(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 273 982 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
08.01.2003 Bulletin 2003/02

(21) Application number: **00917278.4**

(22) Date of filing: **12.04.2000**

(51) Int Cl.[7]: **G04C 3/00**, G04C 3/14, G04C 10/00, G04G 1/00

(86) International application number:
PCT/JP00/02360

(87) International publication number:
WO 01/079940 (25.10.2001 Gazette 2001/43)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant: **Seiko Instruments Inc.**
Chiba-shi, Chiba-ken 261-0023 (JP)

(72) Inventors:
- **WATANABE, Mamoru, c/o Seiko Instruments Inc**
Chiba-shi, Chiba 261-0023 (JP)
- **JUJO, Koichiro, c/o Seiko Instruments Inc.**
Chiba-shi, Chiba 261-0023 (JP)
- **TOKORO, Takeshi, c/o Seiko Instruments Inc.**
Chiba-shi, Chiba 261-0023 (JP)

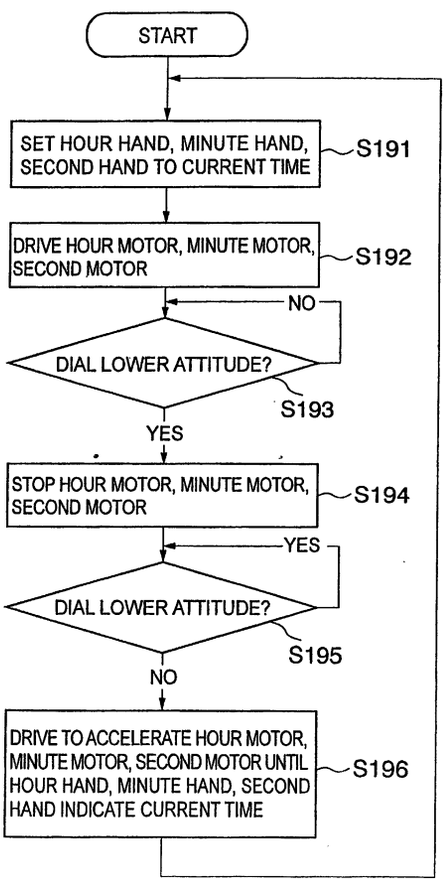
(74) Representative: **BOVARD AG - Patentanwälte**
Optingenstrasse 16
3000 Bern 25 (CH)

(54) ANALOG ELECTRONIC TIMEPIECE WITH POSTURE SENSOR

(57) An analog electronic timepiece of the invention includes a plurality of motors, a plurality of display members operated by rotation of the plurality of motors for displaying time information, an attitude sensor 610 for detecting an attitude of the analog electronic timepiece, an attitude detecting portion 340 for detecting the attitude of the analog electronic timepiece based on an output signal of the attitude sensor 610 and an output determining portion 344 for outputting a signal for controlling operation of the rotation of the plurality of motors based on an output signal of the attitude detecting portion 340.

When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into a previously determined attitude, based on the output signal of the attitude detecting portion 340, all of themotors are stopped. The output determining portion 344 is constituted to measure a difference between current time and time at which an hour hand, a minute hand and a second hand are stopped. When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the previously determined attitude, based on the output signal of the attitude detecting portion 340, the hour motor 210 is driven to accelerate to reach a position at which the hour hand indicates the current time, the minute motor 240 is driven to accelerate to reach a position at which the minute hand indicates the current time and the second motor 270 is driven to accelerate to reach a position at which the second hand indicates the current time.

FIG.19



EP 1 273 982 A1

Description

[Technical Field]

[0001] The present invention relates to an analog electronic timepiece having an attitude sensor constituted to detect an attitude of the analog electronic timepiece by the attitude sensor and to control rotation of a display member of the analog electronic timepiece based on a result of detecting the attitude.

[Background of the Invention]

(1) Structure of conventional analog electronic timepiece

[0002] Conventionally, a movement (machine body) of an analog electronic timepiece is provided with a main plate constituting a base plate of the movement. A dial is attached to the movement.

[0003] According to an analog electronic timepiece, assuming a state of being attached with a dial, there are defined "flat attitude" in which the dial becomes horizontal and "erect attitude (vertical attitude)" in which the dial becomes vertical. According to the invention, particularly, an attitude in which the dial becomes horizontal by directing the dial to a lower side is referred to as "flat attitude" and an attitude in which the dial becomes horizontal by directing the dial to an upper side is referred to as "back flat attitude".

[0004] Generally, in both sides of the main plate, a side having the dial is referred to as "back side" of movement and a side opposed to the side having the dial is referred to as "front side". A train wheel integrated to "front side" of movement is referred to as "front train wheel" and a train wheel integrated to "back side" of movement is referred to as "back train wheel".

[0005] The movement (machine body) of the analog electronic timepiece is provided with the main plate constituting the base plate of the movement.

[0006] The "front side" of the movement is arranged with abattery, a circuit block, an hour motor, an hour display train wheel, a minute motor, a minute display train wheel, a second motor, a second display train wheel and so on. The hour display train wheel is rotated by rotation of the hour motor and "hour" of current time is displayed by an hour hand. The minute display train wheel is rotated by rotation of the minute motor and "minute" of the current time is displayed by a minute hand. The second display train wheel is rotated by rotation of the second motor and "second" of the current time is displayed by a second hand.

(2) Representative literatures disclosing conventional technologies

[0007]

- Japanese Utility Model Laid-Open No. 122885/1985 discloses an analog electronic timepiece having a plurality of step motors.
- Japanese Utility Mode Laid-Open No. 87288/1989 discloses a train wheel structure of an analog electronic timepiece having two or more of rotors.
- Japanese Patent Laid-Open No. 77678/1990 discloses a multiple function electronic timepiece having a plurality of stepmotors, alarming means and a plurality of external operating means.
- Japanese Patent Laid-Open No. 109094/1991 discloses an analog electronic timepiece having a plurality of step motors, in which the respective motors are driven by signals having different frequencies.
- Japanese Patent Laid-Open No. 148193/1988 discloses an electricity charging type electronic timepiece constituted to interrupt display of current time by stopping driving motors when potential of a secondary battery is lowered to a set value and simultaneously count a difference between time at which the motors are stopped driving and current time by operating a real time storing circuit. The set value of potential of the second battery is a value proximate to minimum voltage necessary for driving the motors and by stopping the motors consuming current far larger than current consumed in an electronic circuit including the real time storing circuit, current consumption of the second battery is restrained and the electricity charging type electronic timepiece can continue to be operated during a time period until the secondary buttery is charged again.

(3) Problem of conventional technology

[0008] The conventional analog electronic timepiece is constituted always to display "hour" by rotation of the hour motor, display "minute" by rotation of the minute motor and display "second" by rotation of the second motor when a reset switch is temporarily released to thereby operate the timepiece. Therefore, it is difficult to reduce power consumption of the motors.

[0009] Further, according to the conventional analog electronic timepiece, when the reset switch is operated for reducing power consumption of the motors, although the hour motor, the minute motor and the second motor can be stopped, when the timepiece is operated again by releasing the reset switch, positions of the hour hand, the minute hand and the second hand must be set to current time. Therefore, according to the conventional analog electronic timepiece, operation of the analog electronic timepiece after operating the reset switch becomes troublesome.

[0010] Further, according to the conventional analog

electronic timepiece, in order to prolong battery life of the time piece, the size (diameter, thickness) of the battery must be enlarged. Therefore, when the size (diameter, thickness) of the battery is enlarged, the size (diameter, thickness) of the timepiece is also enlarged.

(4) Object of invention

[0011] Hence, in order to resolve the above-described problem of the conventional analog electronic timepiece, it is an object of the invention to provide an analog electronic timepiece constituted to detect an attitude of the analog electronic timepiece and control rotation of a display member by a result of the detection and having small power consumption of motors.

[0012] It is another object of the invention to provide an analog electronic timepiece which is small-sized, thin and having long battery life.

[0013] It is another object of the invention to provide an analog electronic timepiece having excellent operability.

[Summary of the Invention]

[0014] According to an aspect of the invention, there is provided an analog electronic timepiece characterized in an analog electronic timepiece comprising a plurality of motors, a plurality of display members operated by rotation of the plurality of motors for displaying time information, an attitude sensor for detecting an attitude of the analog electronic timepiece, and an attitude detecting portion for detecting the attitude of the analog electronic timepiece based on an output signal of the attitude sensor, wherein operation of the rotation of the plurality of motors is controlled based on an output signal of the attitude detecting portion.

[0015] It is preferable that the analog electronic timepiece of the invention further includes a drive control portion for controlling the operation of the rotation of the plurality of motors and an output determining portion for operating the drive control portion based on the output signal of the attitude detecting portion.

[0016] It is preferable that the analog electronic timepiece of the invention is constituted such that the plurality of motors include an hour motor, a minute motor and a second motor, an hour display train wheel is rotated by driving the hour motor and "hour" is displayed by an hour hand, a minute display train wheel is rotated by driving the minute motor and "minute" is displayed by a minute hand, a second display train wheel is rotated by driving a second motor and "second" is displayed by a secondhand, when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, all of the motors are stopped.

[0017] It is preferable that the analog electronic timepiece of the invention is constituted such that there is provided an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand, the minute hand and the second hand are stopped, and when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the hour motor is driven to accelerate to reach a position at which the hour hand indicates the current time, the minute motor is driven to accelerate to reach a position at which the minute hand indicates the current time and the second motor is driven to accelerate to reach a position at which the second hand indicates the current time.

[0018] The analog electronic timepiece of the invention may be constituted such that when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the second motor is stopped. According to the constitution, it is preferable that there is provided an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the second hand is stopped, when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the second motor is driven to accelerate to reach a position at which the second hand indicates the current time.

[0019] Further, the analog electronic timepiece of the invention maybe constituted such that when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the minute motor and the second motor are stopped. According to the constitution, it is preferable that there is provided an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the minute hand and the second hand are stopped, when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the minute motor is driven to accelerate to reach a position at which the minute hand indicates the current time and the second motor is driven to accelerate to reach a position at which the second hand indicates the current time.

[0020] Further, it is preferable that the analog electronic timepiece of the invention further comprising a date wheel rotated by rotation of the hour display train wheel.

[0021] Further, it is preferable that the analog electronic timepiece of the invention is constituted such that the plurality of motors include an hour/minute motor and a second motor, a minute display train wheel is rotated by driving the hour/minute motor, "minute" is displayed

by a minute hand, a minute train wheel is rotated by rotating the minute display train wheel and "hour" is displayed by the hour hand, the second display train wheel is rotated by driving the second motor and "second" is displayed by the second hand, wherein when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the hour/minute motor and the second motor are stopped, further comprising an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand, the minute hand and the second hand are stopped, and when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the hour/minute motor is driven to accelerate to reach a position at which the hour hand and the minute hand indicate the current time and the second motor is driven to accelerate to reach a position at which the second hand indicates the current time.

[0022] Further, it is preferable that the analog electronic timepiece of the invention is constituted such that when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the second motor is stopped, there is provided an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the second hand is stopped, and when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the second motor is driven to accelerate to reach a position at which the second hand indicates the current time.

[0023] By constituting in this way, there can be realized an analog electronic timepiece in which power consumption of the motors is small and which is small-sized, thin and having long battery life.

[0024] Further, it is preferable that the analog electronic timepiece of the invention further comprising a date wheel rotated by rotation of a minute train wheel.

[0025] Further, according to the analog electronic timepiece of the invention, it is preferable that the previously determined attitude is an attitude by which a dial is directed to a lower side.

[0026] Further, according to the analog electronic timepiece of the invention, it is preferable that a step of determining that the analog electronic timepiece is brought into the previously determined attitude by the attitude detecting portion is determined with a threshold of a constant detecting time period as a reference.

[0027] Or, the analog electronic timepiece of the invention may be constituted such that a step of determining that the analog electronic timepiece is not brought into the previously determined attitude by the attitude detecting portion is determined with a threshold of a constant detecting time period as a reference.

[0028] Further, according to the analog electronic timepiece of the invention, it is preferable that the step of determining that the analog electronic timepiece is brought into the previously determined attitude by the attitude detecting portion is determined by detecting that the signal outputted by the attitude sensor is outputted continuously during a constant time period.

[0029] Or, the analog electronic timepiece of the invention may be constituted such that the step of determining that the analog electronic timepiece is not brought into the previously determined attitude by the attitude detecting portion is determined by detecting that the signal outputted by the attitude sensor is outputted continuously during a constant time period.

[0030] By constituting in this way, the attitude of the analog electronic timepiece can be detected firmly by excluding influence by chattering of the attitude sensor.

[0031] Further, the invention is applicable also to an analog electronic timepiece having a structure with no second hand.

[0032] That is, according to another aspect of the invention, there is provided an analog electronic timepiece characterized in an analog electronic timepiece comprising one or more of motors, display members operated by rotation of one or more of the motors for displaying time information, an attitude sensor for detecting an attitude of the analog electronic timepiece, and an attitude detecting portion for detecting the attitude of the analog electronic timepiece based on an output signal of the attitude sensor, wherein operation of the rotation of one or more of the motors is controlled based on an output signal of the attitude detecting portion.

[0033] According to the analog electronic timepiece of the invention, it is preferable that the analog electronic timepiece further comprises a drive control portion for controlling the operation of the rotation of one or more of the motors and an output determining portion for operating the drive control portion based on the output signal of the attitude detecting portion.

[0034] Further, it is preferable that the analog electronic timepiece of the invention is constituted such that one or more of the motors include an hour motor and a minute motor, wherein an hour display train wheel is rotated by driving the hour motor and "hour" is displayed by an hour hand, a minute display train wheel is rotated by driving the minute motor and "minute" is displayed by a minute hand, when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the hour motor and the minute motor are stopped, further comprising an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand and the minute hand are stopped, when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously

determined attitude, by operating the output determining portion based on the signal outputted by the attitude detecting portion, the hour motor is driven to accelerate to reach a position at which the hour hand indicates the current time and the minute motor is driven to accelerate to reach a position at which the minute hand indicates the current time.

[0035] Further, it is preferable that the analog electronic timepiece of the invention is constituted such that one or more of the motors include an hour/minute motor, wherein a minute display train wheel is rotated by driving the hour/minute motor, "minute" is displayed by a minute hand, a minute train wheel is rotated by rotating the minute display train wheel and "hour" is displayed by an hour hand, when the attitude detecting portion determines that the analog electronic timepiece is brought into a previously determined attitude, the hour/minute motor is stopped, further comprising an output determining portion for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand and the minute hand are stopped, and when the attitude detecting portion determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion based on a signal outputted by the attitude detecting portion, the hour/minute motor is driven to accelerate to reach a position at which the hour hand and the minute hand indicate the current time.

[0036] By constituting in this way, according to the analog electronic timepiece having the structure with no second hand, power consumption of the motors can be reduced and battery life can be prolonged.

[Brief Description of the Drawings]

[0037]

Fig. 1 is a plane view showing an outline shape viewing a movement from a front side according to a first embodiment of an analog electronic timepiece according to the invention (in Fig. 1, portions of parts are omitted).

Fig. 2 is an outline partial sectional view showing a portion from a second motor to a second hand according to the first embodiment of the analog electronic timepiece according to the invention.

Fig. 3 is an outline partial sectional view showing a portion from a minute motor to a minute hand according to the first embodiment of the analog electronic timepiece according to the invention.

Fig. 4 is an outline partial sectional view showing a portion from an hour motor to an hour hand according to the first embodiment of the analog electronic timepiece according to the invention.

Fig. 5 is a block diagram showing an outline constitution of portions of circuits, motors, train wheels and indicators according to the first embodiment of the analog electronic timepiece of the invention.

Fig. 6 is a vertical sectional view showing an outline shape of an attitude sensor applied to the analog electronic timepiece according to the invention.

Fig. 7 is a plane view showing outline shapes of patterns provided at an inner face of a case lower half portion of the attitude sensor applied to the analog electronic timepiece of the invention.

Fig. 8 is a vertical sectional view showing a state of inclining the attitude sensor in the attitude sensor applied to the analog electronic timepiece of the invention.

Fig. 9 is a vertical sectional view showing a state of vertically arranging the attitude sensor in the attitude sensor applied to the analog electronic timepiece of the invention.

Fig. 10 is a perspective view showing shapes of lead wires in the attitude sensor applied to the analog electronic timepiece of the invention.

Fig. 11 is a table showing a relation ship between attitudes of arranging the analog electronic timepiece and conductive states of patterns according to the first embodiment of the analog electronic timepiece of the invention.

Fig. 12 is a flowchart showing operation of a constitution of stopping all of motors (type 1A) based on a result of an attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

Fig. 13 is a flowchart showing operation of a constitution of stopping only a second motor (type 1B) based on a result of the attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

Fig. 14 is a flowchart showing operation of a constitution of stopping a second motor and a minute motor (type 1C) based on a result of the attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

Fig. 15 is a plane view showing an outline shape viewing a movement from a front side according to a second embodiment of an analog electronic timepiece of the invention (in Fig. 15, portions of parts are omitted).

Fig. 16 is an outline partial sectional view showing a portion from a second motor to a second hand according to the second embodiment of the analog electronic timepiece of the invention.

Fig. 17 is an outline partial sectional view showing a portion from an hour/minute motor to a minute hand and an hour hand according to the second embodiment of the analog electronic timepiece of the invention.

Fig. 18 is a block diagram showing an outline constitution of portions of circuits, motors, train wheels and indicators according to the second embodiment of the analog electronic timepiece of the invention.

Fig. 19 is a flowchart showing operation of a constitution of stopping all of motors (type 2A) based on a result of an attitude detected by the attitude sensor according to the second embodiment of the analog electronic timepiece of the invention.

Fig. 20 is a flowchart showing operation of a constitution of stopping only a second motor (type 2B) based on a result of the attitude detected by the attitude sensor according to the second embodiment of the analog electronic timepiece of the invention.

Fig. 21 is a plane view showing an outline shape viewed from a front side when the analog electronic timepiece of the invention is made complete (a state of attaching a dial and hands to a movement and containing these in a case).

[Best Mode for Carrying Out the Invention]

[0038] An explanation will be given of embodiments of an analog electronic timepiece according to the invention in reference to the drawings as follows.

(1) First embodiment of analog electronic timepiece according to the invention

[0039] First, an explanation will be given of a first embodiment of an analog electronic timepiece according to the invention.

(1•1) Constitution of movement of analog electronic timepiece

[0040] In reference to Fig. 1 through Fig. 5, according to a first embodiment of an analog electronic timepiece of the invention, amovement (machine body) 100 of the analog electronic timepiece is provided with a main plate 102 constituting a base plate of the movement. A winding stem 110 is rotatably integrated to a winding stem guide hole of the main plate 102. A dial 104 (shown in Fig. 2 by imaginary lines) is attached to the movement 100. The movement 100 is provided with a changeover spring 166 for determining a position of the winding stem 110 in an axial line direction.

[0041] "Front side" of the movement 100 is arranged with a battery 120, a circuit block 116, an hour motor 210, an hour display train wheel 220, a minute motor 240, a minute display train wheel 250, a second motor 270, a second display train wheel 280 and so on. There is constructed a constitution in which the hour display train wheel 220 is rotated by rotation of the hour motor 210 and "hour" of current time is displayed by an hour hand 230. There is constructed a constitution in which the minute display train wheel 250 is rotated by rotation of the minute motor 240 and "minute" of current time is displayed by a minute hand 260. There is constructed a constitution in which the second display train wheel 280 is rotated by rotation of the second motor 270 and "second" of current time is displayed by a second hand 290.

[0042] IC 118 and a crystal oscillator 122 are attached to the circuit block 116. The circuit block 116 is fixed to the main plate 102 and a train wheel bridge 112 by a switch spring 162 via an insulating plate 160. The changeover spring 166 is integrally formed with the switch spring 162.

[0043] The battery 120 constitutes a power source of the analog electronic timepiece. As the power source of the analog electronic timepiece, a chargeable secondary battery can be used and a chargeable capacitor can be used. The crystal oscillator 122 constitutes an oscillation source of the analog electronic timepiece and is oscillated by, for example, 32,768 Hertz.

[0044] In reference to Fig. 1, Fig. 2 and Fig. 5, the second motor 270 includes a second coil block 272, a second stator 274 and a second rotor 276. When the second coil block 272 inputs a second motor drive signal, the second stator 274 is magnetized to thereby rotate the second rotor 276. The second rotor 276 is constituted to rotate by, for example, 180 degrees per second.

[0045] There is constructed a constitution in which based on rotation of the second rotor 276, a second wheel 284 is rotated via rotation of a second transmission wheel 282. The second wheel 284 is constituted to rotate by one rotation per minute. The second hand 290 is attached to the second wheel 284. The second wheel 284 may be arranged at center of the analog electronic timepiece or may be arranged at a position different from the center of the analog electronic timepiece. The second hand 290 constitutes a second display member. As the second display member, the second hand may be used, a circular disk may be used or a display member having other shape including flower or a geometrical shape may be used.

[0046] The second display train wheel 220 includes the second transmission wheel 282 and the second wheel 284. The second rotor 276 and the second transmission wheel 282 are rotatably supported by the main plate 102 and the train bridge 112. The second wheel 284 is rotatably supported by a center pipe 126 provided at a second bridge 114 and the train bridge 112.

[0047] A date wheel 170 is rotatably supported by the main plate 102. A date wheel holder 172 supports the date wheel 170 relative to the main plate 102.

[0048] A battery minus terminal 170 is attached to the main plate 102. The battery minus terminal 170 conducts a cathode of the battery 120 and a minus input portion Vss of IC 118 via a minus pattern of the circuit block 116. A battery holder 172 is attached to the switch spring 162. The battery holder 172 and the switch spring 162 conduct an anode of the battery 120 and a plus input portion Vdd of IC 118 via a plus pattern of the circuit block 116.

[0049] In reference to Fig. 1, Fig. 3 and Fig. 5, the minute motor 240 includes a minute coil block 242, a minute stator 244 and a minute rotor 246. When the minute coil block 242 inputs a minute motor drive signal,

the minute stator 244 is magnetized to thereby rotate the minute rotor 246. The minute rotor 246 is constituted to rotate by, for example, 180 degrees per 20 seconds.

[0050] There is constructeda constitution in which a first minute transmission wheel 252 is rotated based on rotation of the minute rotor 246 and a minute wheel 256 is rotated via a second minute transmission wheel 254 based on rotation of the first minute transmission wheel 252. The minute wheel 256 is constituted to rotate by one rotation per hour. The minute hand 260 is attached to the minute wheel 256. Rotational center of the minute wheel 256 is the same as the rotational center of the second wheel 284. The minute hand 260 constitutes a minute display member. As the minute display member, the minute hand may be used, a circular disk may be used, or a display member having other shape including flower or a geometrical shape may be used.

[0051] The minute display train wheel 250 includes the first minute transmission wheel 252, the second minute transmission wheel 254 and the minute wheel 256. The minute rotor 246, the first minute transmission wheel 252 and the second minute transmission wheel 254 are rotatably supported by the main plate 102 and the train bridge 112. The minute wheel 256 is brought into contact with an outer peripheral portion of the center pipe 126 provided at the second bridge 114 and is rotatably supported thereby.

[0052] In reference to Fig. 1, Fig. 4 and Fig. 5, the hour motor 210 includes an hour coil block 212, an hour stator 214 and an hour rotor 216. When the hour coil block 212 inputs an hour motor drive signal, the hour stator 214 is magnetized to thereby rotate the hour rotor 126. The hour rotor 126 is constituted to rotate by, for example, 180 degrees per 20 minutes.

[0053] A first hour transmission wheel 222 is rotated based on rotation of the hour rotor 216. An hour wheel 226 is constituted to rotate via rotation of a second hour transmission wheel 224 based on rotation of the first hour transmission wheel 222. The hour wheel 226 is constituted to rotate by one rotation per 12 hours. The hour hand 230 is attached to the hour wheel 226. Rotational center of the hour wheel 226 is the same as rotational center of the minute wheel 256. Therefore, the rotational center of the hour wheel 226, the rotational center of the minute wheel 256 and the rotational center of the second wheel 284 are the same.

[0054] The hour hand 230 constitutes an hour display member. As the hour display member, the hour hand may be used, a circular disk may be used, or a displaymember having other shape including flower or a geometrical shape may be used.

[0055] The hour display train wheel 220 includes the first hour transmission wheel 222, the second hour transmission wheel 224 and the hour wheel 226. The hour rotor 216, the first hour transmission wheel 222 and the second hour transmission wheel 224 are rotatably supported by the main plate 102 and the train bridge 112. The hour wheel 226 is brought into contact with an outer peripheral portion of the hour wheel 256 and is rotatably supported thereby.

[0056] A date indicator driving wheel (not illustrated) is constituted to rotate by rotating the hour wheel 226. The date indicator driving wheel is provided to rotate by one rotation per day by rotation of the hour wheel 226. A date indicator driving finger (not illustrated) provided at the date indicator driving wheel is constituted to feed the day wheel 170 by one tooth per day.

[0057] An attitude sensor 610 is attached to the circuit block 116 in a state of being contained in a casing. A material of the casing may be a metal such as aluminum or may be plastic. A method of attaching the casing to the circuit block 116 may be by adhering, soldering or welding. Further, as a method of attaching the casing to the circuit block 116, as shown by Fig. 1 and Fig. 4, two attaching terminal portions provided at the casing may fixedly be attached to the circuit block 116 by soldering, or the casing may directly be attached to the circuit block 116.

(1•2) Constitution of IC

[0058] In reference to Fig. 5, IC 118 includes a dividing portion 312, a time measuring portion 314 and a time setting portion 316. The dividing portion 312 is constituted to divide a signal outputted by the crystal oscillator 122. The time measuring portion 314 is constituted to measure current time based on an output signal of the dividing portion 312. The time setting portion 316 is constituted to output signals for controlling to drive the motors based on the output signal of the time measuring portion 314.

[0059] A drive control portion 328 is provided to control operation of an hour motor drive portion 320, a minute motor drive portion 322 and a second motor drive portion 324.

[0060] A time set switch 330 is provided for controlling operation of the time setting portion 316. There is constructed a constitution in which by operating the time set switch 330, the time setting portion 316 is operated, the drive control portion 328 is operated and the hour motor driving portion 320, the minute motor driving portion 322 and the second motor driving portion 324 can be operated.

[0061] The time set switch 330 is constituted by a switch terminal portion integrally formed with the switch spring 162 and a switch pattern of the circuit block 116.

[0062] A reset switch 332 is provided to reset operation of the time setting portion 316. There is constructed a constitution in which by operating the reset switch 332, the time setting portion 316 is reset and by operating the drive control portion 328, operation of the hour motor driving portion 320, the minute motor driving portion 322 and the second motor driving portion 324 can be stopped.

[0063] The reset switch 332 is constituted to operate by pulling out the winding stem 110.

[0064] An attitude detecting portion 340 is provided to detect an attitude of the analog electronic timepiece based on an output signal of the attitude sensor 610.

[0065] An output determining portion 344 is constituted to operate the drive control portion 328 by inputting an output signal of the time measuring portion 314 based on an output signal of the attitude detecting portion 340.

[0066] The hour motor driving portion 320 is constituted to be capable of outputting a signal for driving the hour motor 210 to the hour motor 210 based on the output signal of the drive control portion 328 and stopping driving the hour motor 210 based on the output signal of the drive control portion 328. By driving the hour motor 210, the hour display train wheel 220 is rotated and "hour" can be displayed by the hour hand 230.

[0067] The minute motor driving portion 322 is constituted to be capable of outputting a signal for driving the minute motor 240 to the minute motor 240 based on the output signal of the drive control portion 328 and stopping driving the minute motor 240 based on the output signal of the drive control portion 328. By driving the minute motor 240, the minute display train wheel 250 is rotated and "minute" can be displayed by the minute hand 260.

[0068] The second motor driving portion 324 is constituted to be capable of outputting a signal for driving the second motor 270 to the second motor 270 based on the output signal of the drive control portion 328 and stopping driving the second motor 270 based on the output signal of the drive control portion 328. By driving the second motor 270, the second display train wheel 280 is rotated and "second" can be displayed by the second hand 290.

[0069] According to the embodiment of the analog electronic timepiece of the invention, circuits for executing various functions may be constituted in IC, for example, CPU, ROM, RAM and the like are provided in IC. IC may be PLA-IC including programs for executing various operations.

[0070] Further, according to the embodiment of the analog electronic timepiece of the invention, as necessary, along with IC, externally mounted elements such as resistors, capacitors, coils, diodes or transistors can be used.

(1•3) Attitude sensor

[0071] Next, an explanation will be given of an attitude sensor applied to the analog electronic timepiece of the invention.

[0072] Further, the attitude sensor applied to the analog electronic timepiece of the invention is not limited to a constitution described below but any publicly-known attitude sensor can be used.

[0073] In reference to Fig. 6, the attitude sensor 610 is provided with a case 610a having a shape viewed from above being substantially circular and a shape viewed from a side being substantially "oval".

[0074] The "oval shape" defined here includes a shape in which a portion of a circular arc having a radius of a first dimension and a portion of a circular arc having a radius the same as the radius of the first dimension, are arranged to be opposed to each other such that inner sides thereof are proximate to each other and portions of the both circular arcs are connected by a portion of a circular arc having a radius of a second dimension, includes a shape in which portions of the both circular arcs are connected by a straight line and includes a shape in which portions of the both circular arcs are connected by portions of a plurality of circular arcs. In this case, the first dimension is preferably smaller than the second dimension.

[0075] The case 610a is formed symmetrically in the up and down direction relative to a central plane 610c. That is, the case 610a includes a case upper half portion 610u and a case lower half portion 610d. Therefore, according to the case 610a, the case upper half portion 610u and the case lower half portion 610d are formed symmetrically relative to the central plane 610c. That is, the case upper half portion 610u and the case lower half portion 610d are formed by the same dimensions and shape.

[0076] Therefore, for example, the case 610a can be formed by fabricating two of the case upper half portions 610u and bonding together the two case upper half portions 610u at portions thereof in correspondence with the plane 610c. The bonding may be carried out by adhesion, may be carried out by welding or may be carried out by using an adhering tape.

[0077] In this way, by forming the case 610 having the shape viewed from side substantially in the oval shape, a small-sized and thin attitude sensor 610 can be realized.

[0078] In Fig. 6, there are defined an X axis line (in Fig. 6, right direction is defined as positive direction) and a Y axis line (in Fig. 6, a direction orthogonal to paper face and directed from top to back of paper face is defined as positive direction) in the horizontal direction and there is defined a Z axis line (in Fig. 6, upper direction is defined as positive direction) in a direction orthogonal to the X axis line and the Y axis line.

[0079] According to the case 610a, a shape of a plane including the X axis line and the Y axis line, that is, a shape of a cross-sectional face of the central portion, is substantially circular and a shape in a plane including the X axis line and the Z axis line, that is, a shape of a vertical face at the central portion is substantially oval.

[0080] The case 610a is formed by a board of plastic such as polyimide or glass epoxy or an insulating material such as quartz.

[0081] In reference to Fig. 6 and Fig. 7, a pattern constituting an electrode of the attitude sensor 610 (hereinafter, simply referred to as "pattern") A1 is provided at an inner face of a center of the case lower half portion 610d. An outer peripheral portion of pattern A1 is formed

in a circular shape.

[0082] Pattern B1 is provided at the inner face of the center of the case lower half portion 610d and on an outer peripheral side of pattern A1. An inner peripheral portion of pattern B1 is formed in a circular shape concentric with the outer peripheral portion of pattern A1 spaced apart from the outer peripheral portion of pattern A1 at an interval. An outer peripheral portion of pattern B1 is formed in a circular shape concentric with the inner peripheral portion of pattern B1 spaced apart from the inner peripheral portion of pattern B1 at an interval. That is, pattern B1 is formed in a ring-like shape.

[0083] Pattern C1 is provided at the inner face of the center of the case lower half portion 610d and on an outer peripheral side of pattern B1. An inner peripheral portion of pattern C1 is formed in a circular shape concentric with the outer peripheral portion of pattern B1 spaced apart from the outer peripheral portion of pattern B1 at an interval. An outer peripheral portion of pattern C1 is formed in a circular shape concentric with the inner peripheral portion of pattern C1 spaced apart from the inner peripheral portion of pattern C1 at an interval. That is, pattern C1 is formed in a ring-like shape.

[0084] Pattern D1 is provided at the inner face of the center of the case lower half portion 610d and on an outer peripheral side of pattern C1. An inner peripheral portion of pattern D1 is formed in a circular shape concentric with the outer peripheral portion of pattern C1 spaced apart from the outer peripheral portion of pattern C1 at an interval. An outer peripheral portion of pattern D1 is formed in a circular shape concentric with the inner peripheral portion of pattern D1 spaced apart from the inner peripheral portion of pattern D1 at an interval. That is, pattern D1 is formed in a ring-like shape.

[0085] Pattern E1 is provided at the inner face of the center of the case lower half portion 610d and on an outer peripheral side of pattern D1. An inner peripheral portion of pattern E1 is formed in a circular shape concentric with the outer peripheral portion of pattern D1 spaced apart from the outer peripheral portion of pattern D1 at an interval. An outer peripheral portion of pattern E1 is formed in a circular shape concentric with the inner peripheral portion of pattern E1 spaced apart from the inner peripheral portion of pattern E1 at an interval. That is, pattern E1 is formed in a ring-like shape.

[0086] There are formed patterns A2, B2, C2, D2 and E2 at the case upper half portion 610u similar to the shapes of the patterns A1, B1, C1, D1 and E1 of the case lower half portion 610d. That is, an outer peripheral portion of pattern A2 is formed in a circular shape and patterns B2, C2, D2 and E2 are formed in a ring-like shape. Further, shapes of patterns A1, B1, C1, D1 and E1 of the case lower half portion 610d and shapes of patterns A2, B2, C2, D2 and E2 of the case upper half portion 610u are substantially the same respectively.

[0087] As has been explained, the respective patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 are insulated from each other.

[0088] According to the embodiment of the analog electronic timepiece of the invention, the attitude sensor 610 is arranged relative to the main plate 102 such that the X-axis line and the Y-axis line are in parallel with a surface of the main plate 102 and in parallel with a surface of the dial 104. Therefore, the attitude sensor 610 is constituted relative to the main plate 102 such that the Z axis line is orthogonal to the surface of the main plate 102 and orthogonal to the surface of the dial 104.

[0089] In reference to Fig. 10, lead wires for transmitting signals from the patterns are respectively connected to patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2.

[0090] Detecting patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 are provided at the circuit block 116. Patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 of the attitude sensor 610 are connected to the detecting patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 of the circuit block 116 by the lead wires. The detecting patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 of the circuit block 116 are respectively connected to detecting pattern input terminals of IC 118. A detected signal inputted to the detecting pattern input terminal of IC 118 is inputted to the attitude detecting portion 340.

[0091] Therefore, by detecting conductive states of the detecting patterns A1, B1, C1, D1, E1, A2, B2, C2, D2 and E2 of the circuit block 116, conductive states of patterns A1, B1, C1 D1, E1, A2, B2, C2, D2 and E2 of the attitude sensor 610 can be detected.

[0092] In reference to Fig. 6, a conductive fluid 608 is contained in the case 610a. The conductive fluid 608 is, for example, mercury. Although the volume of the conductive fluid 608 is 1/28 of the volume of the case 610a in the example shown by Fig. 6, it is preferable that the volume of the conductive fluid 608 is 1/50 through 1/10 of the volume of the case 610a. The volume of the conductive fluid 608 is determined to be capable of being brought into contact with two patterns or three patterns.

[0093] In the horizontal state shown by Fig. 6, the conductive fluid 608 is brought into contact with pattern A1 and pattern B1. Therefore, in the state shown by Fig. 6, pattern A1 and pattern B1 are shortcircuited (that is, conducted to each other) by the conductive fluid 608.

[0094] That is, Fig. 6 shows a state of the attitude sensor 610 when the analog electronic timepiece of the invention is arranged in "flat attitude". When pattern A1 and pattern B1 are conducted to each other, the attitude detecting portion 340 outputs a detected signal when "flat attitude" is detected. In this way, "flat attitude" is attitude of "dial lower".

[0095] Next, in reference to Fig. 8, in a state in which the attitude sensor 610 is arranged to be inclined by 45 degrees relative to a horizontal face, the conductive fluid 608 is brought into contact with pattern C1, pattern D1 and pattern E1. Therefore, in the state shown by Fig. 8, pattern C1, pattern D1 and pattern E1 are shortcircuited (that is, conducted to each other) by the conductive fluid 608.

[0096] That is, Fig. 8 shows a state of the attitude sensor 610 when the analog electronic timepiece of the invention is arranged in "skewed attitude". When pattern C1 pattern D1 and pattern E1 are conducted to each other, the attitude detecting portion 340 outputs a detected signal when "skewed attitude" is detected.

[0097] Next, in reference to Fig. 9, in a state in which the attitude sensor 610 is arranged to make 90 degrees relative to the horizontal face (vertically), the conductive fluid 608 is brought into contact with pattern E1 and pattern E2. Therefore, in the state shown by Fig. 9, pattern E1 and pattern E2 are shortcircuited (that is, conducted to each other) by the conductive fluid 608.

[0098] That is, Fig. 9 shows a state of the attitude sensor 610 when the analog electronic timepiece of the invention is arranged in "erect attitude". When pattern E1 and pattern E2 are conducted to each other, the attitude detecting portion 340 outputs a detected signal when "erect attitude" is detected.

[0099] In reference to Fig. 11, there is shown relationships between states of conducting various patterns and the states of respective attitudes in the attitude sensor applied to the analog electronic timepiece of the invention.

[0100] In Fig. 11, notations A1, B1, C1, D1, E1, E2, D2, C2, B2 and A2 respectively designate pattern A1, pattern B1, pattern C1, pattern D1, pattern E1, pattern E2, pattern D2, pattern C2, pattern B2 and pattern A2. Notation "ON" designates that a corresponding pattern is brought into a state of being conducted to other pattern designated as "ON". "OFF" designates that a corresponding pattern is brought into a state in which the pattern is not conducted to any other pattern.

(1•3•1) Attitude state 1

[0101] Attitude state 1 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "flat attitude". Here, "flat attitude" is an attitude of "dial lower".

[0102] Attitude state 1 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 0 degree through 7 degree relative to the horizontal face.

[0103] According to attitude state 1, in the circuit block 116, pattern A1 and pattern B1 are constituted to conduct each other.

(1•3•2) Attitude state 2

[0104] Attitude state 2 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "flat attitude".

[0105] Attitude state 2 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 8 degree through 12 degree relative to the horizontal face.

[0106] According to attitude state 2, in the circuit block 116, pattern B1 and pattern C1 are constituted to conduct each other.

(1•3•3) Attitude state 3

[0107] Attitude state 3 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "flat attitude".

[0108] Attitude state 3 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 13 degree through 30 degree relative to the horizontal face.

[0109] According to attitude state 3, in the circuit block 116, pattern B1, pattern C1 and pattern D1 are constituted to conduct each other.

(1•3•4) Attitude state 4

[0110] Attitude state 1 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "skewed attitude".

[0111] Attitude state 4 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 31 degree through 60 degree relative to the horizontal face.

[0112] According to attitude state 4, in the circuit block 116, pattern C1, pattern D1 and pattern E1 are constituted to conduct each other.

(1•3•5) Attitude state 5

[0113] Attitude state 5 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "erect attitude".

[0114] Attitude state 5 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 61 degree through 89 degree relative to the horizontal face.

[0115] According to attitude state 5, in the circuit block 116, pattern D1, pattern E1 and pattern E2 are constituted to conduct each other.

(1•3•6) Attitude state 6

[0116] Attitude state 6 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "erect attitude".

[0117] Attitude state 6 corresponds to a state in which the analog electronic timepiece of the invention is at 90 degree relative to the horizontal face, that is, arranged vertically.

[0118] According to attitude state 6, in the circuit block 606, pattern E1 and pattern E2 are constituted to conduct each other.

(1•3•7) Attitude state 7

[0119] Attitude state 7 shown in Fig. 11 corresponds

to a case in which the analog electronic timepiece of the invention is brought into "erect attitude".

[0120] Attitude state 7 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 91 degree through 119 degree relative to the horizontal face.

[0121] According to attitude state 7, in the circuit block 116, pattern E1, pattern E2 and pattern D2 are constituted to conduct each other.

(1•3•8) Attitude state 8

[0122] Attitude state 8 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "skewed attitude".

[0123] Attitude state 8 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 120 degree through 149 degree relative to the horizontal face.

[0124] According to attitude state 8, in the circuit block 116, pattern E2, pattern D2 and pattern C2 are constituted to conduct each other.

(1•3•9) Attitude state 9

[0125] Attitude state 9 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "back flat attitude". Here, "back flat attitude" is an attitude of "dial upper".

[0126] Attitude state 9 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 150 degree through 167 degree relative to the horizontal face.

[0127] According to attitude state 9, in the circuit block 116, pattern D2, pattern C2 and pattern B2 are constituted to conduct each other.

(1•3•10) Attitude state 10

[0128] Attitude state 10 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "back flat attitude". Here, "back flat attitude" is an attitude of "dial upper".

[0129] Attitude state 10 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 168 degree through 172 degree relative to the horizontal face.

[0130] According to attitude state 10, in the circuit block 116, pattern C2 and pattern B2 are constituted to conduct each other.

(1•3•11) Attitude state 11

[0131] Attitude state 11 shown in Fig. 11 corresponds to a case in which the analog electronic timepiece of the invention is brought into "back flat attitude". Here, "back flat attitude" is an attitude of "dial upper".

[0132] Attitude state 11 corresponds to a case in which the analog electronic timepiece of the invention falls in a range of 173 degree through 180 degree relative to the horizontal face.

[0133] According to attitude state 11, in the circuit block 116, pattern B2 and pattern A2 are constituted to conduct each other.

(1•4) Operation of analog electronic timepiece of the invention

[0134] Next, an explanation will be given of operation of the analog electronic timepiece of the invention.

(1•4•1) Type 1A

[0135] An explanation will be given of a constitution (type 1A) for stopping all the motors based on a result of an attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

[0136] In reference to Fig. 5 and Fig. 12, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour motor 210 is operated and the hour hand 230 is set to "hour" of current time, the minute motor 240 is operated and the minute hand 260 is set to "minute" of current time and the second motor 270 is operated and the second hand 290 is set to "second" of current time (step S121).

[0137] Next, the reset switch 332 is released, the hour motor 210 is operated, "hour" of current time is displayed by the hour hand 230, the minute motor 240 is operated, "minute" of current time is displayed by the minute hand 260, the second motor 270 is operated and "second" of current time is displayed by the second hand 290 (step S122).

[0138] When a signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is not outputted continuously for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S123).

[0139] The threshold is set preferably in a range of 0.5 through 60 minutes and is set more preferably in a range of 1 through 5 minutes.

[0140] By constituting in this way, the attitude of the analog electronic timepiece can be detected firmly by excluding influence by chattering of the attitude sensor 610.

[0141] Or, the determination by the attitude detecting portion 340 that the analog electronic timepiece is

brought into the dial lower attitude (flat attitude) can be carried out by detecting that the signal outputted by the attitude sensor 610 is outputted by a plurality of times during a constant time period. For example, there can be constructed a constitution in which in one time operation of the attitude detecting portion 340 for detecting the attitude of the analog electronic timepiece, when the signal determining that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) is similarly outputted at two times of immediately after starting of detection and one minute after starting of detection, the analog electronic timepiece is determined to be brought into the dial lower attitude (flat attitude) by the attitude detecting portion 340.

[0142] It is preferable in the constitution that the signal outputted by the attitude sensor 610 is outputted by a predetermined number of times during a constant time period. It is preferable that the predetermined number of times is set in, for example, a range of 2 through 10 times.

[0143] A time interval of operation for detecting the attitude of the analog electronic timepiece by the attitude detecting portion 340 is constituted such that, for example, when the above-described threshold is set in a range of 1 through 5 minutes, operation is carried out once per 10 minutes. It is preferable that the time interval is set in a range of 5 through 60 minutes.

[0144] By constituting in this way, the attitude of the analog electronic timepiece can be detected firmly at every constant time period.

[0145] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for stopping driving the motors to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 stops driving the hour motor 210 by the hour motor drive portion 320, stops driving the minute motor 240 by the minute motor drive portion 322 and stops driving the second motor 270 by the second motor drive portion 324 (step S124).

[0146] As a result, the hour motor 210 stops operating, the hour hand 230 is stopped at a position indicated thereby, the minute motor 240 stops operating, the minute hand 260 is stopped at a position indicated thereby, the second motor 270 stops operating and the second hand 290 is stopped at a position indicated thereby.

[0147] The output determining portion 344 inputs a signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the hour hand 230, the minute hand 260 and the second hand 290 are stopped.

[0148] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation at step S123 is carried out again.

[0149] After the hour motor 210 stops operating, the minute motor 240 stops operating and the second motor 270 stops operating, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude "flat attitude" outputted by the attitude sensor 610 is outputted (step S125).

[0150] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for driving to accelerate the motors to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 operates the hour motor drive portion 320 to thereby drive to accelerate the hour motor 210 to reach a position at which the hour hand 230 indicates current time, operates the minute motor drive portion 322 to thereby drive to accelerate the minute motor 240 to reach a position at which the minute hand 260 indicates current time and operates the second motor drive portion 324 to thereby drive to accelerate the second motor 270 to reach a position at which the second hand 290 indicates current time (step S126).

[0151] At S126, when the signal outputted by the attitude sensor 610 for indicating that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), is outputted continuously for a threshold of a constant detecting time period, for example, 0.1 second, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude).

[0152] The threshold is set preferably in a range of 0.1 through 0.5 second and is set more preferably in a range of 0.1 through 0.2 second.

[0153] Or, the determination by the attitude detecting portion 340 that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), is carried out by detecting that the signal outputted by the attitude sensor 610 is outputted continuously during a constant time period. For example, there can also be constructed a constitution in which in one time operation of the attitude detecting portion 340 for detecting the attitude of the analog electronic timepiece, when there is outputted the signal for determining that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) continuously at two times during a time period of 0.1 second, the analog electronic timepiece is determined to be brought into the dial lower attitude (flat attitude) by the attitude detecting portion 340.

[0154] As a result, the hour hand 230 indicates "hour" of current time, the minute hand 260 indicates "minute" of current time and the second hand 290 indicates "second" of current time.

[0155] According to the accelerated driving method, all of the hour hand 230, the minute hand 260 and the second hand 290 may be rotated regularly in the clockwise direction or all of the hour hand 230, the minute

hand 260 and the second hand 290 may be rotated reversely in the counterclockwise direction. Or, according to the accelerated driving method, there may be constructed a constitution in which there is calculated a relationship between a position which the hour hand 230 intends to indicate and a position at which the hour hand 230 is stopped, there is calculated a relationship between a position in which the minute hand 260 intends to indicate and a position at which the minute hand 260 is stopped, there is calculated a relationship between a position which the second hand 290 intends to indicate and a position at which the secondhand 290 is stopped and the hour hand 230, the minute hand 260 and the second hand 290 are respectively rotated in a rotating direction in regular rotation or reverse rotation in which the hour hand 230, the minute hand 260 and the second hand 290 can reach the positions indicated thereby more fastly.

[0156] For example, the output determining portion 344 is constituted to be provided with a counter for measuring a time period between time of stopping the hour hand 230, the minute hand 260 and the second hand 290 and current time. Further, the counter is constituted to start when the hour hand 230, the minute hand 260 and the second hand 290 are stopped and the counter is constituted to stop when the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude). Further, by operating the drive control portion 328, the hour motor 210 is driven to accelerate to reach the position at which the hour hand 230 indicates current time by operating the hour motor drive portion 320, the minute motor 240 is driven to accelerate to reach the position at which the minute hand 260 indicates current time by operating the minute motor drive portion 322 and the second motor 270 is driven to accelerate to reach the position at which the second hand 290 indicates current time by operating the second motor drive portion 324.

[0157] In this case, there may be constructed a constitution in which with regard to the time period for driving to accelerate the hands in this way, the hands may further be driven to accelerate for correction by using the counter. By the constitution, current time can accurately be displayed by the hour hand 230, the minute hand 260 and the second hand 290.

[0158] Or, the output determining portion 344 is constituted to be provided with a calculating portion for calculating relationships between positions at which the hour hand 230, the minute hand 260 and the second hand 290 are stopped and positions to be indicted by the hour hand 230, the minute hand 260 and the second hand 290 at current time. Further, there can also be constructed a constitution in which by operating the drive control portion 328, the hour motor 210 is driven to accelerate to reach the position at which the hour hand 230 indicates current time by operating the hour motor drive portion 320, the minute motor 240 is driven to accelerate to reach the position at which the minute hand 260 indicates current time by operating the minute motor drive portion 322 and the second motor 270 is driven to accelerate to reach the position at which the second hand 290 indicates current time by operating the second motor drive portion 324.

[0159] When current time is displayed by the hour hand 230, the minute hand 260 and the second hand 290 by driving to accelerate the hour hand 230, the minute hand 260 and the second hand 290, the operation returns to step 122 and normal operation is carried out.

[0160] Further, according to the constitution in which the hour motor 210 is driven to accelerate to reach the position at which the hour hand 230 indicates current time by the hour motor drive portion 320, the minute motor 240 is driven to accelerate to reach the position at which the minute hand 260 indicates current time by the minute motor drive portion 322 and the second motor 270 is driven to accelerate to reach the position at which the second hand 290 indicates current time by the second motor drive portion 324, it is preferable to provide an hour motor rotation detecting portion for detecting whether a number of pulses outputted by the hour motor drive portion 320 is the same as a number of steps of rotating the hour motor 210, a minute motor rotation detecting portion for detecting whether a number of pulses outputted by the minute motor drive portion 322 is the same as a number of steps of rotating the minute motor 240 and an hour motor rotation detecting portion for detecting whether a number of pulses outputted by the second motor drive portion 324 is the same as a number of steps of rotating the second motor 270.

[0161] At step S125, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 detects the attitude of the analog electronic timepiece again (step S125).

[0162] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial lower attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece according to the invention can be made about 2/3 of power consumption of a conventional analog electronic timepiece. Therefore, according to the analog electronic timepiece of the invention, when there is used a battery having dimensions and shape the same as those of the conventional analog electronic timepiece, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

[0163] As a modified example, there can be constructed a constitution in which at step S124, the hour hand 230 is not stopped at a position indicated thereby, the minute hand 260 is not stopped at a position indicated thereby, the second hand 290 is not stopped at a position indicated thereby and the hour hand 230, the minute hand 260 and the second hand 290 are driven to accel-

erate and made to stop at previously set stop positions.

[0164] The previously set stop positions may be a position at which 12 o'clock indicator of the dial is disposed or a position at which a stop mark is provided at the dial.

[0165] For example, there can be constructed a constitution in which in reference to Fig. 21, when the hour hand 230, the minute hand 260 and the secondhand 290 indicate current time, 10 o'clock 10 minute 36 second as shown by imaginary lines in Fig. 21, in the case in which the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the hour hand 230, the minute hand 260 and the second hand 290 are driven to accelerate and stopped at the position at which 12 o'clock indicator of the dial is disposed as shown by bold lines in Fig. 21.

(1•4•2) Type 1B

[0166] An explanation will be given of operation of a constitution (type 1B) for stopping only the second motor 270 based on a result of the attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

[0167] In the following explanation, a description will mainly be given of a point in which constitution and operation of type 1B differ from constitution and operation of type 1A according to the first embodiment of the analog electronic timepiece of the invention. Therefore, with regard to portions which are not described below, the above-described explanation with respect to type 1A will be applied thereto.

[0168] In reference to Fig. 5 and Fig. 13, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour motor 210 is operated and the hour hand 230 is set to "hour" of current time, the minute motor 240 is operated and the minute hand 260 is set to "minute" of current time and the second motor 270 is operated and the second hand 290 is set to "second" of current time (step S131).

[0169] Next, the reset switch 332 is released, the hour motor 210 is operated, "hour" of current time is displayed by the hour hand 230, the minute motor 240 is operated, "minute" of current time is displayed by the minute hand 260, the second motor 270 is operated and "second" of current time is displayed by the second hand 290 (step S132).

[0170] When a signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is continuously outputted for a threshold of constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is not outputted for a threshold of contact detecting time period, for example, 1 minute continuously, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S133).

[0171] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for stopping driving the second motor 270 to the drive control portion 328. When the drive control portion 328 inputs the signal outputtedby the output determining portion 344, the drive control portion 328 stops driving the second motor 270 by the second motor drive portion 324 (step S134).

[0172] As a result, the second hand 290 is stopped at a position indicated thereby. At this occasion, the hour hand 230 and the minute hand 260 continue indicating current time.

[0173] The output determining portion 344 inputs a signal with regard to current time outputted by the measuring portion 314 and measures a difference between current time and time at which the second hand 290 is stopped.

[0174] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S133 is carried out again.

[0175] After stopping operating the second motor 270, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is outputted (step S135).

[0176] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for driving to accelerate the second motor 270 to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 operates the second motor drive portion 324 and drives to accelerate the second motor 270 to reach a position at which the second hand 290 indicates current time (step S136).

[0177] As a result, the hour hand 230 indicates "hour" of current time, the minute hand 260 indicates "minute" of current time and the second hand 290 indicates "second" of current time.

[0178] According to the accelerated driving method, the second hand 290 may be rotated regularly in the clockwise direction or the second hand 290 may be rotated reversely in the counterclockwise direction. Or, according to the accelerated driving method, there may be constructed a constitution in which there is calculated a relationship between a position which the second hand 290 intends to indicate and a position at which the second hand 290 is stopped and the second hand 290 is respectively rotated in a rotating direction of regular rotation or reverse rotation in which the second hand 290 can reach the position at which the second hand 290

intends to indicate more fastly.

[0179] When the second hand 290 is driven to accelerate and current time is displayed by the hour hand 230, the minute hand 260 and the second hand 290, the operation returns to step 132 and normal operation is carried out.

[0180] At step S135, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 detects the attitude of the analog electronic timepiece again (step S135).

[0181] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial lower attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece according to the invention can be made about 2/3 of power consumption of the conventional analog electronic timepiece. Therefore, according to the analog electronic timepiece of the invention, when a battery having dimensions and shape the same as those of the conventional analog electronic timepiece is used, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

[0182] According to the constitution, the hour hand 230 always indicates "hour" of current time and the minute hand 260 always indicates "minute" of current time. Therefore, even in a state in which the second hand 290 is stopped, "hour" and "minute" of current time can be read.

(1•4•3) Type 1C

[0183] An explanation will be given of operation of a constitution (type 1C) for stopping the minute motor 240 and the second motor 270 based on a result of the attitude detected by the attitude sensor according to the first embodiment of the analog electronic timepiece of the invention.

[0184] In the following explanation, a description will mainly be given of a point in which constitution and operation of type 1C differ from constitution and operation of type 1A. Therefore, with regard to portions which are not described below, the above-described explanation with regard to type 1A will be applied thereto.

[0185] In reference to Fig. 5 and Fig. 14, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour motor 210 is operated and the hour hand 230 is set to "hour" of current time, the minute motor 240 is operated and the minute hand 260 is set to "minute" of current time and the second motor 270 is operated and the secondhand 290 is set to "second" of current time (step S141).

[0186] Next, the reset switch 332 is released, the hour motor 210 is operated, "hour" of current time is displayed by the hour hand 230, the minute motor 240 is operated, "minute" of current time is displayed by the minute hand 260, the second motor 270 is operated and "second" of current time is displayed by the second hand 290 (step S142).

[0187] When the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is not continuously outputted for a threshold of constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S143).

[0188] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for stopping driving the minute motor 240 and the second motor 270 to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the outputted determining portion 344, the drive control portion 328 stops driving the minute motor 240 by the minute motor drive portion 322 and stops driving the second motor 270 by the second motor drive portion 324 (step S144).

[0189] As a result, the minute motor 240 stops operating, the minute hand 260 is stopped at a position indicated thereby, the second motor 270 stops operating and the second hand 290 is stopped at a position indicated thereby.

[0190] The output determining portion 344 inputs the signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the minute hand 260 and the second hand 290 are stopped.

[0191] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S143 is carried out again.

[0192] After stopping operating the minute motor 240 and stopping operating the second motor 270, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is outputted (step S145).

[0193] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for driving to accelerate the minute motor 240 and the second motor 270 to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 outputs the signal to the minute motor drive portion 322, drives to accelerate the minute motor 240 to reach a position at which the minute hand 260 indicates current

time, outputs the signal to the second motor drive portion 324 and drives to accelerate the second motor 270 to reach the position at which the second hand 290 indicates current time (step S146).

[0194] As a result, the hour hand 230 indicates "hour" of current time, the minute hand 260 indicates "minute" of current time and the second hand 290 indicates "second" of current time.

[0195] According to the accelerated driving method, all of the minute hand 260 and the second hand 290 may be rotated regularly in the clockwise direction or all of the minute hand 260 and the second hand 290 may be rotated reversely in the counterclockwise direction. Or, according to the accelerated driving method, there may be constructed a constitution in which there is calculated a relationship between a position at which the minute hand 260 intends to indicate and a position at which the minute hand 260 is stopped, there is calculated a relationship between a position at which the second hand 290 intends to indicate and a position at which the second hand 290 is stopped and the minute hand 260 and the second hand 290 are respectively rotated in a rotating direction of regular rotation or reverse rotation in which the hands can reach the positions which the hands intend to indicate more fastly.

[0196] When the minute hand 260 and the second hand 290 are driven to accelerate and current time is displayed by the hour hand 230, the minute hand 260 and the second hand 290, the operation returns to step 142 and normal operation is carried out.

[0197] At step S145, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 detects the attitude of the analog electronic timepiece again (step S145).

[0198] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial lower attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece according to the invention can be made about 2/3 of power consumption of the conventional analog electronic timepiece. Therefore, according to the analog electronic timepiece of the invention, when a battery having dimensions and shape the same as those of the conventional analog electronic timepiece is used, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

[0199] According to the constitution, the hour hand 230 always indicates "hour" of current time. Therefore, even in a state in which the minute hand 260 and the second hand 290 are stopped, "hour" of current time can be read.

(2) Second embodiment of analog electronic timepiece of the invention

[0200] Next, an explanation will be given of a second embodiment of an analog electronic timepiece according to the invention.

[0201] In the following explanation, a description will mainly be given of a point in which the second embodiment of the analog electronic timepiece of the invention differs from the first embodiment of the analog electronic timepiece of the invention. Therefore, with regard to portions which are not described below, the above-described explanation with regard to the first embodiment of analog electronic timepiece of the invention will be applied thereto.

(2•1) Constitution of movement of second embodiment of analog electronic timepiece according to the invention

[0202] In reference to Fig. 15 through Fig. 18, according to the second embodiment of the analog electronic timepiece of the invention, a movement (machine body) 400 of the analog electronic timepiece is provided with a main plate 402 constituting a base plate of the movement.

[0203] "Front side" of the movement 400 is arranged with the battery 120, a circuit block 416, an hour/minute motor 440, a minute display train wheel 450, the second motor 270, the second display train wheel 280 and so on. There is constructed a constitution in which the minute display train wheel 450 is rotated by rotation of the hour/minute motor 440 and "minute" of current time is displayed by the minute hand 260. There is constructed a constitution in which "hour" of current time is displayed by the hour hand 230 via rotation of a minute train wheel 460 rotated by rotating the minute display train wheel 450. There is constructed a constitution in which the second display train wheel 280 is rotated by rotation of the second motor 270 and "second" of current time is displayed by the second hand 290.

[0204] IC 418 and the crystal oscillator 122 are attached to the circuit block 416. The circuit block 416 is fixed to the main plate 402 and a train bridge 412 by the switch spring 162 via the insulating plate 160.

[0205] In reference to Fig. 15, Fig. 16 and Fig. 18, the second motor 270 includes the second coil block 272, the second stator 274 and the second rotor 276. The second wheel 284 is constituted to rotate via rotation of the second transmission wheel 282 based on rotation of the second rotor 276. The second wheel 284 is constituted to rotate by one rotation per minute. The second hand 290 is attached to the second wheel 284.

[0206] The second display train wheel 220 includes the second transmission wheel 282 and the second wheel 284. The second rotor 276 and the second transmission wheel 282 are rotatably supported by the main plate 402 and the train bridge 412. The second wheel 284 is rotatably supported by the center pipe 126 provided at the second bridge 114 and the train bridge 412.

[0207] The battery minus terminal 170 is attached to the main plate 402. The battery minus terminal 170 conducts the cathode of the battery 120 and the minus input

portion Vss of IC 418 via a minus pattern of the circuit block 416. The battery holder 172 is attached to the switch spring 162. The battery holder 172 and the switch spring 162 conduct the anode of the battery 120 and a plus input portion Vdd of IC 418 via a plus pattern of the circuit block 416.

[0208] In reference to Fig. 15, Fig. 17 and Fig. 18, the hour/minute motor 440 includes an hour/minute coil block 442, an hour/minute stator 444 and an hour/minute rotor 446. When the hour/minute coil block 442 inputs an hour/minute motor drive signal, the hour/minute stator 444 is magnetized to thereby rotate the hour/minute rotor 446. The hour/minute rotor 246 is constituted to rotate by, for example, 180 degrees per 20 seconds.

[0209] There is constructed a constitution in which a first minute transmission wheel 452 is rotated based on rotation of the hour/minute rotor 446 and a minute wheel 456 is rotated via a second minute transmission wheel 454 based on rotation of the first minute transmission wheel 452. The minute wheel 456 is constituted to rotate by one rotation per hour. The minute hand 260 is attached to the minute wheel 456. Rotational center of the minute wheel 456 is the same as rotational center of the second wheel 284.

[0210] The minute display train wheel 450 includes the first minute transmission wheel 452, the second minute transmission wheel 454 and the minute wheel 456. The hour/minute rotor 446, the first minute transmission wheel 452 and the second minute transmission wheel 454 are rotatably supported by the main plate 402 and the train bridge 412. The minute wheel 456 is brought into contact with the outer peripheral portion of the center pipe 126 provided at the second bridge 114 and is rotatably supported thereby.

[0211] A minute wheel 462 is rotated based on rotation of the minute wheel 456. The hour wheel 226 is constituted to rotate based on rotation of the minute wheel 462. The hour wheel 226 is constituted to rotate by one rotation per 12 hours. The hour hand 230 is attached to the hour wheel 226. Rotational center of the hour wheel 226 is the same as the rotational center of the minute wheel 456. Therefore, rotational center of the hour wheel 226, rotational center of the minute wheel 456 and rotational center of the second wheel 284 are the same.

[0212] The minute train wheel 460 includes the minute wheel 462 and the hour wheel 226. The minute wheel 462 is rotatably supported by the main plate 402 and the train bridge 412. The hour wheel 226 is brought into contact with an outer peripheral portion of the minute wheel 456 and is rotatably supported thereby.

[0213] The attitude center 610 is attached to the circuit block 416. The attitude sensor 610 is the same as that applied to the first embodiment of the analog electronic timepiece according to the invention.

(2•2) Constitution of IC of second embodiment of analog electronic timepiece according to the invention

[0214] In reference to Fig. 18, IC 418 includes the dividing portion 312, the time measuring portion 314 and a time setting portion 426. The dividing portion 312 is constituted to divide the signal outputted by the crystal oscillator 122. The time measuring portion 314 is constituted to measure current time based on the output signal of the dividing portion 312. The time setting portion 426 is constituted to output a signal for controlling to drive the motors based on the output signal of the time measuring portion 314.

[0215] A drive control portion 428 is provided to control operation of an hour/minute motor drive portion 420 and the second motor drive portion 324.

[0216] The time set switch 330 is provided to control operation of the time setting portion 426. There is constructed a constitution in which the time setting portion 426 is operated by operating the time set switch 330 and the hour/minute motor drive portion 420 and the second motor drive portion 324 are operated by driving the drive control portion 428.

[0217] The time set switch 330 is constituted by the switch terminal portion integrally formed with the switch spring 162 and a switch pattern of the circuit block 416.

[0218] The reset switch 332 is provided to reset operation of the time setting portion 426. There is constructed a constitution in which by operating the reset switch 332, the time setting portion 426 is reset and by operating the drive control portion 428, operation of the hour/minute motor drive portion 420 and the second motor drive portion 324 can be stopped.

[0219] The attitude detecting portion 340 is provided to detect the attitude of the analog electronic timepiece based on the output signal of the attitude sensor 610.

[0220] An output determining portion 424 is constituted to input the output signal of the time measuring portion 314 based on the output signal of the attitude detecting portion 340 and operate the drive control portion 428.

[0221] The hour/minute motor drive portion 420 is constituted to be capable of outputting a signal for driving the hour/minute motor 440 to the hour/minute motor 440 based on an output signal of the drive control portion 428 and stopping driving the hour/minute motor 440 based on the output signal of the drive control portion 428.

[0222] The minute display train wheel 450 is rotated by driving the hour/minute motor 440 and "minute" can be displayed by the minute hand 260.

[0223] The minute train wheel 460 is rotated by rotating the minute display train wheel 450 and "hour" can be displayed by the hour hand 230.

[0224] The second motor drive portion 324 is constituted to be capable of outputting the signal for driving the second motor 270 to the second motor 270 based on the output signal of the drive control portion 428 and

stopping driving the second motor 270 based on the output signal of the drive control portion 428.

[0225] The second display train wheel 280 is rotated by driving the second motor 270 and "second" can be displayed by the second hand 290.

(2•3) Operation of second embodiment of analog electronic timepiece of the invention

[0226] Next, an explanation will be given of operation of the second embodiment of the analog electronic timepiece according to the invention.

(2•3•1) Type 2A

[0227] An explanation will be given of operation of a constitution (type 2A) for stopping all the motors based on a result of the attitude detected by the attitude sensor according to the second embodiment of the analog electronic timepiece of the invention.

[0228] In reference to Fig. 18 and Fig. 19, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour/minute motor 440 is operated and the hour hand 230 is set to "hour" of current time, the minute hand 260 is set to "minute" of current time and the second hand 290 is set to "second" of current time by operating the second motor 270 (step S191).

[0229] Next, by releasing the reset switch 332, the hour/minute motor 440 is operated, "hour" of current time is displayed by the hour hand 230, "minute" of current time is displayed by the minute hand 260, the second motor 270 is operated and "second" of current time is displayed by the second hand 290 (step S192) .

[0230] When a signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is not outputted continuously for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting potion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S193).

[0231] The threshold is set preferably in a range of 0.5 through 60 minutes and is set more preferably in a range of 1 through 5 minutes.

[0232] By constituting in this way, the attitude of the analog electronic timepiece can be detected firmly by excluding influence by chattering of the attitude sensor 610.

[0233] A time interval of operation of detecting the attitude of the analog electronic timepiece by the attitude detecting portion 340, is constituted to carry out the operation once per 10 minutes when the above-described threshold is set in, for example, a range of 1 through 5 minutes. The time interval is set preferably in a range of 5 through 60 minutes.

[0234] By constituting in this way, the attitude of the analog electronic timepiece can be detected firmly at every constant time period.

[0235] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for stopping driving the motors to the drive control portion 428. When the drive control portion 428 inputs the signal outputted by the output determining portion 424, the drive control portion 428 stops driving the hour/minute motor 440 by the hour/minute motor drive portion 420 and stops driving the second motor 270 by the second motor drive portion 324 (step S194) .

[0236] As a result, the hour/minute motor 440 stops operating, the hour hand 230 is stopped at a position indicated thereby, the minute hand 260 is stopped at a position indicated thereby, the second motor 270 stops operating and the second hand 290 is stopped at a position indicated thereby.

[0237] The output determining portion 424 inputs a signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the hour hand 230, the minute hand 260 and the second hand 290 are stopped.

[0238] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S193 is carried out again.

[0239] After stopping operating the hour/minute motor 440 and stopping operating the second motor 270, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is outputted (step S195).

[0240] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for driving to accelerate the motors to the drive control portion 428. When the drive control portion 428 inputs the signal outputted by the output determining portion 424, the drive control portion 428 operates the hour/minute motor drive portion 420, drives to accelerate the hour/minute motor 440 until the hour hand 230 reaches a position indicating current time and the minute hand 260 reaches a position indicating current time, operates the second-motor drive portion 324 and drives to accelerate the second motor 270 until the second hand 290 reaches a position indicating current time (step S196).

[0241] As a result, the hour hand 230 indicates "hour" of current time, the minute hand 260 indicates "minute" of current time and the second hand 290 indicates "sec-

ond" of the current time.

[0242] According to the accelerated driving method, all of the hour hand 230, the minute hand 260 and the second hand 290 may be rotated regularly in the clockwise direction or all of the hour hand 130, the minute hand 260 and the second hand 290 may be rotated reversely in the counterclockwise direction. Or, according to the accelerated driving method, there may be constructed a constitution in which there is calculated a relationship between a position at which the hour hand 230 intends to indicate and a position at which the hour hand 230 is stopped, there is calculated a relationship between aposition at which the minute hand 260 intends to indicate and a position at which the minute hand 260 is stopped, there is calculated a relationship between a position at which the second hand 290 intends to indicate and a position at which the second hand 290 is stopped and the hour hand 230, the minute hand 260 and the second hand 290 are respectively rotated in a rotational direction of regular rotation or reverse rotation in which the hands can reach positions at which the hands intend to indicate more fastly.

[0243] When the hour hand 230, the minute hand 260 and the second hand 290 are driven to accelerate and current time is displayed by the hour hand 230, the minute hand 260 and the second hand 290, the operation returns to step 192 and normal operation is carried out.

[0244] At step S195, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 224 detects the attitude of the analog electronic timepiece again (step S195).

[0245] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial lower attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece of the invention can be made about 2/3 of power consumption of the conventional analog electronic timepiece. Therefore, according to the analog electronic timepiece of the invention, when a battery having dimensions and shape the same as those of the conventional analog electronic timepiece is used, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

(2•3•2) Type 2B

[0246] An explanation will be given of an operation of a constitution (type 2B) for stopping only the second motor 270 based on a result of the attitude detected by the attitude sensor according to the second embodiment of the analog electronic timepiece of the invention.

[0247] In the following explanation, a description will mainly be given of a point in which constitution and operation of type 2B differ from constitution and operation of type 2A according to the second embodiment of the analog electronic timepiece of the invention. Therefore, with regard to portions which are not described below, the above-described explanation with regard to type 2A will be applied thereto.

[0248] In reference to Fig. 18 and Fig. 20, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour/minute motor 440 is operated and the hour hand 230 is set to "hour" of current time, the minute hand 260 is set to "minute" of current time and the second hand 290 is set to "second" of current time by operating the second motor 270 (step S201).

[0249] Next, the reset switch 332 is released, the hour/minute motor 440 is operated, "hour" of current time is displayed by the hour hand 230, "minute" of current time is displayed by the minute hand 260, the second motor 270 is operated and "second" of current time is displayed by the second hand 290 (step S202).

[0250] When a signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is not outputted continuously for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S203).

[0251] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for stopping driving the second motor 270 to the drive control portion 428. When the drive control portion 428 inputs the signal outputted by the output determining portion 424, the drive control portion 428 stops driving the second motor 270 by the second motor drive portion 324 (step S204).

[0252] As a result, the second hand 290 is stopped at a position indicated thereby. At this occasion, the hour hand 230 and the minute hand 260 continue indicating current time.

[0253] The output determining portion 424 inputs a signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the second hand 290 is stopped.

[0254] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S203 is carried out again.

[0255] After stopping operating the second motor 270, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is output-

ted (step S205).

[0256] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for driving to accelerate the second motor 270 to the drive control portion 428. When the drive control portion 428 inputs the signal outputted by the output determining portion 424, the drive control portion 428 outputs a signal to the second motor drive portion 324 and drives to accelerate the second motor 270 till the second hand 290 reaches a position indicating current time (step S206).

[0257] As a result, the hour hand 230 indicates "hour" of current time, the minute hand 260 indicates "minute" of current time and the second hand 290 indicates "second" of current time.

[0258] According to accelerated driving method, the second hand 290 may be rotated regularly in the clockwise direction or the second hand 290 maybe rotated reversely in the counterclockwise direction, or according to the accelerated driving method, there may be constructed a constitution in which there is calculated a relationship between a position at which the second hand 290 intends to indicate and a position at which the second hand 290 is stopped and the second hand 290 may be rotated respectively in a rotational direction of regular rotation or reverse rotation in which the second hand 290 can reach the position at which the second hand 290 intends to indicate more fastly.

[0259] When the second hand 290 is driven to accelerate and current time is displayed by the hour hand 230, the minute hand 260 and the second hand 290, the operation returns to step 202 and normal operation is carried out.

[0260] At step S205, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 424 detects the attitude of the analog electronic timepiece again (step S205).

[0261] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial low attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece according to the invention can be made about 2/3 of power consumption of the conventional analog electronic timepiece. Therefore, according to the analog electronic timepiece of the invention, when there is used a battery having dimensions and shape the same as those of the conventional analog electric timepiece, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

[0262] According to the constitution, the hour hand 230 always indicates "hour" of current time and the minute hand 260 always indicates "minute" of current time. Therefore, even in a state in which the second hand 290 is stopped, "hour" and "minute" of current time can be read.

(3) Structure having no second hand

[0263] Although according to the embodiment of the analog electronic timepiece of the invention, explained above, an explanation has been given of cases having the second hand, the invention is applicable to an analog electronic timepiece having a structure with no second hand.

[0264] For example, according to the first embodiment of the analog electronic timepiece of the invention, in the structure shown by Fig. 1, Fig. 2 and Fig. 5, the second motor 270 (second coil block 272, second stator 274, second rotor 276) is removed and the second display train wheel 220 (second transmission wheel 282, second wheel 284) and the secondhand 290 are removed. Further, IC 118 is not provided with the second motor drive portion 324.

[0265] Further, in Fig. 12, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour motor 210 is operated and the hour hand 230 is set to "hour" of current time and the minute motor 240 is operated and the minute hand 260 is set to "minute" of current time (step S121).

[0266] Next, the reset switch 332 is released, the hour motor 210 is operated, "hour" of current time is displayed by the hour hand 230, the minute motor 240 is operated and "minute" of current time is displayed by the hour hand 260 (step S122).

[0267] When a signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610, is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is not outputted continuously for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S123).

[0268] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for stopping driving the motors to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 stops driving the hour motor 210 by the hour motor drive portion 320 and stops driving the minute motor 240 by the minute motor drive portion 322 (step S124).

[0269] As a result, the hour motor 210 stops operating, the hour hand 230 is stopped at a position indicated thereby, the minute motor 240 stops operating and the minute hand 260 is stopped at a position indicated thereby.

[0270] The output determining portion 344 inputs a signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the hour hand 230 and the minute hand 260 are stopped.

[0271] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S123 is carried out again.

[0272] After stopping operating the hour motor 210 and stopping operating the minute motor 240, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is outputted (step S125).

[0273] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 344 outputs a signal for driving to accelerate the motors to the drive control portion 328. When the drive control portion 328 inputs the signal outputted by the output determining portion 344, the drive control portion 328 operates the hour motor drive portion 320, drives to accelerate the hour motor 210 until the hour hand 230 reaches a position indicating current time, operates the minute motor drive portion 322 and drives to accelerate the minute motor 240 until the minute hand 260 reaches a position indicating current time (step S126).

[0274] As a result, the hour hand 230 indicates "hour" of current time and the minute hand 260 indicates "minute" of current time.

[0275] When the hour hand 230 and the minute hand 260 are driven to accelerate and current time is displayed by the hour hand 230 and the minute hand 260, the operation returns to step 122 and normal operation is carried out.

[0276] At step S125, when the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 344 detects the attitude of the analog electronic timepiece again (step S125).

[0277] Further, for example, according to the second embodiment of the analog electronic timepiece of the invention, in the structure shown by Fig. 15, Fig. 16, Fig. 18, the second motor 270 (second coil block 272, second stator 274, second rotor 176) is removed and the second display train wheel 220 (second transmission wheel 282, second wheel 284) and the second hand 290 are removed. Further, IC 118 is not providedwith the second motor drive portion 324.

[0278] Further, in Fig. 18, first, the analog electronic timepiece is reset by operating the reset switch 332, by operating the time set switch 330, the hour/minute motor 440 is operated and the hour hand 230 is set to "hour" of current time and the minute hand 260 is set to "minute" of current time" (step S191).

[0279] Next, the reset switch 332 is released, the hour/minute motor 440 is operated, "hour" of current time is displayed by the hour hand 230 and "minute" of current time is displayed by the minute hand 260 (step S192).

[0280] When the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is continuously outputted for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude) and when the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is not outputted continuously for a threshold of a constant detecting time period, for example, 1 minute, the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude) (step S193).

[0281] When the attitude detecting portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for stopping driving the motors to the drive control portion 428. When the drive control portion 428 inputs a signal outputted by the output determining portion 424, the drive control portion 428 stops driving the hour/minute motor 440 by the hour/minute motor drive portion 420 (step S194) .

[0282] As a result, the hour/minute motor 440 stops operating, the hour hand 230 is stopped at a position indicated thereby and the minute hand 260 is stopped at a position indicated thereby.

[0283] The output determining portion 424 inputs a signal with regard to current time outputted by the time measuring portion 314 and measures a difference between current time and time at which the hour hand 230 and the minute hand 260 are stopped.

[0284] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), after elapse of a constant time interval, operation of step S193 is carried out again.

[0285] After stopping operating the hour/minute motor 440, the attitude detecting portion 340 determines whether the signal indicating the dial lower attitude (flat attitude) outputted by the attitude sensor 610 is outputted (step S195).

[0286] When the attitude detecting portion 340 determines that the analog electronic timepiece is not brought into the dial lower attitude (flat attitude), the output determining portion 424 outputs a signal for driving to accelerate the motors to the drive control portion 428. When the drive control portion 428 inputs the signal outputted by the output determining portion 424, the drive control portion 428 operates the hour/minute motor drive portion 420 and drives to accelerate the hour/minute motor 440 until the hour hand 230 reaches a position indicating current time and the minute hand 260 reaches a position indicating current time (step S196).

[0287] As a result, the hour hand 230 indicates "hour"

of current time and the minute hand 260 indicates "minute" of current time.

[0288] When the hour hand 230 and the minute hand 260 are driven to accelerate and current time is displayed by the hour hand 230 and the minute hand 260, the operation returns to step 192 and the normal operation is carried out.

[0289] At step S195, when the attitude determining portion 340 determines that the analog electronic timepiece is brought into the dial lower attitude (flat attitude), the output determining portion 424 detects attitude of the analog electronic timepiece again (step S195).

[0290] According to the constitution, for example, assuming that the analog electronic timepiece is removed from the arm and is brought into the dial lower attitude (flat attitude) for 8 hours at night every day, power consumption of the analog electronic timepiece of the invention can be made about 2/3 of power consumption of the conventional analog electric timepiece. Therefore, according to the analog electronic timepiece of the invention, even in the structure which is not provided with the second hand, when a battery having dimensions and shape the same as those of the conventional analog electronic timepiece is used, battery life can be made about 1.5 times as much as that of the conventional analog electronic timepiece.

(4) Effect of the Invention

[0291] As has been explained above, according to the analog electronic timepiece of the invention, operation of the motors is constituted to control in correspondence with the attitude of the analog electronic timepiece. Therefore, the analog electronic timepiece of the invention can save power consumption more than the conventional analog electronic timepiece.

[Industrial Applicability]

[0292] The analog electronic timepiece having the attitude sensor according to the invention is suitable for realizing an analog electronic timepiece having small power consumption. Further, the analog electronic timepiece having the attitude sensor according to the invention is suitable for realizing an analog electronic timepiece which is small-sized and thin and having long battery type.

Claims

1. An analog electronic timepiece **characterized in** an analog electronic timepiece comprising:

   a plurality of motors;
   a plurality of display members (230, 260, 290) operated by rotation of the plurality of motors for displaying time information;
   an attitude sensor (610) for detecting an attitude of the analog electronic timepiece; and
   an attitude detecting portion (340) for detecting the attitude of the analog electronic timepiece based on an output signal of the attitude sensor (610);

   wherein operation of the rotation of the plurality of motors is controlled based on an output signal of the attitude detecting portion (340).

2. The analog electronic timepiece according to Claim 1, **characterized in** further comprising a drive control portion (328) for controlling the operation of the rotation of the plurality of motors and an output determining portion (344) for operating the drive control portion (328) based on the output signal of the attitude detecting portion (340).

3. The analog electronic timepiece according to Claim 1 or Claim 2, **characterized in that** the plurality of motors include an hour motor (210), a minute motor (240) and a second motor (270);

   wherein an hour display train wheel (220) is rotated by driving the hour motor (210) and "hour" is displayed by an hour hand (230);

   wherein a minute display train wheel (250) is rotated by driving the minute motor (240) and "minute" is displayed by a minute hand (260);

   wherein a second display train wheel (280) is rotated by driving a second motor (270) and "second" is displayed by a second hand (290);

   wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the hour motor (210), the minute motor (240) and the second motor (270) are stopped, further comprising:

   an output determining portion (344) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand (230), the minute hand (260) and the second hand (290) are stopped; and
   when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (344) based on a signal outputted by the attitude detecting portion (340), thehourmotor (210) is driven to accelerate to reach a position at which the hour hand (230) indicates the current time, the minute motor (240) is driven to accelerate to reach a position at which the minute hand (260) indicates the current time and the second motor (270) is driven to accelerate to reach a position at which the second

hand (290) indicates the current time.

4. The analog electronic timepiece according to Claim 1 or Claim 2, **characterized in that** the plurality of motors include an hour motor (210), a minute motor (240) and a second motor (270);

wherein an hour display train wheel (220) is rotated by driving the hour motor (210) and "hour" is displayed by an hour hand (230);

wherein a minute display train wheel (250) is rotated by driving the minute motor (240) and "minute" is displayed by a minute hand (260);

wherein a second display train wheel (280) is rotated by driving a second motor (270) and "second" is displayed by a second hand (290);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the second motor (270) is stopped, further comprising:

an output determining portion (344) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the second hand (290) is stopped; and

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (344) based on a signal outputted by the attitude detecting portion (340), the second motor (270) is driven to accelerate to reach a position at which the second hand (290) indicates the current time.

5. The analog electronic timepiece according to Claim 1 or Claim 2, **characterized in that** the plurality of motors include an hour motor (210), a minute motor (240) and a second motor (270);

wherein an hour display train wheel (220) is rotated by driving the hour motor (210) and "hour" is displayed by an hour hand (230);

wherein a minute display train wheel (250) is rotated by driving the minute motor (240) and "minute" is displayed by a minute hand (260);

wherein a second display train wheel (280) is rotated by driving a second motor (270) and "second" is displayed by a second hand (290);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the minute motor (240) and the second motor (270) are stopped, further comprising:

an output determining portion (344) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the minute hand (260) and the second hand (290) are stopped;

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (344) based on a signal outputted by the attitude detecting portion (340), the minute motor (240) is driven to accelerate to reach a position at which the minute hand (260) indicates the current time and the second motor (270) is driven to accelerate to reach a position at which the second hand (290) indicates the current time.

6. The analog electronic timepiece according to any one of Claim 3 through Claim 5, **characterized in** further comprising a date wheel (170) rotated by rotation of the time display train wheel (220).

7. The analog electronic timepiece according to Claim 1 or Claim 2, **characterized in that** the plurality of motors include an hour/minute motor (440) and a second motor (270);

wherein a minute display train wheel (450) is rotated by driving the hour/minute motor (440), "minute" is displayed by a minute hand (260), a minute train wheel (460) is rotated by rotating the minute display train wheel (250) and "hour" is displayed by the hour hand (230);

wherein the second display train wheel (280) is rotated by driving the second motor (270) and "second" is displayed by the second hand (290);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the hour/minute motor (440) and the second motor (270) are stopped, further comprising:

an output determining portion (424) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand (230), the minute hand (260) and the second hand (290) are stopped; and

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (440) based on a signal outputted by the attitude detecting portion (340), the hour/minute motor (440) is driven to accelerate to reach a position at which the hour hand (230) and the minute hand (260) indicate the current time and the second motor (270) is driven to accelerate to reach a position at which the second hand (290) indicates the current time.

8. The analog electronic timepiece according to Claim 1 or Claim 2, **characterized in that** the plurality of motors include an hour/minute motor (440) and a second motor (270);

wherein a minute display train wheel (450) is rotated by driving the hour/minute motor (440), "minute" is displayed by a minute hand (260), a minute train wheel (460) is rotated by rotating the minute display train wheel (250) and "hour" is displayed by the hour hand (230);

wherein the second display train wheel (280) is rotated by driving the second motor (270) and "second" is displayed by the second hand (290);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the second motor (270) is stopped, further comprising:

an output determining portion (424) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the second hand (290) is stopped; and

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (424) based on a signal outputted by the attitude detecting portion (340), the second motor (270) is driven to accelerate to reach a position at which the second hand (290) indicates the current time.

9. The analog electronic timepiece according to Claim 7 or Claim 8, **characterized in** further including a date wheel (170) rotated by rotation of the minute train wheel (460).

10. The analog electronic timepiece according to any one of Claim 3 through Claim 9, **characterized in that** the previously determined attitude is an attitude by which a dial is directed to a lower side.

11. The analog electronic timepiece according to any one of Claim 3 through Claim 10, **characterized in that** a step of determining that the analog electronic timepiece is brought into the previously determined attitude by the attitude detecting portion (340) is determined with a threshold of a constant detecting time period as a reference.

12. The analog electronic timepiece according to any one of Claim 3 through Claim 10, **characterized in that** a step of determining that the analog electronic timepiece is not brought into the previously determined attitude by the attitude detecting portion (340) is determined with a threshold of a constant detecting time period as a reference.

13. The analog electronic timepiece according to any of Claim 3 through Claim 12, **characterized in that** the step of determining that the analog electronic timepiece is brought into the previously determined attitude by the attitude detecting portion (340) is determined by detecting that the signal outputted by the attitude sensor (610) is outputted by a previously determined number of times during a constant time period.

14. The analog electronic timepiece according to any one of Claim 3 through Claim 12, **characterized in that** the step of determining that the analog electronic timepiece is not brought into the previously determined attitude by the attitude detecting portion (340) is determined by detecting that the signal outputted by the attitude sensor (610) is outputted by a previously determined number of times during a constant time period.

15. An analog electronic timepiece **characterized in** an analog electronic timepiece comprising:

one or more of motors;
display members (230, 260) operated by rotation of one or more of the motors for displaying time information;
an attitude sensor (610) for detecting an attitude of the analog electronic timepiece; and
an attitude detecting portion (340) for detecting the attitude of the analog electronic timepiece based on an output signal of the attitude sensor (610);

wherein operation of the rotation of one or more of the motors is controlled based on an output signal of the attitude detecting portion (340).

16. The analog electronic timepiece according to Claim 1, **characterized in** further comprising a drive control portion (328) for controlling the operation of the rotation of one or more of the motors and an output determining portion (344) for operating the drive control portion (328) based on the output signal of the attitude detecting portion (340).

17. The analog electronic timepiece according to Claim 15 or Claim 16, **characterized in that** one or more of the motors include an hour motor (210) and a minute motor (240);

wherein the hour display train wheel (220) is rotated by driving the hour motor (210) and "hour" is displayed by an hour hand (230);

wherein a minute display train wheel (250) is rotated by driving the minute motor (240) and "minute" is displayed by a minute hand (260);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the hour motor (210) and the minute motor (240) are stopped, further comprising:

an output determining portion (344) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand (230) and the minute hand (260) are stopped; and

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (344) based on the signal outputted by the attitude detecting portion (340), the hour motor (210) is driven to accelerate to reach a position at which the hour hand (230) indicates the current time and the minute motor (240) is driven to accelerate to reach a position at which the minute hand (260) indicates the current time.

18. The analog electronic timepiece according to Claim 15 or Claim 16, **characterized in that** one or more of the motors include an hour/minute motor (440);

wherein a minute display train wheel (450) is rotated by driving the hour/minute motor (440), "minute" is displayed by a minute hand (260), a minute train wheel (460) is rotated by rotating the minute display train wheel (250) and "hour" is displayed by an hour hand (230);

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is brought into a previously determined attitude, the hour/minute motor (440) is stopped, further comprising:

an output determining portion (424) for inputting a signal with regard to current time and measuring a difference between the current time and time at which the hour hand (230) and the minute hand (260) are stopped; and

wherein when the attitude detecting portion (340) determines that the analog electronic timepiece is not brought into the previously determined attitude, by operating the output determining portion (424) based on a signal outputted by the attitude detecting portion (340), the hour/minute motor (440) is driven to accelerate to reach a position at which the hour hand (230) and the minute hand (260) indicate the current time.

FIG.1

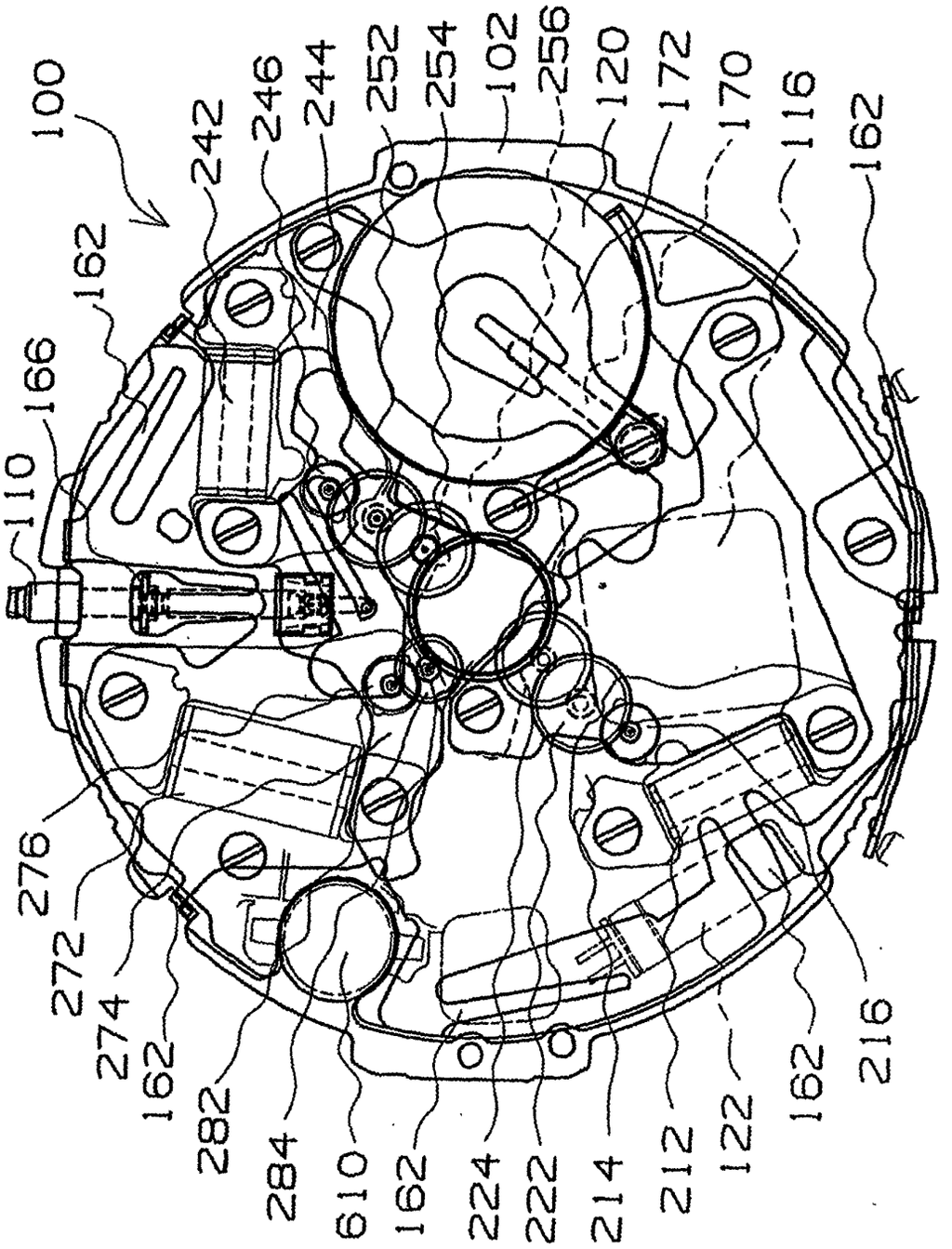

100
242
246
244
252
254
102
256
120
172
170
116
162
162
166
110
276
272
274
162
282
284
610
162
224
222
214
212
122
162
216

FIG. 2

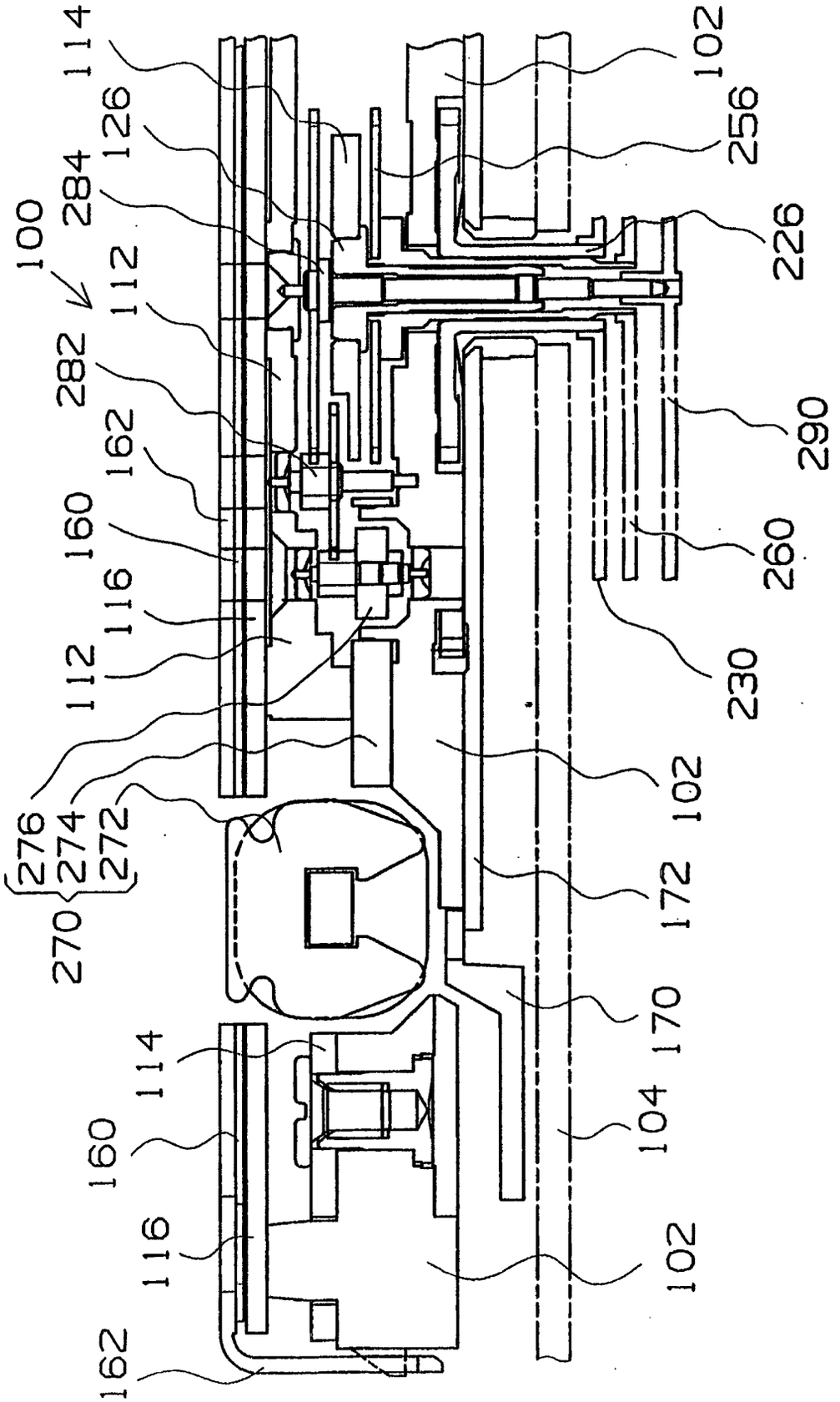

100
102
104
112
114
116
126
160
162
170
172
226
230
256
260
270
272
274
276
282
284
290

FIG. 3

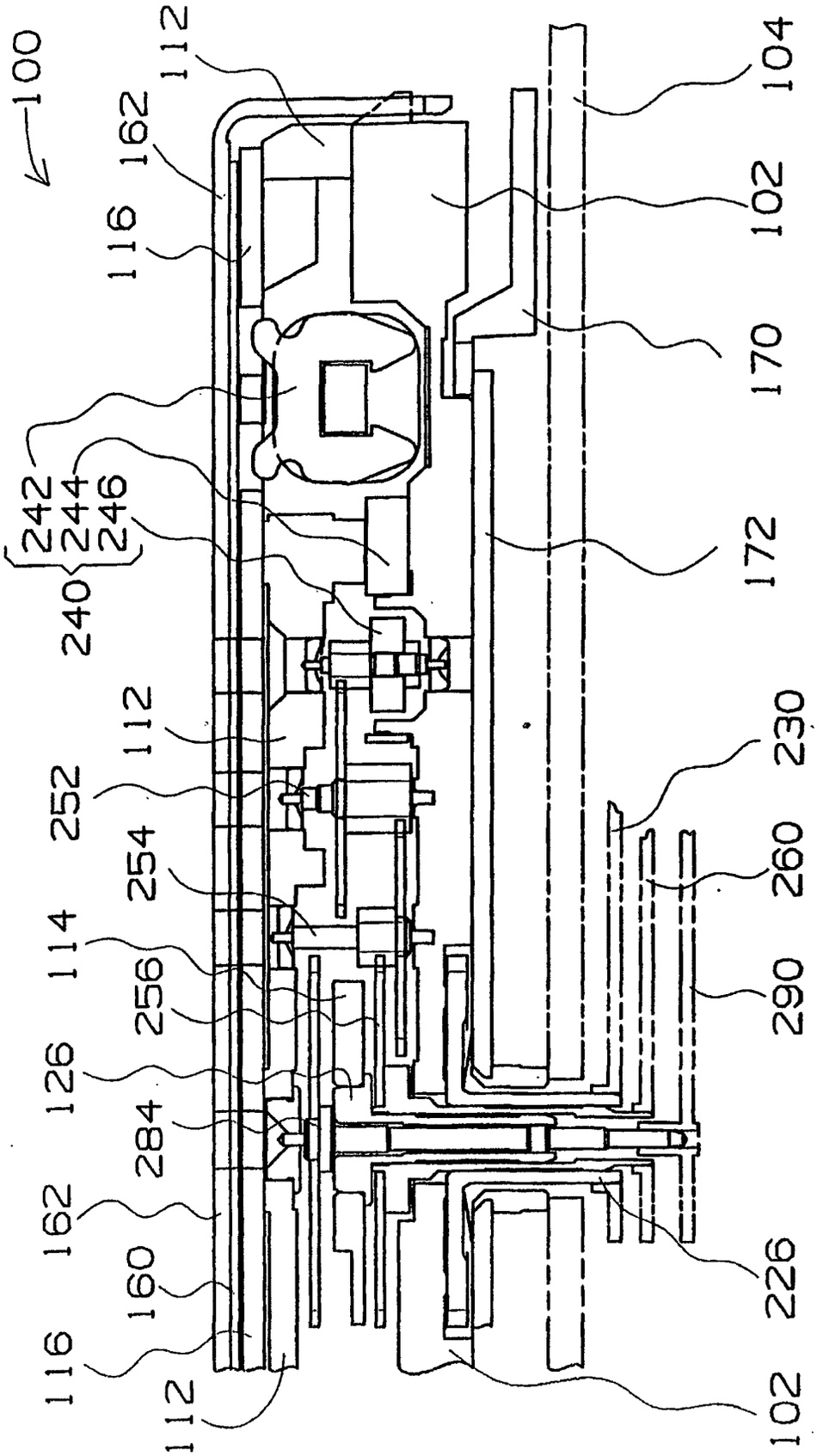

100
112
162
116
242
244
246
240
252
254
114
256
126
284
160
104
102
170
172
230
260
290
226

FIG. 4

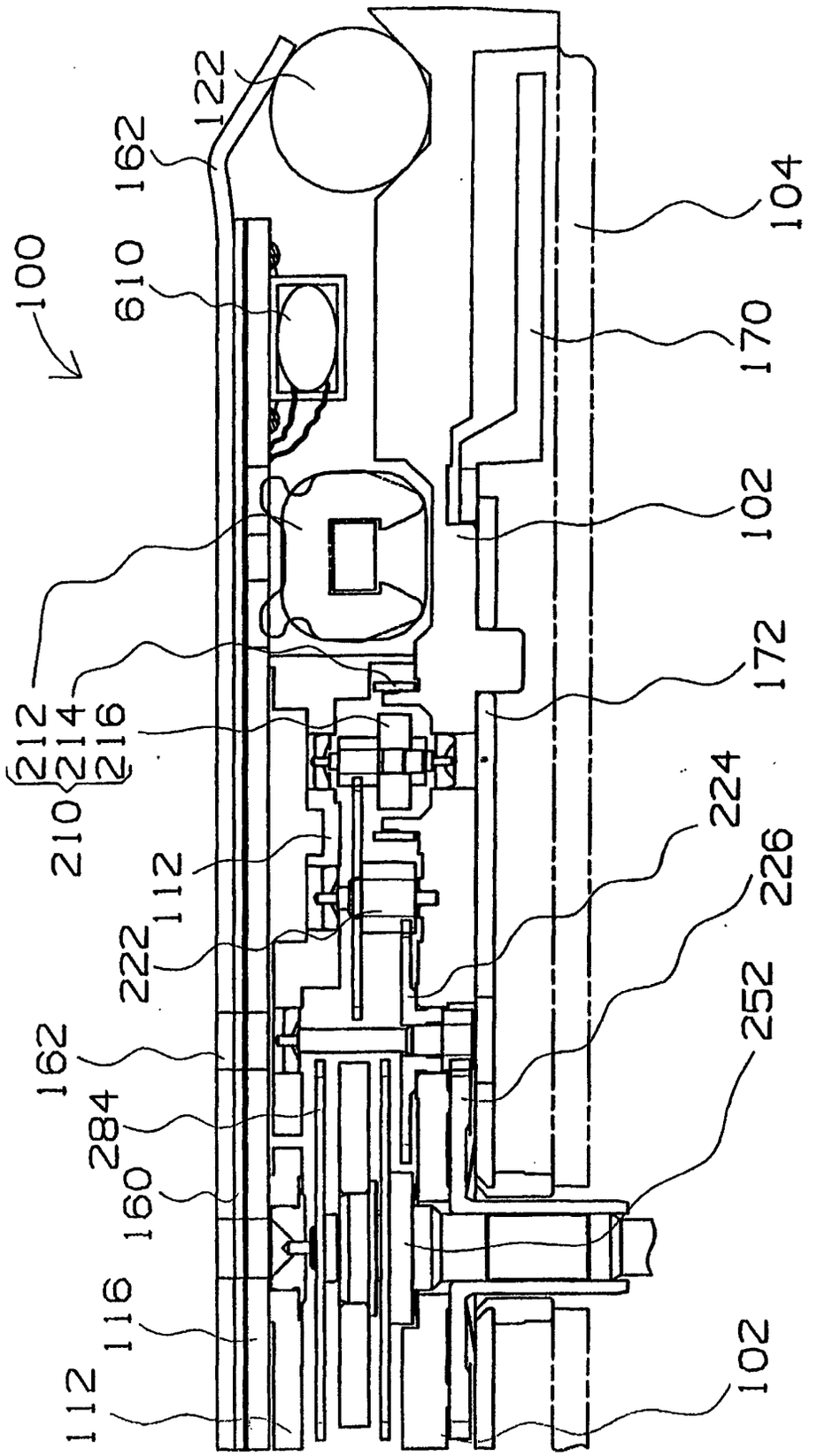

100
610
162
122
104
170
102
172
212
214
216
210
224
226
112
222
252
162
284
160
116
112
102

FIG.5

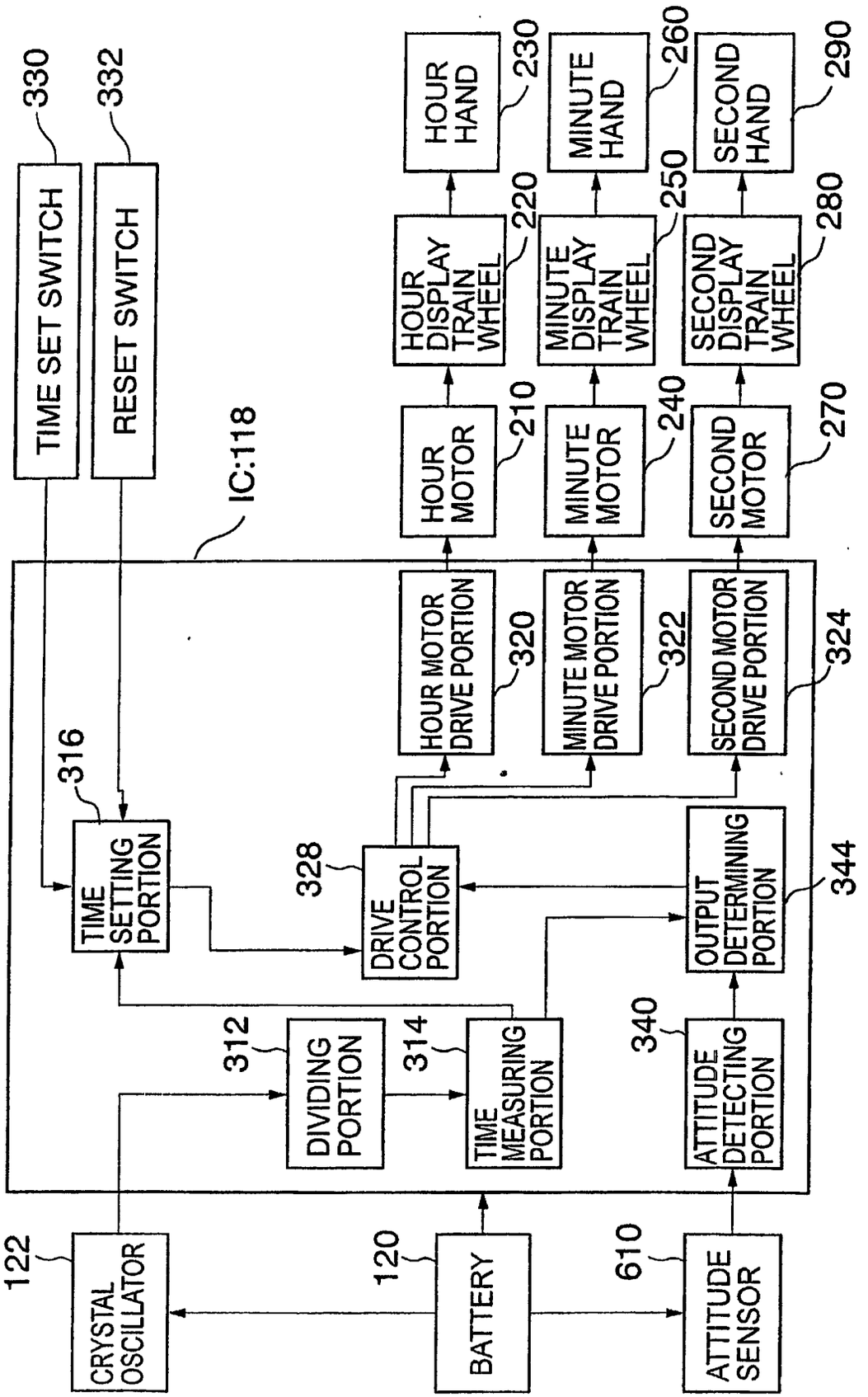

330
TIME SET SWITCH
332
RESET SWITCH
IC:118
316
TIME SETTING PORTION
328
DRIVE CONTROL PORTION
HOUR MOTOR DRIVE PORTION
320
MINUTE MOTOR DRIVE PORTION
322
SECOND MOTOR DRIVE PORTION
324
HOUR MOTOR
210
MINUTE MOTOR
240
SECOND MOTOR
270
HOUR DISPLAY TRAIN WHEEL
220
MINUTE DISPLAY TRAIN WHEEL
250
SECOND DISPLAY TRAIN WHEEL
280
HOUR HAND
230
MINUTE HAND
260
SECOND HAND
290
OUTPUT DETERMINING PORTION
344
312
DIVIDING PORTION
314
TIME MEASURING PORTION
340
ATTITUDE DETECTING PORTION
122
CRYSTAL OSCILLATOR
120
BATTERY
610
ATTITUDE SENSOR

FIG. 6

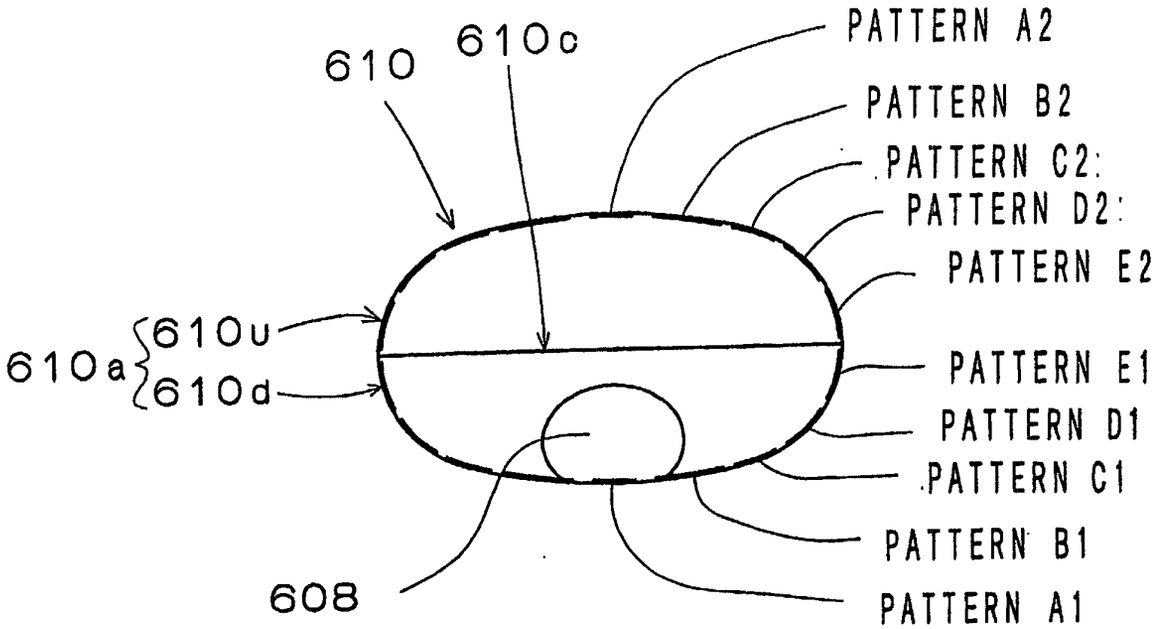

610
610c
PATTERN A2
PATTERN B2
PATTERN C2
PATTERN D2
PATTERN E2
610a
610u
610d
PATTERN E1
PATTERN D1
PATTERN C1
PATTERN B1
608
PATTERN A1

FIG. 7

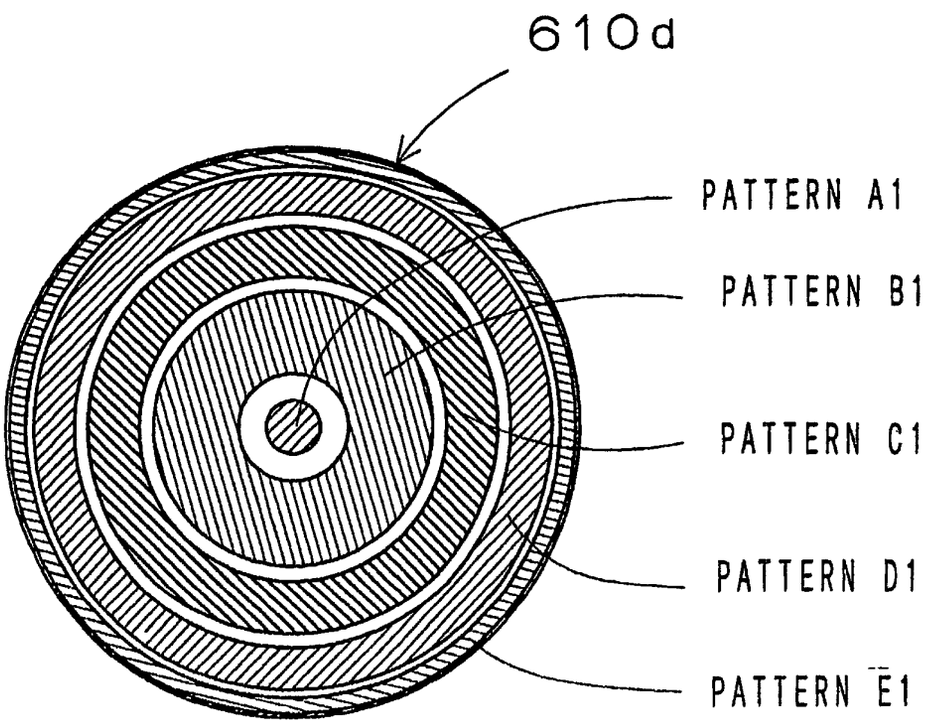

610d
PATTERN A1
PATTERN B1
PATTERN C1
PATTERN D1
PATTERN E1

FIG. 8

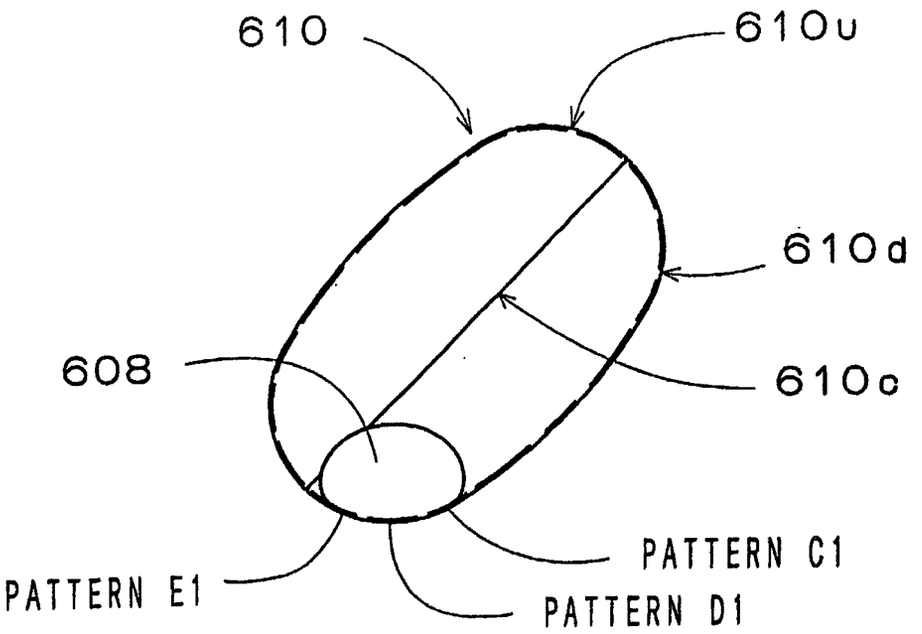

610
610u
610d
608
610c
PATTERN C1
PATTERN E1
PATTERN D1

FIG. 9

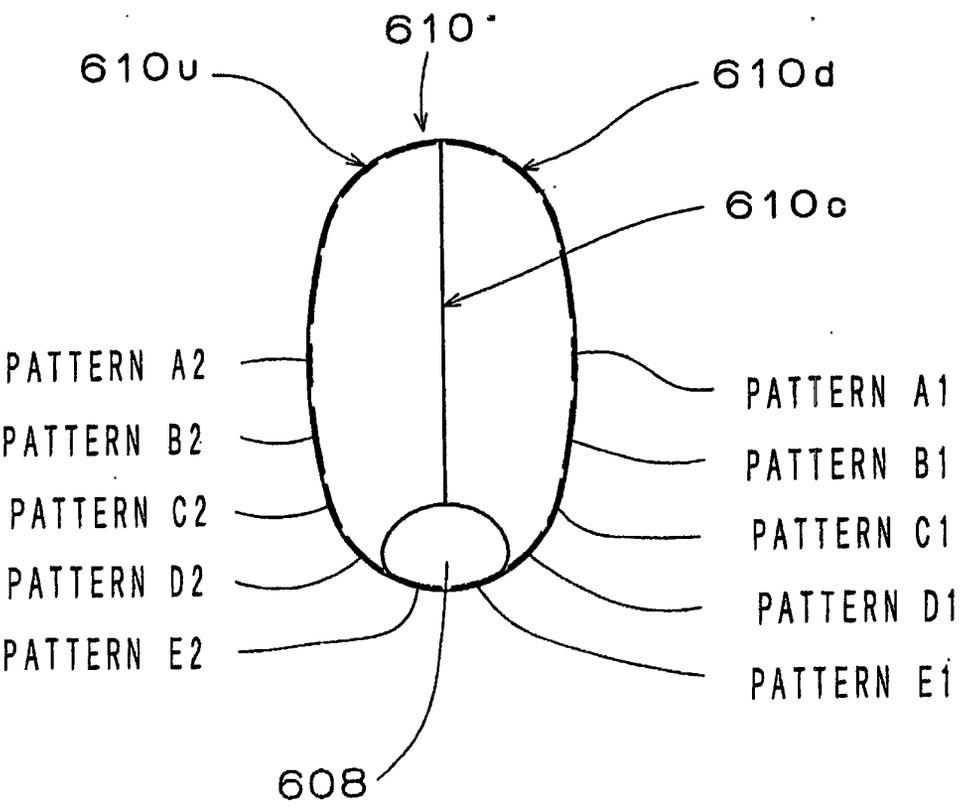

610'
610u
610d
610c
PATTERN A2
PATTERN B2
PATTERN C2
PATTERN D2
PATTERN E2
PATTERN A1
PATTERN B1
PATTERN C1
PATTERN D1
PATTERN E1
608

FIG. 10

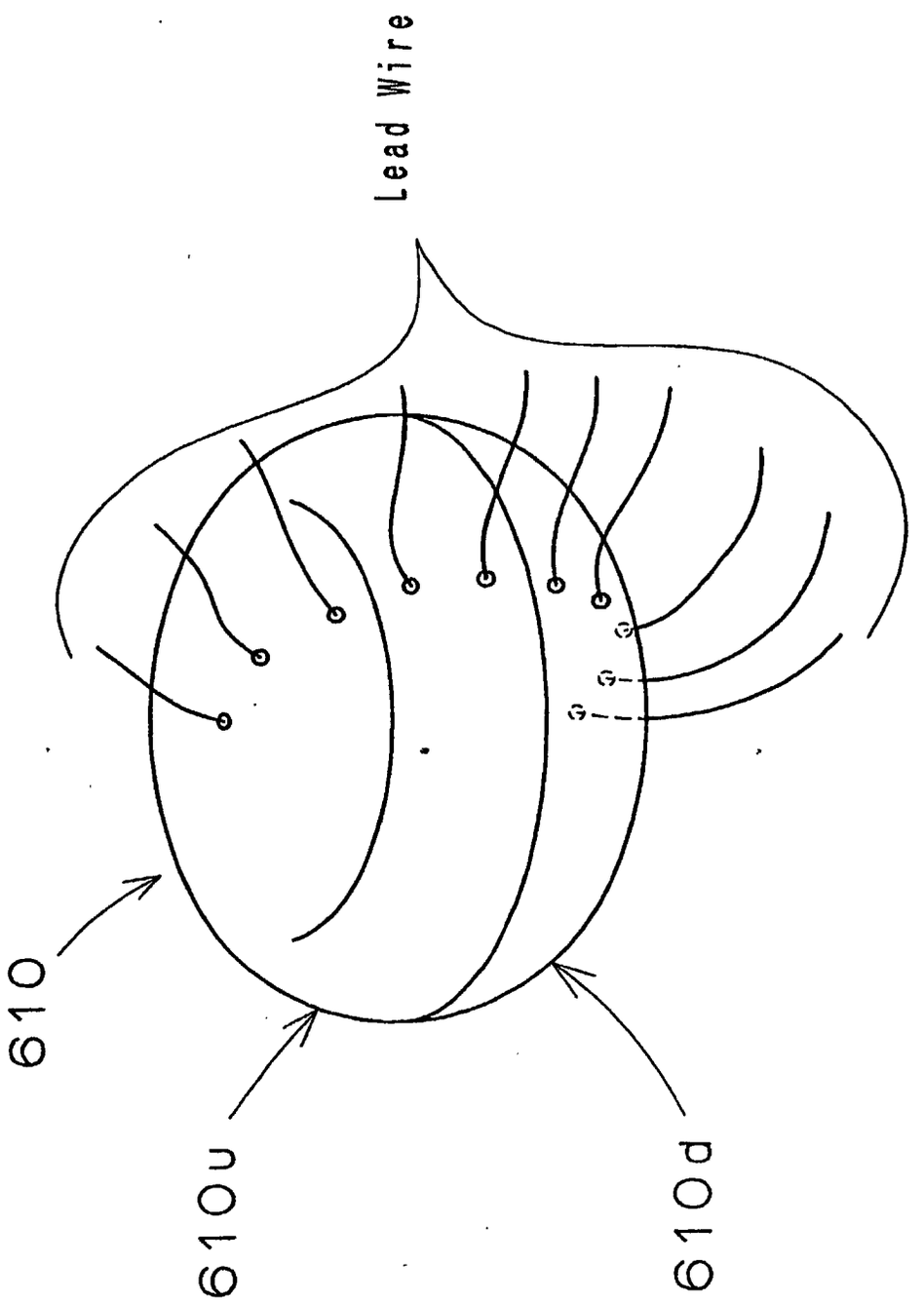


FIG.11

	A1	B1	C1	D1	E1	E2	D2	C2	B2	A2	ATTITUDE	
ATTITUDE STATE 1	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0° ~ 7°	FLAT (DIAL LOWER)
ATTITUDE STATE 2	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	8° ~ 12°	
ATTITUDE STATE 3	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	13° ~ 30°	
ATTITUDE STATE 4	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	31° ~ 60°	SKEWED
ATTITUDE STATE 5	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	61° ~ 89°	ERECT
ATTITUDE STATE 6	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	90°	
ATTITUDE STATE 7	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	91° ~ 119°	
ATTITUDE STATE 8	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	120° ~ 149°	SKEWED
ATTITUDE STATE 9	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	150° ~ 167°	BACK FLAT (DIAL UPPER)
ATTITUDE STATE 10	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	168° ~ 172°	
ATTITUDE STATE 11	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	173° ~ 180°	

FIG.12

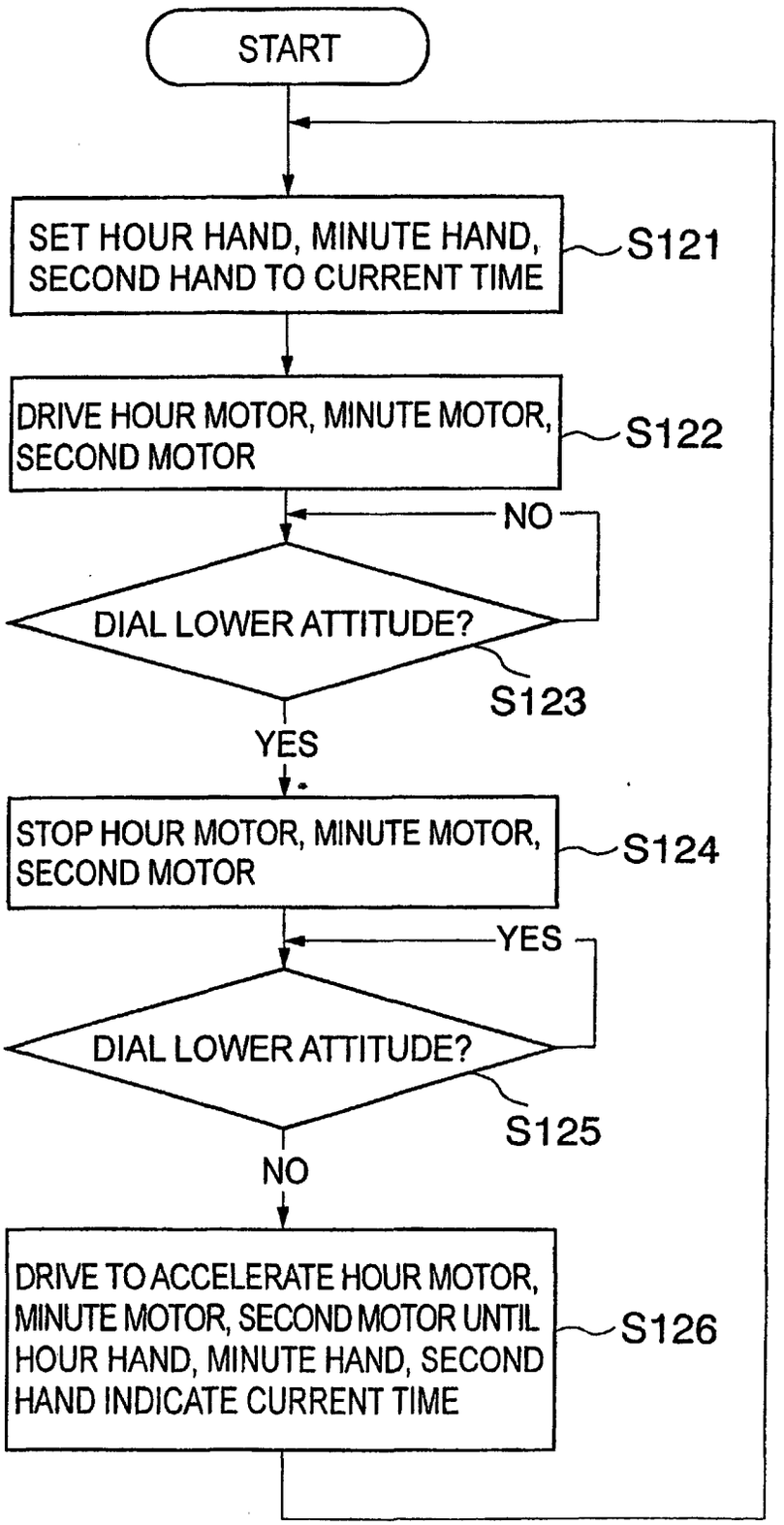

START
SET HOUR HAND, MINUTE HAND, SECOND HAND TO CURRENT TIME
S121
DRIVE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S122
NO
DIAL LOWER ATTITUDE?
S123
YES
STOP HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S124
YES
DIAL LOWER ATTITUDE?
S125
NO
DRIVE TO ACCELERATE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR UNTIL HOUR HAND, MINUTE HAND, SECOND HAND INDICATE CURRENT TIME
S126

FIG.13

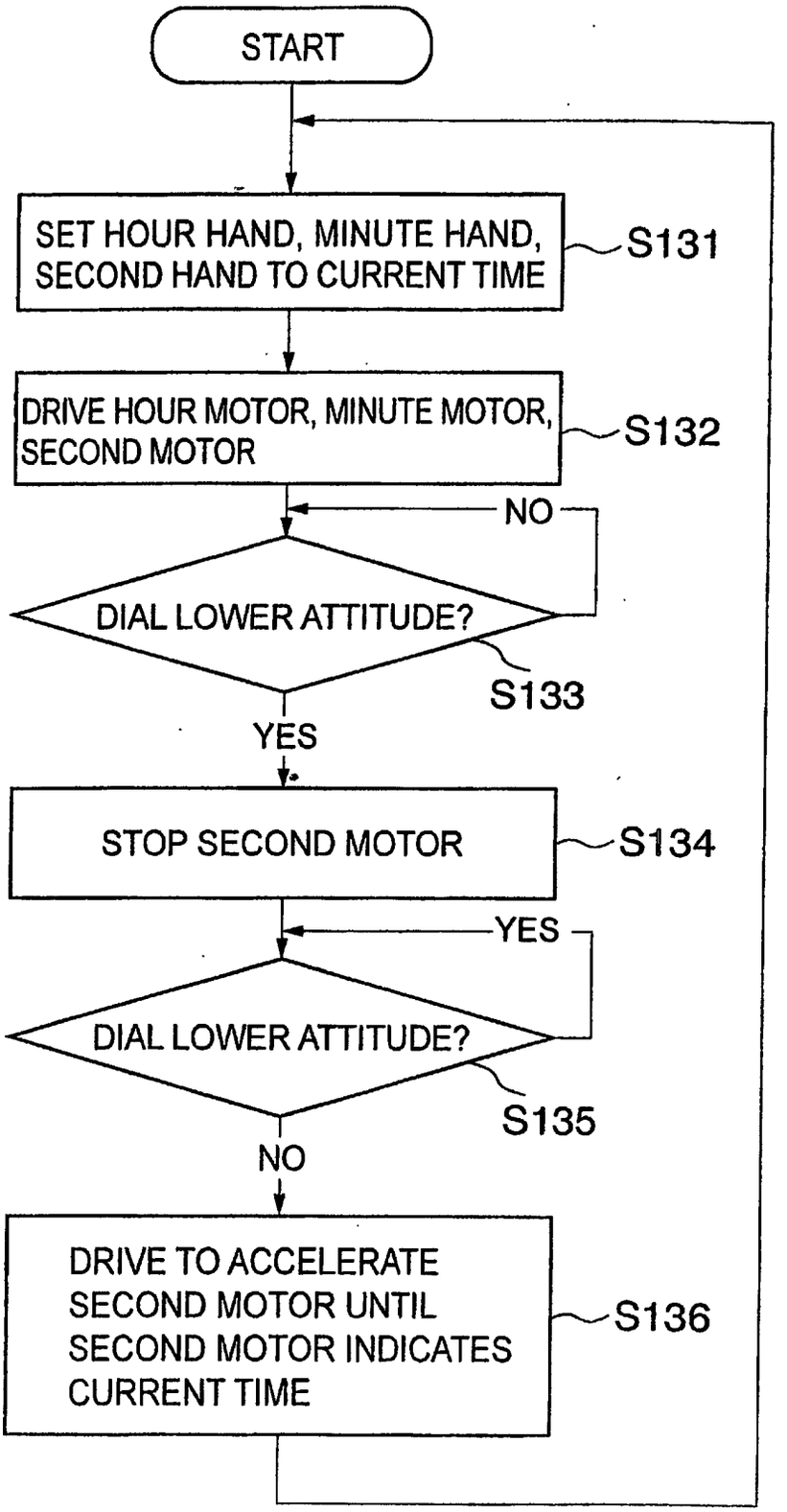

START
SET HOUR HAND, MINUTE HAND, SECOND HAND TO CURRENT TIME
S131
DRIVE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S132
NO
DIAL LOWER ATTITUDE?
S133
YES
STOP SECOND MOTOR
S134
YES
DIAL LOWER ATTITUDE?
S135
NO
DRIVE TO ACCELERATE SECOND MOTOR UNTIL SECOND MOTOR INDICATES CURRENT TIME
S136

FIG.14

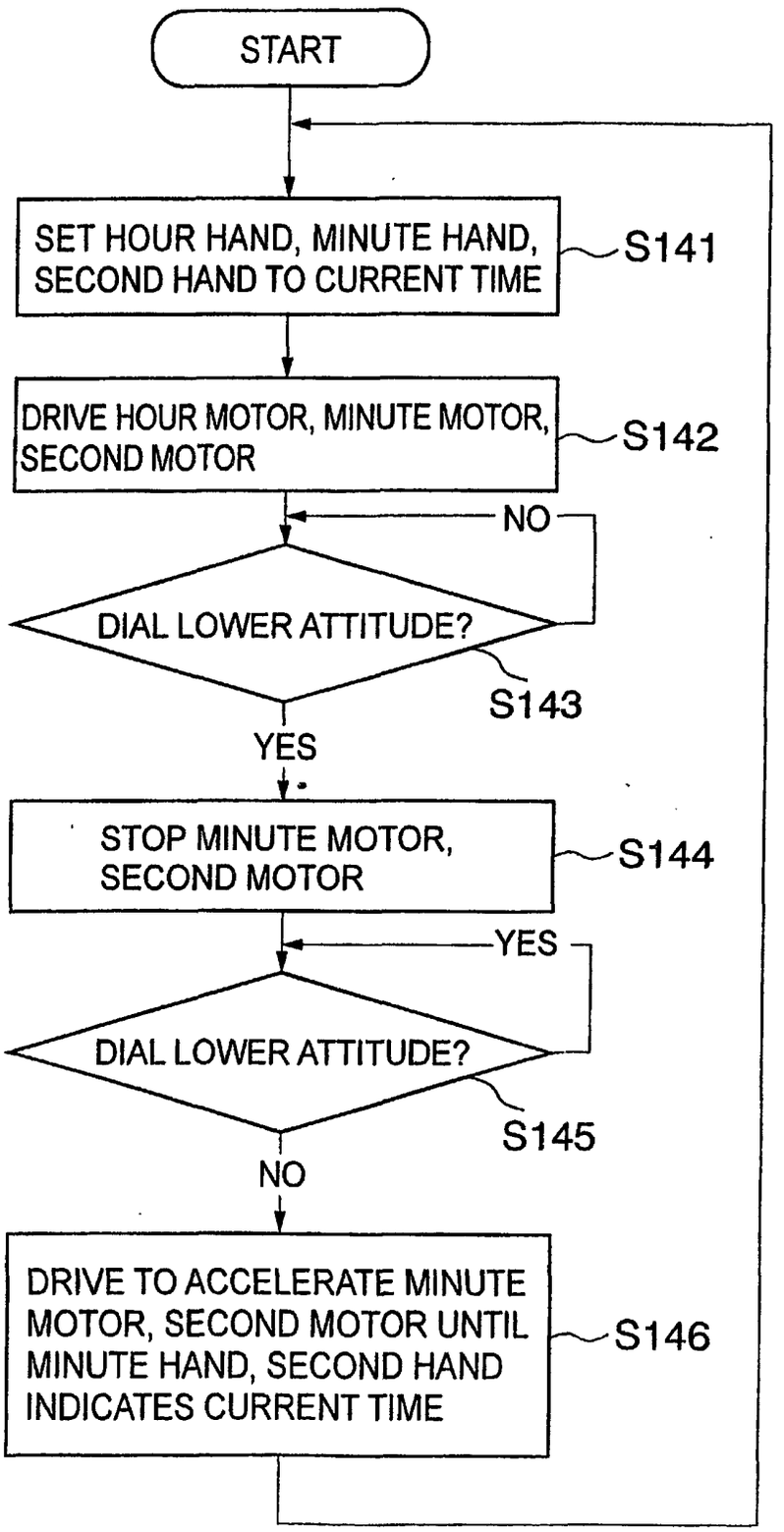

START
SET HOUR HAND, MINUTE HAND, SECOND HAND TO CURRENT TIME
S141
DRIVE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S142
NO
DIAL LOWER ATTITUDE?
S143
YES
STOP MINUTE MOTOR, SECOND MOTOR
S144
YES
DIAL LOWER ATTITUDE?
S145
NO
DRIVE TO ACCELERATE MINUTE MOTOR, SECOND MOTOR UNTIL MINUTE HAND, SECOND HAND INDICATES CURRENT TIME
S146

FIG. 15

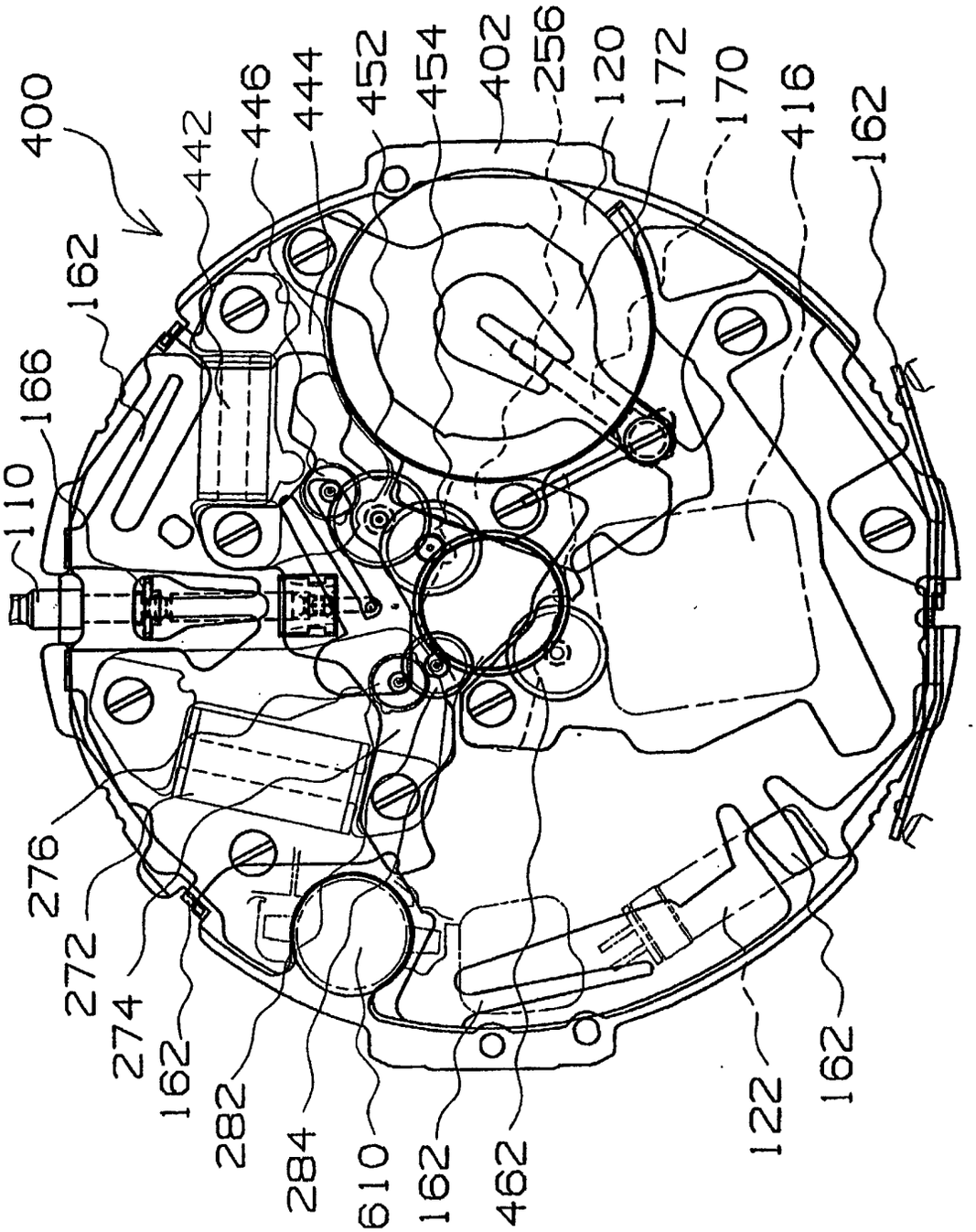

400
442
446
444
452
454
402
256
120
172
170
416
162
162
166
110
276
272
274
162
282
284
610
162
462
122
162

FIG. 16

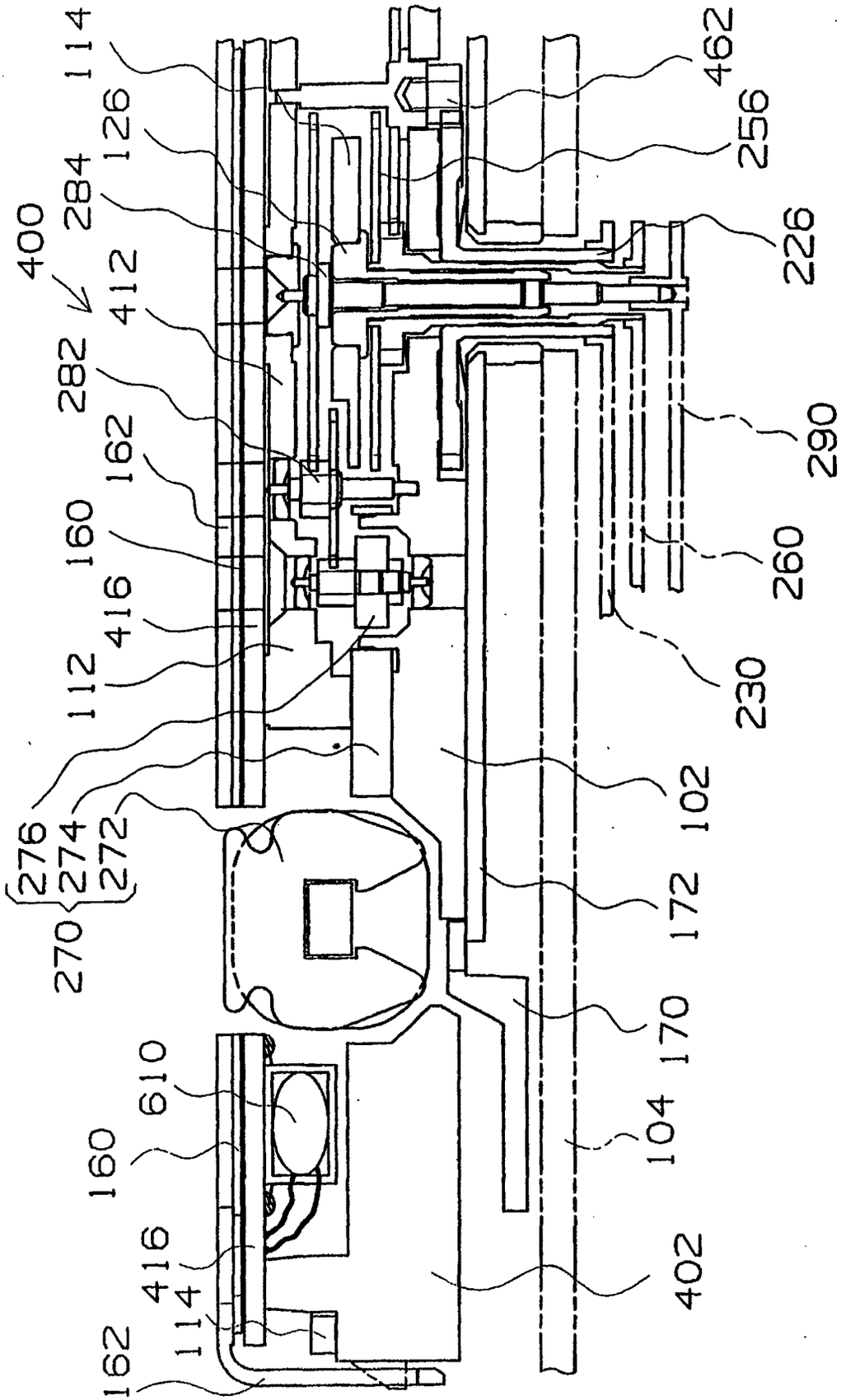

114
126
284
400
412
282
162
160
416
112
276
274
272
270
610
160
416
114
162
462
256
226
290
260
230
102
172
170
104
402

FIG. 17

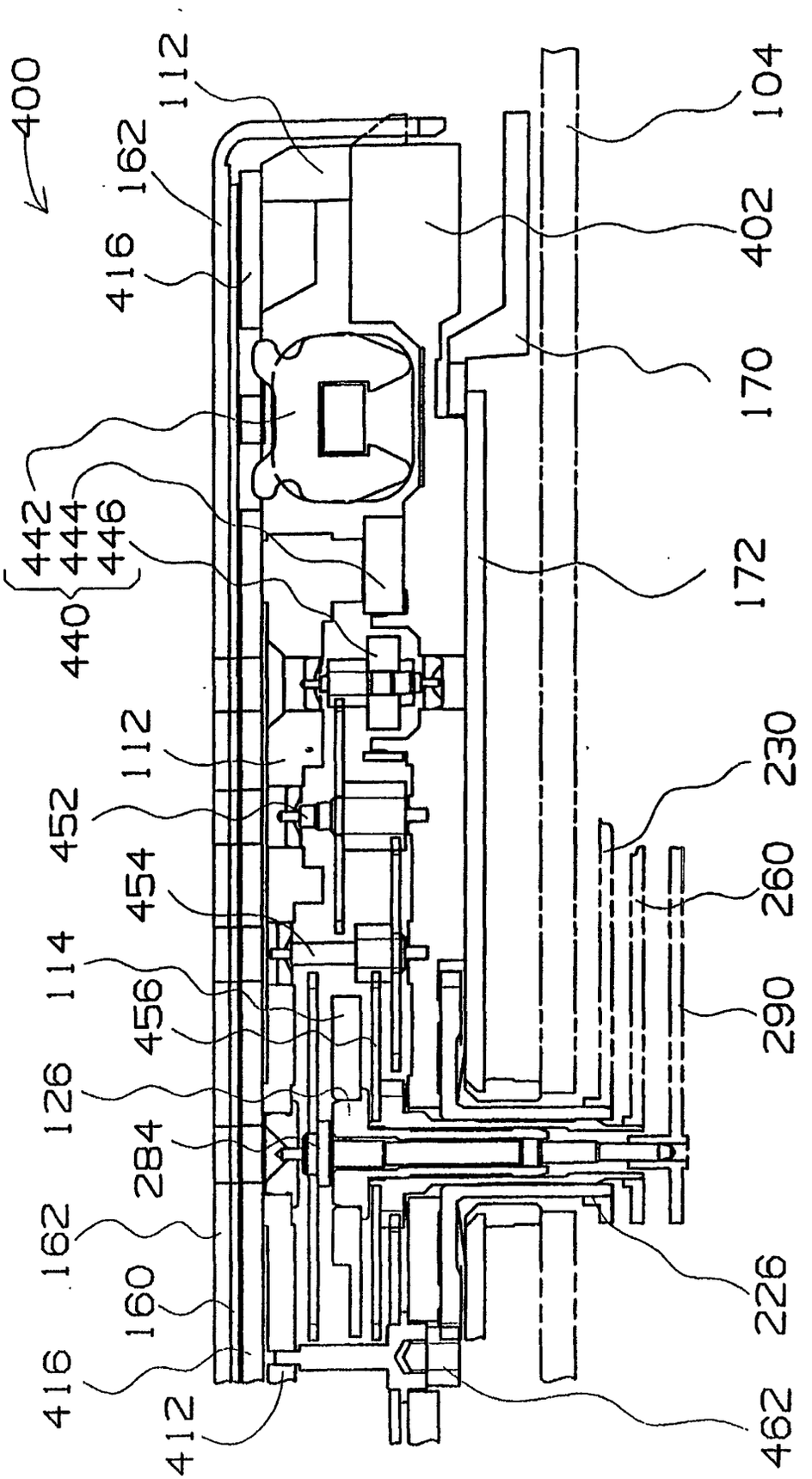

400
112
162
416
442
444
446
440
112
452
454
114
456
126
284
162
160
416
412
104
402
170
172
230
260
290
226
462

FIG.18

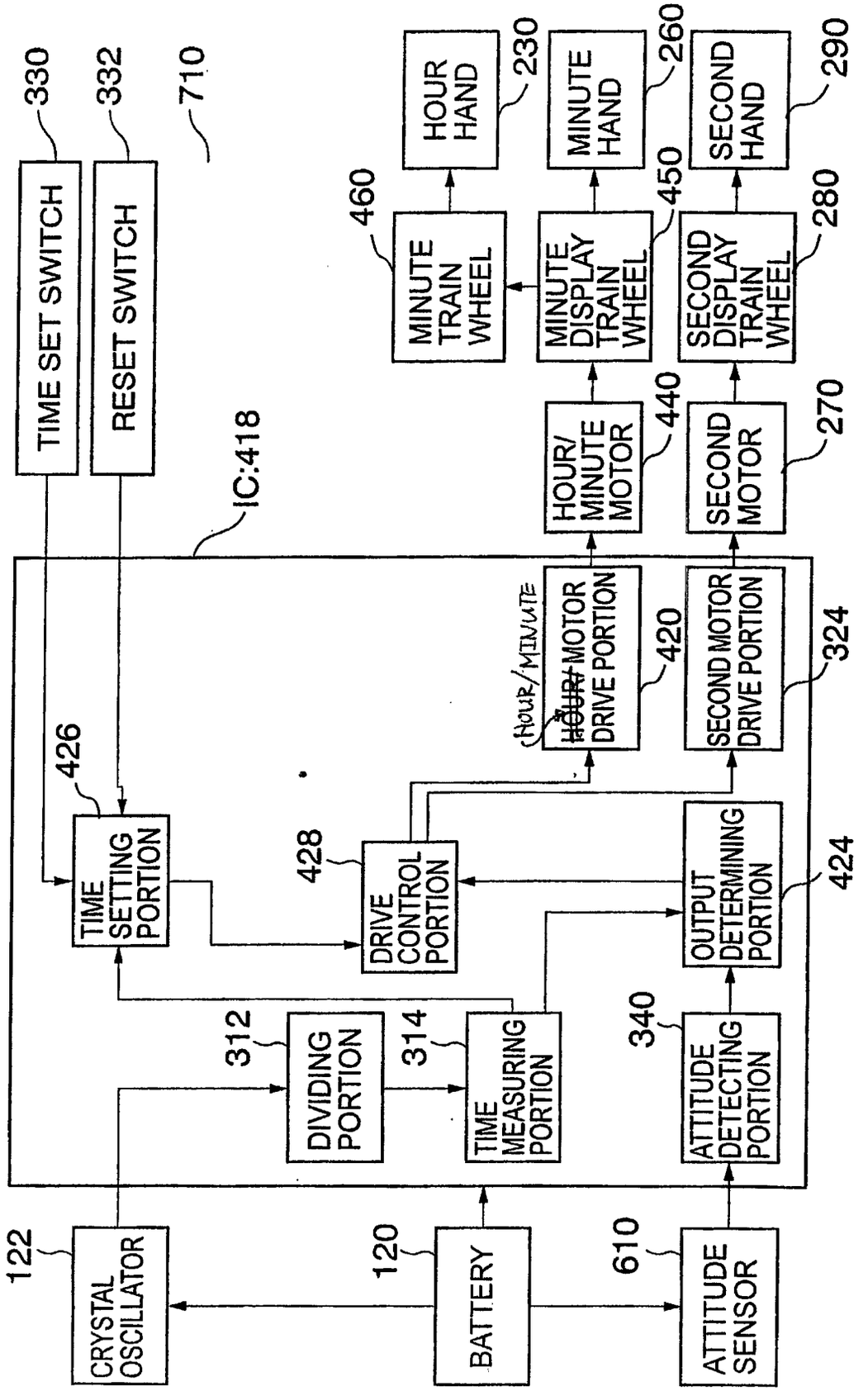

330
TIME SET SWITCH
332
RESET SWITCH
710
IC:418
122
CRYSTAL OSCILLATOR
120
BATTERY
610
ATTITUDE SENSOR
312
DIVIDING PORTION
314
TIME MEASURING PORTION
340
ATTITUDE DETECTING PORTION
426
TIME SETTING PORTION
428
DRIVE CONTROL PORTION
424
OUTPUT DETERMINING PORTION
HOUR/MINUTE MOTOR DRIVE PORTION
420
SECOND MOTOR DRIVE PORTION
324
HOUR/ MINUTE MOTOR
440
SECOND MOTOR
270
460
MINUTE TRAIN WHEEL
MINUTE DISPLAY TRAIN WHEEL
450
SECOND DISPLAY TRAIN WHEEL
280
HOUR HAND
230
MINUTE HAND
260
SECOND HAND
290

FIG.19

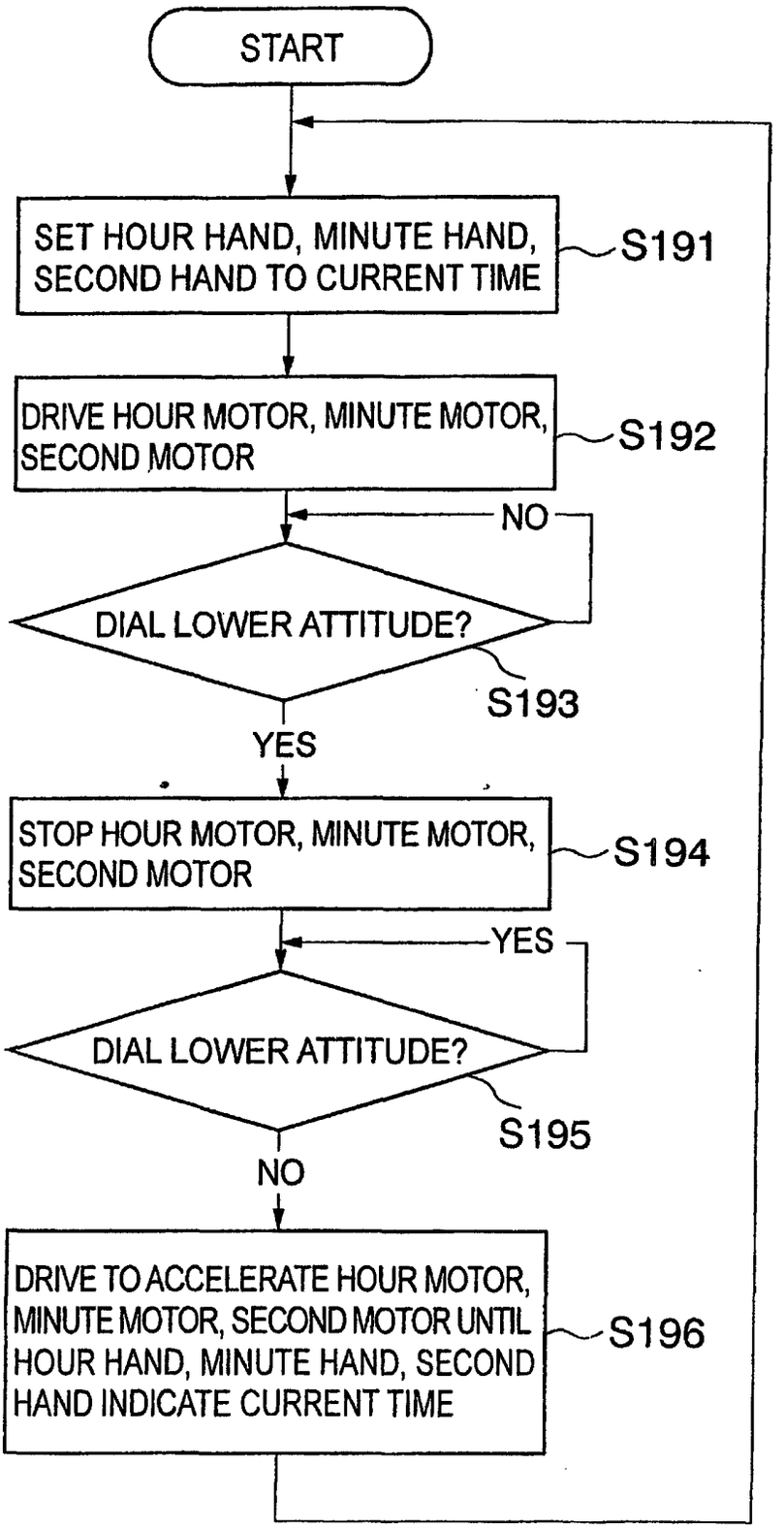

START
SET HOUR HAND, MINUTE HAND, SECOND HAND TO CURRENT TIME
S191
DRIVE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S192
NO
DIAL LOWER ATTITUDE?
S193
YES
STOP HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S194
YES
DIAL LOWER ATTITUDE?
S195
NO
DRIVE TO ACCELERATE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR UNTIL HOUR HAND, MINUTE HAND, SECOND HAND INDICATE CURRENT TIME
S196

FIG.20

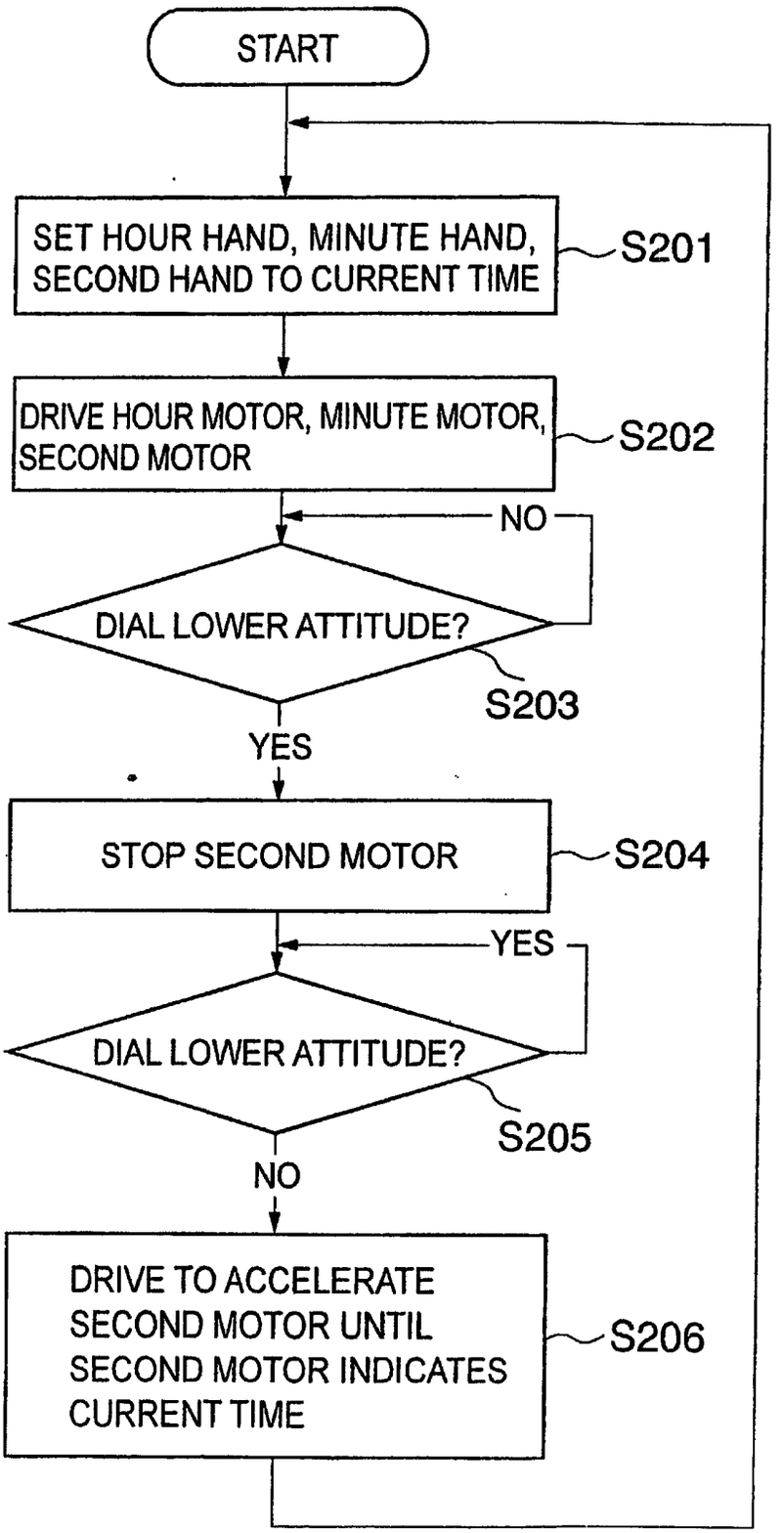
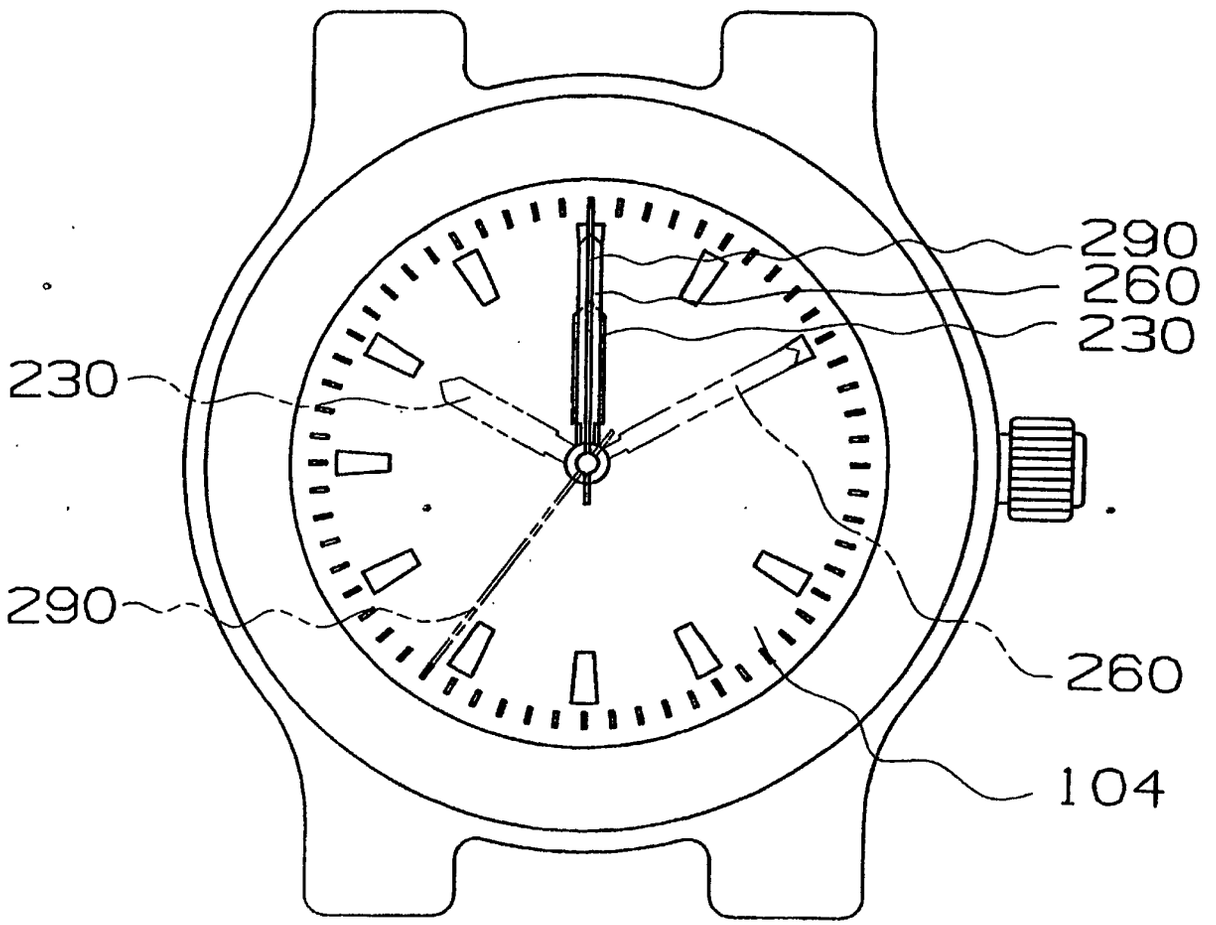

START
SET HOUR HAND, MINUTE HAND, SECOND HAND TO CURRENT TIME
S201
DRIVE HOUR MOTOR, MINUTE MOTOR, SECOND MOTOR
S202
NO
DIAL LOWER ATTITUDE?
S203
YES
STOP SECOND MOTOR
S204
YES
DIAL LOWER ATTITUDE?
S205
NO
DRIVE TO ACCELERATE SECOND MOTOR UNTIL SECOND MOTOR INDICATES CURRENT TIME
S206

FIG. 21



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/02360

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] G04C3/00, G04C3/14, G04C10/00, G04G1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] G04C3/00, G04C3/14, G04C10/00-10-04,
G04G1/00, 305, G04C9/00-9/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	JP, 11-142542, A (Rhythm Watch Co., Ltd.), 28, May, 1999 (28.05.99), (Family: none)	
X	Claims; Par. Nos. [0022]-[0028]; Fig. 4	15,16
Y	Claims; Par. Nos. [0022]-[0028]; Fig. 4	1,2
Y	US, 4744067, A1 (Eta SA Fabriques d'Ebauches), 10 May, 1988 (10.05.88), Claims; column 7, lines 5-15: Fig. 1 & JP, 62-93686, A & EP, 221363, A & CH, 665081, A	1,2
Y	GB, 2037025, A (Kabushiki Kaisha Daini Seikosha), 02 July, 1980 (02.07.80), Claims; page 1, line 94 to page 2, line 68; Figs. 1, 2 & JP, 55-63781, A	1-18
Y	JP, 9-304555, A (Seiko Epson Corp.), 28 November, 1997 (28.11.97), (Family: none) Claims; Par. Nos. [0007]-[0011], [0029]	1-18

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 May, 2000 (09.05.00)	23 May, 2000 (23.05.00)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/02360

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Figs. 1-5	
Y	JP, 11-73831, A (Seiko Epson Corp), 16 March, 1999 (16.03.99), (Family: none) Claims; Par. Nos. [0012]-[0013], [0031]; Fig. 7	1-18

Form PCT/ISA/210 (continuation of second sheet) (July 1992)