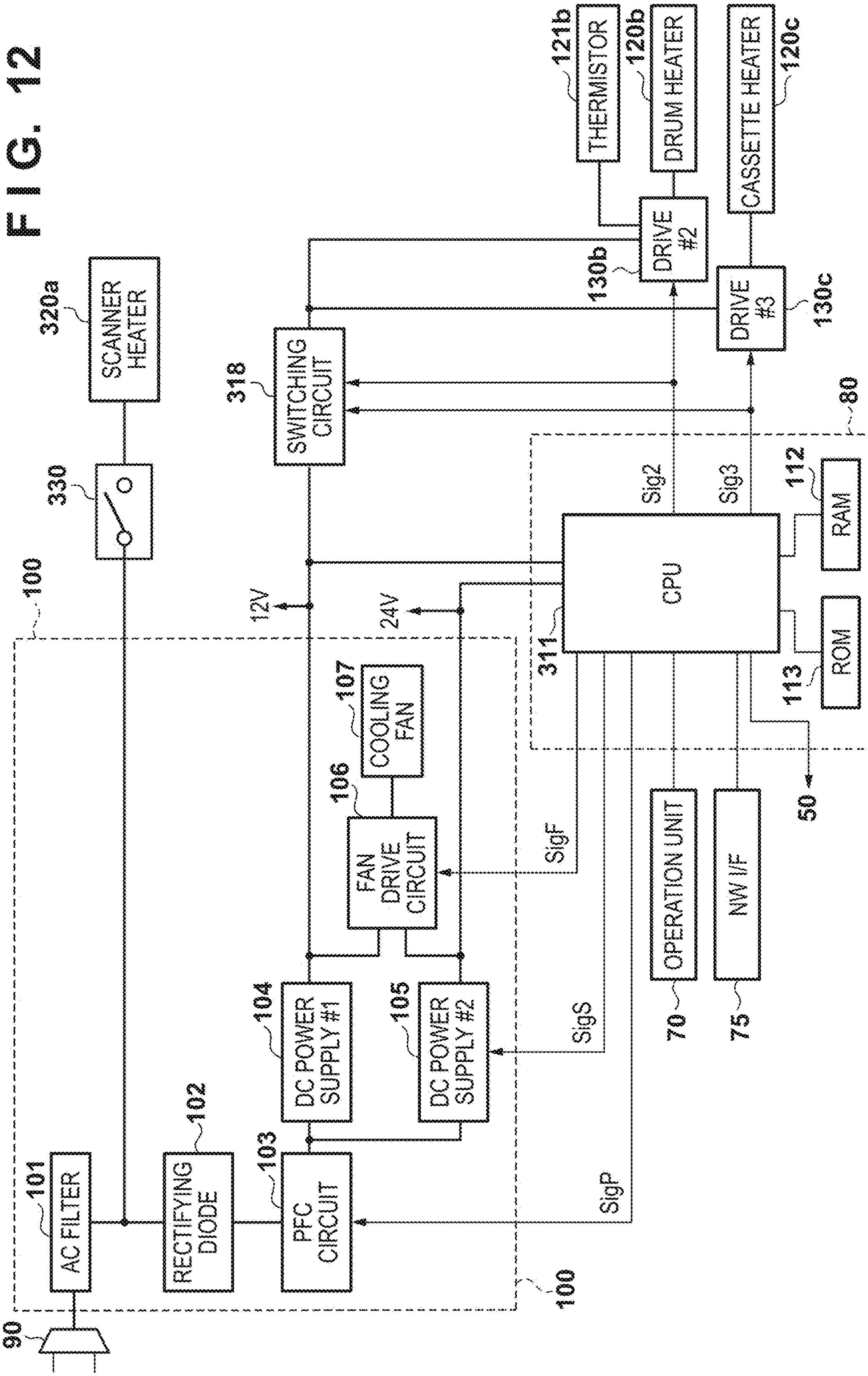

START
S241
P_{REQ} = 0W ?
YES
NO
S245
SUPPLY POWER TO POWER SUPPLY FOR HEATERS
S243
SHUT OFF POWER SUPPLY PATH TO POWER SUPPLY FOR HEATER
S247
YES
P_{REQ} < 40W ?
NO
START COOLING FAN FOR POWER SUPPLY FOR HEATERS
S249
END

FIG. 12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101
AC FILTER
102
RECTIFYING DIODE
103
PFC CIRCUIT
104
DC POWER SUPPLY #1
105
DC POWER SUPPLY #2
106
FAN DRIVE CIRCUIT
107
COOLING FAN
100
12V
24V
SigP
SigS
SigF
330
320a
SCANNER HEATER
318
SWITCHING CIRCUIT
311
CPU
Sig2
Sig3
112
RAM
113
ROM
80
50
70
OPERATION UNIT
75
NW I/F
130b
DRIVE #2
130c
DRIVE #3
121b
THERMISTOR
120b
DRUM HEATER
120c
CASSETTE HEATER

FIG. 13

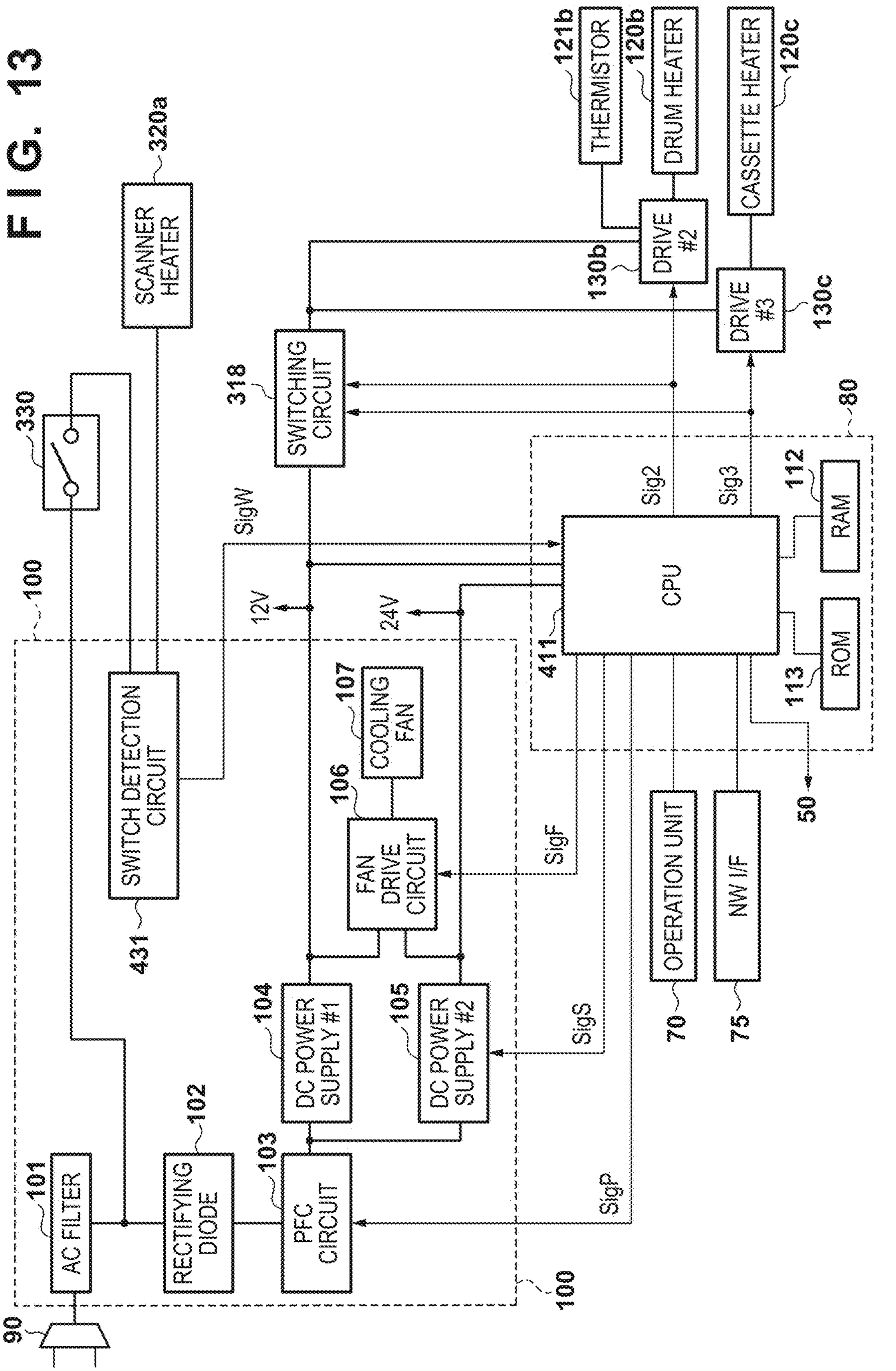
90
AC FILTER
101
RECTIFYING DIODE
102
PFC CIRCUIT
103
DC POWER SUPPLY #1
104
DC POWER SUPPLY #2
105
FAN DRIVE CIRCUIT
106
COOLING FAN
107
SWITCH DETECTION CIRCUIT
431
100
330
SCANNER HEATER
320a
SigW
12V
24V
SigF
SigS
SigP
SWITCHING CIRCUIT
318
CPU
411
Sig2
Sig3
RAM
112
ROM
113
80
OPERATION UNIT
70
NW I/F
75
50
DRIVE #2
130b
DRIVE #3
130c
THERMISTOR
121b
DRUM HEATER
120b
CASSETTE HEATER
120c

FIG. 14

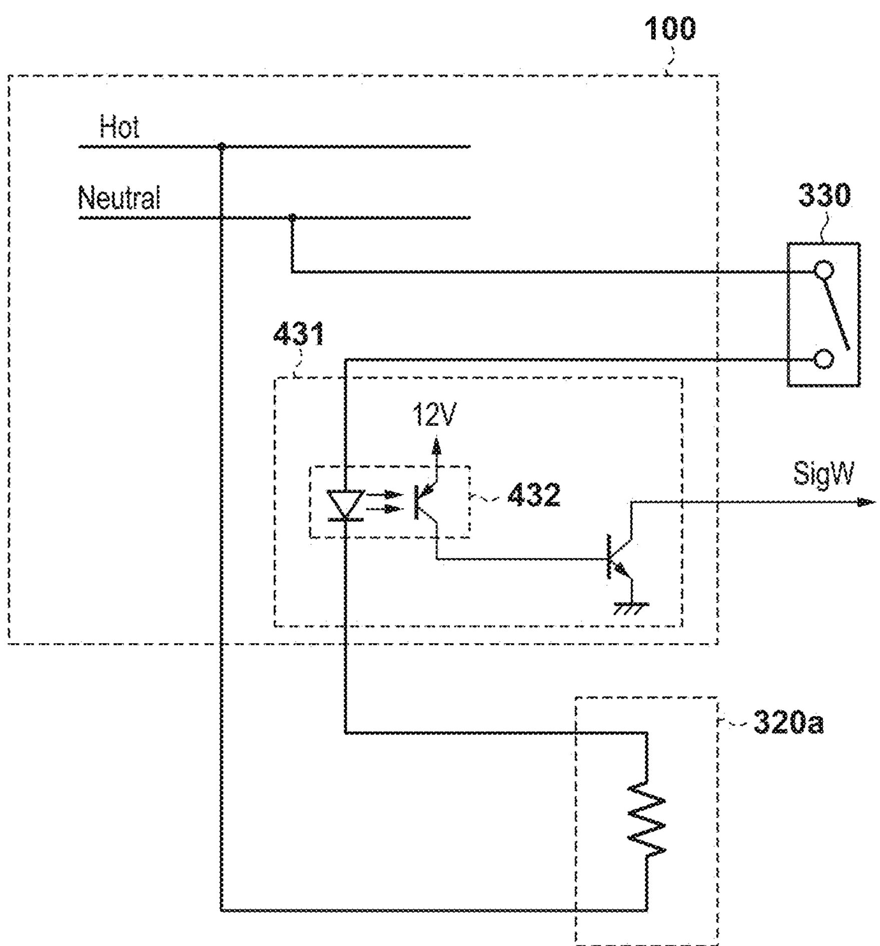

IMAGE-PROCESSING APPARATUS

BACKGROUND

Field of the Disclosure

[0001] The present disclosure relates to an image-processing apparatus.

Description of the Related Art

[0002] Image-processing apparatuses such as printers and scanners are exposed to various factors that cause the ambient temperature to fluctuate, depending on the region, season, or time of day, for example. If, for example, the temperature of an apparatus that has cooled down at night or in the morning then rises sharply in response to air-conditioning equipment in the office starting to operate, condensation will arise inside the apparatus, and moisture from this condensation will cause printing failures or operating failures. To prevent such failures due to temperature fluctuations, a technology is known in which a heater is installed in an apparatus to manage the temperature within the apparatus. Since it is necessary to run the heater even while the normal operations are not underway, the apparatus is generally connected to an alternating current (AC) commercial power supply to supply power to the heater. However, when power is supplied to the heater from an AC commercial power supply, the performance of the heater may differ depending on the installation environment of the apparatus.

[0003] Japanese Patent Laid-Open No. 2017-53954 discloses an image-forming apparatus that converts AC voltage from a commercial power supply into direct current (DC) voltage and supplies power to a heater with the DC voltage. With the image-forming apparatus of Japanese Patent Laid-Open No. 2017-53954, to prevent excessive power consumption when power is supplied from a DC power supply to a plurality of heaters, the supply of power from the DC power supply is controlled such that power is supplied only to no more than a predetermined number of heaters simultaneously.

SUMMARY

[0004] According to an aspect, there is provided an image-processing apparatus including: one or more heaters; a power supply unit including at least one direct current power supply, the power supply unit being configured to operate in one of a plurality of operation states having respective different total consumed powers; one or more drive circuits configured to drive the one or more heaters, respectively, using power supplied from the at least one direct current power supply; and a controller configured to control, on the basis of a driving state of the one or more heaters, the power supply unit to operate in an operation state selected such that a surplus of the total consumed power is reduced.

[0005] Further features of the present disclosure will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a schematic diagram illustrating an example of a configuration of a multifunction peripheral according to one or more aspects of the present disclosure.

[0007] FIG. **2** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to one or more aspects of the present disclosure.

[0008] FIG. **3** is a circuit diagram illustrating activation control of a PFC circuit.

[0009] FIG. **4** is an explanatory diagram illustrating an example of a UI provided for setting one or more heaters.

[0010] FIG. **5** is a circuit diagram illustrating an example of a detailed configurations of a switching circuit and a heater drive circuit illustrated in FIG. **2**.

[0011] FIG. **6** is a mapping table that defines correspondence relationships between driving states of heaters and operation states of a power supply unit according to one or more aspects of the present disclosure.

[0012] FIG. **7** is a flowchart illustrating an example of a flow of state control processing according to one or more aspects of the present disclosure.

[0013] FIG. **8** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to one or more aspects of the present disclosure.

[0014] FIG. **9** is a mapping table that defines correspondence relationships between driving states of heaters and operation states of a power supply unit according to one or more aspects of the present disclosure.

[0015] FIG. **10** is a flowchart illustrating an example of a flow of state control processing according to one or more aspects of the present disclosure.

[0016] FIG. **11** is a flowchart illustrating an example of a detailed flow of heater power supply control processing illustrated in FIG. **10**.

[0017] FIG. **12** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according one or more aspects of the present disclosure.

[0018] FIG. **13** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to one or more aspects of the present disclosure.

[0019] FIG. **14** is a circuit diagram illustrating an example of a detailed configuration of a switch detection circuit illustrated in FIG. **13**.

DESCRIPTION OF THE EMBODIMENTS

[0020] Hereinafter, embodiments will be described in detail with reference to the attached drawings. Note, the following embodiments are not intended to limit the scope of the claimed disclosure. Multiple features are described in the embodiments, but limitation is not made to a disclosure that requires all such features, and multiple such features may be combined as appropriate. Furthermore, in the attached drawings, the same reference numerals are given to the same or similar configurations, and redundant description thereof is omitted.

[0021] The technology disclosed in Japanese Patent Laid-Open No. 2017-53954 does not take into account differences in the operation state of the DC power supply. For example, the power supply efficiency of a DC power supply depends on the operation state, such as activating/deactivating a power factor correction (PFC) circuit or a cooling fan, or turning on/off each of a plurality of DC power supplies that may be present. If a large amount of heating is required for the apparatus as a whole, it is necessary to operate the power supply circuit to a large extent to enhance the power supply efficiency. On the other hand, if only a small amount of heat is required (or heating is unnecessary), it is desirable to reduce the power consumption in the power supply circuit in order to meet the needs of energy conservation.

[0022] In light of the foregoing, some embodiments of the present disclosure aim to further improve energy conservation performance in an image-processing apparatus having a heater.

1. Apparatus Overview

[0023] FIG. **1** is a schematic diagram illustrating an example of a configuration of a multifunction peripheral **1** according to an embodiment. Referring to FIG. **1**, the multifunction peripheral **1** includes a printer unit **10**, a scanner unit **50**, an operation unit **70**, a network interface (I/F) **75**, a control unit **80**, and a power supply unit **100**. Each of the multifunction peripheral **1**, the printer unit **10**, and the scanner unit **50** is an example of an image-processing apparatus.

[0024] The printer unit **10** is an image-forming apparatus that forms an image on a sheet. The printer unit **10** includes a sheet feed cassette **15**, an image-forming unit **20**, a conveyance section **30**, a fixing unit **40**, and a discharge tray **45**.

[0025] The image-forming unit **20** includes process units **25**Y, **25**M, **25**C, and **25**K, an intermediate transfer belt **27**, a secondary transfer unit **28**, and a belt cleaner **29**. The process units **25**Y, **25**M, **25**C, and **25**K are units that form toner images of four color components, namely yellow, magenta, cyan, and black, using an electrophotographic method. In other words, the printer unit **10** according to the present embodiment is a color laser printer capable of printing full-color images. However, in another embodiment, the printer unit **10** may be a black-and-white printer, or a printer capable of printing images using another image-forming method, such as the ink jet method. The configurations of the process units **25**Y, **25**M, **25**C, and **25**K may be similar to each other, and thus the process unit **25**Y will be described here as an example.

[0026] The process unit **25**Y includes a photosensitive drum **21**, a charger **22**, a laser unit **23**, a developer **24**, a primary transfer roller **25**, and a drum cleaner **26**. The photosensitive drum **21** is an image carrier, and rotates in the direction of an arrow A_1 in the figure. The charger **22** electrically charges the surface of the photosensitive drum **21** to a uniform potential. The laser unit **23** has a semiconductor laser as a light source, and forms an electrostatic latent image on the surface of the photosensitive drum **21** by exposing the photosensitive drum **21** with a laser beam according to input image data. The developer **24** develops the electrostatic latent image to form a toner image by supplying toner to the electrostatic latent image on the surface of the photosensitive drum **21**. The primary transfer roller **25** transfers the toner image (here, the yellow toner image) on the surface of the photosensitive drum **21** to the intermediate transfer belt **27** with an applied high transfer voltage. Magenta, cyan, and black toner images are similarly formed in the process units **25**M, **25**C, and **25**K, respectively. Then, by transferring those toner images onto the yellow toner image on the intermediate transfer belt **27** sequentially, a full-color toner image is formed on the intermediate transfer belt **27**. The intermediate transfer belt **27** conveys the toner image to the position of the secondary transfer unit **28**.

[0027] The sheet feed cassette **15** is a container unit that contains a bundle of sheets. The conveyance section **30** includes conveyance paths **31**, **32**, and **33**, a feed roller **34**, and a plurality of conveyance rollers. The feed roller **34** picks up a sheet (also called "recording material") P one by one from the sheet bundle contained in the sheet feed cassette **15** and feeds the sheet P to the conveyance path **31**. When the sheet P conveyed along the conveyance path **31** reaches the secondary transfer position, the secondary transfer unit **28** transfers the toner image on the intermediate transfer belt **27** onto the sheet P with a secondary transfer roller to which a transfer voltage, which is a high voltage, is applied. The transfer voltage can be optimized according to the type of the sheet P. The conveyance section **30** may include a correction mechanism (not shown) that corrects skew in the sheet P on the conveyance path **31**.

[0028] The drum cleaner **26** removes toner remaining on the surface of the photosensitive drum **21**. The belt cleaner **29** removes toner remaining on the intermediate transfer belt **27**.

[0029] The fixing unit **40** includes a fixing roller pair, and fixes the toner image onto the sheet P by heating and pressurizing the sheet P onto which the toner image has been transferred. The sheet P that has passed through the fixing unit **40** is discharged to the discharge tray **45**.

[0030] When double-sided printing is performed, after exiting to the conveyance path **32**, the direction of travel of the sheet P is reversed, and the sheet P enters a double-sided conveyance path **33**. The sheet P returns to the conveyance path **31** having been flipped, and a toner image is transferred onto the back surface of the sheet P by the secondary transfer unit **28**. The fixing unit **40** heats and pressurizes the sheet P again to fix that toner image onto the sheet P. The sheet P is then discharged to the discharge tray **45**.

[0031] The scanner unit **50** is a reading apparatus that optically reads a document. The scanner unit **50** includes a document platform **51**, an optical system **52**, and an image sensor **53**. The document to be read by the scanner unit **50** is placed on the document platform **51**, or is fed sheet by sheet by an automatic document feeder (ADF) that is not shown in FIG. **1**. The optical system **52** includes a light source, a mirror, and a lens. The light source irradiates the document with white light. Light reflected by the surface of the document is further reflected by one or more mirrors, passes through the lens, and is guided to the image sensor **53**. The image sensor **53** includes color filters for three color components of R, G, and B, and generates read image data by converting the light of each color component into an image signal. The image sensor **53** outputs the read image data to the control unit **80**.

[0032] The operation unit **70** provides a user interface for the multifunction peripheral **1** to interact with a user. Typically, the operation unit **70** may be a combination of a receiving unit that receives user inputs (e.g., instructions related to a job and various user settings) and a display unit that displays images or information, and may include a touch panel, buttons, switches, a keypad, and the like.

[0033] The network I/F **75** is an interface for the multifunction peripheral **1** to communicate with other apparatuses over a network. The network I/F **75** may be a wired interface or a wireless interface.

[0034] The control unit **80** controls the overall operations of the multifunction peripheral **1** described above. For example, when a print job is instructed to be executed, the control unit **80** controls the printer unit **10** to form an image on a sheet on the basis of input image data received from an external apparatus. When a scan job is instructed to be executed, the control unit **80** controls the scanner unit **50** to read a sheet, and saves the read image data in storage (not shown) or sends the read image data to a designated destination. When a copy job is instructed to be executed, the control unit **80** controls the scanner unit **50** to read a sheet, and controls the printer unit **10** to form an image on another sheet on the basis of the read image data.

[0035] The multifunction peripheral **1** further includes heaters **120***a*, **120***b*, and **120***c*. The heater **120***a* is disposed within the scanner unit **50**, and heats the optical system **52** to prevent reading failures due to condensation. In the following descriptions, the heater **120***a* will also be referred to as a "scanner heater". The heater **120***b* is disposed in the vicinity of the process units **25**Y, **25**M, **25**C, and **25**K, and heats the image-forming unit **20** (e.g., the photosensitive drum **21** and the intermediate transfer belt **27**) to prevent image formation failures due to condensation. In the following descriptions, the heater **120***b* will also be referred to as a "drum heater". The heater **120***c* is disposed below the sheet feed cassette **15**, and heats the sheet feed cassette **15** and the sheet bundle within the cassette to prevent conveyance failures due to moisture being absorbed by the sheets. In the following descriptions, the heater **120***c* will also be referred to as a "cassette heater".

[0036] In the following descriptions, the heaters **120***a*, **120***b*, and **120***c* will be collectively referred to as "heaters **120**" by omitting the letters from the reference signs when there is no need to distinguish the heaters from each other. Although FIG. **1** illustrates an example in which the multifunction peripheral **1** includes three heaters **120** for heating the interior of the apparatus, the number of heaters **120** included in the multifunction peripheral **1** may be any number that is one or more.

[0037] Phenomena due to temperature fluctuations, such as condensation within the apparatus and moisture being absorbed by the sheets, can also occur when the multifunction peripheral **1** is not operating. Accordingly, it is necessary for the multifunction peripheral **1** to be configured such that power can be supplied to each of the heaters **120** during a sleep state, where the supply of power to the drive system is deactivated to conserve energy, and in a power off state. The power supply unit **100** functions as a DC power supply by converting AC voltage from a commercial power supply into DC voltage. The power supply unit **100** can supply power to each of the heaters **120** regardless of whether the multifunction peripheral **1** is powered on or off. In addition, when the multifunction peripheral **1** is powered on, the power supply unit **100** supplies power for operating the electronic circuitry to the control system of the multifunction peripheral **1**, including the control unit **80**. Furthermore, when the multifunction peripheral **1** is in a standby mode, which is a preparation stage for image-forming operations, and in a print mode (or a scanning mode), which is when the image-forming operations are being executed, the power supply unit **100** supplies power to the drive system of the multifunction peripheral **1** to enable the drive members to operate.

[0038] The present embodiment enables a user to set whether to activate each of the heaters **120** through a user interface (UI) provided by the operation unit **70** in order to make it possible to manage the temperature of the multifunction peripheral **1** flexibly in a variety of temperature environments. When more heaters **120** are active, the amount of heating required by the apparatus as a whole increases, and the power consumption increases. In this case, it is desirable to activate means for improving the power supply efficiency in the power supply unit **100**. On the other hand, if some or all of the heaters **120** are not active and the amount of heating required by the apparatus as a whole is small, the power consumed by the means for improving the power supply efficiency in the power supply unit **100** itself is wasteful. In this case, it is desirable to reduce a surplus of power consumed by the power supply unit **100** in order to meet the needs of energy conservation. Accordingly, several practical examples for selectively switching the operation state of the power supply unit **100** on the basis of the driving state of the heaters will be described in the following sections.

2. First Practical Example

<2-1. Example of Configuration of Heater-Related Circuitry>

[0039] FIG. **2** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to a first practical example. In addition to the operation unit **70**, the network I/F **75**, the control unit **80**, the power supply unit **100**, and the heaters **120***a*, **120***b*, and **120***c* described with reference to FIG. **1**, a power plug **90**, a switching circuit **118**, and heater drive circuits **130***a*, **130***b*, and **130***c* are illustrated in FIG. **2**.

[0040] The power supply unit **100** includes an alternating current (AC) filter **101**, a rectifying diode **102**, a power factor correction (PFC) circuit **103**, a first direct current (DC) power supply **104**, a second DC power supply **105**, a fan drive circuit **106**, and a cooling fan **107**. The control unit **80** includes a Central Processing Unit (CPU) **111**, a Random Access Memory (RAM) **112**, and a Read-Only Memory (ROM) **113**.

[0041] The power plug **90** is connected to a commercial power supply, which is an AC power supply. The AC filter **101** removes noise by filtering the power from the commercial power supply received through the power plug **90**. The rectifying diode **102** rectifies the AC power passing through the AC filter **101**. The PFC circuit **103** corrects the power factor of the power input from the rectifying diode **102**. For example, the PFC circuit **103** can correct the power factor of the power by suppressing harmonic components of current flowing through the circuit to correct distortion in the waveform. In the present practical example, the PFC circuit **103** operates in accordance with a PFC control signal SigP input from the CPU **111**. When the PFC circuit **103** is active, the power following the power factor correction is supplied to the first DC power supply **104** and the second DC power supply **105**. When the PFC circuit **103** is inactive, the power for which the power factor has not been corrected is supplied to the first DC power supply **104** and the second DC power supply **105**.

[0042] FIG. **3** is a circuit diagram illustrating activation control of the PFC circuit **103**, which is based on the PFC control signal SigP. In the example illustrated in FIG. **3**, the PFC circuit **103** includes a photocoupler **115**, a switch **116**, and a PFC control unit **117**. The photocoupler **115** is constituted by a secondary-side light-emitting element and a primary-side light-receiving element. When the signal value of the PFC control signal SigP input from the CPU **111** indicates that the PFC circuit is to be active, the photocoupler **115** turns the switch **116** on such that an operating power of 3.3V is output to the PFC control unit **117**. As a result, the power factor of the power supply unit **100** is corrected by the PFC control unit **117** activating the PFC circuit **103**. When the signal value of the PFC control signal SigP indicates that the PFC circuit is to be inactive, the photocoupler **115** causes the switch **116** to shut off the supply of operating power to the PFC control unit **117**. The PFC circuit **103** is deactivated as a result. Returning to FIG. **2**, the first DC power supply **104** generates DC power by converting the AC voltage of power supplied from the PFC circuit **103** into DC voltage. In the present practical example, the voltage of the DC power generated by the first DC power supply **104** is 12 V. This DC power is the power supplied to the heaters **120***a*, **120***b*, and **120***c*. The DC power from the first DC power supply **104** is also output to the fan drive circuit **106** and the control unit **80**.

[0043] The second DC power supply **105** generates DC power by converting the AC voltage of the power supplied from the PFC circuit **103** into DC voltage. In the present practical example, the voltage of the DC power generated by the second DC power supply **105** is 24 V. This DC power is supplied to the fan drive circuit **106** in parallel with the DC power from the first DC power supply **104**, and further to the control unit **80** and the drive system (not shown) of the multifunction peripheral **1**. The second DC power supply **105** is activated in response to a power control signal SigS input from the CPU **111**. When the second DC power supply **105** is inactive, no power is supplied to the drive system of the multifunction peripheral **1**.

[0044] The cooling fan **107** is a cooling unit that cools the first DC power supply **104** and the second DC power supply **105** of the power supply unit **100**. The fan drive circuit **106** drives the cooling fan **107** using the DC power supplied from the first DC power supply **104** or the second DC power supply **105**. The fan drive circuit **106** and the cooling fan **107** are activated in response to a fan control signal SigF input from the CPU **111** to the fan drive circuit **106**.

[0045] The CPU **111** controls execution of jobs in the multifunction peripheral **1**, as described above with respect to the control unit **80**. The RAM **112** provides a temporary storage area for operations by the CPU **111**. The ROM **113** stores computer programs to be executed by the CPU **111**. Furthermore, in the present practical example, the CPU **111** also functions as a controller that controls the supply of power from the power supply unit **100** to the one or more heaters **120** on the basis of user settings received through the UI.

[0046] FIG. **4** illustrates a heater settings screen **71** as an example of the UI provided by the operation unit **70** for setting each of the heaters **120**. The heater settings screen **71** illustrated in FIG. **4** includes a first button B**1**, a second button B**2**, and a third button B**3**. The first button B**1** is a button for setting the driving state of the scanner heater **120***a*. The user can activate or deactivate the scanner heater **120***a* by operating the first button B**1**. The second button B**2** is a button for setting the driving state of the drum heater **120***b*. The user can activate or deactivate the drum heater **120***b* by operating the second button B**2**. The third button B**3** is a button for setting the driving state of the cassette heater **120***c*. The user can activate or deactivate the cassette heater **120***c* by operating the third button B**3**. In the example in FIG. **4**, the scanner heater **120***a* and the cassette heater **120***c* are set to be active, and the drum heater **120***b* is set to be inactive. The CPU **111** outputs drive signals Sig**1**, Sig**2**, and Sig**3** to the heater drive circuits **130***a*, **130***b*, and **130***c*, respectively, on the basis of the user settings received in this manner. Note that instead of the operation unit **70** of the multifunction peripheral **1**, a UI similar to that of the heater settings screen **71** may be provided to the user through a display in another apparatus that communicates with the multifunction peripheral **1**.

[0047] Returning to FIG. **2**, the switching circuit **118** is a switching means that opens and closes a power supply path from the first DC power supply **104** to each of the heaters **120**. When all of the drive signals Sig**1**, Sig**2**, and Sig**3** output from the CPU **111** to the heater drive circuits **130***a*, **130***b*, and **130***c*, respectively, indicate that the corresponding heater is to be deactivated, the switching circuit **118** shuts off the supply of the DC power of 12V from the first DC power supply **104**. When one or more of the drive signals Sig**1**, Sig**2**, and Sig**3** indicate that the corresponding heater is to be activated, the switching circuit **118** causes the first DC power supply **104** to supply the heater drive circuits **130***a*, **130***b*, and **130***c* with the DC power.

[0048] The heater drive circuits **130***a*, **130***b*, and **130***c* are drive means for driving the heaters **120***a*, **120***b*, and **120***c*, respectively, using the power supplied from at least one of the DC power supplies of the power supply unit **100**. When the drive signal Sig**1** input from the CPU **111** indicates that the scanner heater **120***a* is to be activated, the heater drive circuit **130***a* drives the scanner heater **120***a* using the DC power supplied from the first DC power supply **104**. When the drive signal Sig**2** input from the CPU **111** indicates that the drum heater **120***b* is to be activated, the heater drive circuit **130***b* drives the drum heater **120***b* using the DC power supplied from the first DC power supply **104**. When the drive signal Sig**3** input from the CPU **111** indicates that the cassette heater **120***c* is to be activated, the heater drive circuit **130***c* drives the cassette heater **120***c* using the DC power supplied from the first DC power supply **104**. In other words, in the present practical example, the heater drive circuits **130***a*, **130***b*, and **130***c* drive the corresponding heaters **120***a*, **120***b*, and **120***c* in accordance with the user settings accepted by the operation unit **70**.

[0049] Each of the heaters **120** has a resistive heating element that produces heat in response to current flowing therein. The resistance value of the resistive heating element is selected as appropriate at the design stage such that a desired amount of heat is produced in accordance with the supplied power. Each of the heaters **120** may have a temperature adjustment circuit for keeping the temperature of the heated members at or near a target temperature, or for preventing overheating. In the example illustrated in FIG. **2**, a thermistor **121***b* is disposed in the vicinity of the drum heater **120***b*. The resistance value of the thermistor **121***b* changes depending on the temperature inside the image-forming unit **20**. Once the temperature of the heated members detected by the thermistor **121***b* has reached a given threshold, the heater drive circuit **130***b* does not drive the drum heater **120***b*, even if the drive signal Sig**2** indicates that the drum heater **120***b* is to be activated. Similar temperature adjustment circuits may of course be provided for the scanner heater **120***a* and the cassette heater **120***c*.

[0050] FIG. **5** illustrates an example of a detailed configurations of the switching circuit **118** and the heater drive circuits **130***a*, **130***b*, and **130***c* described above. In the example illustrated in FIG. **5**, the switching circuit **118**

includes a switch **119**. When one or more of the drive signals Sig**1**, Sig**2**, and Sig**3** are on, the switch **119** closes the power supply path of the DC power of 12V, which allows the DC power to be supplied to the heater drive circuits **130***a*, **130***b*, and **130***c*.

[0051] In the heater drive circuit **130***a*, a series regulator **131***a* steps down the voltage of the DC power to be supplied to the heater drive circuit **130***a* from 12V to 3.3V, and supplies the DC power of 3.3 Vto each circuit element of the heater drive circuit **130***a*. When the drive signal input through a transistor from a latch circuit **133***a* indicates "on", a switch **132***a* supplies the DC power of 12V to the scanner heater **120***a*. The latch circuit **133***a* receives the drive signal Sig**1** and a latch enable signal SigL from the CPU **111**. The following table is a truth table for the latch circuits of the heater drive circuits **130***a* to **130***c*.

TABLE 1

Heater drive signal SigX (X = 1, 2, 3)	Latch enable signal SigL	Latch output
Low	High	Low
High	High	High
Any	Low	Hold

Truth Table for Latch Circuits of Heater Drive Circuits

[0052] According to the above truth table, when the latch enable signal SigL indicates "High", the latch circuit **133***a* outputs the value of the drive signal Sig**1** input from the CPU **111** to the transistor in the following stage. When the latch enable signal SigL indicates "Low", the latch circuit **133***a* holds the value of the drive signal Sig**1** input the previous time, and outputs the held value to the transistor in the following stage. By having the latch circuit **133***a* hold and output the value of the drive signal Sig**1** in this manner, the scanner heater **120***a* can remain active using the DC power supplied from the first DC power supply **104**, even if the CPU **111** stops operating and the input of the drive signal Sig**1** is interrupted.

[0053] The heater drive circuit **130***c* is configured in the same manner as the heater drive circuit **130***a*.

[0054] The heater drive circuit **130***b* is also configured in the same manner as the heater drive circuit **130***a*. However, the heater drive circuit **130***b* further includes, in the power supply path of the DC power of 12V, a switch **134***b* in the stage following a switch **132***b* turned on and off by the output of a latch circuit **133***b*. Once the temperature of the heated members detected by the thermistor **121***b* has risen and the voltage across both ends of the thermistor **121***b* reaches a threshold voltage of a comparator **135***b*, the switch **134***b* shuts off the power supply path from the switch **132***b* to the drum heater **120***b*. Once the temperature of the heated members falls, the switch **134***b* resumes the supply of power from the switch **132***b* to the drum heater **120***b*.

<2-2. Control of Operation State of Power Supply Unit>

[0055] As described above, the multifunction peripheral **1** has one or more heaters **120** for heating the interior of the apparatus. Each of the heaters **120** is driven using power supplied from at least one DC power supply (the first DC power supply **104**, in the present practical example) of the power supply unit **100**. Meanwhile, the power supply unit **100** includes the following circuits, which are activated in response to the control of the control unit **80** and consume power:

[0056] the PFC circuit **103**

[0057] the fan drive circuit **106** and the cooling fan **107**

[0058] the second DC power supply **105**

[0059] The operation state of the power supply unit **100** can be categorized into several states depending on whether these circuits are active, and the total consumed power of the power supply unit **100** is different in each operation state. The PFC circuit **103** corrects the power factor in the power supply unit **100** and increases the power capacity of the multifunction peripheral **1**, but it does not necessarily need to activate the PFC circuit **103** when the required power amount in the multifunction peripheral **1** is low. The cooling fan **107** ensures a stable power supply by cooling the DC power supplies of the power supply unit **100**, but when the power amount used in the multifunction peripheral **1** is low, the heat produced by the power supply unit **100** is also low, and therefore it does not necessarily need to activate the cooling fan **107**. Accordingly, on the basis of the driving states of the heaters **120**, the CPU **111** selects an operation state of the power supply unit **100** such that the surplus of the total consumed power of the power supply unit **100** is reduced, and causes the power supply unit **100** to operate in the selected operation state.

[0060] In the present practical example, the control unit **80** is assumed to have a memory (e.g., the ROM **113**) that stores, in advance, the power amount required when driving each of the heaters **120**. For the heaters **120** set to be driven, the CPU **111** determines the required power amount to be supplied from the power supply unit **100** by totaling the stored power amounts. When determining the required power amount, the CPU **111** may take into account the operation mode of the multifunction peripheral **1** (e.g., the drive system consumes more power in the standby mode and the print mode) in addition to the driving states of the heaters **120**. Then, on the basis of a comparison between the determined required power amount and a predetermined threshold, the CPU **111** selects an operation state in which the power supply unit **100** is to be operated.

[0061] As a first example, candidates for the operation states of the power supply unit **100** include a first state, in which the PFC circuit **103** is active and the total consumed power of the power supply unit **100** is a first power value, and a second state, in which the PFC circuit **103** is inactive and the total consumed power of the power supply unit **100** is a second power value. The second power value is lower than the first power value. When the required power amount determined on the basis of the driving states of the heaters **120***a* to **120***c* is greater than a predetermined power threshold, the CPU **111** selects the first state, so that the required power amount is covered sufficiently, and activates the PFC circuit **103**. On the other hand, when the required power amount determined is lower than the power threshold, the CPU **111** selects the second state and deactivates the PFC circuit **103** to reduce a surplus of power consumption.

[0062] As a second example, candidates for the operation states of the power supply unit **100** include a first state, in which the cooling fan **107** is active and the total consumed power of the power supply unit **100** is a first power value, and a second state, in which the cooling fan **107** is inactive and the total consumed power of the power supply unit **100** is a second power value. The second power value is lower than the first power value. Note that the first power value and the second power value here may be different from the corresponding values in the first example described above. When the required power amount determined on the basis of the driving states of the heaters **120***a* to **120***c* is greater than a predetermined power threshold, the CPU **111** selects the first state, so that the required power amount is covered sufficiently, and activates the cooling fan **107**. On the other hand, when the required power amount determined is lower than the power threshold, the CPU **111** selects the second state and deactivates the cooling fan **107** to reduce a surplus of power consumption.

[0063] Of course, it is also conceivable to combine the first example and the second example. For example, the CPU **111** may compare a required power amount P_{REQ} determined on the basis of the driving states of the heaters **120***a* to **120***c* with a first power threshold TH_1 and a second power threshold TH_2, and select an operation state of the power supply unit **100** as follows. Here, it is assumed that $TH_1<TH_2$.

- **[0064]** If $P_{REQ}<TH_1$, then both the PFC circuit and the cooling fan are deactivated
- **[0065]** If $TH_1 \leq P_{REQ} <TH_2$, then only one of the PFC circuit and the cooling fan is activated.
- **[0066]** If $TH_2 \leq P_{REQ}$, then both the PFC circuit and the cooling fan are activated

[0067] FIG. **6** is a mapping table that defines correspondence relationships between the driving states of the heaters **120** and the operation states of the power supply unit **100** according to the present practical example. The leftmost column of the mapping table indicates the operation mode of the multifunction peripheral **1**. The operation mode of the multifunction peripheral **1** is one of "power off", "sleep", "standby", and "print". "Power off" is a state in which all functions of the multifunction peripheral **1** are inactive. "Sleep" is a state in which only some functions of the control system of the multifunction peripheral **1** are active (e.g., receiving queries through the network I/F and responding thereto). "Standby" is a state in which a job is not being executed, but all functions of the multifunction peripheral **1** are active or can be activated immediately. "Print" is a state in which a job is being executed in the multifunction peripheral **1**.

[0068] The second to fourth columns from the left in the mapping table represent the driving state ("on" or "off") of the scanner heater **120***a*, the drum heater **120***b*, and the cassette heater **120***c*, respectively. The two driving states of the three heaters **120** can be combined for a total of eight driving states. As an example, the scanner heater **120***a* in "on" state consumes 10 W of power as a rated power. The drum heater **120***b* in "on" state consumes 20 W of power as a rated power. Although the supply of power to the drum heater **120***b* may be shut off due to the actions of the temperature adjustment circuit even when the driving state thereof is "on", the actions of the temperature adjustment circuit are assumed to be ignored when determining the power amount. The cassette heater **120***c* in "on" state consumes 10 W of power as a rated power.

[0069] The fifth column in the mapping table indicates the total value of the required power amount, corresponding to the driving states of the heaters **120***a* to **120***c* in each row. For example, the total value of the required power amount in the eighth row, where the driving states of all the heaters **120***a* to **120***c* are "on", is 10+20+10=40 [W]. The sixth column in the mapping table indicates the power amount supplied from the first DC power supply **104** to the control system, corresponding to the operation mode of the multifunction peripheral **1** in each row. Regardless of the driving states of the heaters **120***a* to **120***c*, before being powered on, the required power amount of the control system is 0 [W], and in the sleep mode, the required power amount of the control system is 1 [W]. In the standby mode and the print mode, the required power amount of the control system is a maximum of 30 [W] (but in reality, the power consumption varies depending on the type of control performed). The seventh column in the mapping table indicates the power amount supplied from the second DC power supply **105**, corresponding to the operation mode of the multifunction peripheral **1** in each row. Regardless of the driving states of the heaters **120***a* to **120***c*, in the power off and sleep modes, the second DC power supply **105** is inactive, and the required power amount is therefore 0 [W]. In the standby mode and the print mode, power is supplied from the second DC power supply **105** to the drive system, and the required power amount thereof is a maximum of 290 [W] (but in reality, the power consumption varies depending on the type of operations performed).

[0070] The eighth to eleventh columns in the mapping table indicate how the CPU **111** selects an operation state of the power supply unit **100** with respect to the driving states of the heaters **120***a* to **120***c* in each row. Specifically, the eighth column indicates whether the PFC circuit **103** is on or off. In the example illustrated in FIG. **6**, the CPU **111** activates the PFC circuit **103** when the total value of the required power amounts of the heaters **120***a* to **120***c* is 30 W or higher, and deactivates the PFC circuit **103** when the total value of the required power amounts is less than 30 W. This threshold of 30 W can correspond to the first power threshold TH_1 mentioned above.

[0071] The ninth column indicates whether the cooling fan **107** is on or off. In the example illustrated in FIG. **6**, the CPU **111** activates the cooling fan **107** when the total value of the required power amounts of the heaters **120***a* to **120***c* is 40 W or higher, and deactivates the cooling fan **107** when the total value of the required power amounts is less than 40 W. This threshold of 40 W can correspond to the second power threshold TH_2 mentioned above.

[0072] The tenth column indicates whether the first DC power supply **104** is on or off. In the present practical example, the first DC power supply **104** is always connected to the commercial power supply, and thus the tenth column indicates "on" in all rows. Note that the power that the first DC power supply **104** is capable of outputting depends on the operation states of the PFC circuit **103** and the cooling fan **107**.

[0073] The eleventh column indicates whether the second DC power supply **105** is on or off. In the present practical example, the second DC power supply **105** is only activated in the standby mode and the print mode, and thus the eleventh column indicates "on" only in the bottom row, and "off" in the remaining rows corresponding to the power off and sleep modes.

[0074] As an example, when both the PFC circuit **103** and the cooling fan **107** are inactive, the maximum value of the power that the first DC power supply **104** is capable of outputting is less than 30 W. When only the PFC circuit **103** is active, the maximum value of the power that the first DC power supply **104** is capable of outputting is greater than 30

W and less than 40 W. When both the PFC circuit **103** and the cooling fan **107** are active, the maximum value of the power that the first DC power supply **104** is capable of outputting reaches 70 W. The mapping table in FIG. **6** assumes that the power supply unit **100** has such performance.

[0075] In the standby mode and the print mode, by activating both the PFC circuit **103** and the cooling fan **107** and further activating the second DC power supply **105**, a sufficient amount of power can be stably supplied to the one or more heaters, the control system, and the drive system. On the other hand, if the PFC circuit **103** and the cooling fan **107** are active in the power-off or sleep mode when several of the heaters are set to be inactive, the power capacity of the power supply unit **100** is much greater than the required power amount. This means that at least some of the power consumed by the PFC circuit **103**, the fan drive circuit **106**, and the cooling fan **107** is wasted. In the present practical example, one or both of the PFC circuit **103** and the cooling fan **107** are deactivated dynamically in accordance with the mapping table described above (or in accordance with a comparison of the required power amount with the power threshold). This makes it possible to eliminate wasteful power consumption and optimize the power consumption of the multifunction peripheral **1**.

[0076] <2-3. Flow of Processing>

[0077] FIG. **7** is a flowchart illustrating an example of a flow of state control processing that can be executed by the control unit **80** (e.g., the CPU **111**) to control a power supply state in the multifunction peripheral **1** according to the present practical example. In the following descriptions, the processing steps will be abbreviated as "S".

[0078] The state control processing illustrated in FIG. **7** is started in response to the multifunction peripheral **1** being powered on. First, in step S**101**, the control unit **80** starts up, and commences the operations. In step S**103**, the control unit **80** outputs the PFC control signal SigP to the PFC circuit **103** to activate the PFC circuit **103**. The control unit **80** also outputs the fan control signal SigF to the fan drive circuit **106** to start driving the cooling fan **107**. The control unit **80** furthermore outputs the power control signal SigS to the second DC power supply **105** to activate the second DC power supply **105**.

[0079] Next, in step S**105**, the control unit **80** obtains user settings related to the driving of the heaters **120***a* to **120***c* (called "heater settings" hereinafter), which are received through the UI of the operation unit **70**. Next, in step S**107**, the control unit **80** determines whether the heater settings have been changed since the previous calculation of the required power amount P_{REQ}. If the heater settings have been changed, the sequence moves to step S**109**.

[0080] In step S**109**, the control unit **80** calculates the required power amount P_{REQ} on the basis of the heater settings obtained in step S**105**. For example, the control unit **80** can calculate the required power amount P_{REQ} by totaling the power amounts defined in advance for the heaters **120** set to be active. Then, in step S**111**, the control unit **80** outputs the drive signals Sig**1**, Sig**2**, and Sig**3** to the heater drive circuits **130***a*, **130***b*, and **130***c*, respectively, in accordance with the heater settings.

[0081] If the heater settings have not been changed in step S**107**, steps S**109** and S**111** are skipped. In this case, the heater drive circuits **130***a*, **130***b*, and **130***c* drive the corresponding heaters **120***a*, **120***b*, and **120***c* in accordance with the drive signal values held in the respective latch circuits.

[0082] Next, in step S**113**, the control unit **80** stands by to receive a job. The operation mode of the multifunction peripheral **1** is the standby mode from step S**105** to step S**113**. When a job is received in the standby mode, in step S**115**, the control unit **80** controls one or both of the printer unit **10** and the scanner unit **50** to execute the received job. The operation mode of the multifunction peripheral **1** in step S**115** is the print mode (or the scanning mode, if a scan job is executed).

[0083] Next, in step S**117**, the control unit **80** determines whether the multifunction peripheral **1** should be powered off or transition to the sleep mode. For example, if an operation for turning the power off has been detected in the operation unit **70**, the multifunction peripheral **1** is powered off. If an operation instructing a transition to the sleep mode is detected, or a predetermined length of time has passed without any operations being performed, the multifunction peripheral **1** transitions to the sleep mode. If the multifunction peripheral **1** is powered off or transitions to the sleep mode, the sequence moves to step S**121**. If the multifunction peripheral **1** remains in the standby mode, the sequence returns to step S**105**.

[0084] In step S**121**, the control unit **80** outputs the power control signal SigS to the second DC power supply **105** to deactivate the second DC power supply **105**. The subsequent processing branches on the basis of a comparison between the required power amount P_{REQ} calculated in step S**109** and the two power thresholds TH_1 and TH_2. Here, it is assumed that the first power threshold $TH_{1=30}$ [W] and the second power threshold $TH_{2=40}$ [W].

[0085] If the required power amount P_{REQ} is lower than the first power threshold TH_1 (P_{REQ} <30 W; step S**123**-YES), in step S**125**, the control unit **80** outputs the PFC control signal SigP to the PFC circuit **103** to deactivate the PFC circuit **103**. Additionally, in step S**127**, the control unit **80** outputs the fan control signal SigF to the fan drive circuit **106** to stop the driving of the cooling fan **107**.

[0086] If the required power amount P_{REQ} is greater than the first power threshold TH_1 and lower than the second power threshold TH_2 (30 W≤P_{REQ} <40 W; step S**129**-YES), in step S**131**, the control unit **80** outputs the fan control signal SigF to the fan drive circuit **106** to stop the driving of the cooling fan **107**.

[0087] If the required power amount P_{REQ} is greater than the second power threshold TH_2 (40 W<P_{REQ}), the PFC circuit **103** and the cooling fan **107** are not deactivated.

[0088] Next, in step S**133**, the control unit **80** determines whether the multifunction peripheral **1** should be returned to the standby mode. For example, if any operation is detected in the operation unit **70**, the multifunction peripheral **1** returns to the standby mode from the sleep mode. In this case, the sequence returns to step S**103**. If the condition for returning to the standby mode is not satisfied, in step S**135**, the control unit **80** determines whether the multifunction peripheral **1** should remain in the sleep mode or should be powered off. If the multifunction peripheral **1** should remain in the sleep mode, the sequence returns to step S**133**. If the multifunction peripheral **1** should be powered off, the sequence moves to step S**137**. In step S**137**, the control unit **80** stops operating, and the multifunction peripheral **1** turns into a state in which no power is supplied. The flowchart illustrated in FIG. **7** assumes the relationships between the driving states of the heaters **120***a*, **120***b*, and **120***c* and the operation states of the power supply unit **100** defined in the mapping table in FIG. **6**. However, the relationships between the driving states of the one or more heaters **120** and the operation states of the power supply unit **100** are not limited to the examples described above. For example, the values of the first power threshold TH_1 and the second power threshold TH_2 may be different from those in the example described above. An operation state in which only the cooling fan **107** is active may be employed instead of an operation state in which only the PFC circuit **103** is active.

[0089] In addition to the driving states of the heaters **120**, the control unit **80** may determine the required power amount P_{REQ} on the basis of the power consumption of components, aside from the heaters, that depend on the operation mode of the multifunction peripheral **1**. In particular, when there is a significant difference in the power consumption of one or both of the control system and the drive system from operation mode to operation mode, adding such a difference to the determination of the required power amount makes it possible to more accurately determine the surplus of the total consumed power and appropriately select an operation state of the power supply unit.

[0090] Although an example in which whether to activate each circuit in the power supply unit **100** is determined on the basis of a comparison of the required power amount and the power threshold has been described here, the technology according to the present disclosure is not limited to this example. For example, the control unit **80** may store a mapping table associating each driving state of the heaters with the corresponding operation state of the power supply unit **100** in advance in the memory, and determine an operation state of the power supply unit **100** directly from the heater settings, without calculating the required power amount, by referring to the mapping table in the memory.

[0091] The control unit **80** may determine an operation state of the power supply unit **100** on the basis of the number of heaters to be driven. As an example, the control unit **80** may cause the power supply unit **100** to operate in a first state when a first number of heaters are to be driven, and may cause the power supply unit **100** to operate in a second state when a second number of heaters, smaller than the first number, are to be driven. As another example, the control unit **80** may cause the power supply unit **100** to operate in a first state when at least one heater is to be driven, and may cause the power supply unit **100** to operate in a second state when no heaters are to be driven. Here, the first state is a state in which the total consumed power of the power supply unit **100** is a first power value, and the second state is a state in which the total consumed power of the power supply unit **100** is a second power value lower than the first power value.

[0092] Although the first practical example described the multifunction peripheral **1** (and more generally, the image-processing apparatus) as including three heaters **120***a*, **120***b*, and **120***c*, the technology according to the present disclosure can also be applied when the image-processing apparatus includes only one heater. In addition, the technology according to the present disclosure can also be applied when the image-processing apparatus includes a plurality of heaters but only one of those heaters is subject to the determination of the driving state. For example, the controller of the image-processing apparatus may cause the power supply unit to operate in a first state, in which the total consumed power is a first power value, when one heater is to be operated, and may cause the power supply unit to operate in a second state, in which the total consumed power is a lower second power value, when the heater is not to be operated.

3. Second Practical Example

<3-1. Example of Configuration of Heater-Related Circuitry>

[0093] FIG. **8** is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to a second practical example. The configuration of the circuitry illustrated in FIG. **8** differs from the configuration of the circuitry according to the first practical example and illustrated in FIG. **2** in that a heater power supply unit **200** and an additional cooling fan **207** are provided. In addition, in the present practical example, the CPU **111** and the switching circuit **118** according to the first practical example are replaced with a CPU **211** and a switching circuit **218**.

[0094] The heater power supply unit **200** is a circuit that generates DC power to be supplied to the heaters **120***a*, **120***b*, and **120***c*. The heater power supply unit **200** includes an AC relay **201**, a rectifying diode **202**, a third DC power supply **204**, and a fan drive circuit **206**.

[0095] AC power passing through the AC filter **101** of the power supply unit **100** is supplied to the AC relay **201**. In the present practical example, the AC relay **201** is activated in response to a power control signal SigR input from the CPU **211**. When the AC relay **201** is active, the power from the AC filter **101** is relayed to the rectifying diode **202**. When the AC relay **201** is inactive, the supply of power to the rectifying diode **202** and subsequent circuits is shut off.

[0096] The rectifying diode **202** rectifies the AC power supplied via the AC relay **201**. The third DC power supply **204** generates DC power by converting the AC voltage rectified by the rectifying diode **202** into DC voltage. In the present practical example, the voltage of the DC power generated by the third DC power supply **204** is 12 V. This DC power is the power supplied to the heaters **120***a*, **120***b*, and **120***c*. The DC power from the third DC power supply **204** is also output to the fan drive circuit **206**.

[0097] The cooling fan **207** is a cooling unit that cools the third DC power supply **204** of the heater power supply unit **200**. The fan drive circuit **206** drives the cooling fan **207** using the DC power supplied from the third DC power supply **204**. The fan drive circuit **206** and the cooling fan **207** is activated in response to a fan control signal SigH input from the CPU **211** to the fan drive circuit **206**.

[0098] The CPU **211** controls execution of jobs in the multifunction peripheral **1** in the same manner as the CPU **111** according to the first practical example. Furthermore, in the present practical example, the CPU **211** also functions as a controller that controls the supply of power from the heater power supply unit **200** to the one or more heaters **120** on the basis of user settings received through a UI such as that described with reference to FIG. **4**.

[0099] The switching circuit **218** is a switching means that opens and closes a power supply path from the third DC power supply **204** to each of the heaters **120**. When all of the drive signals Sig**1**, Sig**2**, and Sig**3** output from the CPU **211** to the heater drive circuits **130***a*, **130***b*, and **130***c*, respectively, indicate that the corresponding heater is to be deactivated, the switching circuit **218** shuts off the supply of the DC power of 12V from the third DC power supply **204**. When one or more of the drive signals Sig**1**, Sig**2**, and Sig**3**

indicate that the corresponding heater is to be activated, the switching circuit **218** causes the third DC power supply **204** to supply the heater drive circuits **130***a*, **130***b*, and **130***c* with the DC power. The detailed configurations of the switching circuit **218** and the heater drive circuits **130***a*, **130***b*, and **130***c* may be similar to the configurations described with reference to FIG. **5** in the first practical example.

<3-2. Control of Operation State of Power Supply Unit>

[0100] Each of the heaters **120** is driven using power supplied from at least one DC power supply (the third DC power supply **204**, in the present practical example) of the heater power supply unit **200**. Meanwhile, the heater power supply unit **200** includes the following circuits, which are activated in response to the control of the control unit **80** and consume power:

[0101] the fan drive circuit **206** (and the cooling fan **207**)

[0102] the third DC power supply **204**

The operation state of the heater power supply unit **200** can be categorized into several states depending on whether these circuits are active, and the total consumed power of the heater power supply unit **200** is different in each operation state. Accordingly, on the basis of the driving states of the heaters **120**, the CPU **211** selects an operation state of the heater power supply unit **200** such that a surplus of the total consumed power of the heater power supply unit **200** is reduced, and causes the heater power supply unit **200** to operate in the selected operation state.

[0103] In the present practical example, the control unit **80** is assumed to have a memory that stores, in advance, the power amount required when driving each of the heaters **120**. For the heaters **120** set to be driven, the CPU **211** determines the required power amount to be supplied from the heater power supply unit **200** by totaling the stored power amounts. When determining the required power amount, the CPU **211** may take into account the operation mode of the multifunction peripheral **1** in addition to the driving states of the heaters **120**. Then, on the basis of a comparison between the determined required power amount and a predetermined threshold, the CPU **211** selects an operation state in which the heater power supply unit **200** is to be operated.

[0104] As a first example, candidates for the operation states include a first state, in which the cooling fan **207** is active and the total consumed power of the heater power supply unit **200** is a first power value, and a second state, in which the cooling fan **207** is inactive and the total consumed power of the heater power supply unit **200** is a second power value. The second power value is lower than the first power value. When the required power amount determined on the basis of the driving states of the heaters **120***a* to **120***c* is greater than a predetermined power threshold, the CPU **211** selects the first state, so that the required power amount is covered sufficiently, and activates the cooling fan **207**. On the other hand, when the required power amount determined is lower than the power threshold, the CPU **211** selects the second state and deactivates the cooling fan **207** to reduce a surplus of power consumption.

[0105] As a second example, candidates for the operation states include a third state in which power is supplied from the third DC power supply **204** to the one or more heaters **120**, and a fourth state in which the power supply path through the third DC power supply **204** is shut off. A fourth power value, which is the total consumed power of the heater power supply unit **200** in the fourth state, is lower than a third power value, which is the total consumed power of the heater power supply unit **200** in the third state. When one or more of the heaters **120***a* to **120***c* are set to be active, the CPU **211** selects the third state and causes the AC relay **201** to relay the power. On the other hand, when all of the heaters **120***a* to **120***c* are set to be inactive, the CPU **211** selects the fourth state and causes the AC relay **201** to shut off the power supply path in order to reduce a surplus of power consumption.

[0106] Of course, it is also conceivable to combine the first example and the second example. For example, the CPU **211** may select an operation state of the heater power supply unit **200** on the basis of the driving states of the heaters **120***a* to **120***c* as follows. Here, TH_3 is a third power threshold:

[0107] If $P_{REQ}=0$, then the third DC power supply **204** and the cooling fan **207** are deactivated

[0108] If $0<P_{REQ}<TH_3$, then the third DC power supply **204** is activated and the cooling fan **207** is deactivated.

[0109] If $TH_3 \leq P_{REQ}$, then the third DC power supply **204** and the cooling fan are activated

[0110] FIG. **9** is a mapping table that defines correspondence relationships between the driving states of the heaters **120** and the operation states of the power supply unit **100** and the heater power supply unit **200** according to the present practical example. The leftmost column of the mapping table indicates the operation mode of the multifunction peripheral **1**. The operation mode of the multifunction peripheral **1** is one of "power off", "sleep", "standby", and "print".

[0111] The second to fourth columns from the left in the mapping table represent the driving state ("on" or "off") of the scanner heater **120***a*, the drum heater **120***b*, and the cassette heater **120***c*, respectively. The required power amounts of the heaters **120***a*, **120***b*, and **120***c* are assumed to be 10 W, 20 W, and 10 W, respectively, as in the first practical example.

[0112] The fifth column in the mapping table indicates the total value of the required power amount required by the heater power supply unit **200**, corresponding to the driving states of the heaters **120***a* to **120***c* in each row. The sixth column in the mapping table indicates the power amount supplied from the first DC power supply **104** to the control system, corresponding to the operation mode of the multifunction peripheral **1** in each row. The seventh column in the mapping table indicates the power amount supplied from the second DC power supply **105**, corresponding to the operation mode of the multifunction peripheral **1** in each row. Regardless of the driving states of the heaters **120***a* to **120***c*, in the power off and sleep modes, the second DC power supply **105** is inactive, and the required power amount is therefore **0** [W]. In the standby mode and the print mode, power is supplied from the second DC power supply **105** to the drive system, and the required power amount thereof is a maximum of 290 [W].

[0113] The eighth to eleventh columns in the mapping table indicate how the CPU **211** selects an operation state of the power supply unit **100** with respect to the driving states of the heaters **120***a* to **120***c* in each row. In the present practical example, the PFC circuit **103** of the power supply unit **100** is controlled to be inactive before being powered on and in the sleep mode, and to be active in the standby mode and the print mode. The cooling fan **107** is also controlled to be inactive before being powered on and in the sleep mode, and to be active in the standby mode and the print mode. The first DC power supply **104** is always connected to the commercial power supply, and is active unless it is powered off. The second DC power supply **105** is also controlled to be inactive before being powered on and in the sleep mode, and to be active in the standby mode and the print mode.

[0114] The twelfth and thirteenth columns in the mapping table indicate how the CPU **211** selects an operation state of the heater power supply unit **200** with respect to the driving states of the heaters **120***a* to **120***c* in each row.

[0115] The twelfth column indicates whether the third DC power supply **204** is on or off. In the example illustrated in FIG. **9**, when at least one of the heaters **120** is active, i.e., when the total value of the required power amount required by the heater power supply unit **200** is greater than zero, the third DC power supply **204** is active, regardless of the operation mode of the multifunction peripheral **1**.

[0116] The thirteenth column indicates whether the cooling fan **207** is on or off. In the example illustrated in FIG. **9**, the CPU **211** activates the cooling fan **207** when the total value of the required power amounts of the heaters **120***a* to **120***c* is 40 W or higher, and deactivates the cooling fan **207** when the total value of the required power amounts is less than 40 W. This threshold of 40Wcan correspond to the third power threshold TH_3 mentioned above.

[0117] As an example, when the cooling fan **207** is inactive, the maximum value of the power that the third DC power supply **204** is capable of outputting is less than 40 W. When the cooling fan **207** is active, the maximum value of the power that the third DC power supply **204** is capable of outputting is 40 W or higher. The mapping table in FIG. **9** assumes that the heater power supply unit **200** has such performance.

[0118] In the present practical example, one or both of the third DC power supply **204** and the cooling fan **207** are deactivated dynamically in accordance with the mapping table described above (or in accordance with a comparison of the required power amount with the power threshold). This makes it possible to eliminate wasteful power consumption and optimize the power consumption of the multifunction peripheral **1**.

<3-3. Flow of Processing>

[0119] FIG. **10** is a flowchart illustrating an example of a flow of state control processing that can be executed by the control unit **80** (e.g., the CPU **211**) to control a power supply state in the multifunction peripheral **1** according to the present practical example.

[0120] The state control processing illustrated in FIG. **10** is started in response to the multifunction peripheral **1** being powered on. First, in step S**201**, the control unit **80** starts up, and commences the operations. In step S**203**, the control unit **80** outputs the PFC control signal SigP to the PFC circuit **103** to activate the PFC circuit **103**. The control unit **80** also outputs the fan control signal SigF to the fan drive circuit **106** to start driving the cooling fan **107**. The control unit **80** furthermore outputs the power control signal SigS to the second DC power supply **105** to activate the second DC power supply **105**.

[0121] Next, in step S**205**, the control unit **80** obtains the heater settings received through the UI of the operation unit **70**. Next, in step S**207**, the control unit **80** determines whether the heater settings have been changed since the previous calculation of the required power amount P_{REQ}. If the heater settings have been changed, the sequence moves to step S**209**.

[0122] In step S**209**, the control unit **80** calculates the required power amount P_{REQ} on the basis of the heater settings obtained in step S**205**. For example, the control unit **80** can calculate the required power amount P_{REQ} by totaling the power amounts defined in advance for the heaters **120** set to be active. Next, in step S**210**, the control unit **80** sets the operation state of the heater power supply unit **200** by executing heater power supply control processing. The heater power supply control processing will be described in detail below with reference to FIG. **11**. Then, in step S**211**, the control unit **80** outputs the drive signals Sig**1**, Sig**2**, and Sig**3** to the heater drive circuits **130***a*, **130***b*, and **130***c*, respectively, in accordance with the heater settings.

[0123] If the heater settings have not been changed in step S**207**, steps S**209** to S**211** are skipped. In this case, the heater drive circuits **130***a*, **130***b*, and **130***c* drive the corresponding heaters **120***a*, **120***b*, and **120***c* in accordance with the drive signal values held in the respective latch circuits.

[0124] Next, in step S**213**, the control unit **80** stands by to receive a job. The operation mode of the multifunction peripheral **1** is the standby mode from step S**205** to step S**213**. When a job is received in the standby mode, in step S**215**, the control unit **80** controls one or both of the printer unit **10** and the scanner unit **50** to execute the received job. The operation mode of the multifunction peripheral **1** in step S**215** is the print mode (or the scanning mode, if a scan job is executed).

[0125] Next, in step S**217**, the control unit **80** determines whether the multifunction peripheral **1** should be powered off or transition to the sleep mode. For example, if an operation for turning the power off has been detected in the operation unit **70**, the multifunction peripheral **1** is powered off. If an operation instructing a transition to the sleep mode is detected, or a predetermined length of time has passed without any operations being performed, the multifunction peripheral **1** transitions to the sleep mode. If the multifunction peripheral **1** is powered off or transitions to the sleep mode, the sequence moves to step S**221**. If the multifunction peripheral **1** remains in the standby mode, the sequence returns to step S**205**.

[0126] In step S**221**, the control unit **80** outputs the power control signal SigS to the second DC power supply **105** to deactivate the second DC power supply **105**. Next, in step S**223**, the control unit **80** outputs the PFC control signal SigP to the PFC circuit **103** to deactivate the PFC circuit **103**. Next, in step S**225**, the control unit **80** outputs the fan control signal SigF to the fan drive circuit **106** to stop the driving of the cooling fan **107**.

[0127] Next, in step S**233**, the control unit **80** determines whether the multifunction peripheral **1** should be returned to the standby mode. For example, if any operation is detected in the operation unit **70**, the multifunction peripheral **1** returns to the standby mode from the sleep mode. In this case, the sequence returns to step S**203**. If the condition for returning to the standby mode is not satisfied, in step S**235**, the control unit **80** determines whether the multifunction peripheral **1** should remain in the sleep mode or should be powered off. If the multifunction peripheral **1** should remain in the sleep mode, the sequence returns to step S**233**. If the multifunction peripheral **1** should be powered off, the sequence moves to step S**237**. In step S**237**, the control unit

80 stops operating, and the multifunction peripheral 1 turns into a state in which no power is supplied.

[0128] FIG. 11 is a flowchart illustrating an example of a detailed flow of the heater power supply control processing performed in step S210 of FIG. 10.

[0129] With reference to FIG. 11, first, in step S241, the control unit 80 determines whether the required power amount P_{REQ} calculated in step S209 is equal to zero. If P_{REQ} is equal to zero, in step S243, the control unit 80 outputs the power control signal SigR to the AC relay 201, and shuts off the power supply path to the third DC power supply 204, which is the power supply for heaters.

[0130] If P_{REQ} is greater than zero, in step S245, the control unit 80 outputs the power control signal SigR to the AC relay 201 to cause power to be supplied from the commercial power supply to the third DC power supply 204. Next, in step S247, the control unit 80 compares the required power amount P_{REQ} with the third power threshold TH_3, which is 40 [W].

[0131] If the required power amount P_{REQ} is lower than the third power threshold TH_3 (P_{REQ} <40 W; step S247-YES), the control unit 80 does not activate the cooling fan 207 for cooling the power supply for the heater (deactivates the cooling fan 207). If the required power amount P_{REQ} is equal to or higher than the third power threshold TH_3, in step S249, the control unit 80 outputs the fan control signal SigH to the fan drive circuit 206 to start driving the cooling fan 207.

[0132] The flowchart illustrated in FIG. 11 assumes the relationships between the driving states of the heaters 120*a*, 120*b*, and 120*c* and the operation states of the heater power supply unit 200 defined in the mapping table in FIG. 9. However, the relationships between the driving states of the one or more heaters 120 and the operation states of the heater power supply unit 200 are not limited to the examples described above. For example, the value of the third power threshold TH_3 may be different from that in the example described above.

[0133] In the present practical example too, the control unit 80 may store a mapping table associating each driving state of the heaters with the corresponding operation state of the heater power supply unit 200 in advance in the memory, and determine an operation state of the heater power supply unit 200 directly from the heater settings, without calculating the required power amount.

4. Variations

<4-1. First Variation>

[0134] Many variations on the embodiments and two practical examples described above are conceivable. For example, at least one of the heaters 120 in the multifunction peripheral 1 may be supplied with AC power rather than DC power to be active.

[0135] FIG. 12 is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to a first variation. The configuration of the circuitry illustrated in FIG. 12 differs from the configuration of the circuitry according to the first practical example and illustrated in FIG. 2 in that an AC-powered scanner heater 320*a* and switch 330 are provided instead of the DC-powered scanner heater 120*a* and heater drive circuit 130*a*. In addition, in the present variation, the CPU 111 and the switching circuit 118 according to the first variation are replaced with a CPU 311 and a switching circuit 318.

[0136] The switching circuit 318 is a switching means that opens and closes a power supply path from the first DC power supply 104 to the drum heater 120*b* and the cassette heater 120*c*. When both of the drive signals Sig2 and Sig3 output from the CPU 311 to the heater drive circuits 130*b* and 130*c*, respectively, indicate that the corresponding heater is to be deactivated, the switching circuit 218 shuts off the supply of the DC power of 12V from the first DC power supply 104. When one or more of the drive signals Sig2 and Sig3 indicate that the corresponding heater is to be activated, the switching circuit 318 causes the first DC power supply 104 to supply the heater drive circuits 130*b* and 130*c* with the DC power.

[0137] The switch 330 is an opening and closing means that can be physically opened and closed by the user. One end of the switch 330 is connected to a branch point between the AC filter 101 and the rectifying diode 102, and the other end of the switch 330 is connected to the scanner heater 320*a*. When the switch 330 is closed by the user, AC power passing through the AC filter 101 is supplied to the scanner heater 320*a*. In other words, the switch 330 can open and close the power supply path from the commercial power supply to the scanner heater 320*a*. The scanner heater 320*a* is a resistive heating element disposed within the scanner unit 50. When the switch 330 is closed, the scanner heater 320*a* heats the optical system 52 using AC power supplied from the commercial power supply to prevent reading failures due to condensation.

[0138] In the present variation, the CPU 311 can obtain only the driving state settings of the drum heater 120*b* and the cassette heater 120*c* through a UI such as the heater settings screen 71 illustrated in FIG. 4. Accordingly, on the basis of the driving states of the two heaters 120, the CPU 311 selects an operation state of the power supply unit 100 such that a surplus of the total consumed power of the power supply unit 100 is reduced, and causes the power supply unit 100 to operate in the selected operation state.

<4-2. Second Variation>

[0139] FIG. 13 is a block diagram illustrating an example of an overall configuration of heater-related circuitry according to a second variation. In the second variation too, at least one of the heaters 120 in the multifunction peripheral 1 is supplied with AC power rather than DC power to be active.

[0140] The configuration of the circuitry illustrated in FIG. 13 differs from the configuration of the circuitry illustrated in FIG. 12 in that a switch detection circuit 431 is disposed between the scanner heater 320*a* and the switch 330. In addition, in the present variation, the CPU 311 according to the first variation is replaced with a CPU 411.

[0141] The switch detection circuit 431 detects an open/closed state of the switch 330, and outputs a detection signal SigW indicating the detected state to the CPU 411. FIG. 14 illustrates an example of a detailed configuration of the switch detection circuit 431. In the example illustrated in FIG. 14, the switch detection circuit 431 includes a photocoupler 432. The primary-side light-emitting element of the photocoupler 432 emits light when the switch 330 is closed by the user and current flows from the power supply unit 100 to the scanner heater 320*a*. The secondary-side light-receiving element detects the light and outputs the detection signal SigW to the CPU 411.

[0142] The CPU **411** can obtain the driving state settings of the drum heater **120***b* and the cassette heater **120***c* through a UI such as the heater settings screen **71** illustrated in FIG. **4**. In addition, the CPU **411** can obtain the open/closed state of the switch **330** (or the driving state of the scanner heater **320***a*) on the basis of the detection signal SigW input from the switch detection circuit **431**. For example, the CPU **411** may deactivate the power supply from the power supply unit **100** to the drum heater **120***b* and the cassette heater **120***c* when the switch **330** is open (when the power supply to the scanner heater **320***a* is shut off), regardless of the heater settings. Alternatively, the CPU **411** may cause the power supply unit **100** to supply power to the drum heater **120***b* and the cassette heater **120***c* when the switch **330** is closed (when power is supplied to the scanner heater **320***a*), regardless of the heater settings. Then, on the basis of the driving states of the three heaters **120**, the CPU **411** selects an operation state of the power supply unit **100** such that a surplus of the total consumed power of the power supply unit **100** is reduced, and causes the power supply unit **100** to operate in the selected operation state.

[0143] In the two variations described above as well, when some of the heaters are set to be inactive (e.g., through an input made on a screen or operating a physical switch), the power consumption of the power supply unit can be optimized to enhance the energy conservation effect.

5. Conclusion

[0144] Thus far, embodiments of the technology according to the present disclosure, as well as various practical examples and variations thereof, have been described with reference to FIGS. **1** to **14**. In the embodiments described above, the image-processing apparatus includes one or more heaters and a power supply unit including at least one direct current power supply, and the power supply unit operates in one of a plurality of operation states each having a different total consumed power. The one or more heaters are driven using power supplied from the at least one direct current power supply. A controller of the image-processing apparatus causes, on the basis of a driving state of the one or more heaters, the power supply unit to operate in an operation state selected to reduce a surplus of the total consumed power. According to this configuration, when some heaters are not driven, excess power can be prevented from being consumed, and the energy conservation effect can be enhanced. In addition, when many or all heaters are to be driven, a circuit that contributes to improving the power capacity or power supply efficiency of the power supply unit can be activated to ensure a stable power supply.

6. Other Embodiments

[0145] Embodiment(s) of the present disclosure can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

[0146] While the present disclosure has been described with reference to exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0147] This application claims the benefit of priority from Japanese Patent Application No. 2024-024826, filed on Feb. 21, 2024 which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image-processing apparatus comprising:

one or more heaters;

a power supply unit including at least one direct current power supply, the power supply unit being configured to operate in one of a plurality of operation states having respective different total consumed powers;

one or more drive circuits configured to drive the one or more heaters, respectively, using power supplied from the at least one direct current power supply; and

a controller configured to control, on the basis of a driving state of the one or more heaters, the power supply unit to operate in an operation state selected such that a surplus of the total consumed power is reduced.

2. The image-processing apparatus according to claim **1**,

wherein the power supply unit includes at least one circuit configured to be activated and consume power in accordance with control by the controller, and

the plurality of operation states of the power supply unit include:

a first state in which the at least one circuit is active and the total consumed power of the power supply unit is a first power value; and

a second state in which the at least one circuit is active and the total consumed power of the power supply unit is a second power value lower than the first power value.

3. The image-processing apparatus according to claim **2**,

wherein the one or more heaters include a plurality of heaters, and

the controller is configured to:

control the power supply unit to operate in the first state when a first number of the heaters among the plurality of heaters are driven; and

control the power supply unit to operate in the second state when a second number of the heaters among the plurality of heaters are to be driven, the second number being smaller than the first number.

4. The image-processing apparatus according to claim **2**, wherein the controller is configured to:

control the power supply unit to operate in the first state when at least one heater among the one or more heaters is driven; and

control the power supply unit to operate in the second state when none of the one or more heaters is driven.

5. The image-processing apparatus according to claim **2**, wherein the at least one direct current power supply is configured to convert alternating current voltage from a commercial power supply into direct current voltage to supply power with the direct current voltage, and

the at least one circuit includes a power factor correction circuit configured to correct a power factor in the at least one direct current power supply.

6. The image-processing apparatus according to claim **2**, wherein the at least one circuit includes a drive circuit configured to drive a cooling unit that cools the at least one direct current power supply.

7. The image-processing apparatus according to claim **1**, wherein the at least one direct current power supply includes:

a first direct current power supply configured to supply power to the one or more heaters; and

a second direct current power supply configured to supply power to the controller, and

the plurality of operation states of the power supply unit include:

a third state in which power is supplied from the first direct current power supply to the one or more heaters, and the total consumed power of the at least one direct current power supply is a third power value; and

a fourth state in which a power supply path passing through the first direct current power supply is shut off, and the total consumed power of the at least one direct current power supply is a fourth power value lower than the third power value.

8. The image-processing apparatus according to claim **1**, wherein the controller is configured to control the power supply unit to operate in the operation state selected on the basis of a comparison between (i) a required power amount determined on the basis of the driving state of the one or more heaters and (ii) a predetermined threshold.

9. The image-processing apparatus according to claim **8**, wherein the one or more heaters include a plurality of heaters,

the image-processing apparatus further comprises a memory configured to store a power amount required when driving each of the plurality of heaters, and

the controller is configured to determine the required power amount by totaling the power amounts stored in the memory for heaters set to be active.

10. The image-processing apparatus according to claim **8**, wherein the controller is configured to determine the required power amount on the basis of (i) the driving state of the one or more heaters and (ii) a power consumed by a component, aside from the one or more heaters, that depends on an operation mode of the image-processing apparatus.

11. The image-processing apparatus according to claim **1**, further comprising:

a receiving unit configured to receive a setting as to whether to activate each of the one or more heaters,

wherein the one or more drive circuits are configured to drive the one or more heaters in accordance with the setting received by the receiving unit.

12. The image-processing apparatus according to claim **1**, further comprising:

a further heater configured to be driven using power supplied from an alternating current power supply; and

a switch capable of opening and closing a power supply path from the alternating current power supply to the further heater,

wherein the controller is configured to control the driving state of the one or more heaters on the basis of an open/closed state of the switch.

13. The image-processing apparatus according to claim **1**, wherein the image-processing apparatus includes an image-forming apparatus configured to form an image on a sheet, and

the one or more heaters include a heater for heating a container unit configured to contain a sheet bundle.

14. The image-processing apparatus according to claim **1**, wherein the image-processing apparatus includes an image-forming apparatus configured to form an image on a sheet, and

the one or more heaters include a heater for heating an image-forming unit.

15. The image-processing apparatus according to claim **1**, wherein the image-processing apparatus includes a reading apparatus configured to optically read a document, and

the one or more heaters include a heater for heating an optical system of the reading apparatus.

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