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(54) **ULTRASOUND DIAGNOSTIC APPARATUS**

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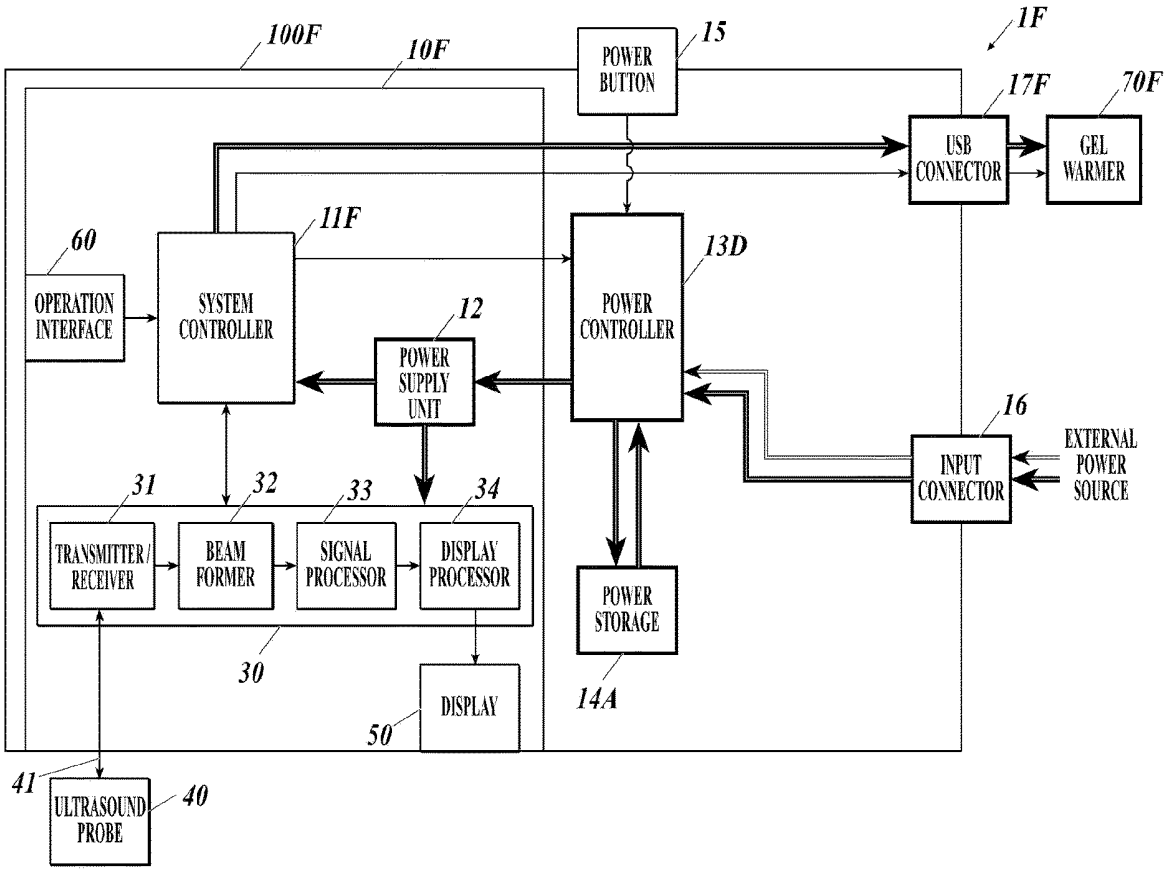
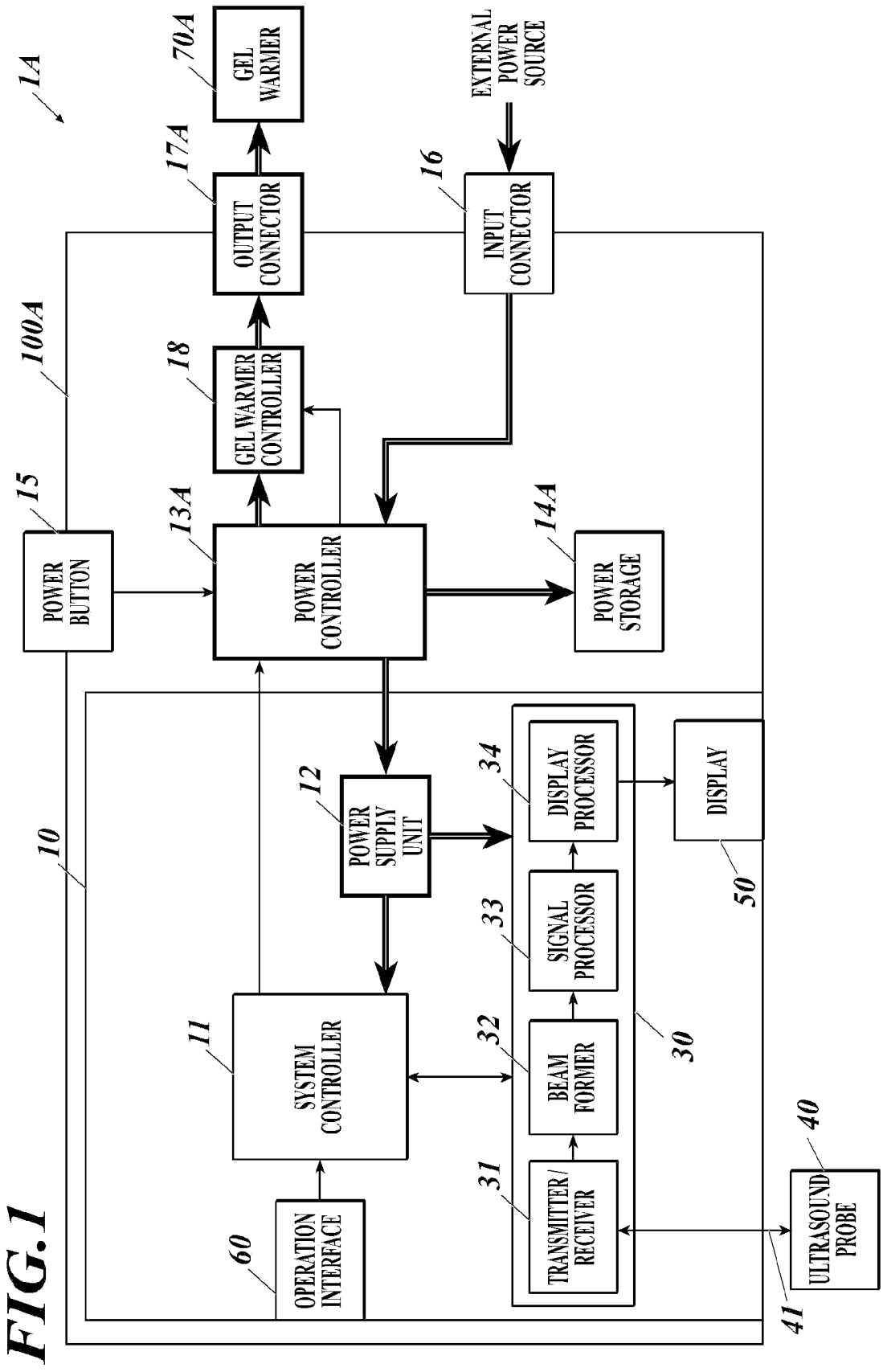
(57) **ABSTRACT**

Disclosed is an ultrasound diagnostic apparatus including: a power storage that stores electric power and that releases the stored power; a first hardware processor that receives power and supplies the received power to a gel heater, in which the gel heater heats gel by the power; and a second hardware processor that receives either power supplied from an external power source or the power released from the power storage and supplies the received power to the first hardware processor. When the first hardware processor receives the power released from the power storage, the first hardware processor shuts off or reduces power supply to the gel heater.

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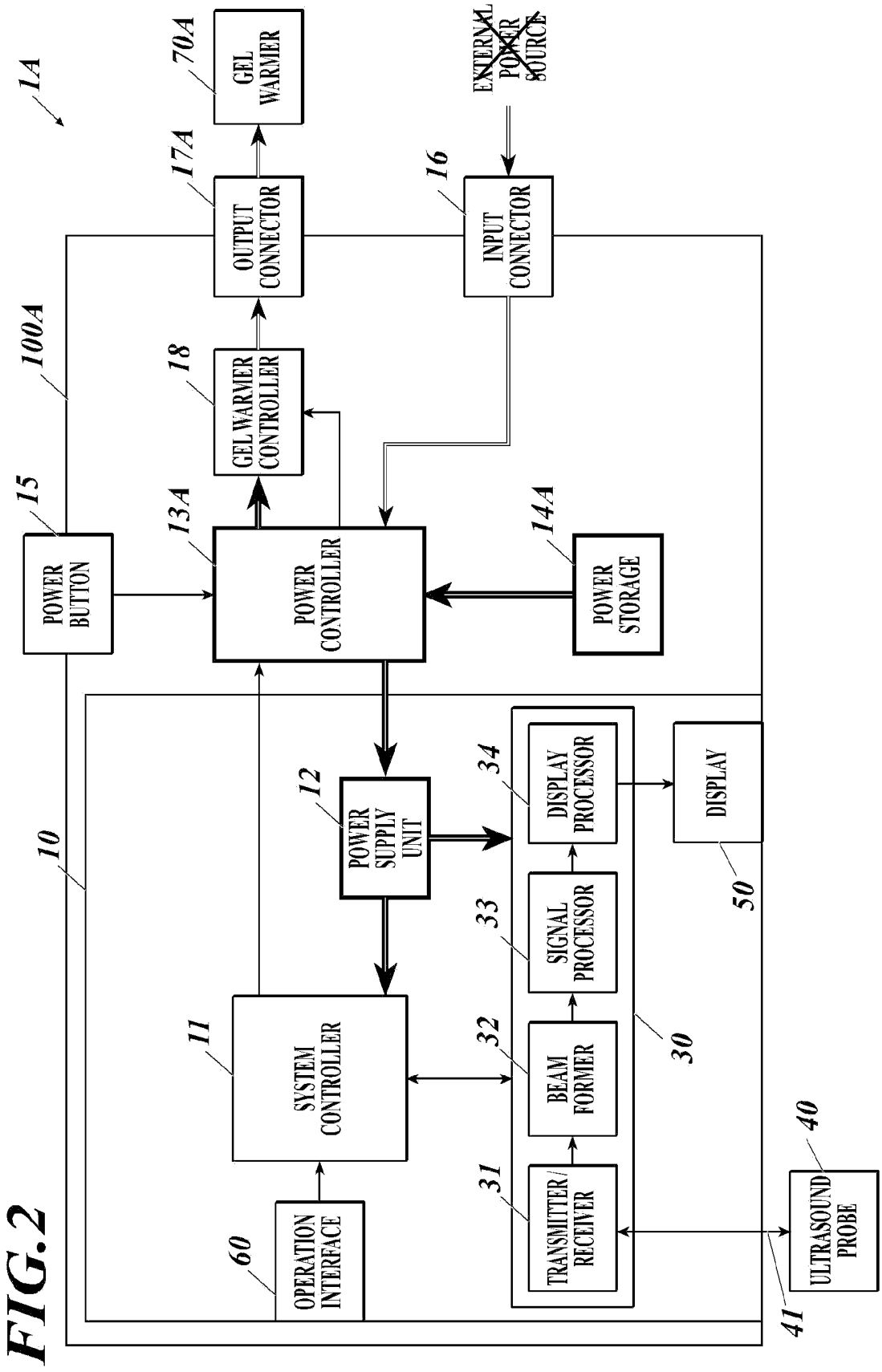
70A
GEL WARMER
EXTERNAL POWER SOURCE
17A
OUTPUT CONNECTOR
16
INPUT CONNECTOR
100A
18
GEL WARMER CONTROLLER
15
13A
14A
POWER BUTTON
POWER CONTROLLER
POWER STORAGE
10
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
33
SIGNAL PROCESSOR
11
32
30
SYSTEM CONTROLLER
BEAM FORMER
31
40
TRANSMITTER/ RECEIVER
ULTRASOUND PROBE
60
OPERATION INTERFACE
41

FIG. 1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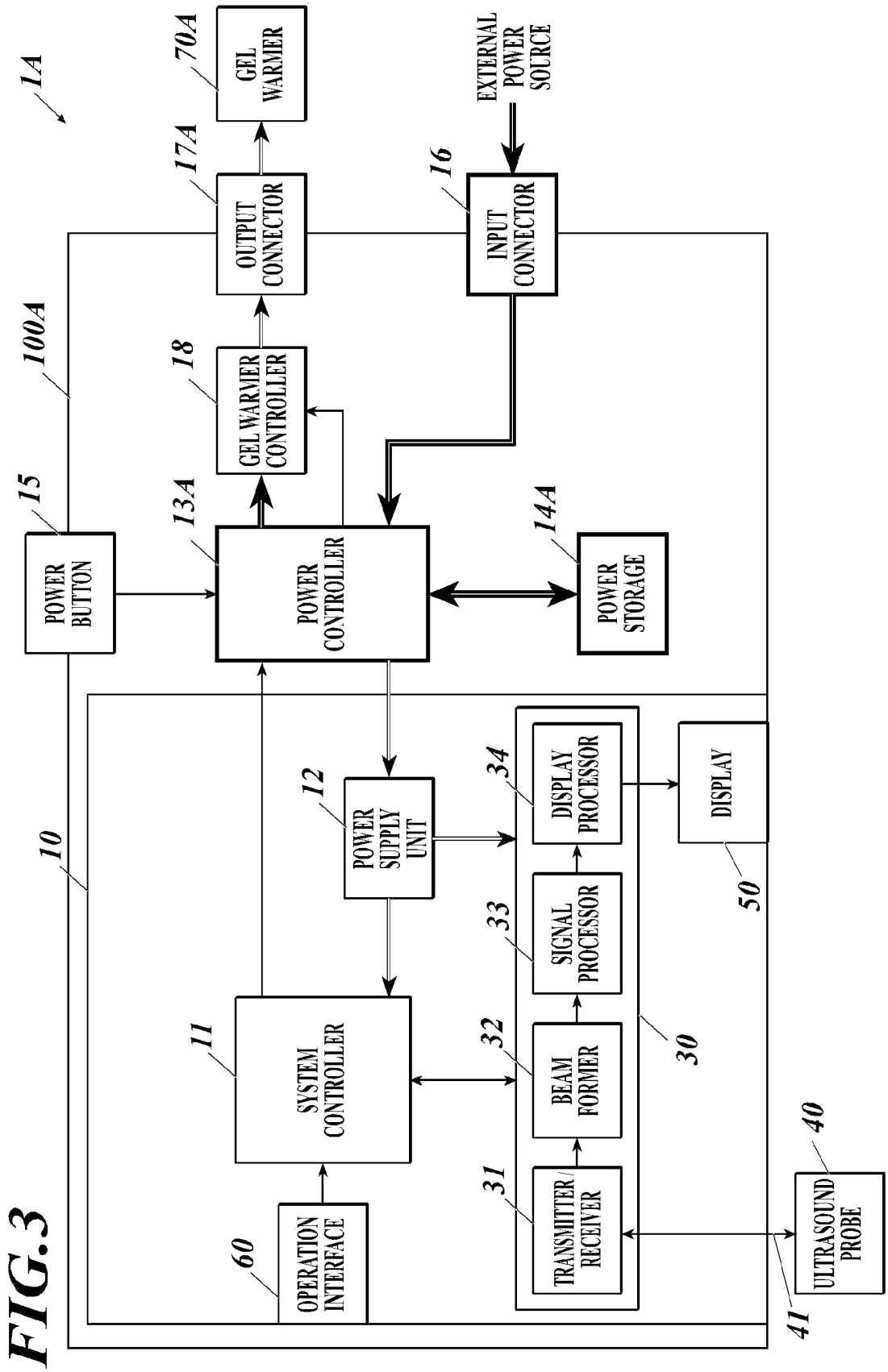
70A
GEL WARMER
EXTERNAL POWER SOURCE
17A
OUTPUT CONNECTOR
16
INPUT CONNECTOR
100A
18
GEL WARMER CONTROLLER
15
13A
14A
POWER BUTTON
POWER CONTROLLER
POWER STORAGE
10
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
33
SIGNAL PROCESSOR
11
SYSTEM CONTROLLER
32
BEAM FORMER
30
31
TRANSMITTER/ RECEIVER
40
ULTRASOUND PROBE
60
OPERATION INTERFACE
41

FIG.2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100A
10
15
POWER BUTTON
13A
POWER CONTROLLER
14A
POWER STORAGE
12
POWER SUPPLY UNIT
11
SYSTEM CONTROLLER
60
OPERATION INTERFACE
18
GEL WARMER CONTROLLER
17A
OUTPUT CONNECTOR
70A
GEL WARMER
16
INPUT CONNECTOR
EXTERNAL POWER SOURCE
30
31
TRANSMITTER / RECEIVER
32
BEAM FORMER
33
SIGNAL PROCESSOR
34
DISPLAY PROCESSOR
50
DISPLAY
40
ULTRASOUND PROBE
41

FIG.3

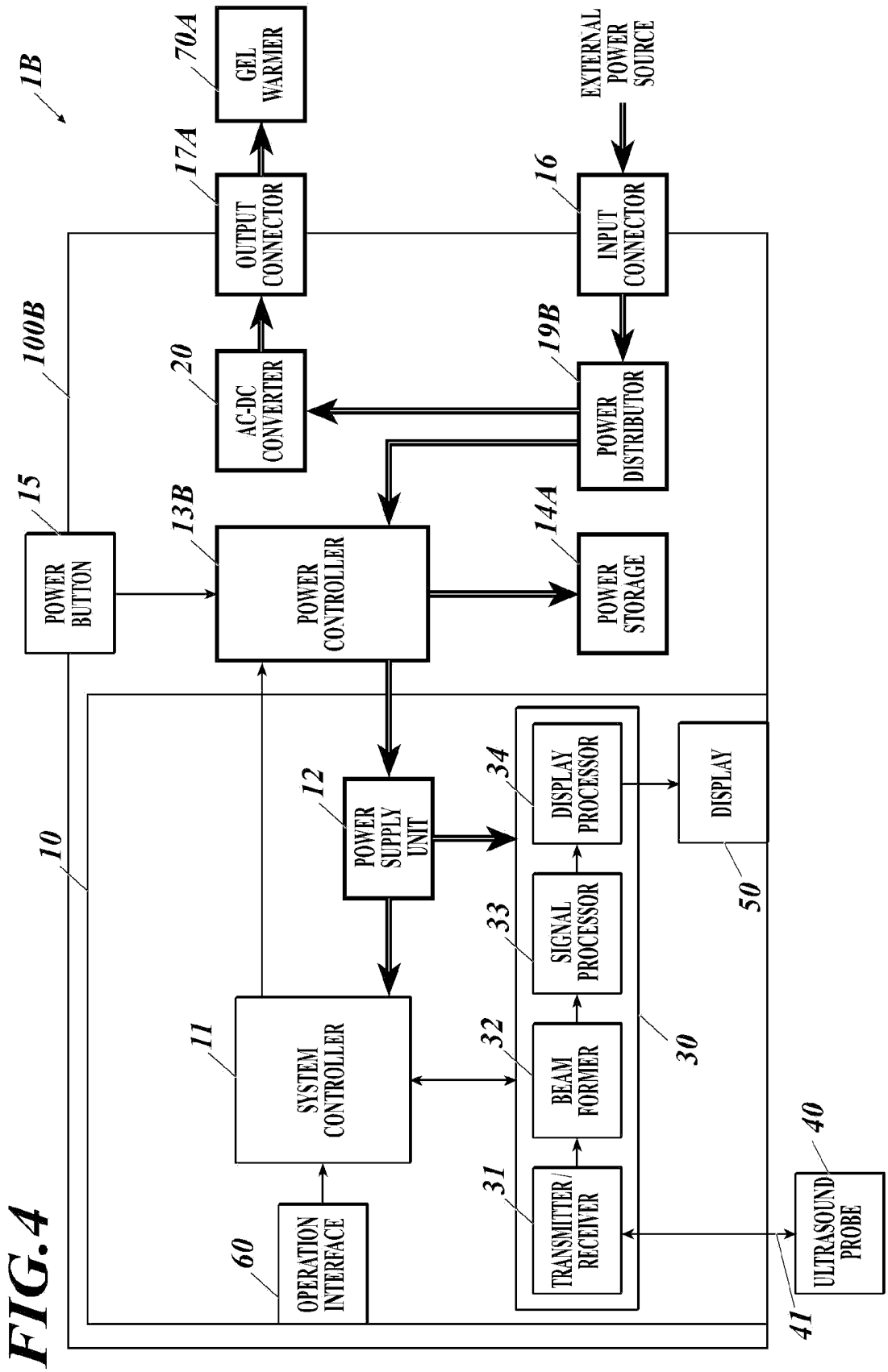
1B
100B
10
15
POWER BUTTON
13B
POWER CONTROLLER
14A
POWER STORAGE
19B
POWER DISTRIBUTOR
16
INPUT CONNECTOR
EXTERNAL POWER SOURCE
20
AC-DC CONVERTER
17A
OUTPUT CONNECTOR
70A
GEL WARMER
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
33
SIGNAL PROCESSOR
11
SYSTEM CONTROLLER
32
BEAM FORMER
30
31
TRANSMITTER/ RECEIVER
40
ULTRASOUND PROBE
41
60
OPERATION INTERFACE

FIG.4

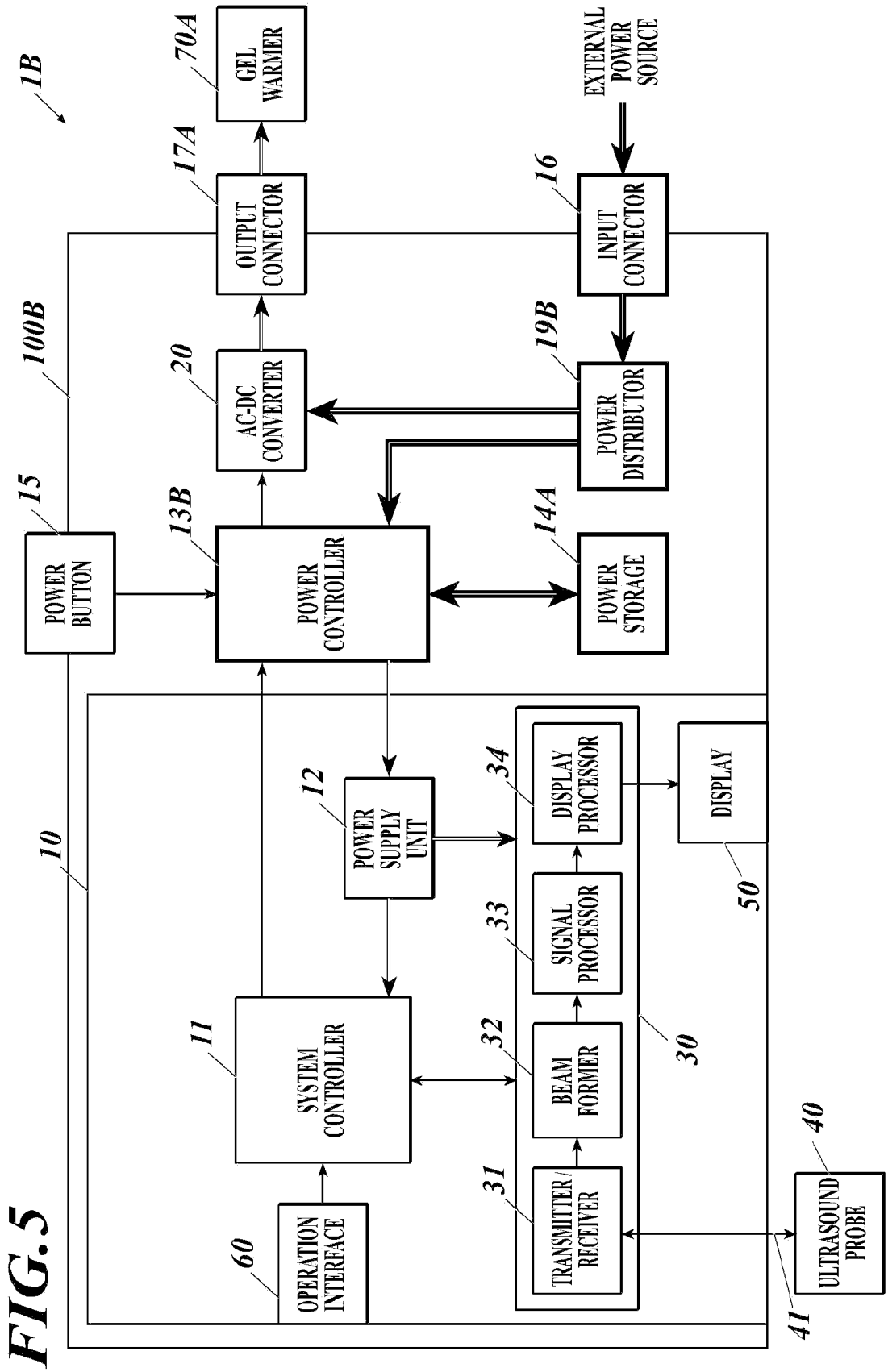
1B
100B
10
15
POWER BUTTON
13B
POWER CONTROLLER
14A
POWER STORAGE
20
AC-DC CONVERTER
19B
POWER DISTRIBUTOR
16
INPUT CONNECTOR
17A
OUTPUT CONNECTOR
70A
GEL WARMER
EXTERNAL POWER SOURCE
12
POWER SUPPLY UNIT
11
SYSTEM CONTROLLER
30
34
DISPLAY PROCESSOR
33
SIGNAL PROCESSOR
32
BEAM FORMER
31
TRANSMITTER / RECEIVER
50
DISPLAY
60
OPERATION INTERFACE
40
ULTRASOUND PROBE
41

FIG.5

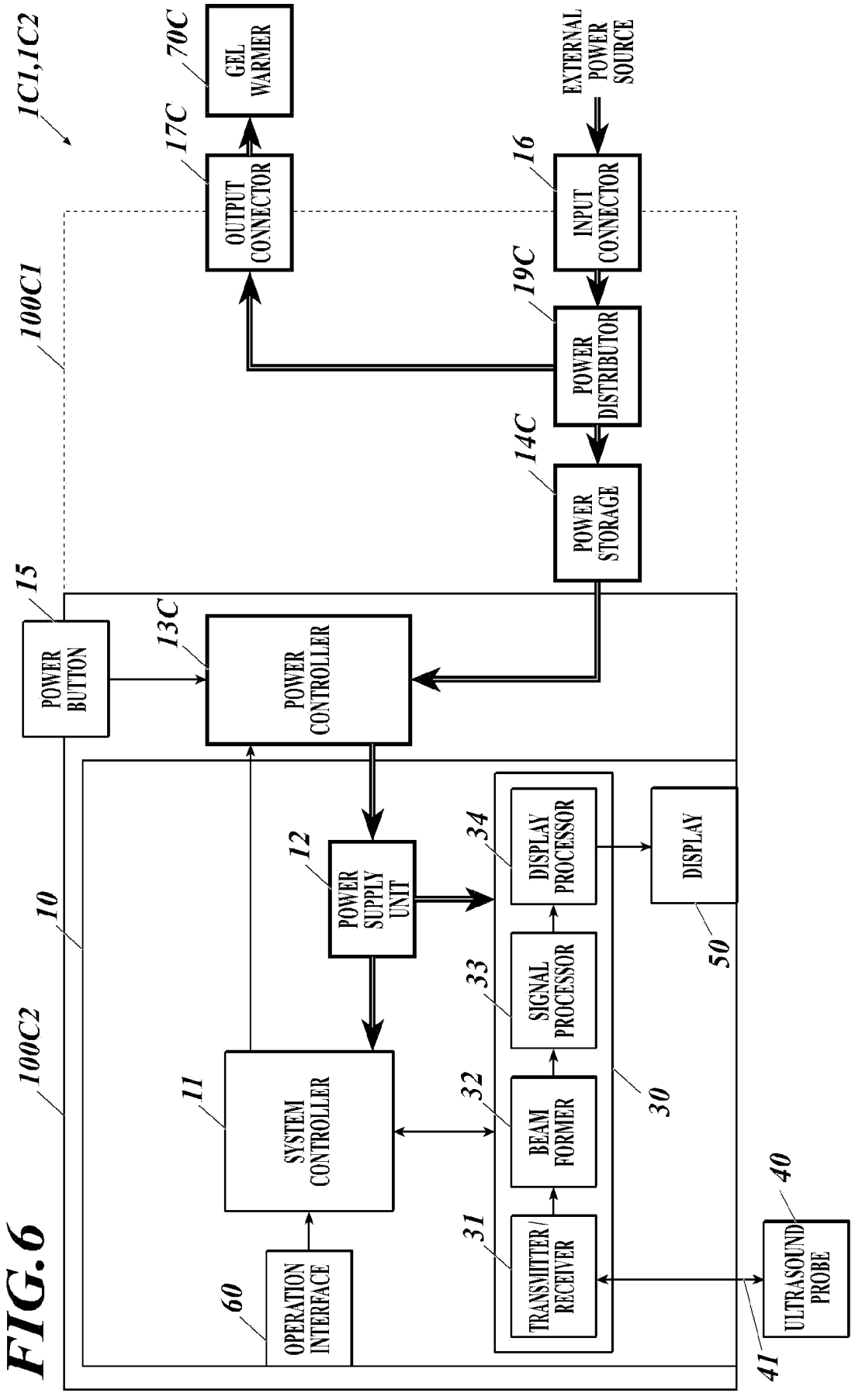
1C1,1C2
100C1
100C2
10
70C
GEL WARMER
17C
OUTPUT CONNECTOR
EXTERNAL POWER SOURCE
16
INPUT CONNECTOR
19C
POWER DISTRIBUTOR
14C
POWER STORAGE
15
POWER BUTTON
13C
POWER CONTROLLER
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
33
SIGNAL PROCESSOR
11
SYSTEM CONTROLLER
32
BEAM FORMER
30
31
TRANSMITTER/ RECEIVER
60
OPERATION INTERFACE
40
ULTRASOUND PROBE
41

FIG. 6

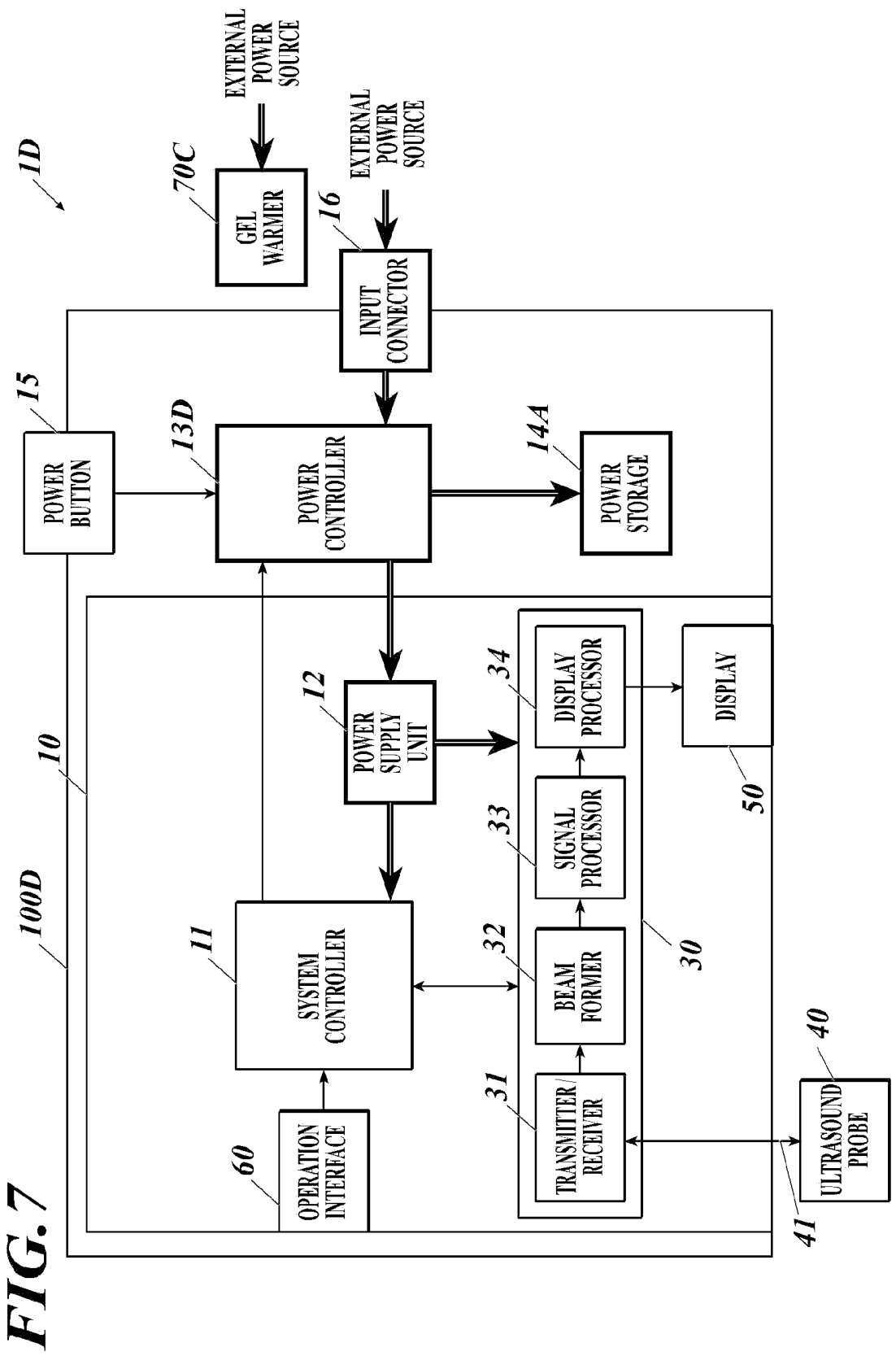
1D
EXTERNAL POWER SOURCE
EXTERNAL POWER SOURCE
70C
GEL WARMER
16
INPUT CONNECTOR
15
POWER BUTTON
13D
POWER CONTROLLER
14A
POWER STORAGE
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
10
100D
33
SIGNAL PROCESSOR
11
SYSTEM CONTROLLER
32
BEAM FORMER
30
31
TRANSMITTER / RECEIVER
40
60
OPERATION INTERFACE
ULTRASOUND PROBE
41

FIG. 7

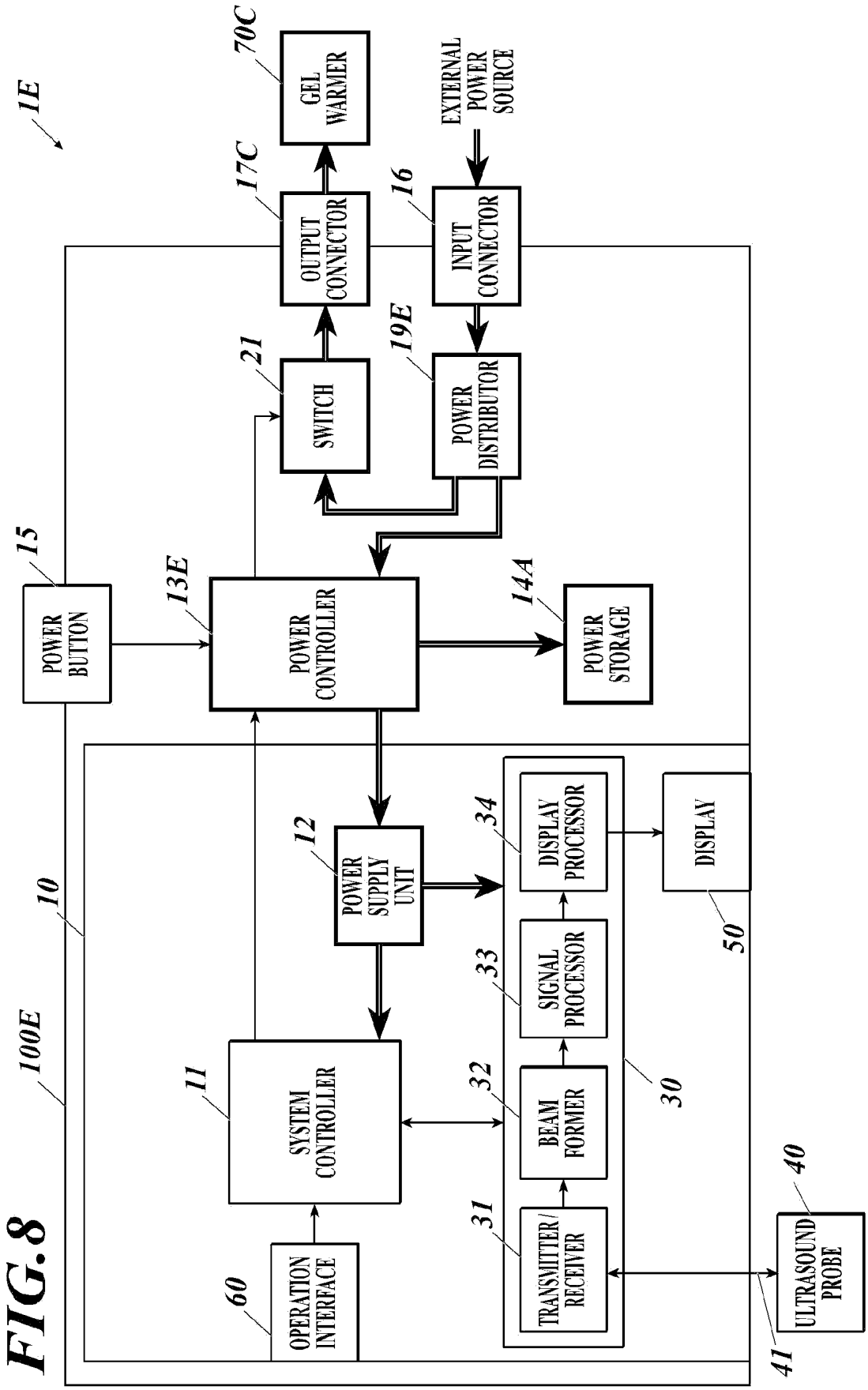
1E
70C
GEL WARMER
EXTERNAL POWER SOURCE
17C
OUTPUT CONNECTOR
16
INPUT CONNECTOR
21
SWITCH
19E
POWER DISTRIBUTOR
15
POWER BUTTON
13E
POWER CONTROLLER
14A
POWER STORAGE
10
12
POWER SUPPLY UNIT
34
DISPLAY PROCESSOR
DISPLAY
50
100E
11
SYSTEM CONTROLLER
33
SIGNAL PROCESSOR
32
BEAM FORMER
30
31
TRANSMITTER / RECEIVER
40
ULTRASOUND PROBE
60
OPERATION INTERFACE
41

FIG. 8

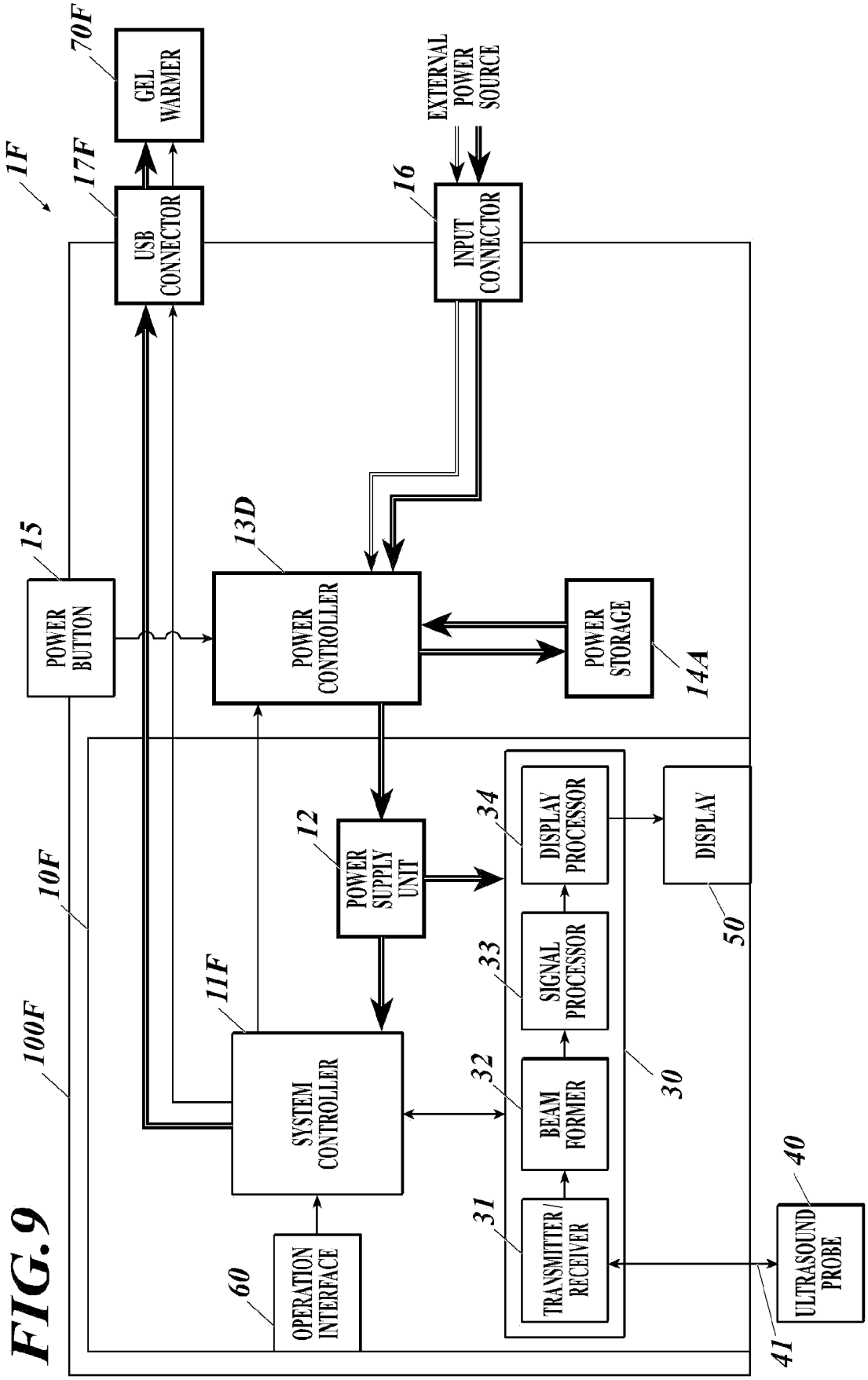
1F
100F
10F
11F
12
13D
14A
15
16
17F
30
31
32
33
34
40
41
50
60
70F
GEL WARMER
USB CONNECTOR
EXTERNAL POWER SOURCE
INPUT CONNECTOR
POWER BUTTON
POWER CONTROLLER
POWER STORAGE
POWER SUPPLY UNIT
DISPLAY PROCESSOR
DISPLAY
SIGNAL PROCESSOR
SYSTEM CONTROLLER
BEAM FORMER
TRANSMITTER/ RECEIVER
OPERATION INTERFACE
ULTRASOUND PROBE

FIG. 9

ULTRASOUND DIAGNOSTIC APPARATUS

BACKGROUND

Technological Field

[0001] The present invention relates to an ultrasound diagnostic apparatus.

Description of the Related Art

[0002] In ultrasound diagnosis, examinations can be repeatedly conducted since an ultrasound examination is very safe and can provide the condition of the heart, a fetus or the like is obtained as an ultrasound image by a simple process of putting an ultrasound probe on the body surface or the inner side of the body cavity. For such ultrasound diagnosis, ultrasound diagnostic apparatuses have been known in the art. Ultrasound image data is obtained by transmitting an ultrasound from an ultrasound probe to a subject, receiving a reflected ultrasound at the ultrasound probe, and subjecting received signals to a variety of processing.

[0003] In an ultrasound examination, gel is used. In order to improve transmission of ultrasound, the gel is applied to the part of a subject, or the live body of a patient, on which an ultrasound probe is put. Since cold gel is uncomfortable for the patient, a gel warmer has been used to heat the gel to a temperature around the body temperature. Typically, the gel is stored in a plastic bottle, and the gel warmer heats the bottle as well as the gel stored therein.

[0004] In this regard, configurations for supplying electric power to a gel warmer in conventional ultrasound diagnostic apparatuses will be described referring to FIG. **7** to FIG. **9**. FIG. **7** is a block diagram illustrating the functional configuration of a conventional ultrasound diagnostic apparatus **1**D. FIG. **8** is a block diagram illustrating the functional configuration of a conventional ultrasound diagnostic apparatus **1**E. FIG. **9** is a block diagram illustrating the functional configuration of a conventional ultrasound diagnostic apparatus **1**F.

[0005] Referring to FIG. **7**, the ultrasound diagnostic apparatus **1**D will be described as a typical example of a conventional ultrasound diagnostic apparatus. The ultrasound diagnostic apparatus **1**D includes a main body **100**D, an ultrasound probe **40**, and a gel warmer **70**C. The main body **100**D, which is a main part of the ultrasound diagnostic apparatus **1**D, includes an ultrasound imaging system **10**, a power controller **13**D, a power storage **14**A, a power button **15**, and an input connector **16**.

[0006] The ultrasound imaging system **10**, which is a component for generating ultrasound image data and displaying an ultrasound image, includes a system controller **11**, a power supply unit **12**, an ultrasound signal processor **30**, a display **50**, and an operation interface **60**. The ultrasound signal processor **30** includes a transmitter/receiver **31**, a beam former **32**, a signal processor **33**, and a display processor **34**. The ultrasound probe **40** is connected to the transmitter/receiver **31** via a cable **41**.

[0007] In FIG. **7**, power lines are illustrated by arrowed double lines, and signal lines for signals such as control signals are illustrated by arrowed single lines. Among the power lines, the portions to which power is being supplied are illustrated by bold lines, and the portions to which power is not being supplied are illustrated by thin lines. Further, among the components of the ultrasound diagnostic apparatus **1**D, except for the ultrasound imaging system **10** and the power button **15**, the components to which power is being supplied are illustrated by bold line frames, and the components to which power is not being supplied are illustrated by thin line frames. This applies to the other figures, too.

[0008] A plug of a power cable of the input connector **16** is connected to a power outlet of an external power source (commercial alternating-current (AC) power supply). Electric power of the external power source is supplied to the power controller **13**D via the input connector **16**. The power controller **13**D receives the AC power from the input connector **16**, converts the AC power to direct-current (DC) power and supplies the DC power to the power storage **14**A to charge it as well as to the power supply unit **12**. The power supply unit **12** supplies the power to each component of the ultrasound signal processor **30**.

[0009] The gel warmer **70**C heats gel by using the input AC power. The gel warmer **70**C includes a power cable and a plug to be connected to an outlet of an external power source. The input connector **16** and the gel warmer **70**C may be powered from the same outlet via a power strip that branches the power line. Thus, the gel warmer **70**C with the plug connected to an outlet does not stop heating until the plug is disconnected from the outlet or a switch is turned off.

[0010] Referring to FIG. **8**, the ultrasound diagnostic apparatus **1**E will be described as another typical example of a conventional ultrasound diagnostic apparatus. The ultrasound diagnostic apparatus **1**E includes a main body **100**E, an ultrasound probe **40**, and a gel warmer **70**C. The main body **100**E, which is a main part of the ultrasound diagnostic apparatus **1**E, includes an ultrasound imaging system **10**, a power controller **13**E, a power storage **14**A, a power button **15**, an input connector **16**, an output connector **17**C, a power distributor **19**E, and a switch **21**.

[0011] The power distributor **19**E receives power through the input connector **16** and distributes the power to the power controller **13**E and the switch **21**. The power controller **13**E receives the AC power from the power distributor **19**E, converts the AC power to DC power and supplies the DC power to the power storage **14**A to charge it as well as to the power supply unit **12**. Further, the power controller **13**E controls ON/OFF of the switch **21** according to a control signal from the system controller **11** or the power button **15** indicating that power is ON/OFF. The output connector **17**C is electrically connected to the switch **21**. For example, the output connector **17**C includes an outlet (socket) to which a plug of the gel warmer **70**C is connectable.

[0012] When the switch **21** is ON, the switch **21** supplies AC power from the power distributor **19**E to the gel warmer **70**C via the output connector **17**C. When the switch **21** is OFF, the switch **21** does not supply the AC power to the gel warmer **70**C via the output connector **17**C. That is, in response to the ultrasound diagnostic apparatus **1**E being turned on, the switch **21** is turned on accordingly to supply power to the gel warmer **70**C. In response to the ultrasound diagnostic apparatus **1**E being turned off, the switch **21** is turned off accordingly to stop supplying power to the gel warmer **70**C.

[0013] Since the ultrasound diagnostic apparatuses **1**D, **1**E include the respective power storages **14**A, the ultrasound diagnostic apparatuses **1**D, **1**E may sometimes be used by

being powered by the power storages **14**A in a place where there is no connection to an external power source. However, when the main bodies **100**D, **100**E are not connected to an external power source, no power is supplied to the gel warmer **70**C, and gel is not heated. To cope with the problem, an ultrasound diagnostic apparatus that supplies power to the gel warmer through a built-in USB (Universal Serial Bus) terminal has been known in the art (e.g. see JP 2011-83365A). The ultrasound diagnostic apparatus disclosed in JP **2011-83365**A controls the temperature of the gel warmer to a temperature set on an operation interface according to a control program.

[0014] Referring to FIG. **9**, the conventional ultrasound diagnostic apparatus **1**F that supplies power to a gel warmer through a USB terminal (USB connector) will be described. The ultrasound diagnostic apparatus **1**F includes a main body **100**F, an ultrasound probe **40**, and a gel warmer **70**F. The main body **100**F, which is a main part of the ultrasound diagnostic apparatus **1**F, includes an ultrasound imaging system **10**F, a power controller **13**D, a power storage **14**A, a power button **15**, an input connector **16** and a USB connector **17**F.

[0015] The ultrasound imaging system **10**F has the same configuration as the ultrasound imaging system **10** in FIG. **7** or FIG. **8** except that the system controller **11** is replaced with a system controller **11**F. In addition to the functions of the system controller **11**, the system controller **11**F, which is further connected to the USB connector **17**F, communicates with an external device that is connected to the USB connector **17**F as well as supplies power to the external device that is connected to the USB connector **17**F in the form of bus power of the USB interface. The gel warmer **70**F is configured to be connectable to the USB connector **17**F.

[0016] When a plug of a power cable from the input connector **16** is connected to an outlet so that power is supplied from an external power source (the arrowed double bold lines in FIG. **9**), the power controller **13**D receives AC power from the external power source, converts the AC power to DC power and supplies the DC power to the power supply unit **12** as well as to the power storage **14**A to charge it. The system controller **11**F supplies power from the power supply unit **12** to the gel warmer **70**F that is connected to the USB connector **17**F. The system controller **11**F also controls the temperature of the gel warmer **70**F through the USB connector **17**F.

[0017] When the plug of the power cable from the input connector **16** is not connected to an outlet so that no external power is supplied (the arrowed double thin lines in FIG. **9**), the power storage **14**A supplies stored power to the power controller **13**D. The power controller **13**D supplies the power from the power storage **14**A to the power supply unit **12**. The system controller **11**F supplies the power from the power supply unit **12** to the gel warmer **70**F that is connected to the USB connector **17**F. Further, the system controller **11**F controls the temperature of the gel warmer **70**F through the USB connector **17**F. Since it is not necessary to connect the gel warmer **70**F (ultrasound diagnostic apparatus **1**F) to an external power source, the burden thereof is eliminated

[0018] However, the gel warmer consumes a large amount of power. Accordingly, a problem with the conventional ultrasound diagnostic apparatus **1**F is that the operable time of the ultrasound diagnostic apparatus **1**F is extremely reduced in a mode where the power storage **14**A supplies power to the gel warmer **70**F.

SUMMARY

[0019] It is an object of the present invention to extend the operable time in a mode where stored power is supplied to a gel warmer.

[0020] To achieve at least one of the abovementioned objects, according to a first aspect of the present invention, an ultrasound diagnostic apparatus reflecting one aspect of the present invention comprises:

[0021] a power storage that stores electric power and that releases the stored power;

[0022] a first hardware processor that receives power and supplies the received power to a gel heater, in which the gel heater heats gel by the power; and

[0023] a second hardware processor that receives either power supplied from an external power source or the power released from the power storage and supplies the received power to the first hardware processor;

[0024] wherein when the first hardware processor receives the power released from the power storage, the first hardware processor shuts off or reduces power supply to the gel heater.

[0025] According to a second aspect of the present invention, an ultrasound diagnostic apparatus reflecting one aspect of the present invention comprises:

[0026] a power storage that stores electric power and releases the stored power;

[0027] a converter that receives AC power, converts the received AC power to DC power and supplies the converted DC power to a gel heater, in which the gel heater heats gel by the DC power;

[0028] a second hardware processor that receives power supplied from an external power source or the power released from the power storage and supplies the received power to a third hardware processor, in which the third hardware processor generates ultrasound image data from a reception signal obtained by an ultrasound probe for transmitting and receiving ultrasound to and from a subject; and

[0029] a power distributor that distributes AC power supplied from the external power source to the second hardware processor and the converter.

[0030] According to a third aspect of the present invention, an ultrasound diagnostic apparatus reflecting one aspect of the present invention comprises:

[0031] a second hardware processor that supplies power to a third hardware processor, in which the third hardware processor generates ultrasound image data from a reception signal obtained at an ultrasound probe for transmitting and receiving ultrasound to and from a subject;

[0032] an uninterruptible power supply that when receiving power, supplies the received power to the second hardware processor and stores the received power, and that when receiving no power, supplies the stored power to the second hardware processor; and

[0033] a power distributor that distributes power from an external power source to the uninterruptible power supply and a gel heater, in which the gel heater heats gel by the power.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinbelow and the appended drawings which are given by way of

illustration only, and thus are not intended as a definition of the limits of the present invention:

[0035] FIG. **1** is a block diagram illustrating the functional configuration of a first ultrasound diagnostic apparatus according to a first embodiment of the present invention when power is being supplied from an external power source;

[0036] FIG. **2** is a block diagram illustrating the functional configuration of the first ultrasound diagnostic apparatus when power is not being supplied from the external power source;

[0037] FIG. **3** is a block diagram illustrating the functional configuration of the first ultrasound diagnostic apparatus in a non-operating state;

[0038] FIG. **4** is a block diagram illustrating the functional configuration of a second ultrasound diagnostic apparatus according to a second embodiment when power is being supplied from an external power source;

[0039] FIG. **5** is a block diagram illustrating the functional configuration of the second ultrasound diagnostic apparatus in a non-operating state;

[0040] FIG. **6** is a block diagram illustrating the functional configuration of a third or fourth ultrasound diagnostic apparatus according to a third embodiment;

[0041] FIG. **7** is a block diagram illustrating the functional configuration of the fifth ultrasound diagnostic apparatus of the prior art;

[0042] FIG. **8** is a block diagram illustrating the functional configuration of the sixth ultrasound diagnostic apparatus of the prior art; and

[0043] FIG. **9** is a block diagram illustrating the functional configuration of the seventh ultrasound diagnostic apparatus of the prior art.

DETAILED DESCRIPTION OF EMBODIMENTS

[0044] Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

[0045] First to third embodiments of the present invention will be described one by one in detail referring to the drawings. However, the present invention is not limited to the illustrated examples.

First Embodiment

[0046] The first embodiment of the present invention will be described referring to FIG. **1** to FIG. **3**. First, the device configuration of this embodiment will be described referring to FIG. **1**. FIG. **1** is a block diagram illustrating the functional configuration of the ultrasound diagnostic apparatus **1**A according to the embodiment when power is being supplied from an external power source.

[0047] The ultrasound diagnostic apparatus **1**A of the embodiment is intended for use in a medical facility having an external power source (commercial power supply) such as a hospital. As illustrated in FIG. **1**, the ultrasound diagnostic apparatus **1**A includes a main body **100**A, an ultrasound probe **40**, and a gel warmer **70**A as a gel heater.

[0048] The ultrasound probe **40** transmits ultrasound (transmission ultrasound) to a subject (not illustrated) such as the live body of a patient and receives ultrasound (reception ultrasound) including reflected ultrasound reflected at the subject and scattered ultrasound. The main body **100**A is connected to an ultrasound probe **40** via a cable **41**. The main body **100**A sends an electric drive signal to the ultrasound probe **40** so as to cause the ultrasound probe **40** to transmit the transmission ultrasound toward the subject. Further, the main body **100**A visualizes the inside of the subject as an ultrasound image based on an electric reception signal that is generated by the ultrasound probe **40** according to the reception ultrasound from the subject received at the ultrasound probe **40**.

[0049] For example, transducers (not illustrated) of the ultrasound probe **40** are arranged in a one-dimensional array in the lateral direction (scanning direction). In the embodiment, for example, the ultrasound probe **40** includes **192** transducers. The transducers may be arranged in a two-dimensional array. The number of transducers may be suitably selected. Further, the ultrasound probe **40** may be of any of electrical scanning type and mechanical scanning type, and the scanning method may be any of linear scanning, sector scanning and convex scanning

[0050] The gel warmer **70**A heats gel by input DC power, which includes a power cable and a connector for connection to an output connector **17**A (described later). The gel warmer **70**A has a function of adjusting the gel heating power according to the amount of power input. In one or more embodiments, the ultrasound diagnostic apparatus is configured to include the gel warmer. However, the ultrasound diagnostic apparatus may be configured not to include the gel warmer.

[0051] The main body **100**A includes an ultrasound imaging system **10** (third hardware processor), a power controller **13**A (second hardware processor), a power storage **14**A, a power button **15**, an input connector **16**, an output connector **17**A, and a gel warmer controller **18** as a gel heating controller (first hardware processor). The ultrasound imaging system **10** includes a system controller **11**, a power supply unit **12**, an ultrasound signal processor **30**, a display **50** and an operation interface **60**. The ultrasound signal processor **30** includes a transmitter/receiver **31**, a beam former **32**, a signal processor **33** and a display processor **34**.

[0052] For example, the operation interface **60** includes a variety of switches, buttons, a track ball, a mouse and a keyboard for inputting a variety of commands such as an instruction to start examination of a subject, measurement conditions, subject information and the like. The operation interface **60** outputs operation information according to an operational input to the system controller **11**. In particular, when the operator (doctor, technician, etc.) puts the ultrasound diagnostic apparatus **1**A (ultrasound imaging system **10**) into a non-operating state (shutdown, hibernation, sleep), the operation interface **60** receives an operator input for putting the device into the non-operating state. The term "shutdown" refers to a state in which the power of the ultrasound diagnostic apparatus **1**A is off. The term "hibernation" refers to a dormant state upon which, i.e. before the power is turned off, data in a RAM (Random Access Memory) is evacuated to an auxiliary storage (not shown) such as an HDD (Hard Disk Drive), which enables resuming a halfway process by reading the data from the auxiliary storage when the device is activated again. The term "sleep" refers to a stand-by state with low power consumption in which power is supplied only to a RAM of the system controller **11** to retain currently working data in the RAM, which enables resuming a halfway process when the device again is activated again.

[0053] The transmitter/receiver **31** generates a drive signal according to a drive voltage (drive voltage value) from the system controller **11**, which is an electric signal corresponding to the drive voltage, and supplies the generated drive signal to the ultrasound probe **40** through the cable **41** so as to cause the ultrasound probe **40** to generate transmission ultrasound. The transmitter/receiver **31** thus functions as a transmitter. As a transmitter, for example, the transmitter/receiver **31** includes a clock generator circuit, a delay circuit, and a pulse generator circuit. The clock generator circuit generates a clock signal for determining the transmission timing and transmission frequency of the drive signal. The delay circuit sets a delay time of the drive signal with respect to each individual pathway corresponding to each transducer. The delay circuit delays transmission of the drive signal by the set delay time so as to focus a transmission beam of the transmission ultrasound. The pulse generator circuit generates a pulse signal as the drive signal at a predetermined frequency. For example, the transmitter/receiver **31** thus configured generates transmission ultrasound by driving a part of the transducers (e.g. 64 adjacent transducers of the 192 transducers) arranged in the ultrasound probe **40**. Then, the transmitter/receiver **31** shifts the active transducers in the lateral direction every time the transmitter/receiver **31** generates transmission ultrasound, so as to scan the subject. In this way, the ultrasound probe **40** transmits and receives ultrasound according to the drive signal from the transmitter/receiver **31**.

[0054] Under the control of the system controller **11**, the transmitter/receiver **31** also functions as a receiver that receives an electric reception signal from the ultrasound probe **40** through the cable **41**. The transmitter/receiver **31** outputs the reception signal of each of the transducers of the ultrasound probe **40**.

[0055] Under the control of the system controller **11**, the beam former **32** generates constructive interference sound ray data from the reception signals of the transducers input from the transmitter/receiver **31**. For example, the beam former **32** includes an amplifier, an analog-to-digital (A/D) converter circuit, and a delay and sum circuit. The amplifier amplifies the reception signals at a predetermined amplification factor with respect to each of individual pathways corresponding to the respective transducers. The A/D converter circuit converts the amplified reception signals by A/D conversion. The delay and sum circuits aligns the time phase of the A/D converted reception signals by adding a delay time with respect to each of the individual pathways corresponding to the respective transducers and sums (delays and sums) the aligned reception signals to generate the sound ray data.

[0056] Under the control of the system controller **11**, the signal processor **33** performs envelope demodulation and logarithmic amplification on the sound ray data input from the beam former **32** and further adjusts the dynamic range and the gain. The signal processor **33** then generates a B-mode (brightness-mode) image data by conversion to brightness. That is, the B-mode image data represents the intensity of the reception signals by brightness. In addition to the B-mode image data for B-mode diagnosis, the signal processor **33** can generate ultrasound image data of other imaging modes such as A (Amplitude) mode, M (Motion) mode, a pulse-Doppler imaging, and color Doppler imaging.

[0057] Further, the signal processor **33** includes an image memory (not illustrated) composed of a semiconductor memory such as a DRAM (Dynamic RAM). Under the control of the system controller **11**, the signal processor **33** stores the generated B-mode image data in the image memory on a frame basis and outputs the stored data as image data of each frame.

[0058] Under the control of the system controller **11**, the display processor **34** converts the frame image data input from the signal processor **33** to image signals by coordinate conversion or the like and outputs the image signals to the display **50**.

[0059] As the display **50**, display devices that can be used include an LCD (Liquid Crystal Display), an organic EL (Electro-Luminescence) display, an inorganic EL display, and a plasma display. Under the control of the system controller **11** via the ultrasound signal processor **30**, the display **50** displays an ultrasound image and the like on a display screen according to an image signal input from the display processor **34**.

[0060] For example, the system controller **11** includes a CPU (Central Processing Unit), a ROM (Read Only Memory), and a RAM. The system controller **11** reads a variety of processing programs such as a system program stored in the ROM, develops the read program on the RAM and controls the components of the ultrasound diagnostic apparatus **1**A according to the developed program. The ROM, which is constituted by a semiconductor non-volatile memory or the like, stores the system program for the ultrasound diagnostic apparatus **1**A, a variety of processing programs executable on the system program and a variety of data such as a gamma table. These programs are stored in the form of program computer-readable program codes, and the CPU sequentially executes operations according to the program codes. The RAM, which is a volatile memory, provides a working area for temporarily storing a variety of programs executed by the CPU and data relating to the programs.

[0061] The power supply unit **12** supplies power to the system controller **11**, the ultrasound signal processor **30**, the display **50**, and the operation interface **60**. In particular, when in a sleep mode, the power supply unit **12** supplies power to the RAM of the system controller **11** and the power button **15** according to an instruction of the power controller **13**A. The power supply unit **12** may be constituted by a regulator (DC-DC converter, series regulator). Alternatively, the regulator may be constituted by a circuit of discreet components, or an IC or a circuit module.

[0062] The power controller **13**A receives power from an external power source (input connector **16**) or the power storage **14**A. The power controller **13**A performs: supplying the power to the power supply unit **12**, the power storage **14**A and the gel warmer controller **18**; waiting for the power button **15** to be pressed; notifying the system controller **11** of information indicating that the power button **15** has been pressed; putting the ultrasound diagnostic apparatus **1**A (ultrasound imaging system **10**) to a non-operating state according to the system controller **11**; executing an activation process; and controlling the gel warmer controller **18**. Further, the power controller **13**A has a function of converting the AC power from the external power source into DC power. The power controller **13**A may have any configuration depending on the complexity of control, which can be constituted by a digital circuit, a small CPU such as a microcomputer, an IC (Integrated Circuit) exclusively for power control or the like.

[0063] For example, the power storage **14**A, which includes a secondary cell (battery) such as a lithium-ion cell embedded in the main body **100**A, is capable of storing the DC power from the power controller **13**A (charge) and releasing the DC power to the power controller **13**A (discharge). Alternatively, the power storage **14**A may be of different type such as a capacitor.

[0064] The power button **15**, which is disposed on the surface of the main body **100**A, receives an operator input of pressing down the button as an operation to turn on/off the power and outputs a corresponding operation signal to the power controller **13**A. Operations that the power button **15** receives include an activating operation after the ultrasound diagnostic apparatus **1**A is put into a non-operating state and a shutdown operation when the ultrasound diagnostic apparatus **1**A is active (in operation).

[0065] The input connector **16**, which is disposed on the surface of the main body **100**A and electrically connected to the power controller **13**A, is provided to be electrically connected to a power cable of a plug that is connected to an external power source (outlet of a commercial power supply). The power of the external power source is supplied to the power controller **13**A through the input connector **16**. The output connector **17**A, which is disposed on the surface of the main body **100**A and electrically connected to the gel warmer controller **18**, is provided to be connected to a connector of the gel warmer **70**A.

[0066] The gel warmer controller **18**, which is electrically connected to the output connector **17**A, allows, stops or reduces supply of the power from the power controller **13**A to the gel warmer **70**A through the output connector **17**A under the control of the power controller **13**A. The gel warmer controller **18** includes a built-in timer and can measure a predetermined period of time by using the timer. With this, the gel warmer controller **18** can supply power to the gel warmer **70**A for the predetermined period of time. Specifically, the timer may be constituted by a digital circuit such as a microcomputer or by an analog circuit that measures the release time of charges accumulated in a capacitor or the like.

[0067] Regarding the components of the ultrasound diagnostic apparatus **1**A, the functions of part or all of the functional blocks thereof can be achieved by a hardware circuit such as an integrated circuit. For example, the integrated circuit is an LSI (Large Scale Integration). Depending on the degree of integration, an LSI may also be referred to as an IC (Integrated Circuit), a system LSI, a super LSI, or an ultra LSI. The integrated circuit may be achieved not by an LSI but by a dedicated circuit or a general-purpose processor. An FPGA (Field Programmable Gate Array) or a reconfigurable processor that is reconfigurable in terms of connections and settings of circuit cells in an LSI may also be used. Alternatively, the functions of part or all of the functional blocks can be achieved by a software. In this case, the software is stored in at least one of a storage media such as a ROM, an optical disk, or a hard disk, and the software is executed by an arithmetic processor.

[0068] Next, the operation of the ultrasound diagnostic apparatus **1**A will be described referring to FIG. **1** to FIG. **3**. FIG. **2** is a block diagram illustrating the functional configuration of the ultrasound diagnostic apparatus **1**A when power is not being supplied from the external power source. FIG. **3** is a block diagram illustrating the functional configuration of the ultrasound diagnostic apparatus **1**A in a non-operating state.

[0069] First, the operation of the ultrasound diagnostic apparatus **1**A when power is being supplied from the external power source will be described referring to FIG. **1**. In the illustrated example, the ultrasound diagnostic apparatus **1**A is in an operating state (a state that is not any non-operating state, i.e. a state when the power is on).

[0070] AC power of the external power source is supplied to the power controller **13**A through the input connector **16**. The power controller **13**A detects supply of the power from the external power source. In response to the detection, the power controller **13**A switches the power supply to the external power source. At the same time, the power controller **13**A generates a control signal indicating that power is being supplied from the external power source, and outputs the generated signal to the gel warmer controller **18**. Further, the power controller **13**A converts the input AC power of the external power source to DC power and supplies the converted DC power to the power supply unit **12**, the power storage **14**A and the gel warmer controller **18**.

[0071] The power supply unit **12** supplies the DC power from the power controller **13**A to the components of the ultrasound imaging system **10**. The power storage **14**A is charged by the DC power supplied from the power controller **13**A. According to the control signal from the power controller **13**A, the gel warmer controller **18** supplies the DC power from the power controller **13**A to the gel warmer **70**A through the gel warmer controller **18** itself and the output connector **17**A.

[0072] Next, the operation of the ultrasound diagnostic apparatus **1**A when no power is being supplied from the external power source as illustrated in FIG. **2** will be described. For example, such situation occurs when the power plug of the input connector **16** of the ultrasound diagnostic apparatus **1**A is temporarily disconnected from an outlet for moving the ultrasound diagnostic apparatus **1**A. When power supply from the external power source is lost, the power controller **13**A of the ultrasound diagnostic apparatus **1**A detects absence of power supply from the external power source. In response to the detection, the power controller **13**A switches the power supply to the power storage **14**A. At the same time, the power controller **13**A generates a control signal indicating that power is being supplied from the power storage **14**A, and outputs the generated signal to the gel warmer controller **18**. Further, the power controller **13**A supplies the DC power (released) from the power storage **14**A to the power supply unit **12** and the gel warmer controller **18**.

[0073] According to the control signal from the power controller **13**A, the gel warmer controller **18** supplies the DC power from the power storage **14**A to the gel warmer **70**A through the gel warmer controller **18** itself and the output connector **17**A for a predetermined period of time by measuring the predetermined period of time with a timer. After the elapse of the predetermined period of time, the power controller **13**A controls the gel warmer controller **18** to shut off the DC power at the gel warmer controller **18** (to stop the power supply to the gel warmer **70**A) or to reduce the amount (voltage or current) of DC power to be supplied to the gel warmer **70**A.

[0074] In this way, even after the external power source is temporarily lost, the gel warmer **70**A continues heating for

the predetermined period of time so that the gel does not get cold. After the elapse of the predetermined period of time, the heating by the gel warmer **70**A is stopped or reduced in order to prevent or reduce discharge of the power storage **14**A.

[0075] Next, the operation of the ultrasound diagnostic apparatus **1**A in a non-operating state will be described referring to FIG. **3**. As illustrated in FIG. **3**, in the situation where power is supplied from the external power source while the ultrasound diagnostic apparatus **1**A is in operation, the power controller **13**A converts the AC power from the external power source to DC power and supplies the DC power to the power supply unit **12**, the power storage **14**A and the gel warmer controller **18** so as to charge the power storage **14**A. Then, when an operator inputs an instruction to put the ultrasound diagnostic apparatus **1**A (ultrasound imaging system **10**) into an non-operating state (shutdown, hibernation or sleep) on the operation interface **60** or the power button **15**, the system controller **11** outputs information on the designated non-operating state to the power controller **13**A and puts the ultrasound imaging system **10** into the non-operating state.

[0076] According to the information on the non-operating state, the power controller **13**A generates a control signal indicating that power is being supplied from an external power source and that the ultrasound imaging system **10** is in the non-operating state, and outputs the generated signal to the gel warmer controller **18**. Further, the power controller **13**A converts the AC power from the external power source to DC power and supplies the DC power to the power storage **14**A (and to the power supply unit **12** when in a sleep mode) to charge the power storage **14**A. In the sleep mode, the power supply unit **12** supplies DC power to the RAM of the system controller **11**. In the case where the input control signal indicates shutdown, the gel warmer controller **18** stops supplying DC power to the gel warmer **70**A, for example, because the ultrasound imaging system **10** will not perhaps be activated for a while. In the case where the input control signal indicates hibernation, the gel warmer controller **18** reduces supply of DC power to the gel warmer **70**A (by reducing the voltage or the current), for example, because the ultrasound diagnostic apparatus **1**A and the gel will probably be used. In the case where the input control signal indicates sleep, the gel warmer controller **18** continues supplying DC power to the gel warmer **70**A without shutting off or reducing the DC power, for example, because the ultrasound diagnostic apparatus **1**A and the gel will be used soon.

[0077] Then, when power supply from an external power source is lost while the ultrasound diagnostic apparatus **1**A is in the non-operating state, the power controller **13**A supplies the DC power from the power storage **14**A to the gel warmer controller **18** according to the information on the designated non-operating state. In the sleep mode, the power controller **13**A supplies the DC power to the power supply unit **12**. Then, in the sleep mode, the power supply unit **12** supplies the DC power to the RAM of the system controller **11**.

[0078] Further, according to the information on the designated non-operating state, the power controller **13**A generates a control signal indicating that power is being supplied from the power storage **14**A and that the ultrasound imaging system **10** is in the non-operating state, and outputs the generated signal to the gel warmer controller **18**. Then, as in the situation where power is being supplied from an external power source, the gel warmer controller **18** allows or shuts off or reduces supply of the DC power to the gel warmer **70**A according to the level or type of the non-operating state (shutdown, hibernation or sleep) specified by the control signal.

[0079] According to the embodiment, the ultrasound diagnostic apparatus **1**A includes: the power storage **14**A that stores power and releases the stored power; the gel warmer controller **18** that supplies input power to the gel warmer **70**A that electrically heats the gel; and the power controller **13**A that receives power from an external power source or the power storage **14**A and outputs the received power to the gel warmer controller **18**. When receiving the power that is released from the power storage **14**A, the gel warmer controller **18** shuts off or reduces power supply to the gel warmer **70**A.

[0080] That is, the power consumption of the gel warmer **70**A is eliminated or reduced when the power stored in the power storage **14**A is supplied to the gel warmer **70**A. Therefore, it is possible to extend the operable time of the ultrasound diagnostic apparatus **1**A.

[0081] When receiving the power released from the power storage **14**A while no power is supplied from an external power source, the power controller **13**A shuts off or reduces power supply to the gel warmer controller **18**. That is, in the situation where the power stored in the power storage **14**A is supplied to the gel warmer **70**A while no power is supplied from an external power source, the power consumption of the gel warmer **70**A is eliminated or reduced. Therefore, it is possible to extend the operable time of the ultrasound diagnostic apparatus **1**A.

[0082] The gel warmer **70**A is configured to be able to change the heating power of the gel according to the amount of power input. When receiving the power from the power storage **14**A, the gel warmer controller **18** reduces the amount of power to be supplied to the gel warmer **70**A. Therefore, it is possible to save power consumption while weakly heating the gel so that the gel does not completely get cold.

[0083] The gel warmer controller **18** shuts off or reduces power supply to the gel warmer **70**A after the elapse of the predetermined time since power supply from an external power source is lost. Therefore, it is possible to save power while heating the gel for the predetermined period of time so that the gel does not get cold.

[0084] The power controller **13**A outputs to the gel warmer controller **18** a control signal indicating whether power is being supplied from an external power source or the power storage **14**A. According to the control signal, the gel warmer controller **18** shuts off or reduces power supply to the gel warmer **70**A when receiving power from the power storage **14**A. Therefore, it is possible to readily switch the power supply to the gel warmer **70**A between allowed and shut-off or reduced according to the power supplying state specified by the control signal.

[0085] The ultrasound diagnostic apparatus **1**A includes the ultrasound imaging system **10** that generates ultrasound image data from signals received from the ultrasound probe **40** that transmits and receives ultrasound to and from a subject. When the ultrasound imaging system **10** is in a non-operating state, the gel warmer controller **18** allows or shuts off or reduces power supply to the gel warmer **70**A according to the level or type of the non-operating state.

Therefore, when the ultrasound imaging system **10** is in a non-operating state, it is possible to reduce power supply to the gel warmer **70**A in harmony with the non-operating state. By stopping or reducing power supply to the gel warmer **70**A when in a non-operating state, it is possible to reduce evaporation of the gel as well as discharge of the power storage **14**A.

[0086] The non-operating state is shutdown, hibernation or sleep. When in a non-operating state that is shutdown, it is possible to reduce evaporation of the gel and discharge of the power storage **14**A, for example, by stopping power supply to the gel warmer **70**A. When in a non-operating state that is hibernation, it is possible to weakly heat the gel, for example, by reducing power supply to the gel warmer **70**A. When in a non-operating state that is sleep, it is possible to keep the gel ready to use as well as the ultrasound imaging system **10**, for example, by continuing power supply to the gel warmer **70**A.

[0087] The power storage **14**A includes a battery. Therefore, it is possible to suitably store and release electric power.

Second Embodiment

[0088] A second embodiment of the present invention will be described referring to FIG. **4** and FIG. **5**. FIG. **4** is a block diagram illustrating the functional configuration of an ultrasound diagnostic apparatus **1**B according to this embodiment when power is being supplied from an external power source. FIG. **5** is a block diagram illustrating the functional configuration of the ultrasound diagnostic apparatus **1**B in a non-operating state.

[0089] In this embodiment, the ultrasound diagnostic apparatus **1**B has the configuration as illustrated in FIG. **4**. In the ultrasound diagnostic apparatus **1**B, the same components as those in the ultrasound diagnostic apparatus **1**A of the first embodiment are denoted by the same reference signs, and the description thereof is omitted.

[0090] As illustrated in FIG. **4**, the ultrasound diagnostic apparatus **1**B includes a main body **100**B, an ultrasound probe **40**, and a gel warmer **70**A. The main body **100**B includes an ultrasound imaging system **10** (third hardware processor), a power controller **13**B (second hardware processor), a power storage **14**A, a power button **15**, an input connector **16**, an output connector **17**A, a power distributor **19**B, an AC-DC converter **20** as a power converter.

[0091] The power controller **13**B receives power from an external power source (input connector **16**) or the power storage **14**A. The power controller **13**B performs: supplying the power to the power supply unit **12**, and the power storage **14**A; waiting for the power button **15** to be pressed; notifying the system controller **11** of information indicating that the power button **15** has been pressed; putting the ultrasound diagnostic apparatus **1**B into a non-operating state according to the system controller **11**; executing an activation process; and controlling the AC-DC converter **20**. Further, the power controller **13**B has a function of converting AC power from the external power source to DC power.

[0092] The power distributor **19**B receives power from the external power source through the input connector **16** and distributes the power to the power controller **13**B and AC-DC converter **20**. The AC-DC converter **20** is a circuit that receives the AC power from the external power source through the power distributor **19**B, converts the AC power to DC power and outputs the DC power to the output connector **17**A.

[0093] Next, the operation of the ultrasound diagnostic apparatus **1**B will be described referring to FIG. **4** and FIG. **5**. First, the operation of the ultrasound diagnostic apparatus **1**B when power is being supplied from the external power source will be described referring to FIG. **4**.

[0094] In the example illustrated in FIG. **4**, the ultrasound diagnostic apparatus **1**B is in operation. The AC power from the external power source is supplied to the power controller **13**B and the AC-DC converter **20** through the input connector **16** and the power distributor **19**B. The power controller **13**B detects power supply from the external power source. If there is power supply from the external power supply, the power controller **13**B switches the power supply to the external power source. At the same time, the power controller **13**B converts the DC power from the external power source to AC power and supplies the DC power to the power supply unit **12** and the power storage **14**A.

[0095] The AC-DC converter **20** converts the AC power from the external power source to DC power and supplies the DC power to the gel warmer **70**A through the output connector **17**A.

[0096] As with the ultrasound diagnostic apparatus **1**A according to the first embodiment, when the power supply from the external power source is lost, the power controller **13**B of the ultrasound diagnostic apparatus **1**B supplies DC power from the power storage **14**B to the power supply unit **12**. Further, since the power supply from an external power source is lost, no power is supplied to the AC-DC converter **20**, and no power is supplied to the gel warmer **70**A accordingly. Therefore, the gel is not heated.

[0097] Next, the operation of the ultrasound diagnostic apparatus **1**B in a non-operating state will be described referring to FIG. **5**. As illustrated in FIG. **5**, in the situation where power is supplied from the external power source to the ultrasound diagnostic apparatus **1**B, the AC power of the external power source is supplied to the power controller **13**B through the input connector **16** and the power distributor **19**B. The power controller **13**B converts the AC power from the external power source to DC power and supplies the DC power to the power supply unit **12** and the power storage **14**A to charge the power storage **14**A. Then, in response to the operator inputting an instruction to put the ultrasound diagnostic apparatus **1**B (ultrasound imaging system **10**) into a non-operating state on the operation interface **60** or the power button **15**, the system controller **11** outputs information on the designated non-operating state to the power controller **13**B and puts the ultrasound imaging system **10** into the non-operating state.

[0098] In response to receiving the information on the non-operating state, the power controller **13**B detects power supply from the external power source. If there is power supply from the external power supply, the power controller **13**B generates a control signal indicating that power is being supplied from the external power source and that the apparatus is in the non-operating state, and outputs the control signal to the AC-DC converter **20**. According to the control signal, the AC-DC converter **20** shuts off supply of the DC power, which is converted from the AC power from the external power source through the input connector **16** and

the power distributor **19**B, to the gel warmer **70**A through the output connector **17**A. As a result, the gel is not heated by the gel warmer **70**A.

[0099] When power supply from the external power source is lost while the ultrasound diagnostic apparatus **1**B is in a non-operating state, the power controller **13**B supplies DC power from the power storage **14**A to the power supply unit **12**. Further, since the power supply from the external power source is lost, no power is supplied to the AC-DC converter **20**, and no power is supplied to the gel warmer **70**A accordingly. As a result, the gel is not heated by the gel warmer **70**A.

[0100] According to the embodiment, the ultrasound diagnostic apparatus **1**B includes: the power storage **14**A that stores power and releases the stored power; the AC-DC converter **20** that outputs converted DC power to the gel warmer **70**A that heats the gel by using the DC power; the power controller **13**B that outputs power from an external power source or power from the power storage **14**A to the ultrasound imaging system **10**; and the power distributor **19**B that distributes the AC power from the external power source to the power controller **13**B and the AC-DC converter **20**.

[0101] In this configuration, when power is being supplied from the power storage **14**A to the power controller **13**B, the power consumption of the gel warmer **70**A is eliminated Therefore, it is possible to extend the operable time of the ultrasound diagnostic apparatus **1**B.

[0102] When the ultrasound imaging system **10** is in a non-operating state, the power controller **13**B causes the AC-DC converter **20** to shut off power supply to the gel warmer **70**A. When the ultrasound imaging system **10** is in a non-operating state, it is possible to control power supply to the gel warmer **70**A in harmony with the non-operating state. By stopping the power supply to the gel warmer **70**A when in a non-operating state, it is possible to reduce evaporation of the gel as well as power consumption.

Third Embodiment

[0103] A third embodiment of the present invention will be described referring to FIG. **6**. FIG. **6** is a block diagram illustrating the functional configuration of an ultrasound diagnostic apparatus **1C1** or **1C2** according to the embodiment.

[0104] In this embodiment, the ultrasound diagnostic apparatus **1C1** or **1C2** has the configuration as illustrated in FIG. **6**. In the ultrasound diagnostic apparatus **1C1** or **1C2**, the same components as those in the ultrasound diagnostic apparatus **1**A of the first embodiment are denoted by the same reference signs, and the description thereof is omitted.

[0105] As illustrated by the solid lines and the dotted lines in FIG. **6**, the ultrasound diagnostic apparatus **1C1** includes a main body **100C1**, an ultrasound probe **40**, and a gel warmer **70**C. The main body **100C1** includes an ultrasound imaging system **10** (third hardware processor), a power controller **13**C (second hardware processor), a power storage **14**C, a power button **15**, an input connector **16**, an output connector **17**C, and a power distributor **19**C.

[0106] The power distributor **19**C receives power from an external power source through the input connector **16** and distributes the power to the power storage **14**C and the output connector **17**A. The output connector **17**C is disposed on the surface of the main body **100C1**. The output connector **17**C is electrically connected to the power distributor **19**C and includes an outlet to which a power plug of the gel warmer **70**C is connected.

[0107] The power storage **14**C is constituted by an uninterruptible power supply (UPS), which is equipped with a power storage unit for storing power such as a secondary battery (cell). The power storage **14**C is capable of supplying power at a predetermined output level for a certain period of time after power supply from the external power source is lost. That is, as well as receiving power from the external power source through the power distributor **19**C and supplying the power to the power controller **13**C, the power storage **14**C also supplies DC power from the power storage unit to the power controller **13**C when the power plug of the ultrasound diagnostic apparatus **1C1** is temporarily disconnected from an outlet of the external power source so that AC power is not supplied from the external power source through the power distributor **19**C.

[0108] The power controller **13**C receives power from the power storage **14**C. The power controller **13** performs: supplying the power to the power supply unit **12**; waiting for the power button **15** to be pressed; notifying the system controller **11** of information indicating that the power button **15** has been pressed; putting the ultrasound diagnostic apparatus **1**C into a non-operating state according to the system controller **11**; and executing an activation process. Further, the power controller **13** C has a function of converting AC power from the power storage **14**C to DC power.

[0109] As an alternative configuration from that of the ultrasound diagnostic apparatus **1C1**, the ultrasound diagnostic apparatus **1C2** as illustrated by the solid line in FIG. **6** may be provided instead. The ultrasound diagnostic apparatus **1C2** includes a main body **100C2**, an ultrasound probe **40**, a power storage **14**C, an input connector **16**, an output connector **17**C, a power distributor **19**C, and a gel warmer **70**C. The main body **100C2** includes an ultrasound imaging system **10**, a power controller **13**C, and a power button **15**. In the ultrasound diagnostic apparatus **1C2**, the power storage **14**, the input connector **16**, the output connector **17**C, the power distributor **19**C and the gel warmer **70**C are configured as separate components from the main body **100C2**. For example, these components are disposed on a seat (cart) for mounting the main body **100C2** and the like.

[0110] Next, the operation of the ultrasound diagnostic apparatus **1C1** will be described referring to FIG. **6**. First, the operation of the ultrasound diagnostic apparatus **1C1** when power is being supplied from an external power source will be described.

[0111] In the example illustrated in FIG. **6**, the ultrasound diagnostic apparatus **1C1** is in operation. AC power of the external power source is supplied to the power storage **14**C and the output connector **17**A through the input connector **16** and the power distributor **19**C. The gel warmer **70**A heats gel by being supplied with AC power from the external power source through the output connector **17**A.

[0112] The power storage **14**C receives AC power of the external power source from the power distributor **19**C and supplies the AC power to the power controller **13**C. The power controller **13**C converts the supplied AC power of the external power source to DC power and supplies the DC power to the power supply unit **12**.

[0113] When the power supply from the external power source is lost in the ultrasound diagnostic apparatus **1C1**, the power storage **14**C supplies DC power from the power

storage unit to the power controller **13**C. The power controller **13**C supplies the DC power from the power storage **14**C to the power supply unit **12**. Since no power is supplied to the gel warmer **70**C, the gel is not heated.

[0114] The operation of the ultrasound diagnostic apparatus **1C2** is the same as that of the above-described ultrasound diagnostic apparatus **1C1**.

[0115] According to the embodiment, the ultrasound diagnostic apparatus **1C1** or **1C2** includes: the power controller **13**C that supplies power to the ultrasound imaging system **10**; the power storage **14**C that, when receiving power, outputs the received power to the power controller **13**C and stores the power and that, when receiving no power, outputs the stored power to the power controller **13**C; and the power distributor **19**C that distributes power from the external power source to the power storage **14**C and the gel warmer **70**C for electrically heating the gel.

[0116] In this configuration, when the power stored in the power storage **14**C is supplied to the power controller **13**C, the power consumption of the gel warmer **70**C can be eliminated Therefore, it is possible to extend the operable time of the ultrasound diagnostic apparatus **1C1** or **1C2**.

[0117] The ultrasound diagnostic apparatus **1C2** includes the main body **100C2** that includes the power controller **13**C. Further, the power storage **14**C and the power distributor **19**C are disposed outside the main body **100C2**. Therefore, it is possible reduce the size of the main body **100C2**.

[0118] The above description for the embodiments merely illustrate suitable examples of ultrasound diagnostic apparatuses according to the present invention, and the present invention is not limited thereto. For example, at least two of the configurations of the above-described embodiments may be combined.

[0119] Further, suitable changes can be made in detailed configurations and detailed operations of the components of the above-described ultrasound diagnostic apparatuses **1A**, **1B**, **1C1**, **1C2** according to the embodiments without departing from the features of the present invention.

[0120] Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims

[0121] The entire disclosure of Japanese patent Application No.2018-195497, filed on 17 Oct. 2018, is incorporated herein by reference in its entirety.

What is claimed is:

1. An ultrasound diagnostic apparatus, comprising:

a power storage that stores electric power and that releases the stored power;

a first hardware processor that receives power and supplies the received power to a gel heater, in which the gel heater heats gel by the power; and

a second hardware processor that receives either power supplied from an external power source or the power released from the power storage and supplies the received power to the first hardware processor;

wherein when the first hardware processor receives the power released from the power storage, the first hardware processor shuts off or reduces power supply to the gel heater.

2. The ultrasound diagnostic apparatus according to claim **1**, wherein when no power is supplied from the external power source and the second hardware processor receives the power released from the power storage, the second hardware processor shuts off or reduces the power supply to the gel heater.

3. The ultrasound diagnostic apparatus according to claim **1**,

wherein the gel heater is capable of changing a heating power of the gel according to an amount of power received, and

wherein when the first hardware processor receives the power released from the power storage, the first hardware processor reduces an amount of power supplying to the gel heater.

4. The ultrasound diagnostic apparatus according to claim **1**, wherein the first hardware processor shuts off or reduces the power supply to the gel heater after elapse of a predetermined period of time since power supply from the external power source is lost.

5. The ultrasound diagnostic apparatus according to claim **1**,

wherein the second hardware processor outputs a control signal to the first hardware processor, the control signal indicating a power supply status of whether power is supplied from the external power source or from the power storage, and

wherein when the first hardware processor receives the power released from the power storage, the first hardware processor shuts off or reduces power supply to the gel heater according to the power supply status indicated by the control signal.

6. The ultrasound diagnostic apparatus according to claim **1**, further comprising:

a third hardware processor that generates ultrasound image data from a reception signal obtained by an ultrasound probe for transmitting and receiving ultrasound to and from a subject,

wherein when the third hardware processor is in an non-operating state, the first hardware processor allows, shuts off or reduces the power supply to the gel heater according to the non-operating state.

7. An ultrasound diagnostic apparatus, comprising:

a power storage that stores electric power and releases the stored power;

a converter that receives AC power, converts the received AC power to DC power and supplies the converted DC power to a gel heater, in which the gel heater heats gel by the DC power;

a second hardware processor that receives power supplied from an external power source or the power released from the power storage and supplies the received power to a third hardware processor, in which the third hardware processor generates ultrasound image data from a reception signal obtained by an ultrasound probe for transmitting and receiving ultrasound to and from a subject; and

a power distributor that distributes AC power supplied from the external power source to the second hardware processor and the converter.

8. The ultrasound diagnostic apparatus according to claim **7**, wherein when the third hardware processor is in an non-operating state, the second hardware processor causes the converter to shut off power supply to the gel heater.

9. The ultrasound diagnostic apparatus according to claim **6**, wherein the non-operating state is any one of shutdown, hibernation and sleep.

10. The ultrasound diagnostic apparatus according to claim **8**, wherein the non-operating state is any one of shutdown, hibernation and sleep.

11. The ultrasound diagnostic apparatus according to claim **1**, wherein the power storage comprises a battery.

12. The ultrasound diagnostic apparatus according to claim **7**, wherein the power storage comprises a battery.

13. An ultrasound diagnostic apparatus, comprising:

a second hardware processor that supplies power to a third hardware processor, in which the third hardware processor generates ultrasound image data from a reception signal obtained at an ultrasound probe for transmitting and receiving ultrasound to and from a subject;

an uninterruptible power supply that when receiving power, supplies the received power to the second hardware processor and stores the received power, and that when receiving no power, supplies the stored power to the second hardware processor; and

a power distributor that distributes power from an external power source to the uninterruptible power supply and a gel heater, in which the gel heater heats gel by the power.

14. The ultrasound diagnostic apparatus according to claim **13**, further comprising: a main body that comprises the second hardware processor,

wherein the uninterruptible power supply and the power distributor are disposed outside the main body.

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摘要(译)

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