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(54) **ELECTRONIC EQUIPMENT AND METHOD OF CONTROLLING THE SAME**

ELEKTRONISCHE EINRICHTUNG UND VERFAHREN ZU IHRER STEUERUNG

Dispositif électronique et procédé de contrôle pour ce dispositif

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Description

Technical Field

[0001] The present invention relates to an electronic device and control method for the electronic device, and particularly relates to an electronic device wherein the operating modes of the electronic device can be switched between a drive mode and an power saving mode, and a control method for the electronic device.

Background Art

[0002] An example of an electronic device of recent years is the electronic wristwatch. These wristwatches contain power supply means, the power supply means including a power generating device having a rotating weight, and storage means (high-capacity capacitor) for storing electrical energy generated by the power generating device. This type of electronic timepiece is capable of operating as a watch for long periods of time without battery replacement because the time display is performed by supplying electrical energy released from the capacitor to the time display unit.

[0003] In this way, electronic timepieces having power generating devices supply stable electrical energy for long periods of time. Thus, when the power generating device has been in a non-generating state for a predetermined period of time or when the electronic timepiece is put on the user, the condition is detected, and the operating mode of the electronic timepiece is switched from an active mode (display mode) in which time display is performed to a power saving mode in which time display is not performed.

[0004] Here, in the power saving mode of the electronic timepiece, time display is not performed, and electrical energy is supplied only to a control circuit for keeping track of the current time. On the other hand, in the display mode (active mode) in which the normal time display is performed, not only is electrical energy supplied to the control circuit, but for example in the case of an analog watch, electrical energy is also supplied to the drive circuit for moving the hands.

[0005] When a user puts an electronic timepiece in power-saving mode onto the wrist and power generation commences, a switch is made from the power-saving mode to the display mode, and in the time display unit, the display is restored to the current time based on the data stored in the counter. For example, in an analog watch using hands, the hands are sped forward to restore it to the current time.

[0006] However, when an electronic timepiece continues to be in the power-saving (non-generating period) for a long time, the electrical energy stored in the high-capacity capacitor is gradually consumed. For this reason, when there is very little electrical energy in the high-capacity capacitor, restoration to the current time becomes impossible. Additionally, in this case, a lot of time is required to accumulate enough electrical energy to reactivate the time display unit itself, so that there is a risk of the activating ability of the electronic timepiece becoming poor.

[0007] EP 0855633 discloses an electronic watch provided with an electric power generator for generating electric energy using external energy, an electric power charger for charging the electric energy generated by the electric power generator, a watch driving system comprising a watch driving circuit and a time display sub-system, operated by electric energy supplied by the electric power charger, a stored electric power detector for detecting an amount of electric energy charged in the electric power charger, and a controller. Operation of at least the time display sub-system of the watch driving system is suspended when the amount of electric energy stored as detected by the stored electric power detector falls below a preset standard value, and thereafter, operation of the suspended portion of the watch driving system is resumed upon detecting conditions for reactivation, such operation being continued at least for a period when preset conditions are met. Thus, when the electronic watch is put to use again after it is left unused for a long time, the watch driving system does not come to a stop immediately after resumption of operation of time display, ensuring stable display of time.

[0008] GB 2037025 discloses an analog electronic timepiece comprising an oscillator circuit which produces a standard time signal. A frequency divider circuit frequency divides the standard time signal. A driving circuit produces a driving signal from the output signal of the divider circuit and drives a stepping motor, which itself drives time indicating hands. A touch sensitive switch produces a signal indicative that the electronic timepiece is not being worn and causes an AND gate to block the driving signal so as to render the stepping motor inoperative. A time counting circuit determines the period for which the stepping motor is rendered inoperative and when the timepiece is worn again setting to the correct time is automatically effected, the time indication being advanced at a rapid rate to compensate for the period for which the stepping motor was rendered inoperative.

[0009] The present invention has been made in consideration of the above-described situation, and offers an electronic device and control method for the electronic device wherein, when there is not enough electrical energy to return to the current time in the power supply means during the power-saving mode, the consumption of electrical energy is reduced to preserve the electrical energy of the power supply means, thus enabling the driven means to be quickly reactivated.

Disclosure of the Invention

[0010] According to a first aspect of the present invention, there is provided an electronic device comprising:

a chargeable power supply portion for supplying electrical energy;
a drive control portion operated by the electrical energy supplied from said power supply portion, configured to output a drive signal;
a driven portion driven by said drive signal;
a mode switching portion configured to switch the operating mode of said driven portion between a drive mode for normal operation and a power-saving mode based on a preset first condition; and characterized by
an operation suspending portion configured to suspend operation of said drive control portion when the amount of electrical energy stored in said power supply portion is determined to be smaller than a predetermined electrical energy amount based on a preset second condition while in a power-saving mode due to said mode switching portion.

[0011] According to a second aspect of the present invention, there is provided a control method for an electronic device comprising:

a chargeable power supply unit for supplying electrical energy;
a drive control unit operated by the electrical energy supplied by said power supply unit, for outputting a drive signal; and
a driven unit driven by receiving the drive signal outputted from said drive control unit;
the control method comprising:

a mode switching step of switching an operating mode of said driven unit between a drive mode and a power-saving mode based on a preset first condition; and characterized by
a drive suspending step of suspending operation of said drive control unit when the amount of electrical energy stored in said power supply unit is determined to be smaller than a predetermined amount of electrical energy according to a preset second condition, while the operation mode is set to the power-saving mode by said mode switching step.

Brief Description of the Drawings

[0012]

Fig. 1 is a diagram showing the schematic structure of an electronic timepiece according to an embodiment of the present invention.
Fig. 2 is a functional block diagram showing a control circuit and peripheral structures according to the same embodiment.
Fig. 3 is a circuit diagram showing the specifics of a power generation state detecting portion.
Fig. 4 is an operational flow chart of an embodiment.
Fig. 5 is a block diagram showing the structure of a power supply peripheral portion according to a first modification example.
Fig. 6 is a block diagram showing the structure of a power supply peripheral portion according to a second modification example.
Fig. 7 is a block diagram showing the structure of a power supply peripheral portion according to a third modification example.
Fig. 8 is a circuit diagram showing the specifics of an oscillation circuit.
Fig. 9 is a flow chart showing the operations of a fourth modification example.
Fig. 10 is a schematic structural diagram of a power generation detecting circuit.
Fig. 11 is a schematic structural diagram of a voltage detecting circuit.
Fig. 12 is a schematic structural diagram of a regulated voltage generating circuit.

Best Mode for Carrying Out the Invention

[0013] Next, preferred modes for carrying out the invention shall be described with reference to the drawings.

[1] Schematic Structure

[0014] Fig. 1 shows the schematic structure of an electronic timepiece 1 according to one embodiment.

[0015] The electronic timepiece 1 is a wristwatch, used by strapping a band connected to the device itself around the wrist of a user.

[0016] The electronic timepiece 1 according to the present embodiment comprises a power generating portion A, power supply portion B, a power generation state detecting portion 91 (see Fig. 2), a control circuit 23, a second hand moving mechanism CS, an hour-minute hand moving mechanism CHM, a second hand drive portion 30S and an external input device 100 (see Fig. 2).

[0017] The power generating portion A generates AC power. The power supply portion B rectifies the AC voltage outputted from the power generating portion A, raises the rectified voltage, stores the raised voltage and supplies the mechanical portions with electrical energy. The power generation state detecting portion 91 (see Fig. 2) detects the state of power generation of the power generating portion A. The control circuit 23 controls the entire device based on detected results outputted from the power generation state detecting portion 91. The second hand moving mechanism CS drives the second hand 55 using a stepping motor 10. The hour-minute hand moving mechanism CHM drives the minute and hour hands using a stepping motor. The second hand drive portion 30S receives the control signals outputted from the control circuit 23 and drives the second hand moving mechanism CS. The hour-minute hand moving mechanism 30HM receives the control signals outputted from the control circuit 23 and drives the hour-minute hand moving mechanism CHM. The external input device 100 (see Fig. 2) performs an instruction operation for transferring the operating mode of the electronic timepiece 1 from a time display mode to a calendar correcting mode, a time correcting mode or forcibly to a power-saving mode to be described below.

[0018] Here, the control circuit 23 switches between a display mode (operating mode) for performing a time display and a power-saving mode by supplying power to the control circuit 23 and the drive portions 30S, 30HM (drive circuits) of the hand moving mechanisms CS, CHM according to the power generation state of the power generating portion A. The power-saving mode is a mode for suspending the power supply to the second hand moving mechanism CS and the hour-minute hand moving mechanism CHM and supplying power to only the control circuit 23. Additionally, when a user picks up the electronic timepiece 1 and shakes it to generate power, and the generation voltage exceeding a predetermined voltage is detected, the control circuit 23 switches the mode from the power-saving mode to the display mode.

[2] Detailed Structure

[0019] Herebelow, the various component parts of the electronic timepiece 1 shall be described. The control circuit 23 shall be explained later using functional blocks.

[2.1] Power Generating Portion

[0020] First, the power generating portion A shall be described.

[0021] The power generating portion A comprises a power generating device 40, a rotating weight 45 and a step-up gear 46.

[0022] As a power generating device 40, an electromagnetic induction type AC power generating device capable of supplying to the outside power induced in a power generating coil 44 connected to a power generating stator 42 due to rotation of a power generating rotor 43 inside the power generating stator 42 is employed.

[0023] Additionally, the rotating weight 45 functions as an element for transmitting kinetic energy to the power generating rotor 43. Then, the movement of the rotating weight 45 is transmitted through the step-up gear 46 to the power generating rotor 43.

[0024] In the wristwatch type electronic timepiece 1, this rotating weight 45 is capable of turning inside the device in response to the movement of the users wrist, thus acquiring kinetic energy by taking advantage of external energy arising in the course of the user's daily life. The power generating device 40 generates power using this kinetic energy, and drives the electronic timepiece 1 using this power.

[2.2] Power Supply Portion

[0025] Next, the power supply portion B shall be described.

[0026] The power supply portion B comprises a limiter circuit LM, a rectifying circuit 47, a high-capacity capacitor 48 and a voltage raising/lowering circuit 49. The limiter circuit LM prevents excessive voltages from being applied to latter-stage circuits. The rectifying circuit 47 is a half-wave rectifying circuit or full-wave rectifying circuit composed of Schottky diodes, silicon diodes, parasitic diodes of MOSFETs in IC's which are commonly known or functional elements using

switching devices such as transistors.

[0027] The voltage raising/lowering circuit 49is constructed using a plurality of capacitors 49a, 49b and 49c, receives a charged voltage Vc from the high-capacity capacitor 48, performs multiple stages voltage raising or lowering operations on the received voltage Vc, and outputs a power supply voltage Vss which is to be a low potential side voltage. Then, the voltage raising/lowering circuit 49 raises or lowers the charge voltage Vc to the power supply voltage Vss according to the control signal ϕ11 outputted from the control circuit 23, and supplies this power supply voltage Vss to the integrated circuit portion 23A of the control circuit 23, the pulse synthesizing circuit 22 and the second hand drive portion 30S and hour-minute hand drive portion 30MH.

[0028] Here, the power supply portion B takes Vdd (high potential side voltage) as the reference potential (GND), and outputs Vss (low potential side voltage) as the power supply voltage.

[2.3] Hand Moving Mechanism

[0029] Next, the hand moving mechanisms CS and CHM shall be described.

[2.3.1] Second Hand Moving Mechanism

[0030] First, the second hand moving mechanism CS shall be described.

[0031] The stepping motor 10 used in the second hand moving mechanism CS is also called a pulse motor, a step motor or a digital motor, often used as actuators in digital control devices. The stepping motor 10 is driven by a pulse signal. In recent years, this type of stepping motor which has been made more compact in size and light in weight for use as actuators in compact electronic devices or information devices suitable for carrying have been widely employed. Typical of these types of electronic devices are electronic timepieces, time switches and chronographs.

[0032] The stepping motor 10 of the present embodiment comprises a drive coil 11 which generates magnetic force by means of a drive pulse supplied from the second hand drive portion 30S, a stator 12 which is excited by the drive coil 11 and a rotor 13 which is rotated by the magnetic field induced inside the stator 12.

[0033] Additionally, the rotor 13 is of the PM type (permanent magnetrotating type) having a disc-shaped bipolar permanent magnet. The stator 12 is provided with magnetic saturation portions 17 and the phases (poles) 15 and 16 around the rotor 13 by the different magnetic poles are generated by the magnetic force generated by the drive coil 11.

[0034] Furthermore, in order to define the direction of rotation of the rotor 13, an inner notch 18 is provided at a suitable position on the inside circumference of the stator 12, and a cogging torque is generated to stop the rotor 13 at a suitable position.

[0035] Then, the rotation of the rotor 13 due to the stepping motor 10 is transmitted to the second hand 55 by means of the gear train 50 comprising the second intermediary gear 51 which is engaged with the rotor 13 and the second gear (second indicating gear) 52, thus enabling the second hand 55 to indicate the seconds.

[2.3.2] Hour-Minute Hand Moving Mechanism

[0036] Next, the hour-minute hand moving mechanism CHM shall be described. The stepping motor 60 used in the hour-minute hand moving mechanism CHM has roughly the same structure as the stepping motor 10.

[0037] The stepping motor 60 of the present embodiment comprises a drive coil 61 for generating magnetic force in response to a drive pulse supplied form the hour-minute hand drive portion 30HM, a stator 62 which is excited by the drive coil 61 and a rotor 63 which rotates according to the magnetic field induced inside the stator 62.

[0038] Additionally, the rotor 63 is of the PM type (permanent magnet rotating type) having a disc-shaped bipolar permanent magnet. Furthermore, the stator 62 is provided with a magnetic saturation portion 67 generated at the respective phases (poles) 65 and 66 around the rotor 63 by the different magnetic poles due to the magnetic force generated by the drive coil 61.

[0039] Furthermore, in order to define the direction of rotation of the rotor 63, an inner notch 68 is provided at a suitable position on the inside circumference of the stator 62, and a cogging torque is generated to stop the rotor 63 at a suitable position.

[0040] Then, the rotation of the rotor 63 of the stepping motor 60 is transmitted to the hands through the gear train 70 comprising the number four gear 71 which is engaged with the rotor 63, the number three gear 72, the number two gear (minute indicating gear) 73, the minute gear 74 and the cylindrical gear (hour indicating gear) 75. The minute hand 76 is connected to the number two gear 73, and the hour hand 77 is connected to the cylindrical gear 75. The hour and minute are indicated by these hands moving in conjunction with the rotation of the rotor 63.

[0041] In the gear train 70, it is of course also possible to connect a transmission system (for example, in order to display the date, a cylindrical intermediary gear, a daily rotating intermediary gear, a daily rotating fear and a day gear), not shown, for displaying the date (calendar). In this case, a calendar correcting gear train (for example, a first calendar

correction transmitting fear, a second calendar correction transmitting gear, a calendar correcting gear and a day gear) can be additionally provided.

[2.4] Second hand Drive Portion and Hour-Minute Hand Drive Portion

[0042] Next, the second hand drive portion 30S and hour-minute hand drive portion 30HM shall be described. Here, since the structure of the second had drive portion 30S and hour-minute hand drive portion 30HM are identical, only the second hand drive portion 30S shall be described with reference to Fig. 1.

[0043] Here, the second hand drive portion 30S supplies the stepping motor 10 with various drive pulses under the control of the control circuit 23.

[0044] Additionally, the second hand drive portion 30S comprises a bridge circuit composed of a serially connected P-channel transistor 33a and N-channel transistor 32a connected, and a P-channel transistor 33b and N-channel transistor 32b. The second hand drive portion 30S comprises rotation detecting resistors 35a and 35b respectively connected in parallel with the transistors 33a and 33b, and sampling P-channel transistors 34a, 34b for supplying chopper pulses to the resistors 35a and 35b.

[0045] As a result, the second hand drive portion 30S supplies drive pulses of different polarities to the drive coil 11, or supplies detecting pulses for generating an induction voltage for detecting rotation of the rotor 13 and detecting the magnetic field, by applying control pulses of different polarity and pulse width at various timings from the control circuits 23 to the gate electrodes of the transistors 32a, 32b, 33a, 33b, 34a and 34b.

[2.5] Control Circuit

[0046] Next, the structure of the control circuit 23 shall be explained with reference to Fig. 2, wherein the functional block diagram of Fig. 2 shows the control circuit 23 and its peripheral structure.

[0047] Here, the control circuit 23 comprises a pulse synthesizing circuit 22, a mode setting portion 90, a time information memory portion 96, a drive control circuit 24 and the like. Additionally, the mode setting portion 90, time information memory portion 96, drive control circuit 24 and the like are mounted on a chip and constitute a Vss drive portion 23A driven by the power supply voltage Vss, the power supply voltage Vss of the voltage raising/lowering circuit 49 being supplied to the Vss drive portion 23A. Furthermore, a constant voltage outputted from the regulated voltage generating circuit (not shown) is supplied to the pulse synthesizing circuit 22. The regulated voltage generating circuit receives the power supply voltage Vss and generates a stable constant voltage.

[0048] Additionally, the pulse synthesizing circuit 22 comprises an oscillator circuit for generating a reference pulse with a stable frequency using a reference oscillation source 21 such as a quartz resonator, a dividing circuit for dividing the reference pulse, and a synthesizing circuit for generating pulses having different pulse widths and waveforms by combining the divided pulses and the reference pulse. Here, a constant voltage is supplied to the pulse generating circuit 22. This constant voltage is generated by the regulated voltage circuit (not shown) which receives the power supply voltage Vss (charge voltage Vc) outputted from the power supply portion B and outputs a constant voltage. On the other hand, the pulse synthesizing circuit 22 suspends the generation of the pulse signals when the supply of the power supply voltage (constant voltage) is suspended, thus suspending the operation of the entire control circuit 23.

[0049] Next, the mode setting portion 90 comprises a power generation state detecting portion 91, a set value switching portion 95 for switching set values used for detection of the power generation state, a voltage detecting circuit 92 for detecting the charge voltage Vc of the high-capacity capacitor 48, a central control circuit 93 for controlling the time display mode according to the power generation state and controlling the voltage gain based on the charge voltage Vc, and a mode memory portion 94 for storing the mode.

[0050] This power generation state detecting portion 91 comprises a first detecting circuit 97 and a second detecting circuit 98. The first detecting circuit 97 determines whether or not power is being generated by comparing the generated voltage Vgen of the power generating device 40 and a set voltage value V0. The second detecting circuit 98 determines whether or not a stable power generation state has been achieved by taking the time over which the power generating device 40 is determined by the first detecting circuit 97 to be in a power generating state as the power generation maintenance time Tgen, and comparing this time Tgen with a set time value T0.

[0051] Here, the specific circuit structure of the power generation state detecting portion 91 shall be explained with reference to Fig. 10. Fig. 10 is a circuit structure example of the periphery of the power generation state detecting circuit when full-wave rectification is being performed.

[0052] Fig. 10 shows the power generation state detecting portion 91, and as peripheral circuits of the power generation state detecting portion 91, a power generating device 40 and a high-capacity auxiliary power supply 48. Here, the power generating device 40 generates AC power. The high-capacity auxiliary power supply 48 accumulates energy by a DC current outputted from a rectifying circuit 47 which rectifies the AC current outputted form the power generating device 40 to convert it to a DC current.

[0053] The power generation state detecting portion 91 comprises a first comparator COMP1A, a second comparator COMP2A and an OR circuit OR1. The first comparator COMP1A compares the voltage V1 of the first output terminal AG1 of the power generating device 40 and the high potential side terminal voltage VDD of the high-capacity auxiliary power supply 48, and outputs first comparison result data DC1. The second comparator COMP2A compares the voltage V2 of the second output terminal AG2 of the power generating device 40 and the high potential side terminal voltage VDD of the high-capacity auxiliary power supply 48, and outputs second comparison result data DC2. The OR circuit OR1 takes the logical sum of the first comparison result data DC1 and the second comparison result data DC2, and outputs the result as power generation detection data DDET.

[0054] The power generation state detecting portion 91, upon power generation by the power generating device 40, discriminates whether or not sufficient power generation is being performed to charge the high-capacity auxiliary power supply 48 based on the power generation state of the power generating device 40 and the operating state of the limiter circuit LM, and outputs power generation detection data DDET having a frequency in accordance with the power generation period to the central control circuit 93.

[0055] Next, other specific circuit structures of the power generation state detecting portion 91 shall be described with reference to Fig. 3. This power generation state detecting circuit portion 91 comprises transistors 91A, 91B, a pull-down resistor 91C, a detecting inverter 91E and a charge current detecting circuit DET. The transistor 91A and transistor 91B are serially connected between the signal line having the high potential side voltage Vdd and the signal line having the low potential side voltage Vss. The pull-down resistor 91C is connected to both ends of the capacitor 91B. The detecting inverter 91E is connected to the connection point 91D between the transistor 91A and the capacitor 91B. The charge current detecting circuit DET is connected between the positive side of the high-capacity capacitor 48 and Vdd.

[0056] When a power generation current flows from the rectifying circuit 47 to the high-capacity capacitor 48, a current also flows to the charge current detecting circuit DET. For example, when the charge current detecting circuit DET is constructed of diodes, a forward voltage VF is generated. When this forward voltage VF is greater than the threshold voltage Vth of the transistor 91A, the transistor 91A is turned on and the capacitor 91B is charged. Furthermore, when the voltage VA of the connection point 91D goes from the low potential side voltage Vss to approach the high potential side voltage Vdd, this state is maintained to some degree by the pull-down resistor 91C, whereby the potential of the voltage VA exceeds the threshold value of the detecting inverter 91E and the output switches from an"L" to an "H".

[0057] By constructing the power generation state detecting portion 91 in this way, the set voltage value V0 and set time value T0 to be explained are set by appropriately selecting the threshold voltage Vth of the transistor 91A, the pull-down resistor 91C and also the threshold value of the detecting inverter 91, to detect the power generation state of the power generating device 40.

[0058] Then, if the conditions of both the first detection circuit 97 and the second detection circuit 98 are met in the power generation state detecting portion 91, the power generating portion A is judged to be in a power generating state. Here, the set voltage value V0 is a negative voltage when Vdd (= GND) is taken as the reference, and indicates the voltage difference from Vdd.

[0059] Here, the set voltage value V0 used in the first detection circuit 97 is switch-controlled by the set value switching portion 95, the set value switching portion 95 changing the set voltage value V0 used in the first detection circuit 97 when the display mode is switched to the power-saving mode. That is, in the present example, the set voltage value is Va when in the display mode, and the set voltage value is Vb when in the power-saving mode, their relationship being set as Va < Vb. Consequently, considerable power generation is necessary to switch from the power-saving mode to the display mode. The set value switching portion 95 can also be made to switch the set time value T0 used in the second detection circuit 98.

[0060] Here, an example of the voltage detecting circuit 92 shall be described with reference to Fig. 11.

[0061] The voltage detecting circuit 92 comprises resistors comprises resistors R1, R2, a reference voltage generating portion 92A, a comparator 92B, a first P-channel MOS transistor 92C and a second P-channel MOS transistor 92D. The serially connected resistors R1 and R2 divide the voltage between the high potential side power supply VDD and the low potential side power supply VSS with a predetermined voltage division ratio to generate a detection voltage VDET. The reference voltage generating portion 92A generates a predetermined reference voltage VREF from the high potential side power supply VDD. The comparator 92B compares the detection voltage VDET which is the voltage at the connection point between the resistor R1 and the resistor R2 with the reference voltage VREF, and outputs voltage detection data DV to the central control circuit 93. The first P-channel MOS transistor 92C is turned on at the voltage detection timing by the sampling signal SP (at level "L" on detection) outputted from the central control circuit 93 and supplies a current to the resistors R1, R2. The second P-channel MOS transistor 92D is turned on at the voltage detection timing by the sampling signal SP (at level "L" on detection) outputted from the central control circuit 93, putting the enable terminal EN of the comparator 92B at the level "H" to put the comparator 92B into an operating state.

[0062] When an "L" level sampling signal SP is inputted to the voltage detecting circuit 92 from the central control circuit 93, the first P-channel MOS transistor 92C and the second P-channel MOS transistor 92D are turned on.

[0063] As a result, power is supplied to the resistors R1, R2, and the resistors R1, R2 divide the voltage between the

high potential side power supply VDD and the low potential side power supply VSS at a predetermined dividing ratio to generate a detection voltage VDET which is applied to the inverse input terminal of the comparator.

[0064] On the other hand, the enable terminal EN of the comparator 92B also goes to "H" level, and the comparator 92B compares the detection voltage VDET and the reference voltage VREF, then outputs the voltage detection data DV to the central control circuit 93.

[0065] Additionally, the central control circuit 93 comprises a power non-generating time measuring circuit 99 for measuring the power non-generating time Tn during which power generation is not detected at the detection circuits 97, 98, and if the power non-generating time Tn continues for at least a predetermined set period of time, then a switch is made from the display mode to the power-saving mode (first condition).

[0066] On the other hand, the restoration from the power-saving mode to the display mode is performed when the power generation state detecting portion 91 detects that the power generating portion A is in a power generating state, and enough electrical energy remains in the charge voltage Vc of the high-capacity capacitor 48 to return from the power-saving mode to the display mode (first condition).

[0067] However, if the limiter circuit is operating (on) while in the power-saving mode, a short circuit which is different from the normal charging path is formed, thus short-circuiting the power generating portion A , making it impossible for the power generation state detecting portion 91 to detect when the power generating portion A is in a power generating state, and impossible to make the transfer from the power-saving mode to the display mode.

[0068] Therefore, in the present embodiment, when in thepower-saving mode, the limiter circuit is turned off (open) regardless of the power generation state of the power generating portion A, and the power generation state detecting portion 91 is enabled to reliably detect the power generation state of the power generating portion A.

[0069] Additionally, since the power supply portion B of the present embodiment comprises a voltage raising/lowering circuit 49, it is possible to drive the hand moving mechanisms CS, CHM by raising the power supply voltage using the voltage raising/lowering circuit 49 even if the charge voltage Vc is somewhat low.

[0070] On the other hand, if the charge voltage Vc is somewhat high, and higher than the drive voltages of the hand moving mechanisms CS, CHM, the hand moving mechanisms CS, CHM can be driven by lowering the power supply voltage using the voltage raising/lowering circuit 49 to lower the power supply voltage. To this end, the central control circuit 93 determines the voltage raising/lowering factor based on the charge voltage Vc to control the voltage raising/lowering circuit 49.

[0071] However, if the charge voltage Vc is too low, it is not possible to obtain a power supply voltage sufficient to operate the hand moving mechanisms CS, CHM even if the voltage is raised. If a transfer is made from the power-saving mode to the display mode in such as case, it is not possible to perform an accurate time display, and power is needlessly expended.

[0072] Therefore, in the present embodiment, it is determined wither the charge voltage Vc is sufficient by comparing the charge voltage Vc with a predetermined set voltage value Vb, and this is made the first condition for transferring from the power-saving mode to the display mode.

[0073] Furthermore, the central control circuit 93 comprises a power-saving mode counter 101 for monitoring whether or not a preset instruction operation for forcible transfer to the power-saving mode has been performed within a predetermined time, if the external input device 100 is operated by the user or if a power non-generating state is detected by the power generation detecting portion 91.

[0074] The mode set in this way is stored in the mode memory portion 94, and the information is supplied to the drive control circuit 24, the time information memory portion 96 and the set value switching portion 95.

[0075] Here, when switching from the display mode to the power-saving mode, the drive control circuit 24 suspends the supply of the control signal to the second hand drive portion 30S and the hour-minute hand drive portion 30HM. As a result, the motors, 10, 60 stop rotating, thus suspending the time display.

[0076] Furthermore, the central control circuit 93 has the function of operation suspending means for suspending the supply of voltage from the power supply portion B to the control circuit 23 and drive portions 30S, 30HM when the power supply voltage has become lower than a predetermined amount of electricity necessary to return from the power-saving mode to the display mode by a procedure described below.

[0077] Then, by means of this procedure, the electrical discharge from the high-capacity capacitor 48 can be reduced even when enough electrical energy remains in the high-capacity capacitor 48 to return from the power-saving mode to the display mode, thus considerably eliminating unnecessary expenditure of electrical charge.

[0078] Next, the time information memory portion 96 is more specifically composed of an up-down counter (not shown), such that after switching from the display mode to the power-saving mode, it receives a reference signal generated by the pulse synthesizing circuit 22, begins measuring time, increments the count value (up-count), and measures the duration of the power-saving mode as the count value.

[0079] Additionally, upon switching from the power-saving mode to the display mode, the up-down counter decrements the count value (down-count), and during the down-count, outputs an acceleration pulse supplied from the drive control circuit to the second hand drive portion 30S and hour-minute drive portion 30HM.

[0080] Then, when the count value of the up-down counter goes to zero, i.e. the power-saving mode duration and an accelerated hand movement time corresponding to the time required for accelerated hand movement has elapsed, a control signal for suspending the transmission of the accelerated pulse is generated, and this control signal is supplied to the second hand movemetn portion 30S and the hour-minute hand drive portion 30HM. As a result, the time display is returned to the current time. In this way, the time information memory portion 96 also has the function of a portion of current time restoring means for restoring the redisplayed time display to the current time.

[0081] Next, the drive control circuit 24 generates a drive pulse according to the mode based on the various types of pulses outputted from the pulse synthesizing circuit 22. First, in the power-saving mode, the supply of the drive pulse is suspended. Next, immediately after the switch has been made from the power-saving mode to the display mode, acceleration pulses with a short pulse interval are supplied as drive pulses to the second hand drive portion 30S and hour-minute hand drive portion 30HM in order to restore the redisplayed time display to the current time (current time restoring means).

[0082] Furthermore, after the supply of the accelerated pulse has been completed, drive pulses of a normal pulse interval are supplied to the second hand drive portion 30S and hour-minute hand drive portion 30HM.

[0083] Reference number 120 denotes a carriage state detecting circuit composed of an angular velocity sensor, a thermal sensor or the like, wherein the carriage state detecting circuit 120 detects whether or not the electronic timepiece 1 is wound around the user's wrist in order to indirectly detect whether or not the power generating device 40 is in a power generating state. Additionally, the carriage state detecting circuit 120 is connected to a non-carrying time measuring circuit 121 provided inside the central control circuit 93. This non-carrying time measuring circuit 121 measures the time of not being carried in a manner roughly similar to that of the power non-generating time measuring circuit 99 descried above.

[0084] Here, the carriage state detecting circuit 120 and non-carrying time measuring circuit 121 are applied to replace the power generation state detecting portion 91 and the power non-generating time measuring circuit 99.

[3] Operation of the Embodiment

[0085] The operating procedures of the electronic timepiece 1 according to the present invention shall be explained with reference to Fig. 4.

[0086] First, the control circuit 23 judges whether or not the electronic timepiece 1 is in power-saving mode (step S1). If in the judgment of step S1, the electronic timepiece 1 is found to be in power-saving mode (step S1; YES), then the procedure jumps to step S5 to be described below.

[0087] On the other hand, if the judgment of step S1 finds that the watch is not in power-saving mode, i.e. in the display mode (step S1; NO), then the central control circuit 93 determines whether or not there is a power supply voltage, i.e. whether or not the power generating device 40 is generating power based on the detected signal from the power generation state detecting device 91 (step S2). If it is determined in step S2 that the power generating device 40 is in a power generating state, then a time display procedure is performed according to step S10 to be described below.

[0088] If the power generating device 40 is found to be in a non-generating state in step S2 (step S2; NO), then the non-generating time Tn is counted by the non-generating time measuring circuit 99 of the central processing circuit 93 (step S3). Then, the central processing circuit 93 determines whether or not the non-generating time Tn continues past a predetermined set time (step S4).

[0089] In the judgment of step S4, if the non-generating time Tn does not continue past the predetermined set time (step S4; NO), then the procedure is returned to step S2, and the procedure from step S2 to step S4 is repeated.

[0090] If in the judgment of step S4, the non-generating time Tn is found to continue past the predetermined set time (step S4; YES), then the mode is switched to the power-saving mode (step S5).

[0091] On the other hand, in the power-saving mode, time information corresponding to the elapsed time of the power-saving mode is counted in the time information memory portion 96 (step S6) in order to perform a time restoration process (step S9) to be described below.

[0092] Then, it is determined whether or not the power supply voltage (charge voltage Vc of the high-capacity capacitor 48 in the present embodiment) is larger than the criterion voltage V1 which is required to switch from the power-saving mode to the display mode (step S7) (second condition). If the charge voltage Vc is found to be greater than the criterion voltage V1 in step S7 (step S7; YES), i.e. it is possible to switch from the power-saving mode back to the display mode, then it is determined whether or not the power generating device 40 is generating power once again (step S8). If it is determined in step S8 that there is no power generation (step S8; NO), then steps S6 and S7 are repeated.

[0093] Additionally, when it is found in step S8 that power generation has begun (step S8; YES), then the mode is switched from the power-saving mode to the display mode, a time restoration process for restoring the time to the count value of the time information memory portion 96 is performed, and the hands 55, 76, 77 are driven as normal (step S10). The time restoration process from the power-saving mode to the display mode is a current time restoration process which is performed faster than the normal drive operation.

[0094] On the other hand, if in step S7, it is found that the charge voltage Vc accumulated in the high-capacity capacitor 48 is less then or equal to the criterion voltage V1 (step S7; NO), i.e. the charge voltage Vc of the high-capacity capacitor 48 has fallen to a voltage which is not capable of restoring the display mode from the power-saving mode, then the supply of the charge voltage Vc supplied from the high-capacity capacitor 48 to the voltage raising/lowering circuit 49 is cut off, and the supply of the power supply voltage Vss outputted from the voltage raising/lowering circuit 49 to the Vss drive portion 23A of the control circuit 23, pulse synthesizing circuit 22 and drive portions 30S, 30HM is cut off (step S11).

[0095] In step S11, the generation of the pulse signal by the pulse synthesizing circuit 22 is stopped and the count by the time information memory portion 96 is suspended by cutting off the supply of the power supply voltage Vss to the Vss drive portion 23A of the control circuit 23, pulse synthesizing circuit 49 and drive portions 30S, 30HM. As a result, the consumption of electrical energy in the control circuit 23 is made zero. For example, the electrical energy consumption rate when in the power-saving mode can be cut to approximately 80% with respect to the power consumption when in the display mode, but in this state, it can be cut further to 99.5%. Additionally, in the Vss drive portion 23A, the supply of the power supply voltage Vss is not cut off to only the power generation state detecting portion 91, and by continuing to supply the power supply voltage Vss, it is possible to stabilize the circuit operations at reactivation.

[0096] Furthermore, in step S12, the power generation state detecting portion 91 monitors whether or not the power generating device 40 has resumed power generation (third condition), and the procedure is held at step S12 until the power generation state detecting portion 91 detects that power generation has begun.

[0097] Here, when the power generation state detecting portion 91 detects that power generation has resumed (step S12; YES), the charge voltage Vc from the high-capacity capacitor 48 is supplied to the voltage raising/lowering circuit 49, the power supply voltage Vss is supplied from the voltage raising/lowering circuit 49 to the Vss drive portion 23A, pulse synthesizing circuit 22 and the drive portions 30A, 30HM to reactivate the electronic timepiece 1.

[0098] In this step S12, the charge voltage Vc of the high-capacity capacitor 48 is detected from the voltage detecting circuit 92 to determine whether or not the minimum required voltage for reactivation is present, and the supply of the charge voltage Vc is suspended until this voltage value is reached, thereby enabling the high-capacity capacitor 48 to be charged quicker.

[0099] Additionally, in this case, a time restoration process cannot be performed because the control circuit 23 is also suspended, thus requiring the user to set the time manually.

[0100] Furthermore, explaining with more specific numerical values, since the high-capacity capacitor 48 is put into a fully charged state after power generation is started when the charge voltage Vc of the high-capacity capacitor 48 is reduced to approximately 0.45 V under the conventional art, the electronic timepiece 1 must to shaken about 300 times. However, in the present embodiment, the criterion voltage V1 is set to 1 V, thus making it difficult for the charge voltage Vc to fall below 1 V, so that in order to put the high-capacity capacitor 48 into a fully charged state since beginning power generation, it is sufficient to shake the electronic timepiece 1 about 100 times, thus enabling the electronic timepiece to be readily reactivated.

[4] Effects of the Embodiment

[0101] As explained above, the electronic timepiece 1 of the present embodiment is such that when the electronic timepiece 1 is in the power-saving mode, i.e. the charge voltage Vc is outputted from the high-capacity capacitor 48 to the voltage raising/lowering circuit 49, and the power supply voltage Vss raised or lowered from the charge voltage Vc by the voltage raising/lowering circuit 49 is supplied to only the control circuit 23, if the charge voltage Vc from the high-capacity capacitor 48 goes to less than or equal to the criterion voltage V1 which is required to return from the power-saving mode to the display mode, then the supply of the charge voltage Vc which is outputted from the high-capacity capacitor 48 to the voltage raising/lowering circuit 47 is suspended, and the supply of the power supply voltage Vss from the power supply portion B (voltage raising/lowering circuit 47) to the drive portion 23A of the control circuit 23, the pulse synthesizing circuit 22 and the drive portions 30S, 30HM is suspended.

[0102] Thus, the needless consumption of electrical energy in the high-capacity capacitor 48 can be eliminated, and the charge voltage Vc maintained in the high-capacity capacitor 48. As a result, when the power generating device 40 begins to generate power, the charge voltage Vc of the high-capacity capacitor 48 can be outputted to the voltage raising/lowering circuit 49, whereby the power supply voltage Vss is supplied from the voltage raising/lowering circuit 49 to the Vss drive potion 23A of the control circuit 23, the pulse synthesizing circuit 22 and the drive portions 30S, 30HM, to quickly reactivate the electronic timepiece 1.

[0103] Additionally, by suppressing unnecessary consumption of charge voltage Vc from the high-capacity capacitor 48, the hands 55 can be quickly activated when the power generating device 40 begins to generate power when a user carries the electronic timepiece 1, thus preventing users from jumping to the conclusion that the electronic timepiece 1 is broken.

[5] Modification Examples of Embodiment

[5.1] First Modification Example

[0104] In the present first modification example, as shown in Fig. 5, the voltage supplied to the regulated voltage drive circuit 200 (e.g. oscillator circuit, dividing circuit, etc.) is made a regulated voltage Vreg set by the regulated voltage generating circuit 201.

[0105] Here, the regulated voltage generating circuit 201 shall be described.

[0106] A structural diagram of the regulated voltage generating circuit 201 is shown in Fig. 12.

[0107] The constant current generating circuit 201 can be largely divided into a constant current source 220, a first current mirror circuit 221, a differential amplifier circuit 222, a second current mirror circuit 223 and a regulated voltage generating portion 224. The constant current source 220 is a depression transistor or the like which generates a constant current IREF. The first current mirror circuit 221 generates a current which is identical to the constant current IREF. The differential amplifier circuit 222 performs differential amplification of the reference voltage V1 and generated voltage V2 generated when the constant current IREF flows. The second current mirror circuit 223 makes the currents flowing in the various portions of the differential amplifier circuit 222 into constant currents. The regulated voltage generating portion 224 generates and outputs a regulated voltage based on the output of the differential amplifier circuit 222.

[0108] The first current mirror circuit 221 has P-channel MOS transistors MP1, MP2 and MP3 having their source S commonly connected to a high potential side power supply VDD and the gate terminal G connected together, with the gate G and drain D of the P-channel MOS transistor MP1 being saturation-connected.

[0109] The differential amplifier circuit 222 comprises a P-channel MOS transistor MP4, a P-channel MOS transistor MP5 and a gate potential maintaining capacitor CGK. The P-channel MOS transistor MP4 has its source S connected to the drain D of the P-channel MOS transistor MP2 and its gate G connected to the drain D of the P-channel MOS transistor MP1. The P-channel MOS transistor MP5 has its source S connected to the drain D of the P-channel MOS transistor MP2 and its gate G connected to the drain D of the P-channel MOS transistor MP3. The gate potential maintaining capacitor CGK has one end connected to the drain of the P-channel MOS transistor.

[0110] The second current mirror circuit 223 comprises an N-channel MOS transistor MN3 and an N-channel MOS transistor MN4. The N-channel MOS transistor MN3 has its drain D connected to the drain D of the P-channel MOS transistor MP4 and its source S connected to the low potential side power supply VSS side. The N-channel MOS transistor MN4 has its gate G connected to the gate G of the N-channel MOS transistor MN3, its drain D connected to the drain of the P-channel MOS transistor MP5 and the gate G of the N-channel MOS transistor MN3, and its source S connected to the low potential side power supply VSS side.

[0111] The regulated voltage generating portion 224 comprises an N-channel MOS transistor MN1 and an N-channel MOS transistor MN2. The N-channel MOS transistor MN1 has its gate G saturation-connected to its drain D, its drain D connected to the drain D of the P-channel MOS transistor MP3 and its source S connected to the other end of the gate potential maintaining capacitor CGK. The N-channel MOS transistor MN2 has its drain D connected to the source S of the N-channel MOS transistor MN1, its source S connected to the low potential side power supply VSS, and its gate G connected to one end of the gate potential maintaining capacitor CGK. Additionally, the connection point between the source S of the N-channel MOS transistor MN1 and the drain of the N-channel MOS transistor MN2 is the output terminal of the regulated voltage VREG.

[0112] Next, the operations of the regulated voltage generating circuit 201 shall be described.

[0113] The first current mirror circuit 221 generates a current (in the drawing, indicated by the same reference IREF) identical to the constant current IREF generated by the constant current supply 220 as the source-drain current of the P-channel MOS transistor MP3, which is supplied to the regulated voltage generating portion 224.

[0114] At this time, the relationship between the drain current Ids of he P-channel MOS transistor MP1 and the gate voltage can be expressed as follows:

$$Ids = \beta \cdot W/(2 \cdot L) \cdot (Vgs - Vth)2$$

[0115] Here, β represents the gain constant.

[0116] Parallel thereto, the differential amplifier circuit 222 performs a differential amplification of the reference voltage V1 and voltage V2, and outputs to the regulated voltage generating portion 224.

[0117] At this time, the source-drain current of the P-channel MOS transistor MP4 and P-channel MOS transistor MP5 have current values which are identical due to the second current mirror circuit.

[0118] The regulated voltage generating portion 224 performs feedback control of the output of the differential amplifier circuit 222 such that the reference voltage V1 and the reference voltage V2 are:

$$V1 = V2$$

[0119] As a result, a regulated voltage Vreg which is determined by the threshold voltage VTP of the P-channel MOS transistor MP1 forming the first current mirror circuit 221, the threshold value VTN of the N-channel MOS transistor MN1 of the regulated voltage generating portion 224 and the constant current IREF is generated.

[0120] When the voltage supplied to the regulated voltage drive circuit 200 (e.g. the oscillator circuit, dividing circuit etc.) is made the regulated voltage Vreg set by the regulated voltage generating circuit 201, an operation suspending means separate from the central control circuit 93 is formed by a latch circuit 202 and the P-channel transistor 203 connected between the output side of the latch circuit 202 and the middle of the high potential side Vdd line is formed between the high-capacity capacitor 48 and the central control circuit 93. When the high potential side voltage Vdd is taken as the reference voltage (GND), the low potential voltage Vss becomes the power supply voltage and the potential difference becomes equal to the charge voltage Vc.

[0121] Additionally, the oscillator circuit and divider circuit are driven by the regulated voltage Vreg outputted from the regulated voltage generating circuit 201.

[0122] Here, during the power-saving mode, the central control circuit 93 monitors the power supply voltage (charge voltage Vc of the high-capacity capacitor 47) by means of the voltage detecting circuit 92, and outputs an"L" to the latch circuit 202 when the voltage drops below a predetermined value. Then, at the latch circuit 202, the signal outputted from the power generation state detecting portion 91 and the signal outputted from the central control circuit 93 are received, a signal putting the transistor 203 to"H" is outputted, and the transistor 203 is put into an off state. Then, the supply of the charge voltage Vc of the high-capacity capacitor 48 to the central control circuit 93, the voltage detecting circuit 92, the regulated voltage generating circuit 201 and the like is cut off. As a result, the regulated voltage Vreg which is outputted from the regulated voltage generating circuit 201 upon receiving the charge voltage Vc is suspended and the operation of the regulated voltage drive circuit 200 is suspended.

[0123] Furthermore, in the power-saving mode, the drive portions 30S, 30HM are suspended, and most of the power consumption on the circuit is consumed by the regulated voltage drive circuit 200 such as the oscillator circuit for generating the reference pulse signal and the divider circuit, and the regulated voltage generating circuit 201, so that by suspending the supply of the regulated voltage Vreg to the regulated voltage drive circuit 200, the power consumption on the regulated voltage drive circuit 200 can be reduced to zero. Furthermore, the power consumption of the entire circuit can be made close to zero by suspending the supply of the power supply voltage Vss to the regulated voltage generating circuit 201.

[0124] Additionally, when the power generation state detecting portion 91 detects that power generation has begun at the power generating portion A and inputs a signal "H" to the latch circuit 202, the transistor 203 goes to an off state, and the charge voltage Vc is supplied tot e central control circuit 93, the voltage detecting circuit 92, and the regulated voltage generating circuit 201. Since a sufficient voltage is held in the high-capacity capacitor 48 when oscillation begins, the initiation of the oscillation can be quickened. Consequently, the electronic timepiece 1 can be readily reactivated.

[0125] When the transistor 203 is put into an off state and the supply of the power supply voltage Vss is suspended, the output of the latch circuit 202 becomes unstable. Therefore, a pull-up resistor having a high resistance value should preferably be connected to the gate terminal side of the transistor 203 in order to ensure that the transistor 203 is in an off state.

[5.2] Second Modification Example

[0126] In the first modification example, the transistor 203 is connected on the line through which the high potential side voltage Vdd is supplied so as to cut off the supplied current. Therefore, in the first modification example, a transistor 203 with a comparatively large capacity must be used. Thus, in the second modification example, the same can be achieved by forming an operation suspending means as shown in Fig. 6.

[0127] The oscillator circuit 301, divider circuit 302 and level shifter 303 are detailed specifics of the regulated voltage drive circuit 200 driven by the regulated voltage Vreg. Additionally, in this modification example, the line having the high potential side voltage Vdd is made the reference line*a*, the line having the low potential side voltage Vss is made the power supply line*b* and the line having the regulated voltage Vreg which is a constant potential is made the regulated voltage line c.

[0128] Here, a P-channel type transistor 304 is connected between lines *a* and *c*, a P-channel type transistor 305 is connected between the line *b* and the regulated voltage circuit 92, and the gate of the transistor 305 is connected to the output side of the central control circuit 92. Additionally, the gate of the transistor 304 is connected to the output side of the central control circuit 92. The transistor 304 and transistor 305 form operation suspension means.

[0129] With the circuit arrangement of the second modification example formed in this way, the power generation state

detecting portion 91 monitors the power generation state of the power generating portion A when the electronic timepiece 1 is in the power-saving mode, and when the power generating portion goes into a non-power generating state, outputs an "L" signal to the transistor 304 and transistor 305. As a result, the transistor 304 goes into an on state and short-circuits the reference line *a* and the regulated voltage line *c*, thereby cutting off the regulated voltage reg supplied to the oscillator circuit 301, the divider circuit 302 and the level shifter 303. At roughly the same time, an "L" signal is inputted to the transistor 305, putting the transistor 305 into an off state, cutting off the charge voltage Vc supplied from the high-capacity capacitor 48 to the regulated voltage generating circuit 92, and also cutting off the supply of the regulated voltage Vreg.

[0130] On the other hand, when power generation is started, an "H" signal is outputted from the central control circuit 93, thus turning the transistor 304 off, turning the transistor 305 on, and activating the regulated voltage generating circuit 92 to supply the regulated voltage Vreg. As a result, a regulated voltage Vreg is supplied also to the oscillator circuit 301, and a reference pulse is generated from the oscillator circuit 301.

[0131] Moreover, with this circuit arrangement, a transistor with relatively low voltage resistance can be used as the transistor, and the power consumption on the regulated voltage generating circuit 92 can be made roughly zero by cutting off the supply of the charge voltage Vc.

[0132] While the transistor 304 was turned on to cut off the supply of the regulated voltage Vreg, it is also possible to connect a transistor on the regulated voltage line c and turn this transistor off to cut off the supply of the charge voltage. Additionally, the latch circuit 202 shown in the first modification example can be internalized in the central control circuit 92.

[0133] Additionally, in the above description, the on/offoperation of the transistor 304 and the on/off operation of the transistor 305 were performed simultaneously, but it is more preferable to provide a delay circuit before the gate of the transistor 304 and operate the transistor 305 first.

[5.3] Third Modification Example

[0134] Next, a third modification example shall be described with reference to Figs. 7 and 8. This modification example is one where the reference pulse generated from the oscillator circuit is cut off.

[0135] First, while the circuit configurationaround the power supply is roughly the same as in the second modification example, the operation suspending means composed of the transistor 304 and the transistor 305 is not connected, and the central control circuit 93 and oscillator circuit 401 are connected by a signal line d over which the oscillator circuit drive signal is outputted.

[0136] Next, the circuit structure of the oscillator circuit 401 internalized into the electronic timepiece 1 in Fig. 8 shall be described.

[0137] Both ends of the quartz oscillator 402 are connected through a drain capacitor 403 and a gate capacitor 404 to a reference line a which has the high potential side voltage Vdd, and is further connected to the series circuit composed of the drain resistor 405 and the feedback resistor 406. Additionally, between the reference line *a* and the regulated voltage line *c*, beginning from the reference line *a* side, a P-channel transistor 407, an N-channel transistor 408 and a P-channel transistor 409 are connected in that order. Furthermore, the gates of the transistors 407, 408 are connected to the connection point between the gate capacitor 404 and the feedback resistor 406, the drain of the transistor 407 and the drain of the transistor 408 are connected to the drain resistor 405, and the gate of the transistor 409 is connected to the output side of the central control circuit 93. On the other hand, the connection point between the drain resistor 405 and the feedback resistor 406 is connected to the divider circuit 302.

[0138] In this oscillator circuit401, the parts other than the quartz oscillator 402 are integrated, forming an oscillation inverter by means of the circuit elements aside from the quartz oscillator 402, the transistor 409 and the feedback resistor 406.

[0139] With the circuit configuration according to the third modification example structured in this way, when the electronic timepiece 1 is in the display mode or the power-saving mode, the oscillator circuit drive signal which is outputted from the central control circuit 93 through the signal lined to the gate of the transistor 409 goes to "H", a regulated voltage Vreg is supplied to the oscillation inverter and a specific vibration due to the quartz oscillator 402 is used to output a reference pulse to the divider circuit 302.

[0140] Additionally, when the electronic timepiece is in the power-saving mode, the power generation state detecting portion 91 monitors the power generation state of the power generating portion A, and when the power generating portion A goes into a non-power generating state, an oscillator circuit drive signal which is at "L" is outputted toward the gate of the transistor 409 to turn the transistor 409 off. Then, the supply of the regulated voltage Vreg to the oscillator inverter is suspended and the reference pulse generated from the oscillator circuit 401 is stopped. As a result, the power consumption of each circuit can be reduced.

[0141] On the other hand, when the power generation state detecting portion 91 detects that-the power generating portion A has begun generating power, an oscillator circuit drive signal which is at"H" is outputted from the central control circuit 93 through the signal line*d* to the gate of the transistor 409, the regulated voltage Vreg is supplied to the oscillator

inverter and the reference pulse is outputted from the oscillator circuit 401 toward the divider circuit 302. [5.4] Fourth Modification Example

[0142] In this fourth modification example, as indicated in the flow chart of Fig. 9, the criterion voltage for shifting from a power-saving mode to cutting off the supply of voltage is determined by a second criterion voltage V2 (hereinafter referred to as the second criterion voltage V2) which is lower than the criterion voltage V1 (hereinafter referred to as the first criterion voltage V1), and a criterion count value T1, the second criterion voltage V2 being the voltage value necessary for the hands 55, 76, 77 to rotate roughly 180 degrees in returning from the power-saving mode to the display mode, and the criterion counter value T1 being the counter value at this time.

[0143] Here, the procedure from step S21 to step S30 is roughly the same as the procedure from step S1 to step S10 in Fig. 4, and its description shall be omitted.

[0144] In the determination of step S27, if the charge voltage Vc of the high-capacity capacitor 48 is less than or equal to the first criterion voltage V1 (step S27; NO), i.e. the voltage of the high-capacity capacitor 48 is a voltage such that it is not possible to return from the power-saving mode to the display mode, then it is determined whether or not the value of the time counter T has exceeded the criterion counter value T1 (step S31).

[0145] In this step S31, if the value of the counter T has exceeded the criterion counter value T1, then the procedure shifts to step S33, and the procedures following step S33 are performed, whereas if it has not exceeded the value, then the procedure of step S32 is performed. That is, in step S32, it is determined whether or not the charge voltage Vc is larger than the second criterion voltage V2, and if the charge voltage Vc is smaller than the second criterion voltage V2 (step S32; NO), i.e. if there is not enough electrical energy left in the high-capacity capacitor 48 to restore the hands 55, 76, 77, then in step S33, the supply of voltage to the control circuit 23 and the drive portions 30S, 30HM is cut off.

[0146] Furthermore, in step S34, the power generation state detecting portion 91 monitors whether or not the power generating device 40has started to generate power, and the process stands by in step S34 until the power generation state detecting portion 91 detects that power generation has begun. On the other hand, if the power generation state detecting portion 91 detects that power generation has begun (step S34; YES), the charge voltage Vc supplied from the high-capacity capacitor 48 is supplied to the control circuit 23 and the drive portions 30S, 30HM to activate the electronic timepiece 1 (step S35).

[0147] On the other hand, if the charge voltage Vc is greater than the second criterion voltage V2 in the determination of step S32 (step S32; YES), i.e. if there is enough energy left in the high-capacity capacitor 48 to restore the hands 55, 76, 77, then the counting of time is continued in step S36, the power generation state detecting portion 91 monitors whether or not power generation has begun in step S37, and if power generation is not detected, then the procedure is repeated from step S31.

[0148] Additionally, if there is power generation in the determination of step S37, then the procedure shifts to step S38 to perform a current time restoration process.

[0149] Thus, in this modification example, the voltage supply is cut off if after the charge voltage Vc has become smaller than the first criterion voltage V1, the value T of the time counter becomes larger than the criterion counter value T1 or the charge voltage Vc become smaller than the second criterion voltage V2. As a result, a time delay can be added before cutting off the supply of the charge voltage Vc, thus considerably suppressing cases where the supply of the charge voltage Vc is cut off, and enabling restoration from the power-saving mode to the display mode for displaying the current time when power generation begins.

[5.6] Sixth Modification Example

[0150] In the above embodiments, an example of an electronic timepiece which displays the hour/minute and second using two motors was described, but the present invention can likewise be applied to electronic timepieces which display the time using a single motor for the hour/minute and second.

[0151] On the other hand, the present invention can also be applied to an electronic timepiece having 3 or more motors (motors for separately controlling the second hand, minute hand, hour hand, calendar, chronograph, etc.).

[5.7] Seventh Modification Example

[0152] In the above embodiments, the watch automatically switches between the display mode and power-saving mode, but it may be such as to detect an operation by the user on an external input device 100 such as a specific operation on a crown, and to then switch forcibly from the display to the power-saving mode or switch from the power-saving mode to voltage supply suspension. Furthermore, the cutoff and initiation of the supply of electrical energy from the power supply portion B can be made to be performed according to operating conditions of the external input device 100.

[5.8] Eighth Modification Example

[0153] In the above-described embodiments, the power generation state detecting portion 91 monitors whether the power generating device 40 is in a power generating state or a non-power generating state, but the invention is not so limited, and the monitoring can be performed indirectly by means of the carriage state detecting circuit 120 shown in Fig. 2 such as to find that the power generating device 40 is in a non-power generating state when in an uncarried state.

[5.9] Ninth Modification Example

[0154] In the above-described embodiments, the charge voltage Vc of the high-capacity capacitor 48 is monitored by the voltage detecting circuit 92, and the supply of electrical energy is cut off if the charge voltage Vc goes to the criterion voltage V1 or below, but the present invention is not so limited, and may be such as to supply and cut off the electrical energy by monitoring the power supply voltage Vss outputted from the voltage raising/lowering circuit 49.

[5.10] Tenth Modification Example

[0155] In the above-described embodiments, an example of a wristwatch-type electronic timepiece 1 was used, but the present invention is not so restricted, and may be applied to other types of portable electronic devices aside from wristwatches, such as calculators, portable telephones, portable computers, PDA's, liquid crystal televisions and portable video decks.

[5.11] Eleventh Modification Example

[0156] In the above-described embodiments, an electromagnetic power generating device which generates power Vgen in an output coil 44 by the rotation of a rotor 43 which is transmitted to the rotor 43 by rotational motion of a rotating weight 45 is employed as the power generating device 40, but the present invention is not so limited, and, for example may use a power generating device which generates power by rotational motion generated by the return force of a spring (corresponding to external energy), or a power generating device which generates power by means of a piezoelectric effect by applying external or auto-induced vibration or displacement (corresponding to external energy) of a piezoelectric element.

[0157] Additionally, the power generating device may be such as to generate power by photoelectric conversion using light energy (corresponding to external energy) from sunlight or the like.

[0158] Furthermore, the power generating device may generate power by means of thermal power generation due to a temperature difference (thermal energy; corresponding to external energy) between a certain portion and another portion.

[0159] Additionally, the structure may be such as to use an electromagnetic induction type power generating device which receives freely propagating electromagnetic waves such as those for broadcast or communication, and uses these for energy (corresponding to external energy).

[5.12] Twelfth Modification Example

[0160] In the above-described embodiments, the reference potential (GND) was set to Vdd (high potential side voltage), but the reference potential (GND) may of course be set to Vss (low potential side voltage). In this case, the set voltage values V0 and Vgen, etc. represent potential differences from a detected level set on the high potential side with Vss as a reference.

[5.13] Thirteenth Modification Example

[0161] In the above-described embodiments, chargeable electrical storage devices such as auxiliary batteries and capacitors were used to store power generated by the power generating device as the power supply, but it is possible to use primary batteries, or else to use both a chargeable electrical storage device and a primary battery together, or to use a power generating device and a primary battery together.

[5.14] Fourteenth Modification Example

[0162] In the above-described embodiments, the case of an anabg electronic timepiece was described, but the invention is also applicable to electronic devices having digital display devices (digital display means) such as liquid crystal panels.

[0163] In this case, the supply of power to the digital display device is cutoff when in the power-saving mode, so that

there is no display.

[0164] When the display is not on, a portion of a display can be left so as to prevent the user from making the mistaken assumption that the watch has broken. For example, a mark which blinks every 2-3 seconds can be displayed on the display screen.

Claims

1. An electronic device (1) comprising:

a chargeable power supply portion (A, B) for supplying electrical energy;
a drive control portion (23) operated by the electrical energy supplied from said power supply portion (A, B), configured to output a drive signal;
a driven portion (CS, CHM) driven by said drive signal;
a mode switching portion (90) configured to switch the operating mode of said driven portion (CS, CHM) between a drive mode for normal operation and a power-saving mode based on a preset first condition; and **characterized by**
an operation suspending portion (93) configured to suspend operation of said drive control portion (23) when the amount of electrical energy stored in said power supply portion (A, B) is determined to be smaller than a predetermined electrical energy amount based on a preset second condition while in a power-saving mode due to said mode switching portion (90).

2. An electronic device (1) in accordance with claim 1, wherein
said operation suspending portion (93) is configured to suspend supply of the electrical energy from said power supply portion (A, B) to said drive control portion (23) when suspending the operation of said drive control portion (23).

3. An electronic device (1) in accordance with claim 1, wherein
said drive control portion (23) comprises a control circuit (24) operated by electrical energy supplied from said power supply portion (A, B), configured to output a control signal, and a drive circuit (30S, 30HM) operated by electrical energy supplied from said power supply portion (A, B), configured to output a drive signal to said driven portion (CS, CHM) based on the control signal; and
said mode switching portion (90) is configured to supply electrical energy to said control circuit (24) and drive circuit (30S, 30HM) in said drive mode, and is configured to supply electrical energy to only said control circuit (24) in power-saving mode.

4. An electronic device (1) in accordance with claim 1,wherein
said power supply portion (A, B) comprises a power generating portion (A) configured to convert external energy into electrical energy, and a power storing portion (B) configured to store electrical energy supplied from said power generating portion (A) and to supply the electrical energy to said drive control portion (23).

5. An electronic device (1) in accordance with claim 4, wherein
said power storing portion (B) comprises an auxiliary battery or a capacitor.

6. An electronic device (1) in accordance with claim 4, wherein
a power generation state detecting portion (91) configured to detect whether or not said power generating portion (A) is in a power generation state is provided; and
said first condition is whether or not said power generating portion (A) is in a power generating state as determined by said power generation state detecting portion (91).

7. An electronic device (1) in accordance with claim 6, wherein
said power generation state detecting portion (91) comprises an energy amount determining portion (97) configured to determine whether or not the amount of electrical energy outputted from said power generating portion (A) exceeds a criterion energy amount; and
a power generation time determining portion (98) configured to determine whether or not a duration over which the electrical energy amount is determined, by said energy amount determining portion (97), to exceed the criterion energy amount exceeds a criterion time value.

8. An electronic device (1) in accordance with claim 1, wherein

a carriage state detecting portion (120) configured to detect whether or not said electronic device (1) is in a carried state is provided;
said first condition requires, for switching the operating mode of said driven portion (CS, CHM) from said drive mode to said power-saving mode, that said electronic device (1) is found to be in a non-carried state by said carriage state detecting portion (120), and the duration over which the electronic device (1) is in a non-carried state continues for a predetermined time; and
said first condition requires, for switching the operating mode of said driven portion (CS, CHM) from said power-saving mode to said drive mode, that the electronic device (1) has switched from a non-carried state to a carried state according to said carriage state detecting portion (120) .

9. An electronic device (1) in accordance with claim 1, wherein
a voltage detecting portion (92) configured to detect the voltage of said power supply portion (A, B) is provided; and
said second condition requires that the voltage of said power supply portion (A, B) detected by said voltage detecting portion (92) goes below a predetermined voltage.

10. An electronic device (1) in accordance with claim 1, wherein
an electrical energy detecting portion configured to detect the amount of electrical energy supplied from said power supply portion (A, B) is provided; and
said second condition requires that the amount of electrical energy capable of being supplied by said power supply portion (A, B) detected by said electrical energy amount detecting portion becomes smaller than a predetermined amount of electrical energy required to restore the operating mode of said drive portion from said power-saving mode to said drive mode.

11. An electronic device (1) in accordance with claim 4, wherein
a power generation state detecting portion (91) configured to detect whether or not said power generating portion (A) is in a power generating state is provided;
an operation initiating portion configured to initiate operation of said drive control portion (23) when a preset third condition is fulfilled while the operation of said drive control portion (23) is in a suspended state due to said operation suspending portion (93) is provided; and
said third condition requires that initiation of power generation by said power generating portion (A) is detected by said power generation state detecting portion (91).

12. An electronic device (1) in accordance with claim 11; wherein
the initiation of power generation of said third condition means that the amount of electrical energy outputted from said power generating portion (A) exceeds an energy amount sufficient for reactivation, and this state continues for a predetermined duration.

13. An electronic device (1) in accordance with claim 1, wherein
a carriage state detecting portion (120) configured to detect whether or not said electronic device (1) is in a carried state is provided;
an operation initiating portion configured to initiate operation of said drive control portion (23) based on a preset third condition when the operation of said drive control portion (23) is in a suspended state due to said operation suspending portion (93) is provided; and
said operation initiating portion is configured to determine when said electronic device (1) is switched from a non-carried state to a carried state using said carriage state detecting portion (120) as said third condition.

14. An electronic device (1) in accordance with claim 13, wherein
the switch from said non-carried state to the carried state is made when the carried state continues for a predetermined duration after switching from a non-carried state to a carried state.

15. An electronic device (1) in accordance with claim 1, wherein
an external operation input portion (100) configured to enable a user to perform operations from the outside is provided; and
the switch from said drive mode to said power-saving mode is performed by said mode switching portion (90) based on the operating conditions of said external operation input portion (100) .

16. An electronic device (1) in accordance with claim 1, wherein
an external operation input portion (100) configured to enable a user to perform operations from the outside is

provided; and
an operation initiating portion configured to initiate operation of said drive control portion (23) based on operating conditions of said external operation input portion (100) when said operation suspending portion (93) detects that the operations of said drive control portion (23) are in a suspended state is provided.

17. An electronic device (1) in accordance with any one of claims 1-16, wherein
said driven portion (CS, CHM) has a time display portion for displaying the time.

18. An electronic device (1) in accordance with claim 17, wherein
said drive control portion (23) comprises a current time restoring portion configured to restore the time display to the current time when the operating mode of the driven portion (CS, CHM) is switched from said power-saving mode to said drive mode by the mode switching portion (90).

19. An electronic device (1) in accordance with claim 18, wherein
said predetermined electrical energy amount is set to an electrical energy amount required to restore the current time from the power-saving mode using said current time restoring portion.

20. An electronic device (1) in accordance with claim 18, wherein
the amount of energy sufficient to perform restoration is set to a minimum amount required to enable time display using said time display portion by initiating the operation of said drive control portion (23).

21. An electronic device (1) in accordance with claim 18, wherein
said time display portion has hands (55, 76, 77) configured to display the time and a motor (10, 60) configured to drive said hands (55, 76, 77); and
said current time restoring portion is configured to restore the motion of the hands (55, 76, 77) by said motor by restoring them at a high-speed hand-moving speed which is higher than the normal hand-moving speed.

22. An electronic device (1) in accordance with claim 1, wherein
said drive control portion (23) comprises a control circuit (24) operated by electrical energy supplied from said power supply portion (A, B), configured to output a control signal; and a drive circuit (30S, 30HM) operated by electrical energy supplied from said power supply portion (A, B), configured to receive the control signal and output a drive signal to said driven portion (CS, CHM);
said control circuit (24) comprises an oscillator circuit (21) configured to generate a reference pulse; and
said operation suspending portion (93) is configured to suspend the operation of said oscillator circuit (21).

23. An electronic device (1) in accordance with claim 22, wherein
said operation suspending portion (93) is configured to suspend the supply of electrical energy to said oscillator circuit (21).

24. An electronic device (1) in accordance with claim 1, wherein
said drive control portion (23) comprises a control circuit (24) operated by electrical energy supplied from said power supply portion (A, B), configured to output a control signal, and a drive circuit (30S, 30HM) operated by electrical energy supplied from said power supply portion (A, B), configured to receive the control signal and output a drive signal to said driven portion (CS, CHM);
said control circuit (24) comprises an oscillator circuit (21) configured to generate a reference pulse, and a divider circuit configured to divide the reference pulse outputted from said oscillator circuit (21); and
said operation suspending portion (93) is configured to suspend operation of said oscillator circuit (21) or said divider circuit.

25. An electronic device (1) in accordance with claim 24, wherein
said operation suspending portion (93) comprises a regulated voltage generating circuit configured to generate a regulated voltage lower than the power supply voltage for driving at least one of the oscillator circuit (21) and the divider circuit; and
said operation suspending portion (93) is configured to suspend the supply of electrical energy to said regulated voltage generating circuit.

26. A control method for an electronic device (1) comprising:

a chargeable power supply unit (A, B) for supplying electrical energy;
a drive control unit (23) operated by the electrical energy supplied by said power supply unit (A, B), for outputting a drive signal; and
a driven unit (CS, CHM) driven by receiving the drive signal outputted from said drive control unit (23);
the control method comprising:

a mode switching step of switching an operating mode of said driven unit (CS, CHM) between a drive mode and a power-saving mode based on a preset first condition; and

characterized by
a drive suspending step of suspending operation of said drive control unit (23) when the amount of electrical energy stored in said power supply unit (A, B) is determined to be smaller than a predetermined amount of electrical energy according to a preset second condition, while the operation mode is set to the power-saving mode by said mode switching step.

27. A control method for an electronic device (1) in accordance with claim 26, wherein:

said power supply unit (A, B) comprises a power generating device (A) for converting external energy into electrical energy, and a power storing device (B) for storing electrical energy supplied from said power generating device (A) and supplying said electrical energy to said drive control unit (23);
said method further comprises a power generation state detecting step of determining whether or not power is being generated by the power generating device (A); and
said first condition requires that power being generated by said power generating device (A) is detected in said power generation state detecting step.

28. A control method for an electronic device (1) in accordance with claim 27, wherein:

said power generation state detecting step comprises an energy amount determining step for determining whether or not the amount of electrical energy outputted from said power generating device (A) has exceeded a criterion energy amount; and
a power generation time determining step of determining whether or not the duration over which the electrical energy amount exceeding the criterion energy amount as determined in said energy amount determining step exceeds a criterion time value.

29. A control method for an electronic device (1) in accordance with claim 26, wherein:

said method further comprises a carriage state detecting step for detecting whether or not the electronic device (1) is being carried;
said first condition requires, for switching the operating mode of said driven unit (CS, CHM) from said drive mode to said power-saving mode, that said electronic device (1) is detected to be in a non-carried state in said carriage state detecting step, and the time over which said electronic device (1) is in a non-carried state continues for a predetermined time, and said first condition requires, for switching the operating mode of said drive unit from said power-saving mode to said drive mode, that a switch from the non-carried state to a carried state is detected in said carriage state detecting step.

30. A control method for an electronic device (1) in accordance with claim 26, comprising:

an electrical energy amount detecting step for detecting an amount of electrical energy supplied from said power supply unit (A, B); and
said second condition requires that the electrical energy amount capable of being supplied by said power supply unit (A, B) detected by said electrical energy detecting step is smaller than a predetermined electrical energy amount required to restore the operating mode of said driven unit (CS, CHM) from said power-saving mode to said drive mode.

31. A control method for an electronic device (1) in accordance with claim 26, wherein:

said power supply unit (A, B) comprises a power generating device (A) for converting external energy into electrical energy, and a power storing device (B) for storing electrical energy supplied from said power generating

device (A), and supplying said electrical energy to said drive control unit (23);
the method comprises a power generation state detecting step of detecting whether or not said power generating device (A) is in a power generation state; and
further comprises an operation initiating step of initiating operation of the drive control unit (23) based on a preset third condition when the operation of said drive control unit (23) being in a suspended state is determined in said operation suspending step; and
said third condition requires that said power generating device (A) initiating power generation is detected in said power generation state detecting step.

32. A control method for an electronic device (1) in accordance with claim 26, wherein:

said power supply unit (A, B) comprises a power generating device (A) for converting external energy into electrical energy, and a power storing device (B) for storing electrical energy supplied from said power generating device (A), and supplying said electrical energy to said drive control unit (23);
said method comprises a carriage state detecting step for detecting whether or not said electronic device (1) is in a carried state; and
further comprises an operation initiating step of initiating operation of the drive control unit (23) based on a preset third condition when the operation of said drive control unit (23) is in a suspended state due to said operation suspending step;
said third condition requires that said electronic device (1) is detected as having switched from a non-carried state to a carried state in said carriage state detecting step.

Patentansprüche

1. Elektronische Vorrichtung (1), umfassend:

einen aufladbaren Stromversorgungsabschnitt (A, B) zum Zuführen von elektrischer Energie;
einen Antriebssteuerabschnitt (23), der durch die elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um ein Antriebssignal auszugeben;
einen angetriebenen Abschnitt (CS, CHM), der von diesem Antriebssignal angetrieben wird;
einen Modusumschaltabschnitt (90), konfiguriert, um auf der Basis einer voreingestellten ersten Bedingung den Betriebsmodus des angetriebenen Abschnitts (CS, CHM) zwischen einem Antriebsmodus für den Normalbetrieb und einem Stromsparmodus umzuschalten; und **gekennzeichnet durch**
einen Betriebsunterbrechungsabschnitt (93), der konfiguriert ist, um den Betrieb des Antriebssteuerabschnitts (23) zu unterbrechen, wenn auf der Basis einer zweiten voreingestellten Bedingung bestimmt wird, dass die Menge an elektrischer Energie, die im Stromversorgungsabschnitt (A, B) gespeichert ist, in einem Stromsparmodus aufgrund des Modusumschaltabschnitts (90) kleiner ist als eine vorbestimmte elektrische Energiemenge.

2. Elektronische Vorrichtung (1) nach Anspruch 1, wobei der Betriebsunterbrechungsabschnitt (93) konfiguriert ist, um die Zuführung der elektrischen Energie vom Stromversorgungsabschnitt (A, B) zum Antriebssteuerabschnitt (23) zu unterbrechen, wenn der Betrieb des Antriebssteuerabschnitts (23) unterbrochen wird.

3. Elektronische Vorrichtung (1) nach Anspruch 1, wobei der Antriebssteuerabschnitt (23) eine Steuerschaltung (24) umfasst, die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um ein Steuersignal auszugeben, und eine Antriebsschaltung (30S, 30HM), die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um auf der Basis des Steuersignals ein Antriebssignal an den angetriebenen Abschnitt (CS, CHM) auszugeben; und
der Modusumschaltabschnitt (90) konfiguriert ist, um der Steuerschaltung (24) und der Antriebsschaltung (30S, 30HM) im Antriebsmodus elektrische Energie zuzuführen, und konfiguriert ist, um im Stromsparmodus nur der Steuerschaltung (24) elektrische Energie zuzuführen.

4. Elektronische Vorrichtung (1) nach Anspruch 1, wobei der Stromversorgungsabschnitt (A, B) einen Stromerzeugungsabschnitt (A) umfasst, konfiguriert, um externe Energie in elektrische Energie umzuwandeln, und einen Stromspeicherabschnitt (B), konfiguriert, um elektrische Energie zu speichern, die vom Stromerzeugungsabschnitt (A) zugeführt wird, und dem Antriebssteuerabschnitt (23) die elektrische Energie zuzuführen.

5. Elektronische Vorrichtung (1) nach Anspruch 4, wobei der Stromspeicherabschnitt (B) eine Hilfsbatterie oder einen

Kondensator umfasst.

6. Elektronische Vorrichtung (1) nach Anspruch 4, wobei ein Stromerzeugungszustandserkennungsabschnitt (91) vorgesehen ist, konfiguriert, um zu erkennen, ob der Stromerzeugungsabschnitt (A) in einem Stromerzeugungszustand ist oder nicht; und
die erste Bedingung ist, ob der Stromerzeugungsabschnitt (A) in einem Stromerzeugungszustand ist oder nicht, wie von diesem Stromerzeugungszustandserkennungsabschnitt (91) bestimmt.

7. Elektronische Vorrichtung (1) nach Anspruch 6, wobei der Stromerzeugungszustandserkennungsabschnitt (91) einen Energiemengenbestimmungsabschnitt (97) umfasst, konfiguriert, um zu bestimmen, ob die Menge der elektrischen Energie, die vom Stromerzeugungsabschnitt (A) ausgegeben wird, eine Kriteriumsenergiemenge übersteigt; und
einen Stromerzeugungszeitbestimmungsabschnitt (98), konfiguriert, um zu bestimmen, ob eine Dauer, über welche hinweg die elektrische Energiemenge durch den Energiemengenbestimmungsabschnitt (97) bestimmt wird und die Kriteriumsenergiemenge übersteigt, einen Kriteriumszeitwert übersteigt.

8. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein Tragzustandserkennungsabschnitt (120) vorgesehen ist, der konfiguriert ist, um zu erkennen, ob die elektronische Vorrichtung (1) in einem getragenen Zustand ist oder nicht;
die erste Bedingung zum Umschalten des Betriebsmodus des angetriebenen Abschnitts (CS, CMH) vom Antriebsmodus in den Stromsparmodus fordert, dass die elektronische Vorrichtung (1) vom Tragzustandserkennungsabschnitt (120) als in einem nicht getragen Zustand befindlich erkannt wird, und die Dauer, über welche hinweg die elektronische Vorrichtung (1) in einem nicht getragenen Zustand ist, eine vorbestimmte Zeit lang andauert; und
diese erste Bedingung zum Umschalten des Betriebsmodus des angetriebenen Abschnitts (CS, CMH) vom Stromsparmodus in den Antriebsmodus fordert, dass die elektronische Vorrichtung (1) dem Tragzustandserkennungsabschnitt (120) gemäß von einem nicht getragenen Zustand zu einem getragenen Zustand umgeschaltet hat.

9. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein Spannungserkennungsabschnitt (92) vorgesehen ist, konfiguriert, um die Spannung des Stromversorgungsabschnitts (A, B) zu erkennen; und
die zweite Bedingung fordert, dass die Spannung des Stromversorgungsabschnitts (A, B), die vom Spannungserkennungsabschnitt (92) erkannt wird, unter eine vorbestimmte Spannung abfällt.

10. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein elektrischer Energieerkennungsabschnitt vorgesehen ist, der konfiguriert ist, um die Menge an elektrischer Energie zu erkennen, die vom Stromversorgungsabschnitt (A, B) zugeführt wird; und
die zweite Bedingung fordert, dass die vom elektrischen Energieerkennungsabschnitt erkannte Menge an elektrischer Energie, die vom Stromversorgungsabschnitt (A, B) zugeführt werden kann, kleiner wird als eine vorbestimmte Menge an elektrischer Energie, die erforderlich ist, um den Betriebsmodus des Antriebsabschnitts vom Stromsparmodus in den Antriebsmodus zurückzusetzen.

11. Elektronische Vorrichtung (1) nach Anspruch 4, wobei ein Stromerzeugungszustandserkennungsabschnitt (91) vorgesehen ist, konfiguriert, um zu erkennen, ob der Stromerzeugungsabschnitt (A) in einem Stromerzeugungszustand ist oder nicht; und
ein betriebseinleitender Abschnitt vorgesehen ist, um den Betrieb des Antriebssteuerabschnitts (23) zu starten, wenn eine voreingestellte dritte Bedingung erfüllt wird, während der Betriebs des Antriebssteuerabschnitts (23) aufgrund des Betriebsunterbrechungsabschnitts (93) in einem unterbrochenen Zustand ist; und
diese dritte Bedingung fordert, dass der Start der Stromerzeugung durch den Stromerzeugungsabschnitt (A) vom Stromerzeugungszustandserkennungsabschnitt (91) erkannt wird.

12. Elektronische Vorrichtung (1) nach Anspruch 11, wobei der Start der Stromerzeugung in der dritten Bedingung bedeutet, dass die Menge an elektrischer Energie, die vom Stromerzeugungsabschnitt (A) ausgegeben wird, eine Energiemenge übersteigt, die zur Reaktivierung ausreicht, und dieser Zustand eine vorbestimmte Zeit lang andauert.

13. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein Tragzustandserkennungsabschnitt (120) vorgesehen ist, der konfiguriert ist, um zu erkennen, ob die elektronische Vorrichtung (1) in einem getragenen Zustand ist oder nicht;
ein betriebseinleitender Abschnitt vorgesehen ist, um den Betrieb des Antriebssteuerabschnitts (23) auf der Basis einer voreingestellten dritten Bedingung zu starten, wenn der Betrieb des Antriebssteuerabschnitts (23) aufgrund des Betriebsunterbrechungsabschnitts (93) in einem unterbrochenen Zustand ist; und
der betriebseinleitende Abschnitt konfiguriert ist, um anhand des Tragzustandserkennungsabschnitts (120) zu be-

stimmen, wann die elektronische Vorrichtung (1) als dritte Bedingung von einem nicht getragenen Zustand in einen getragenen Zustand umschaltet.

14. Elektronische Vorrichtung (1) nach Anspruch 13, wobei die Umschaltung vom nicht getragenen Zustand in den getragenen Zustand erfolgt, wenn der getragene Zustand nach dem Umschalten vom nicht getragenen Zustand in einen getragenen Zustand eine vorbestimmte Zeit lang andauert.

15. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein externer Betätigungseingabeabschnitt (100) vorgesehen ist, um einem Benutzer das Durchführen von Betätigungen von außen zu ermöglichen; und
die Umschaltung vom Antriebsmodus in den Stromsparmodus vom Modusumschaltabschnitt (90) auf der Basis der Betätigungsbedingungen des externen Betätigungseingabeabschnitts (100) durchgeführt wird.

16. Elektronische Vorrichtung (1) nach Anspruch 1, wobei ein externer Betätigungseingabeabschnitt (100) vorgesehen ist, um einem Benutzer das Durchführen von Betätigungen von außen zu ermöglichen; und
ein betriebseinleitender Abschnitt vorgesehen ist, der konfiguriert ist, um den Betrieb des Antriebssteuerabschnitts (23) auf der Basis der Betätigungsbedingungen des externen Betätigungseingabeabschnitts (100) zu starten, wenn der Betriebsunterbrechungsabschnitt (93) erkennt, dass der Betrieb des Antriebssteuerabschnitts (23) in einem unterbrochenen Zustand ist.

17. Elektronische Vorrichtung (1) nach einem der Ansprüche 1-16, wobei der angetriebene Abschnitt (CS, CHM) einen Zeitanzeigeabschnitt zum Anzeigen der Zeit aufweist.

18. Elektronische Vorrichtung (1) nach Anspruch 17, wobei der Antriebssteuerabschnitt (23) einen Abschnitt zur Wiederherstellung der aktuellen Zeit umfasst, der konfiguriert ist, um die Zeitanzeige auf die aktuelle Zeit zu setzen, wenn der Betriebsmodus des Antriebsabschnitts (CS, CHM) durch den Modusumschaltabschnitt (90) vom Stromsparmodus in den Antriebsmodus geschaltet wird.

19. Elektronische Vorrichtung (1) nach Anspruch 18, wobei die vorbestimmte elektrische Energiemenge auf eine elektrische Energiemenge eingestellt ist, die notwendig ist, um aus dem Stromsparmodus mit Hilfe des Abschnitts zur Wiederherstellung der aktuellen Zeit die aktuelle Zeit wiederherzustellen.

20. Elektronische Vorrichtung (1) nach Anspruch 18, wobei die Menge an Energie, die ausreicht, um die Wiederherstellung durchzuführen, auf eine minimale Menge eingestellt ist, die erforderlich ist, um die Zeitanzeige mit dem Zeitanzeigeabschnitt durch Starten des Betriebs des Antriebssteuerabschnitts (23) zu erlauben.

21. Elektronische Vorrichtung (1) nach Anspruch 18, wobei der Zeitanzeigeabschnitt Zeiger (55, 76, 77) umfasst, die konfiguriert sind, um die Zeit anzuzeigen, und einen Motor (10, 60), der konfiguriert ist, um diese Zeiger (55, 76, 77) anzutreiben; und
der Abschnitt zur Wiederherstellung der aktuellen Zeit konfiguriert ist, um die Bewegung der Zeiger (55, 76, 77) durch den Motor wiederherzustellen,
wobei sie mit einer schnellen Zeigerbewegungsgeschwindigkeit bewegt werden, die höher ist als die normale Zeigerbewegungsgeschwindigkeit.

22. Elektronische Vorrichtung (1) nach Anspruch 1, wobei der Antriebssteuerabschnitt (23) eine Steuerschaltung (24) umfasst, die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um ein Steuersignal auszugeben; und eine Antriebsschaltung (30S, 30HM), die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um das Steuersignal zu empfangen und ein Antriebssignal an den angetriebenen Abschnitt (CS, CHM) auszugeben;
wobei diese Steuerschaltung (24) eine Oszillatorschaltung (21) umfasst, die konfiguriert ist, um einen Bezugsimpuls zu erzeugen; und
der Betriebsunterbrechungsabschnitt (93) konfiguriert ist, um den Betrieb der Oszillatorschaltung (21) zu unterbrechen.

23. Elektronische Vorrichtung (1) nach Anspruch 22, wobei der Betriebsunterbrechungsabschnitt (93) konfiguriert ist, um die Zuführung von elektrischer Energie an die Oszillatorschaltung (21) zu unterbrechen.

24. Elektronische Vorrichtung (1) nach Anspruch 1, wobei der Antriebssteuerabschnitt (23) eine Steuerschaltung (24) umfasst, die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird,

konfiguriert, um ein Steuersignal auszugeben, und eine Antriebsschaltung (30S, 30HM), die durch elektrische Energie betrieben wird, die vom Stromversorgungsabschnitt (A, B) zugeführt wird, konfiguriert, um das Steuersignal zu empfangen und ein Antriebssignal an den angetriebenen Abschnitt (CS, CHM) auszugeben;
wobei diese Steuerschaltung (24) eine Oszillatorschaltung (21) umfasst, die konfiguriert ist, um einen Bezugsimpuls zu erzeugen, und eine Dividierschaltung, die konfiguriert ist, um den Bezugsimpuls zu dividieren, der von der Oszillatorschaltung (21) ausgegeben wird; und
der Betriebsunterbrechungsabschnitt (93) konfiguriert ist, um den Betrieb der Oszillatorschaltung (21) oder der Dividierschaltung zu unterbrechen.

25. Elektronische Vorrichtung (1) nach Anspruch 24, wobei der Betriebsunterbrechungsabschnitt (93) eine Konstantspannungserzeugungsschaltung umfasst, konfiguriert, um eine Konstantspannung zu erzeugen, die niedriger ist als die Stromversorgungsspannung zum Betreiben mindestens einer von der Oszillatorschaltung (21) und der Dividierschaltung; und
wobei der Betriebsunterbrechungsabschnitt (93) konfiguriert ist, um die Zuführung von elektrischer Energie an die Konstantspannungserzeugungsschaltung zu unterbrechen.

26. Steuerungsverfahren für eine elektronische Vorrichtung (1), umfassend:

eine aufladbare Stromversorgungseinheit (A, B) zum Zuführen von elektrischer Energie;
eine Antriebssteuereinheit (23), die durch die elektrische Energie betrieben wird, die von der Stromversorgungseinheit (A, B) zugeführt wird, um ein Antriebssignal auszugeben;
eine angetriebene Einheit (CS, CHM), die angetrieben wird, indem sie das Antriebssignal empfängt, das von der Antriebssteuereinheit (23) ausgegeben wird;

wobei das Steuerungsverfahren umfasst:

einen Modusumschaltschritt des Umschaltens eines Betriebsmodus der angetriebenen Einheit (CS, CHM) zwischen einem Antriebsmodus und einem Stromsparmodus auf der Basis einer voreingestellten ersten Bedingung; und **gekennzeichnet durch**
einen Antriebsunterbrechungsschritt der Unterbrechung des Betriebs der Antriebssteuereinheit (23), wenn einer zweiten voreingestellten Bedingung entsprechend bestimmt wird, dass die Menge an elektrischer Energie, die in der Stromversorgungseinheit (A, B) gespeichert ist, kleiner ist als eine vorbestimmte Menge an elektrischer Energie, während der Betriebsmodus **durch** den Modusumschaltschritt in den Stromsparmodus gesetzt ist.

27. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 26, wobei:

die Stromversorgungseinheit (A, B) eine Stromerzeugungsvorrichtung (A) umfasst, um externe Energie in elektrische Energie umzuwandeln, und eine Stromspeichervorrichtung (B), um elektrische Energie zu speichern, die von der Stromerzeugungsvorrichtung (A) zugeführt wird, und diese elektrische Energie der Antriebssteuereinheit (23) zuzuführen;
wobei das Verfahren außerdem einen Stromerzeugungszustandserkennungsschritt umfasst, um zu bestimmen, ob von der Stromerzeugungsvorrichtung (A) Strom erzeugt wird oder nicht; und
die erste Bedingung fordert, dass im Stromerzeugungszustandserkennungsschritt Strom erkannt wird, der von der Stromerzeugungsvorrichtung (A) erzeugt wird.

28. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 27, wobei:

der Stromerzeugungszustandserkennungsschritt einen Energiemengenbestimmungsschritt umfasst, um zu bestimmen, ob die Menge der elektrischen Energie, die von der Stromerzeugungsvorrichtung (A) ausgegeben wird, eine Kriteriumsenergiemenge überstiegen hat; und
einen Stromerzeugungszeitbestimmungsschritt, um zu bestimmen, ob die Dauer, über welche hinweg die elektrische Energiemenge die Kriteriumsenergiemenge übersteigt, wie im Energiemengenbestimmungsschritt bestimmt, einen Kriteriumszeitwert übersteigt.

29. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 26, wobei:

das Verfahren außerdem einen Tragzustandserkennungsschritt umfasst, um zu erkennen, ob die elektronische Vorrichtung (1) getragen wird oder nicht;

die erste Bedingung zum Umschalten des Betriebsmodus der angetriebenen Einheit (CS, CMH) vom Antriebsmodus in den Stromsparmodus fordert, dass die elektronische Vorrichtung (1) im Tragzustandserkennungsschritt als in einem nicht getragen Zustand befindlich erkannt wird, und die Zeit, über welche hinweg die elektronische Vorrichtung (1) in einem nicht getragenen Zustand ist, eine vorbestimmte Zeit lang andauert, und diese erste Bedingung zum Umschalten des Betriebsmodus der angetriebenen Einheit vom Stromsparmodus in den Antriebsmodus fordert, dass im Tragzustandserkennungsschritt eine Umschaltung vom nicht getragenen Zustand in einen getragenen Zustand erkannt wurde.

30. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 26, umfassend:

einen elektrischen Energiemengenerkennungsschritt zum Erkennen einer Menge an elektrischer Energie, die von der Stromversorgungseinheit (A, B) zugeführt wird; und
wobei die zweite Bedingung fordert, dass die im elektrischen Energiemengenerkennungsschritt erkannte elektrische Energiemenge, die von der Stromversorgungseinheit (A, B) zugeführt werden kann, kleiner ist als eine vorbestimmte elektrische Energiemenge, die erforderlich ist, um den Betriebsmodus der angetriebenen Einheit (CS, CHM) vom Stromsparmodus in den Antriebsmodus zurückzusetzen.

31. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 26, wobei:

die Stromversorgungseinheit (A, B) eine Stromerzeugungsvorrichtung (A) umfasst, um externe Energie in elektrische Energie umzuwandeln, und eine Stromspeichervorrichtung (B), um elektrische Energie zu speichern, die von der Stromerzeugungsvorrichtung (A) zugeführt wird, und diese elektrische Energie der Antriebssteuereinheit (23) zuzuführen;
wobei das Verfahren einen Stromerzeugungszustandserkennungsschritt umfasst, um zu erkennen, ob die Stromerzeugungsvorrichtung (A) in einem Stromerzeugungszustand ist oder nicht; und
außerdem einen betriebseinleitenden Schritt umfasst, um den Betrieb der Antriebssteuereinheit (23) auf der Basis einer voreingestellten dritten Bedingung zu starten, wenn im Betriebsunterbrechungsschritt bestimmt wird, dass der Betrieb der Antriebssteuereinheit (23) in einem unterbrochenen Zustand ist, und
diese dritte Bedingung fordert, dass in diesem Stromerzeugungszustandserkennungsschritt ein Start der Stromerzeugung durch die Stromerzeugungsvorrichtung (A) erkannt wird.

32. Steuerungsverfahren für eine elektronische Vorrichtung (1) nach Anspruch 26, wobei:

die Stromversorgungseinheit (A, B) eine Stromerzeugungsvorrichtung (A) umfasst, um externe Energie in elektrische Energie umzuwandeln, und eine Stromspeichervorrichtung (B), um elektrische Energie zu speichern, die von der Stromerzeugungsvorrichtung (A) zugeführt wird, und diese elektrische Energie der Antriebssteuereinheit (23) zuzuführen;
das Verfahren einen Tragzustandserkennungsschritt umfasst, um zu erkennen, ob die elektronische Vorrichtung (1) in einem getragenen Zustand ist oder nicht; und
außerdem einen betriebseinleitenden Schritt umfasst, um den Betrieb der Antriebssteuereinheit (23) auf der Basis einer voreingestellten dritten Bedingung zu starten, wenn der Betrieb der Antriebssteuereinheit (23) aufgrund des Betriebsunterbrechungsschritts in einem unterbrochenen Zustand ist;

wobei diese dritte Bedingung fordert, dass in diesem Tragzustandserkennungsschritt erkannt wird, dass die elektronische Vorrichtung (1) von einem nicht getragenen Zustand in einen getragenen Zustand geschaltet hat.

Revendications

1. Dispositif électronique (1) comprenant :

une section d'alimentation en courant chargeable (A, B) pour fournir de l'énergie électrique ;
une section de contrôle motrice (23) actionnée par l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçue pour émettre un signal moteur ;
une section menée (CS, CHM) entraînée par ledit signal moteur ;
une section de commutation de mode (90) conçue pour commuter le mode de fonctionnement de ladite section menée (CS, CHM) entre un mode moteur pour le fonctionnement normal et un mode d'économie de courant en partant d'une première condition préétablie ; et **caractérisé par**

une section de suspension de fonctionnement (93) conçue pour suspendre le fonctionnement de ladite section de contrôle motrice (23) lorsqu'il est déterminé que la quantité d'énergie électrique accumulée dans ladite section d'alimentation en courant (A, B) est inférieure à une quantité prédéterminée d'énergie électrique en partant d'une seconde condition préétablie lorsqu'on est en mode d'économie de courant du fait de ladite section de commutation de mode (90).

2. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section de suspension de fonctionnement (93) est conçue pour suspendre la fourniture d'énergie électrique par ladite section d'alimentation en courant (A, B) à ladite section de contrôle motrice (23) lors de la suspension du fonctionnement de ladite section de contrôle motrice (23).

3. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section de contrôle motrice (23) comprend un circuit de contrôle (24) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour émettre un signal de contrôle, et un circuit moteur (30S, 30HM) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour émettre un signal moteur vers ladite section menée (CS, CHM) en partant du signal de contrôle ; et
ladite section de commutation de mode (90) est conçue pour fournir de l'énergie électrique audit circuit de contrôle (24) et audit circuit moteur (30S, 30H) dans ledit mode moteur et est conçue pour fournir de l'énergie électrique uniquement audit circuit de contrôle (24) en mode d'économie de courant.

4. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section d'alimentation en courant (A, B) comprend une section de génération de courant (A) conçue pour convertir l'énergie externe en énergie interne et une section d'accumulation de courant (B) conçue pour accumuler de l'énergie électrique fournie par ladite section de génération de courant (A) et pour fournir l'énergie électrique à ladite section de contrôle motrice (23).

5. Dispositif électronique (1) selon la revendication 4, dans lequel
ladite section d'accumulation de courant (B) comprend une batterie auxiliaire ou une capacité.

6. Dispositif électronique (1) selon la revendication 4, dans lequel
il est prévu une section de détection d'état de génération de courant (91) conçue pour détecter si oui ou non ladite section de génération de courant (A) est en état de génération de courant; et
ladite première condition est si oui ou non ladite section de génération de courant (A) est en état de génération de courant comme déterminé par ladite section de détection d'état de génération de courant (91) .

7. Dispositif électronique (1) selon la revendication 6, dans lequel
ladite section de détection d'état de génération de courant (91) comprend une section de détermination de quantité d'énergie (97) conçue pou déterminer si oui ou non la quantité d'énergie électrique émise par ladite section de génération de courant (A) excède un critère de quantité d'énergie ; et
une section de détermination de temps de génération de courant (98) conçue pour déterminer si oui ou non une durée, sur laquelle il est déterminé par ladite section de détermination de quantité de courant (97) que la quantité d'énergie électrique excède le critère de quantité d'énergie, excède un critère de valeur temporelle.

8. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section de détection d'état de portage (120) conçue pour déterminer si oui ou non ledit dispositif électrique (1) est en état porté ;
ladite première condition exige, pour commuter le mode de fonctionnement de ladite section menée (CS, CHM) dudit mode moteur audit mode d'économie de courant, qu'il soit détecté par ladite section de détection d'état de portage (120) que ledit dispositif électrique (1) soit en état non porté et que la durée pendant laquelle le dispositif électrique (1) est en état non porté se poursuive pendant un temps prédéterminé ; et
ladite première condition exige, pour commuter le mode de fonctionnement de ladite section menée (CS, CHM) dudit mode d'économie de courant audit mode moteur, que le dispositif électronique (1) soit passé d'un état non porté à un état porté suivant ladite section de détection d'état de portage (120).

9. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section de détection de tension (92) conçue pour détecter la tension de ladite section d'alimentation en courant (A, B) ; et
ladite seconde condition exige que la tension de ladite section d'alimentation en courant (A, B) détectée par ladite

section de détection de tension (92) passe en dessous d'une tension prédéterminée.

10. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section de détection d'énergie électrique conçue pour détecter la quantité d'énergie électrique fournie par ladite section d'alimentation en courant (A, B) ; et
ladite seconde condition exige que la quantité d'énergie électrique pouvant être fournie par ladite section d'alimentation en courant (A, B) et détectée par ladite section de détection d'énergie électrique devienne inférieure à une quantité prédéterminée d'énergie électrique requise pour repasser le mode de fonctionnement de ladite section motrice dudit mode d'économie de courant audit mode moteur.

11. Dispositif électronique (1) selon la revendication 4, dans lequel
il est prévu une section de détection d'état de génération de courant (91) conçue pour détecter si oui ou non ladite section de génération de courant (A) est en état de génération de courant ;
une section d'initiation de fonctionnement conçue pour initier le fonctionnement de ladite section de contrôle motrice (23) lorsqu'une troisième condition préétablie est remplie pendant que le fonctionnement de ladite section de contrôle motrice (23) est à l'état suspendu du fait de ladite section de suspension de fonctionnement (93) ; et
ladite troisième condition exige que l'initiation de la génération de courant par ladite section de génération de courant (A) soit détectée par ladite section de détection d'état de génération de courant (91) .

12. Dispositif électronique (1) selon la revendication 11, dans lequel
l'initiation de génération de courant de ladite troisième condition signifie que la quantité d'énergie électrique émise par ladite section de génération de courant (A) excède une quantité d'énergie suffisante pour la réactivation et que cet état se poursuit pendant une durée prédéterminée.

13. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section de détection d'état de portage (120) conçue pour détecter si oui ou non ledit dispositif électronique (1) est en état porté ;
une section d'initiation de fonctionnement conçue pour initier le fonctionnement de ladite section de contrôle motrice (23) en partant d'une troisième condition préétablie lorsque le fonctionnement de ladite section de contrôle motrice (23) est à l'état suspendu du fait de ladite section de suspension de fonctionnement (93) ; et
ladite section d'initiation de fonctionnement est conçue pour déterminer quand ledit dispositif électronique (1) passe d'un état non porté à un état porté en utilisant ladite section de détection d'état de portage (120) en tant que dite troisième condition.

14. Dispositif électronique (1) selon la revendication 13, dans lequel
la commutation dudit état non porté à l'état porté a lieu lorsque l'état porté se poursuit pendant une durée prédéterminée après la commutation d'un état non porté à un état porté.

15. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section d'entrée à fonctionnement externe (100) conçue pour permettre à un utilisateur de réaliser des opérations de l'extérieur ; et
la commutation dudit mode moteur audit mode d'économie de courant est réalisée par ladite section de commutation de mode (90) en partant des conditions de fonctionnement de ladite section d'entrée à fonctionnement externe (100).

16. Dispositif électronique (1) selon la revendication 1, dans lequel
il est prévu une section d'entrée à fonctionnement externe (100) conçue pour permettre à un utilisateur de réaliser des opérations de l'extérieur ; et
il est prévu une section d'initiation de fonctionnement conçue pour initier le fonctionnement de ladite section de contrôle motrice (23) en partant des conditions de fonctionnement de ladite section d'entrée à fonctionnement externe (100) lorsque ladite section de suspension de fonctionnement (93) détecte que les opérations de ladite section de contrôle motrice (23) sont à l'état suspendu.

17. Dispositif électronique (1) selon l'une quelconque des revendications 1 à 16, dans lequel
ladite section menée (CS, CHM) comporte une section d'affichage d'heure pour afficher l'heure.

18. Dispositif électronique (1) selon la revendication 17, dans lequel
ladite section de contrôle motrice (23) comprend une section de rétablissement d'heure momentanée, conçue pour remettre l'affichage de l'heure à l'heure momentanée lorsque le mode de fonctionnement de la section menée (CS,

CHM) est commuté dudit mode d'économie de courant audit mode moteur par la section de commutation de mode (90).

19. Dispositif électronique (1) selon la revendication 18, dans lequel
ladite quantité prédéterminée d'énergie électrique est fixée à une quantité d'énergie électrique requise pour rétablir l'heure momentanée à partir du mode d'économie d'énergie en utilisant ladite section de rétablissement d'heure momentanée.

20. Dispositif électronique (1) selon la revendication 18, dans lequel
la quantité d'énergie suffisante pour réaliser le rétablissement est fixée à une quantité minimale requise pour permettre l'affichage de l'heure en utilisant ladite section de rétablissement d'heure en initiant le fonctionnement de ladite section de contrôle motrice (23).

21. Dispositif électronique (1) selon la revendication 18, dans lequel
ladite section d'affichage d'heure a des aiguilles (55, 76, 77) conçues pour afficher l'heure et un moteur (10, 60) conçu pour entraîner lesdites aiguilles (55, 76, 77) ; et
ladite section de rétablissement d'heure momentanée est conçue pour rétablir le mouvement des aiguilles (55, 76, 77) au moyen dudit moteur en les remettant à une vitesse de mouvement d'aiguilles à grande vitesse qui est supérieure à la vitesse normale de mouvement des aiguilles.

22. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section de contrôle motrice (23) comprend un circuit de contrôle (24) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour émettre un signal de contrôle ; et un circuit moteur (30S, 30HM) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour recevoir le signal de contrôle et émettre un signal moteur vers ladite section menée (CS, CHM) ;
ledit circuit de contrôle (24) comprend un circuit oscillateur (21) conçu pour générer une impulsion de référence ; et
ladite section de suspension de fonctionnement (93) est conçue pour suspendre le fonctionnement dudit circuit oscillateur (21).

23. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section de suspension de fonctionnement (93) est conçue pour suspendre la fourniture d'énergie électrique audit circuit oscillateur (21).

24. Dispositif électronique (1) selon la revendication 1, dans lequel
ladite section de contrôle motrice (23) comprend un circuit de contrôle (24) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour émettre un signal de contrôle, et un circuit moteur (30S, 30HM) fonctionnant à l'énergie électrique fournie par ladite section d'alimentation en courant (A, B) et conçu pour recevoir le signal de contrôle et émettre un signal moteur vers ladite section menée (CS, CHM) ;
ledit circuit de contrôle (24) comprend un circuit oscillateur (21) conçu pour générer une impulsion de référence et un circuit diviseur conçu pour diviser l'impulsion de référence émise par ledit circuit oscillateur (21) ; et
ladite section de suspension de fonctionnement (93) est conçue pour suspendre le fonctionnement dudit circuit oscillateur (21) ou dudit circuit diviseur.

25. Dispositif électronique (1) selon la revendication 24, dans lequel
ladite section de suspension de fonctionnement (93) comprend un circuit de génération de tension régulée conçu pour générer une tension régulée inférieure à la tension d'alimentation en courant pour entraîner au moins un élément sur le circuit oscillateur (21) et le circuit diviseur ; et
ladite section de suspension de fonctionnement (93) est conçue pour suspendre la fourniture d'énergie électrique audit circuit de génération de tension régulée.

26. Procédé de contrôle pour dispositif électronique (1), comprenant :

une unité d'alimentation en courant chargeable (A, B) pour fournir de l'énergie électrique ;
un circuit de contrôle moteur (23) fonctionnant à l'énergie électrique fournie par ladite unité d'alimentation en courant (A, B) pour émettre un signal moteur ; et
une unité menée (CS, CHM) entraînée du fait qu'elle reçoit le signal moteur émis par ladite unité de contrôle motrice (23) ;
ce procédé de contrôle comprenant :

une étape de commutation de mode pour commuter un mode de fonctionnement de ladite unité menée (CS, CHM) entre un mode moteur et un mode d'économie de courant en partant d'une première condition préétablie ; et

caractérisé par

une étape de suspension de commande pour suspendre le fonctionnement de ladite unité de contrôle motrice (23) lorsqu'il est déterminé que la quantité d'énergie électrique accumulée dans ladite unité d'alimentation en courant (A, B) est inférieure à une quantité prédéterminée d'énergie électrique suivant une seconde condition préétablie, alors que le mode de fonctionnement est mis en mode d'économie de courant par ladite étape de commutation de mode.

27. Procédé de contrôle pour dispositif électronique (1) selon la revendication 26, dans lequel :

ladite unité d'alimentation en courant (A, B) comprend un dispositif de génération de courant (A) pour convertir l'énergie externe en énergie électrique et un dispositif d'accumulation de courant (B) pour accumuler de l'énergie électrique fournie par ledit dispositif de génération de courant (A) et fournir ladite énergie électrique à ladite unité de contrôle motrice (23) ;
ledit procédé comprend en outre une étape de détection d'état de génération de courant pour déterminer si oui ou non du courant est généré par le dispositif de génération de courant (A) ; et
ladite première condition exige que du courant généré par ledit dispositif de génération de courant (A) soit détecté pendant ladite étape de détection d'état de génération de courant.

28. Procédé de contrôle pour dispositif électronique (1) selon la revendication 27, dans lequel :

ladite étape de détection d'état de génération de courant comprend une étape de détermination de quantité de courant pour déterminer si oui ou non la quantité d'énergie électrique émise par ledit dispositif de génération de courant (A) a excédé un critère de quantité d'énergie ; et
une étape de détermination de temps de génération de courant pour déterminer si oui ou non la durée pendant laquelle la quantité d'énergie électrique excédant le critère de quantité d'énergie telle que déterminé pendant ladite étape de détermination de quantité d'énergie excède un critère de valeur temporelle.

29. Procédé de contrôle pour dispositif électronique (1) selon la revendication 26, dans lequel :

ledit procédé comprend en outre une étape de détection d'état de portage pour détecter si oui ou non le dispositif électronique (1) est porté ;
ladite première condition exige, pour commuter le mode de fonctionnement de ladite unité menée (CS, CHM) dudit mode moteur audit mode d'économie de courant, qu'il soit détecté que ledit dispositif électronique (1) est en état non porté pendant ladite étape de détection d'état de portage et que le temps pendant lequel ledit dispositif électronique (1) est en état non porté se poursuive pendant un temps prédéterminé et ladite première condition exige, pour commuter le mode de fonctionnement de ladite unité motrice dudit mode d'économie de courant audit mode moteur, qu'une commutation de l'état non porté à un état porté soit détectée pendant ladite étape de détection d'état de portage.

30. Procédé de contrôle pour dispositif électronique (1) selon la revendication 26, comprenant :

une étape de détection de quantité d'énergie électrique pour détecter une quantité d'énergie électrique fournie par ladite unité d'alimentation en courant (A, B) ; et
ladite seconde condition exige que la quantité d'énergie électrique pouvant être fournie par ladite unité d'alimentation en courant (A, B) détectée par ladite étape de détection d'énergie électrique soit inférieure à une quantité prédéterminée d'énergie électrique requise pour repasser le mode de fonctionnement de ladite unité menée (CS, CHM) dudit mode d'économie de courant audit mode moteur.

31. Procédé de contrôle pour dispositif électronique (1) selon la revendication 26, dans lequel :

ladite unité d'alimentation en courant (A, B) comprend un dispositif de génération de courant (A) pour convertir l'énergie externe en énergie électrique et un dispositif d'accumulation de courant (B) pour accumuler l'énergie électrique fournie par ledit dispositif de génération de courant (A) et fournir ladite énergie électrique à ladite unité de contrôle motrice (23) ;

ce procédé comprend une étape de détection d'état de génération de courant pour détecter si oui ou non ledit dispositif de génération de courant (A) est en état de génération de courant ; et
comprend en outre une étape d'initiation de fonctionnement pour initier le fonctionnement de l'unité de contrôle motrice (23) à partir d'une troisième condition préétablie lorsqu'il est déterminé que le fonctionnement de ladite unité de contrôle motrice (23) est à l'état suspendu pendant ladite étape de suspension de fonctionnement ; et
ladite troisième condition exige que ledit dispositif de génération de courant (A) initiant la génération de courant soit détecté pendant ladite étape de détection d'état de génération de courant.

32. Procédé de contrôle pour dispositif électronique (1) selon la revendication 26, dans lequel :

ladite unité d'alimentation en courant (A, B) comprend un dispositif de génération de courant (A) pour convertir l'énergie externe en énergie électrique et un dispositif d'accumulation de courant (B) pour accumuler l'énergie électrique fournie par ledit dispositif de génération de courant (A) et fournir ladite énergie électrique à ladite unité de contrôle motrice (23) ;
ledit procédé comprend une étape de détection d'état de portage pour détecter si oui ou non ledit dispositif électronique (1) est en état porté ; et
comprend en outre une étape d'initiation de fonctionnement pour initier le fonctionnement de l'unité de contrôle motrice (23) en partant d'une troisième condition préétablie lorsque le fonctionnement de ladite unité de contrôle motrice (23) est à l'état suspendu du fait de ladite étape de suspension de fonctionnement ;
ladite troisième condition exige qu'il soit détecté que ledit dispositif électronique (1) soit passé d'un état non porté à un état porté pendant ladite étape de détection d'état de portage.

FIG. 1

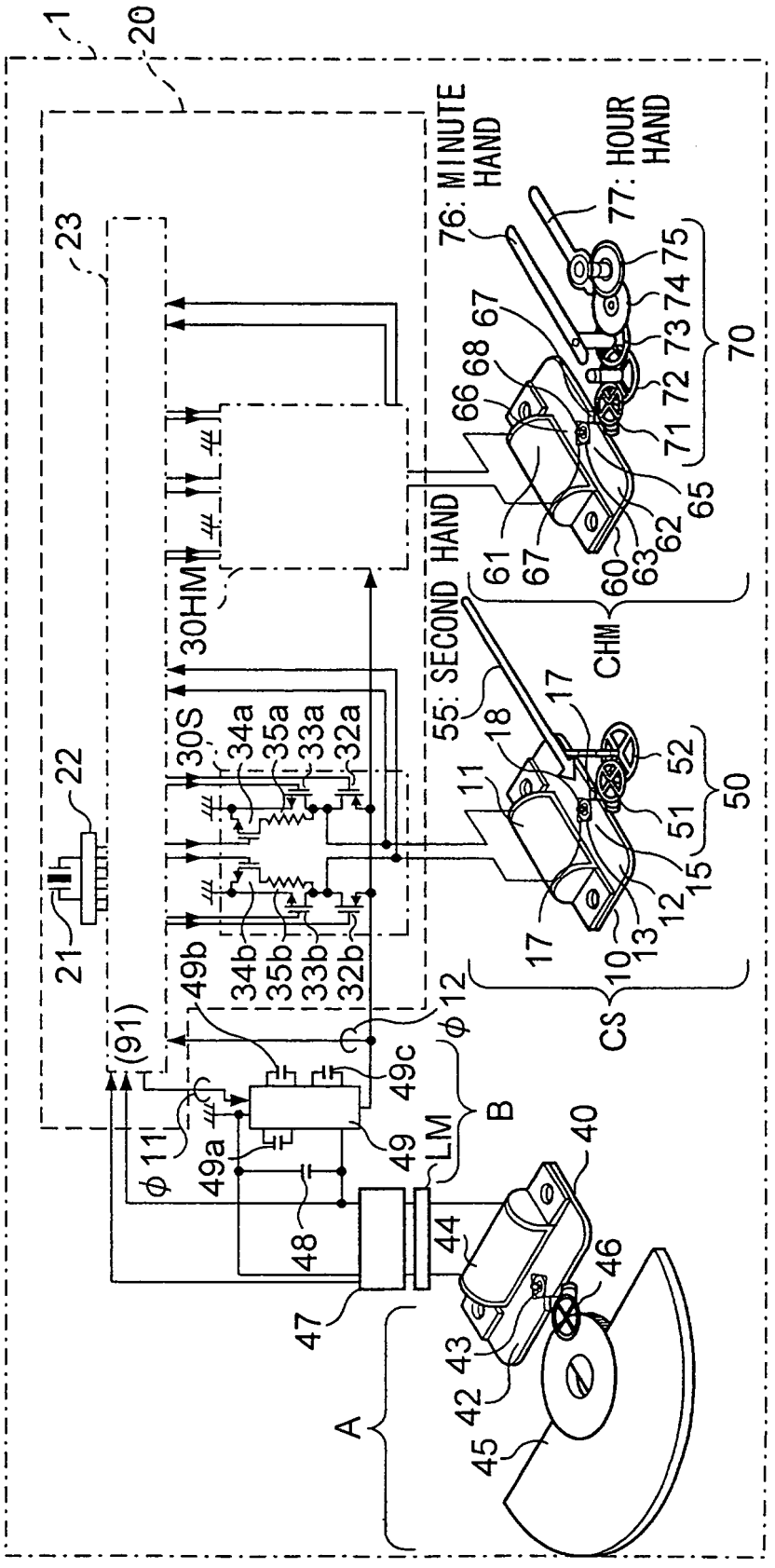

1
20
23
76: MINUTE HAND
77: HOUR HAND
55: SECOND HAND
30HM
30S
34a
35a
33a
32a
34b
35b
33b
32b
22
21
49b
(91)
49c
49a
49
48
47
44
46
43
42
45
40
LM
B
A
CHM
CS
70
50
61
67
60
63
62
65
66
68
71
72
73
74
75
18
17
11
52
51
15
12
13
10
φ12
φ11

FIG. 2

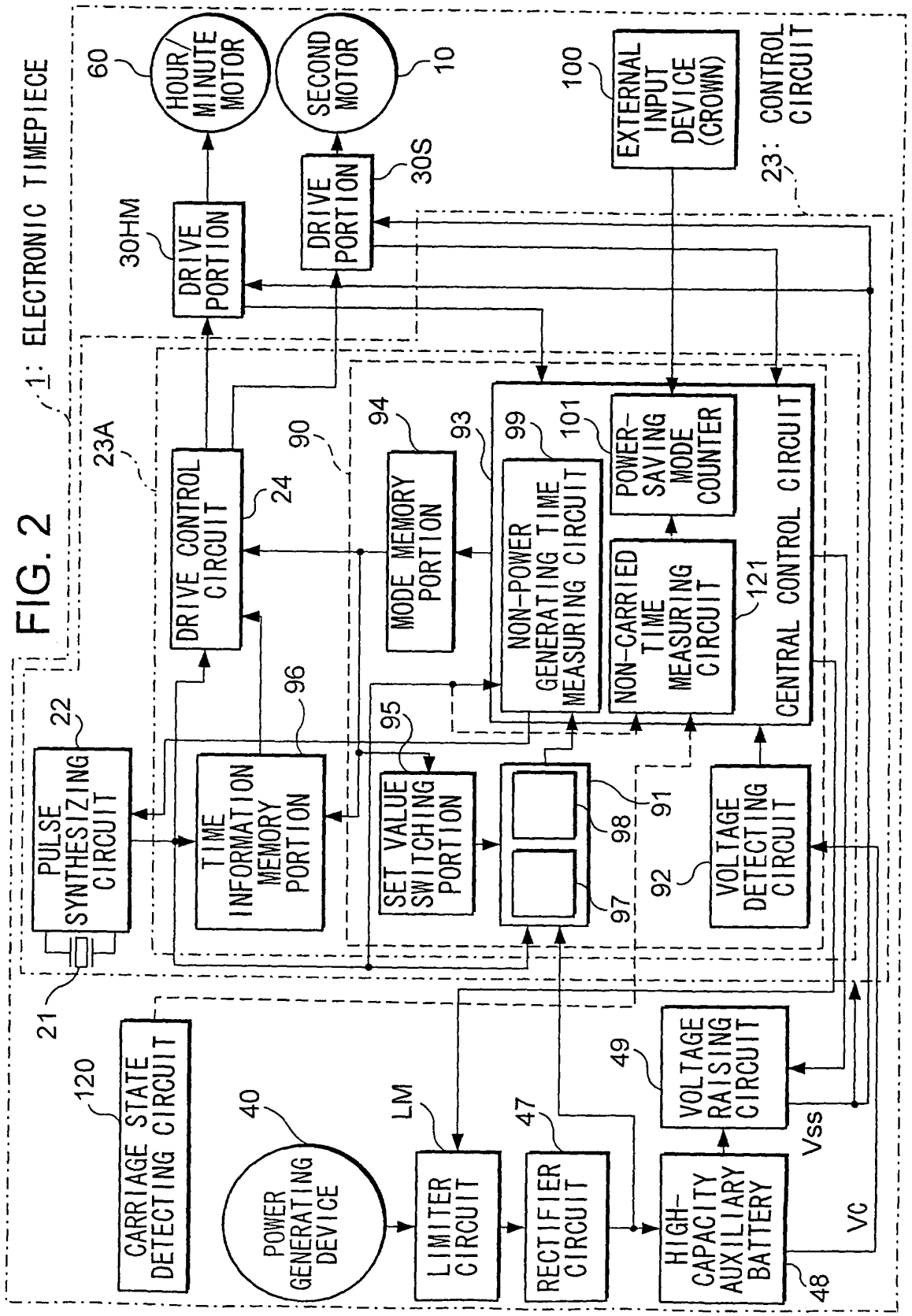

1: ELECTRONIC TIMEPIECE
23: CONTROL CIRCUIT
CENTRAL CONTROL CIRCUIT
HOUR/MINUTE MOTOR
SECOND MOTOR
EXTERNAL INPUT DEVICE (CROWN)
DRIVE PORTION
DRIVE PORTION
DRIVE CONTROL CIRCUIT
MODE MEMORY PORTION
NON-POWER GENERATING TIME MEASURING CIRCUIT
POWER-SAVING MODE COUNTER
NON-CARRIED TIME MEASURING CIRCUIT
PULSE SYNTHESIZING CIRCUIT
TIME INFORMATION MEMORY PORTION
SET VALUE SWITCHING PORTION
VOLTAGE DETECTING CIRCUIT
CARRIAGE STATE DETECTING CIRCUIT
POWER GENERATING DEVICE
LIMITER CIRCUIT
RECTIFIER CIRCUIT
VOLTAGE RAISING CIRCUIT
HIGH-CAPACITY AUXILIARY BATTERY
60
10
100
30HM
30S
23A
90
94
93
99
101
24
96
95
22
98
91
97
92
121
21
120
40
LM
47
49
Vss
VC
48

FIG. 3

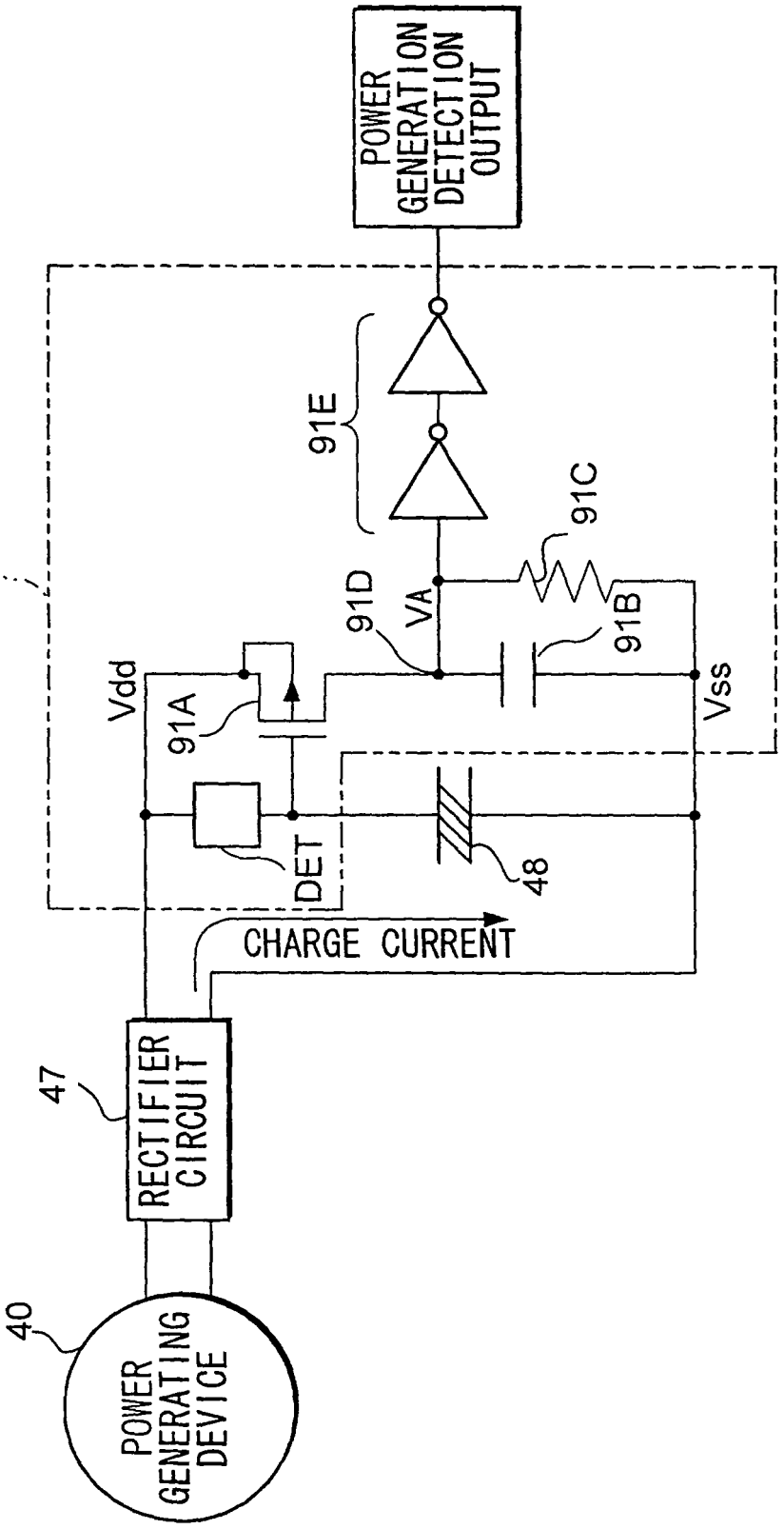

POWER GENERATION DETECTION OUTPUT
91
91E
91C
91D
VA
91B
Vdd
91A
Vss
DET
48
CHARGE CURRENT
47
RECTIFIER CIRCUIT
40
POWER GENERATING DEVICE

FIG. 4

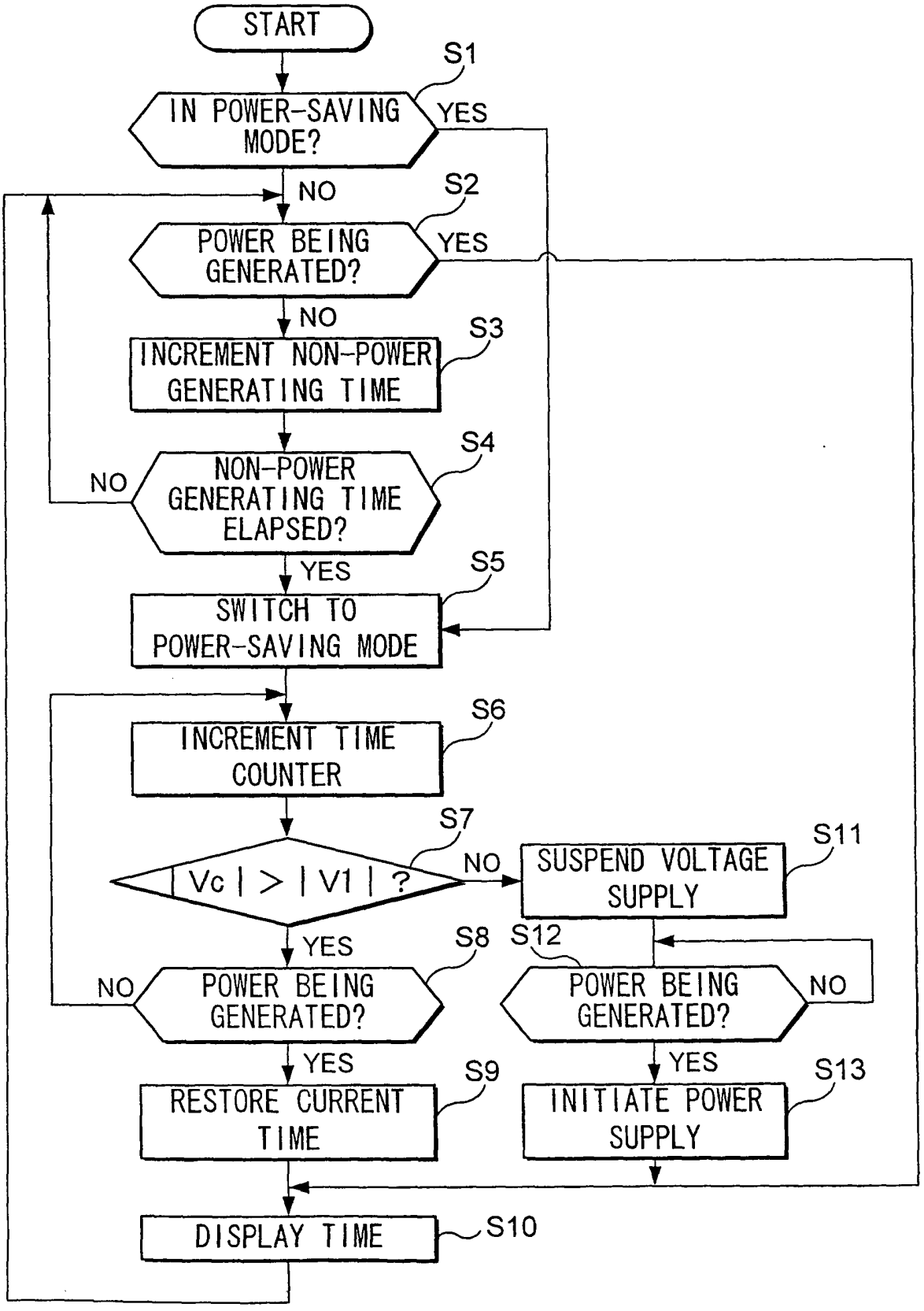

START
S1
IN POWER-SAVING MODE?
YES
NO
S2
POWER BEING GENERATED?
YES
NO
S3
INCREMENT NON-POWER GENERATING TIME
S4
NO
NON-POWER GENERATING TIME ELAPSED?
YES
S5
SWITCH TO POWER-SAVING MODE
S6
INCREMENT TIME COUNTER
S7
| Vc | > | V1 | ?
NO
S11
SUSPEND VOLTAGE SUPPLY
YES
S8
S12
NO
POWER BEING GENERATED?
POWER BEING GENERATED?
NO
YES
YES
S9
S13
RESTORE CURRENT TIME
INITIATE POWER SUPPLY
DISPLAY TIME
S10

FIG. 5

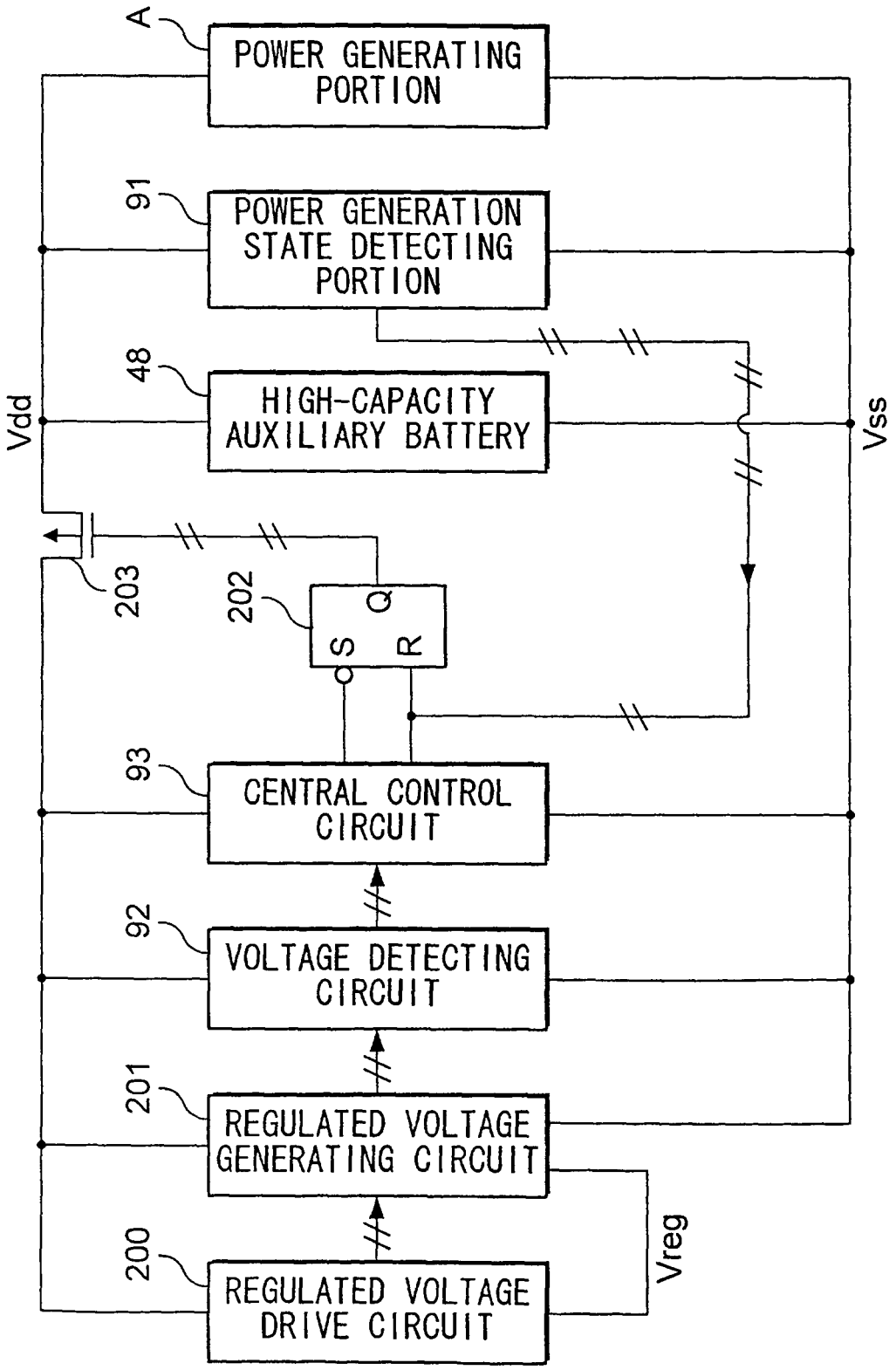

A
POWER GENERATING PORTION
91
POWER GENERATION STATE DETECTING PORTION
48
HIGH-CAPACITY AUXILIARY BATTERY
Vdd
Vss
203
202
Q
S
R
93
CENTRAL CONTROL CIRCUIT
92
VOLTAGE DETECTING CIRCUIT
201
REGULATED VOLTAGE GENERATING CIRCUIT
200
REGULATED VOLTAGE DRIVE CIRCUIT
Vreg

FIG. 6

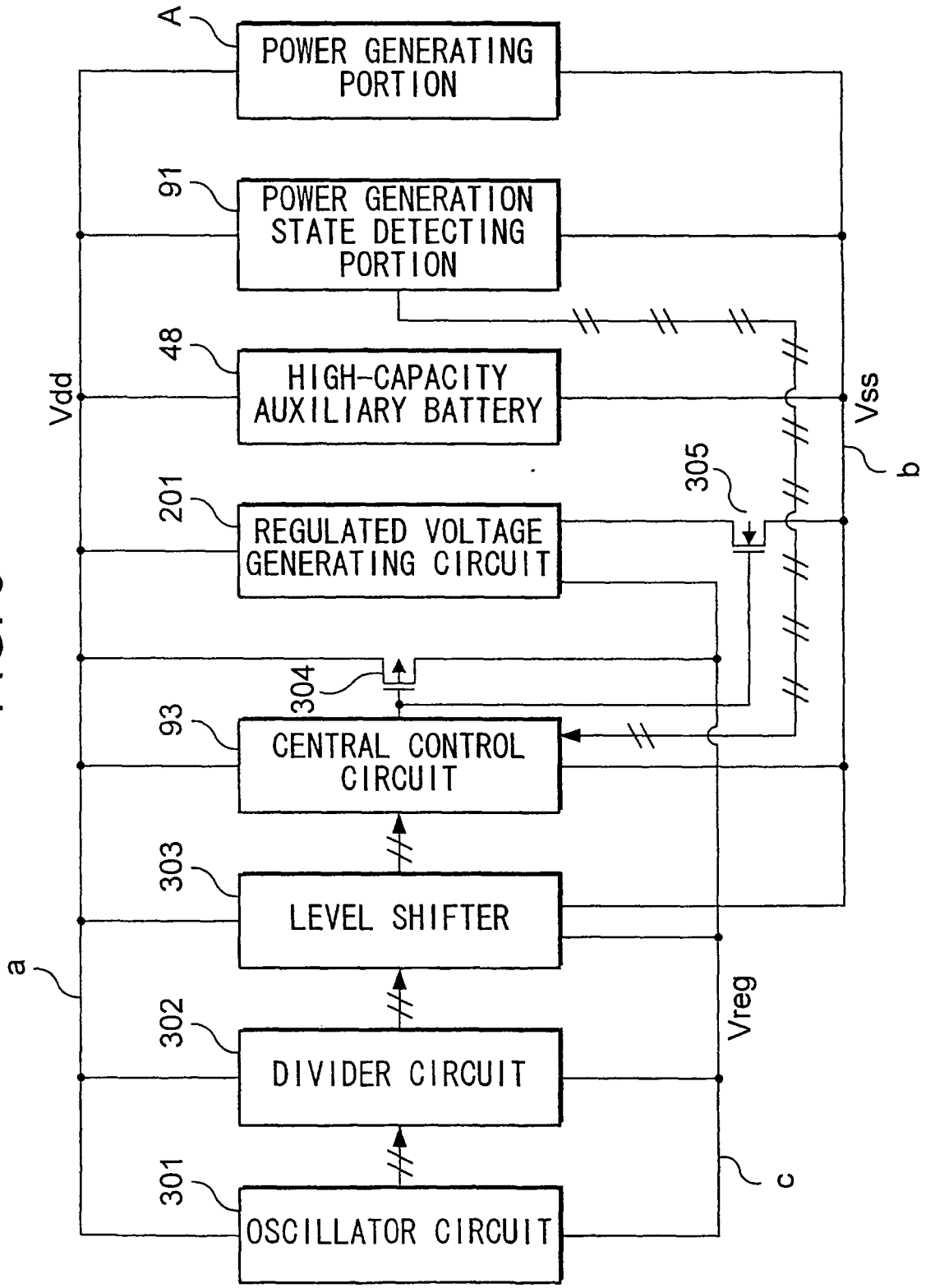

A
POWER GENERATING PORTION
91
POWER GENERATION STATE DETECTING PORTION
48
HIGH-CAPACITY AUXILIARY BATTERY
Vdd
Vss
b
305
201
REGULATED VOLTAGE GENERATING CIRCUIT
304
93
CENTRAL CONTROL CIRCUIT
303
LEVEL SHIFTER
a
302
DIVIDER CIRCUIT
Vreg
301
OSCILLATOR CIRCUIT
c

FIG. 7

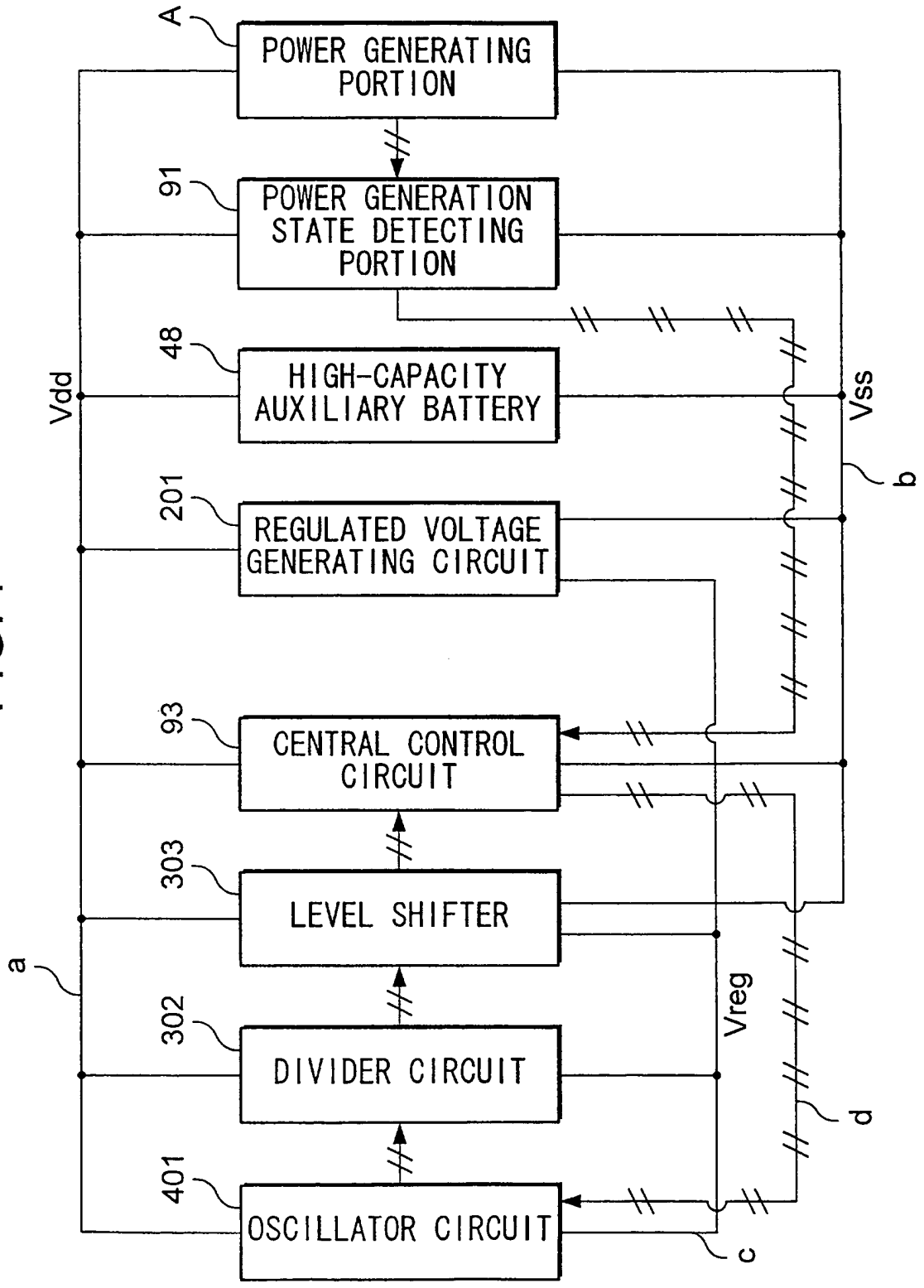

A
POWER GENERATING PORTION
91
POWER GENERATION STATE DETECTING PORTION
48
HIGH-CAPACITY AUXILIARY BATTERY
Vdd
Vss
b
201
REGULATED VOLTAGE GENERATING CIRCUIT
93
CENTRAL CONTROL CIRCUIT
303
LEVEL SHIFTER
a
302
DIVIDER CIRCUIT
Vreg
d
401
OSCILLATOR CIRCUIT
c

FIG. 8

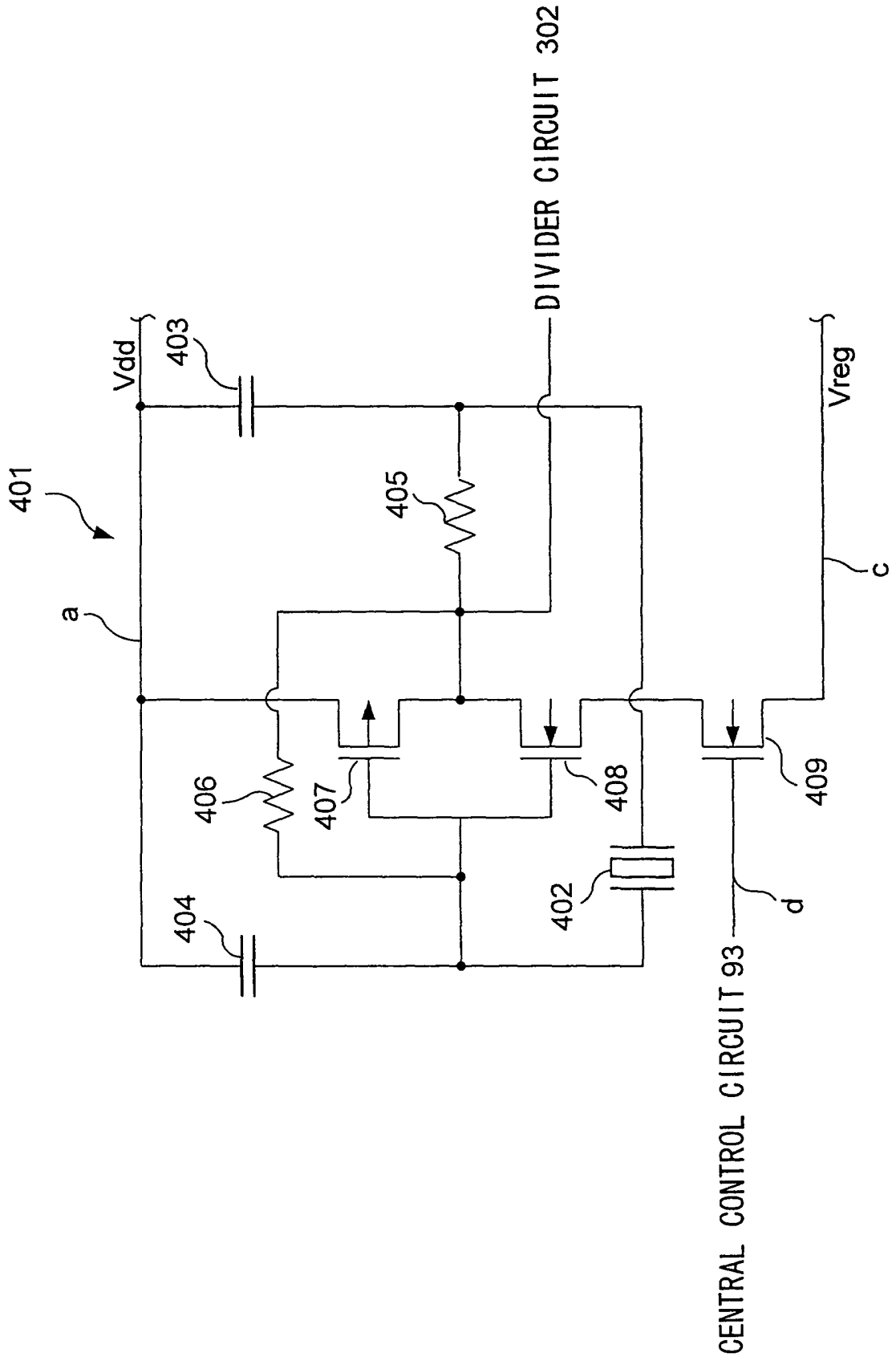

DIVIDER CIRCUIT 302
Vdd
403
401
405
Vreg
a
c
406
407
408
409
402
404
d
CENTRAL CONTROL CIRCUIT 93

FIG 9

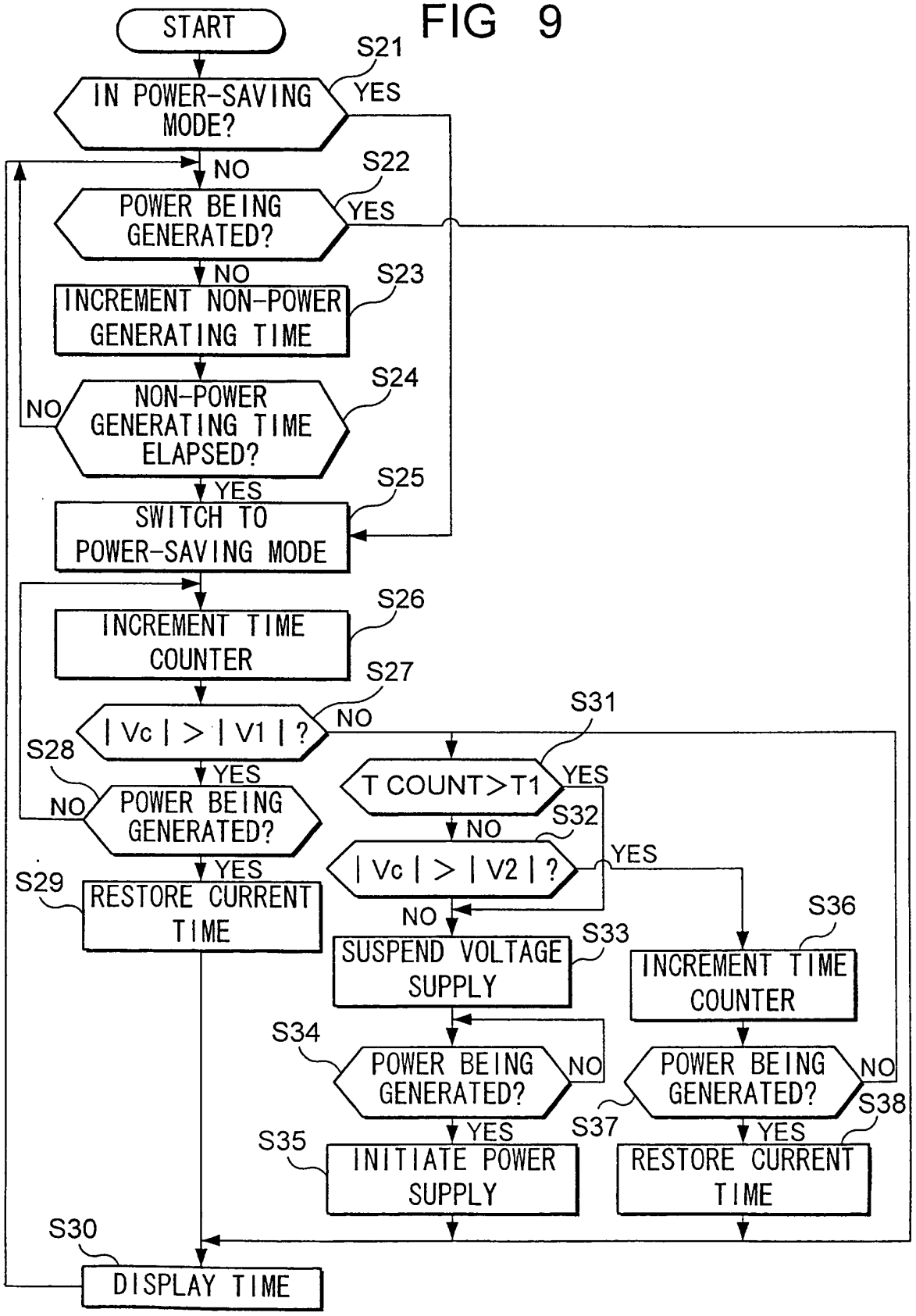

START
S21
IN POWER-SAVING MODE?
YES
NO
S22
POWER BEING GENERATED?
YES
NO
S23
INCREMENT NON-POWER GENERATING TIME
S24
NO
NON-POWER GENERATING TIME ELAPSED?
YES
S25
SWITCH TO POWER-SAVING MODE
S26
INCREMENT TIME COUNTER
S27
| Vc | > | V1 | ?
NO
S31
S28
YES
T COUNT>T1
YES
NO
POWER BEING GENERATED?
S32
| Vc | > | V2 | ?
YES
YES
S29
RESTORE CURRENT TIME
NO
S36
S33
SUSPEND VOLTAGE SUPPLY
INCREMENT TIME COUNTER
S34
POWER BEING GENERATED?
NO
POWER BEING GENERATED?
NO
S37
S38
YES
YES
S35
INITIATE POWER SUPPLY
RESTORE CURRENT TIME
S30
DISPLAY TIME

FIG. 10

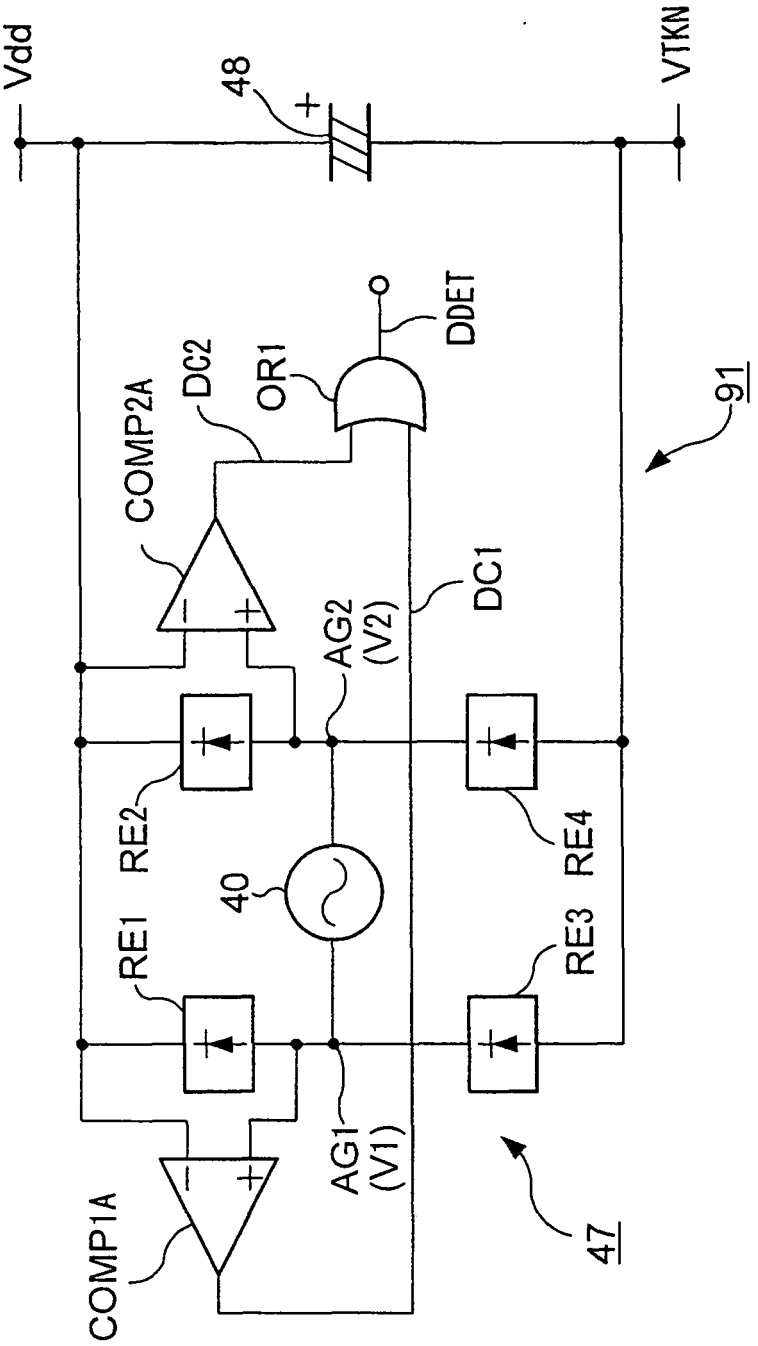

Vdd
48
VTKN
DDET
OR1
DC2
COMP2A
91
DC1
AG2
(V2)
RE2
RE4
40
RE1
RE3
AG1
(V1)
COMP1A
47

FIG. 11

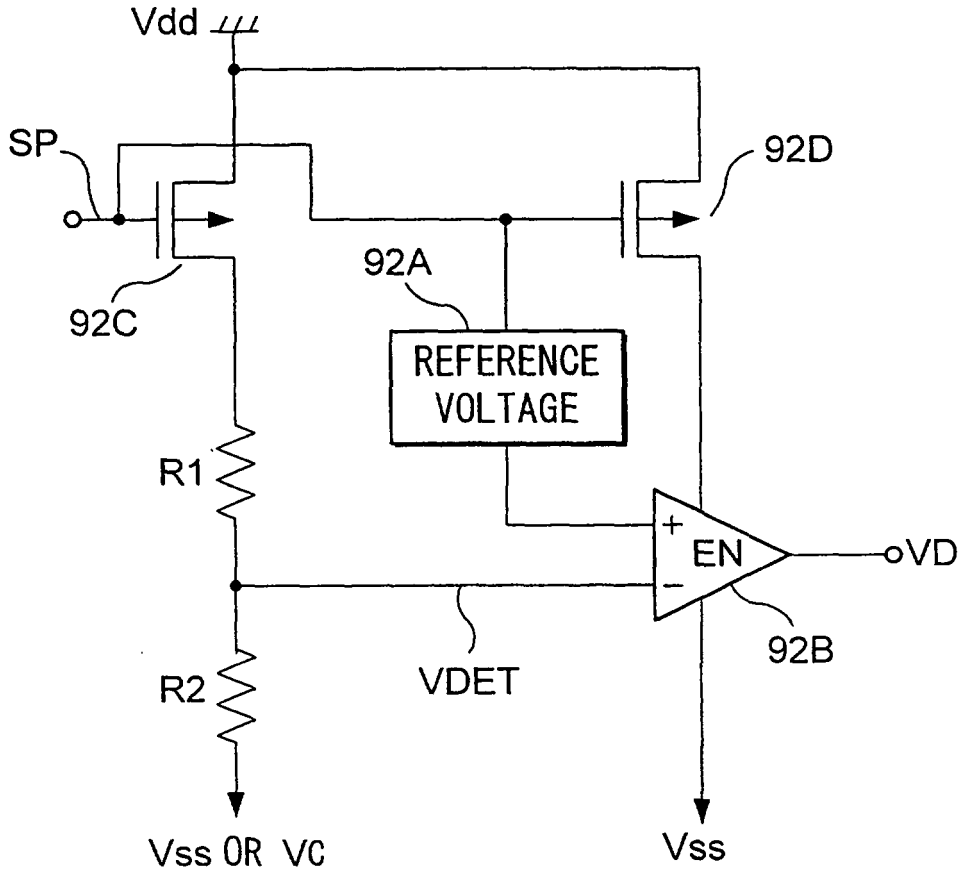
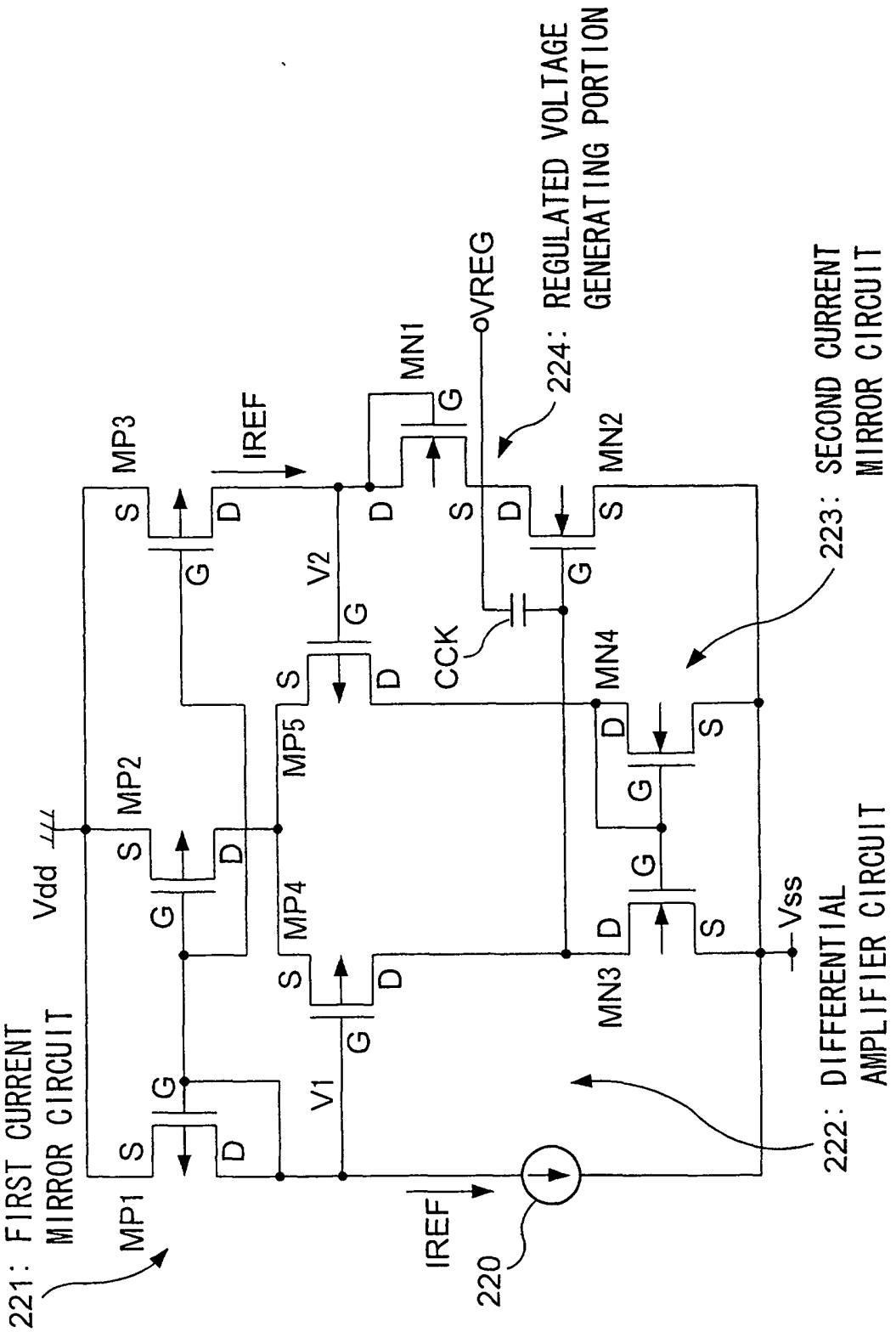

Vdd
SP
92D
92A
92C
REFERENCE VOLTAGE
R1
EN
VD
92B
R2
VDET
Vss OR VC
Vss

FIG. 12


201: REGULATED VOLTAGE GENERATING CIRCUIT
221: FIRST CURRENT MIRROR CIRCUIT
222: DIFFERENTIAL AMPLIFIER CIRCUIT
223: SECOND CURRENT MIRROR CIRCUIT
224: REGULATED VOLTAGE GENERATING PORTION
Vdd
Vss
VREG
IREF
IREF
CCK
V1
V2
MP1
MP2
MP3
MP4
MP5
MN1
MN2
MN3
MN4
220