TECHNICAL INFORMATION

CITIZEN QUARTZ

Cal. No. C03※

CITIZEN

■1. OUTLINE

This solar cell combination watch was developed to expand the series of the solar cell watches.

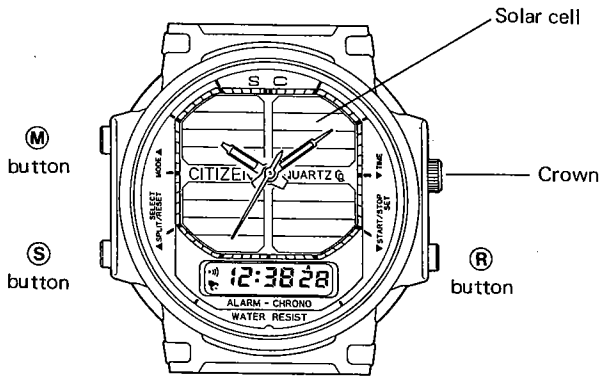
In this watch, an amorphous solar cell is used as the primary power source and a secondary battery is used as the secondary power source.

■2. SPECIFICATIONS

Caliber No.	C030A-01
Type	Solar combination watch (Analog section: with center second)
Module size (mm)	ϕ30 x 25.0 x 27.7 (Thickness: 4.6t) (measured when the power cell section is included)
Accuracy	±20 sec./month at normal temperature
Oscillation	32,768 Hz
Display method	FE twist-type nematic LC (Liquid Crystal)
Integrated circuit	C/MOS-LSI (2 units)
Effective temp. range	0°C ~ +55°C (32°F ~ 131°F)
Converter	Bipolar step motor
Adjustment of time rate	Trimmer condenser
Measurement of time rate	2 seconds
Display functions	
1. Analog section	Hour, minute, second
2. Digital section Normal time Calendar	Hour, minute, second 12/24 hour switching function Month, date, day (Automatic calendar, Common year system)
Alarm	Hour, minute (12H and 24H displays are interlocked with the normal time)
Stopwatch	Minute, second, 1/100 second (Up to 60 minutes timing)
Additional functions	Chime Alarm monitor
Power cell Parts No. Cell code Size (mm) Voltage Capacity Lifetime	 280-403 XR9520W ϕ9.5 x 2.0t 1.55V 30 mAH About 5 years under normal use
Value of current	Under 2.9μA
Value of coil resistance	2.8 kΩ ~ 3.4 kΩ
Remarks	

■3. HANDLING INSTRUCTIONS

1. Nomenclature



Crown ..... Setting of analog time
Ⓜ button ... Mode changing, instant manual return
Ⓢ button ... Selection of digits to be corrected, split, resetting
Ⓡ button ... Correction, start, stop, ON/OFF of alarm

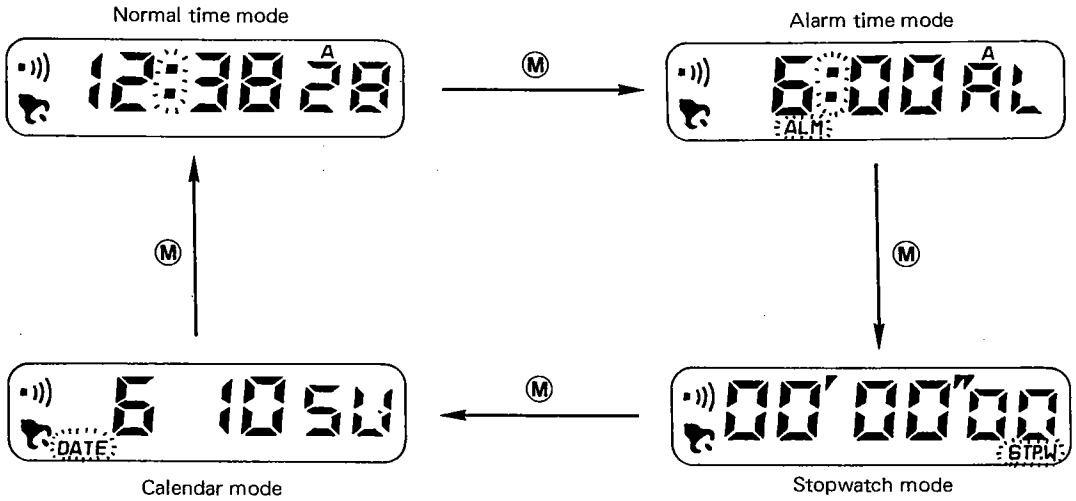
2. Correction of analog time

If the crown is pulled out to its first clicking position, the hands stop running. Then, set time by turning the crown either clockwise or counterclockwise.

When the crown is pushed back into its normal position, the second hand, synchronized with the second timing of the digital section, starts running.

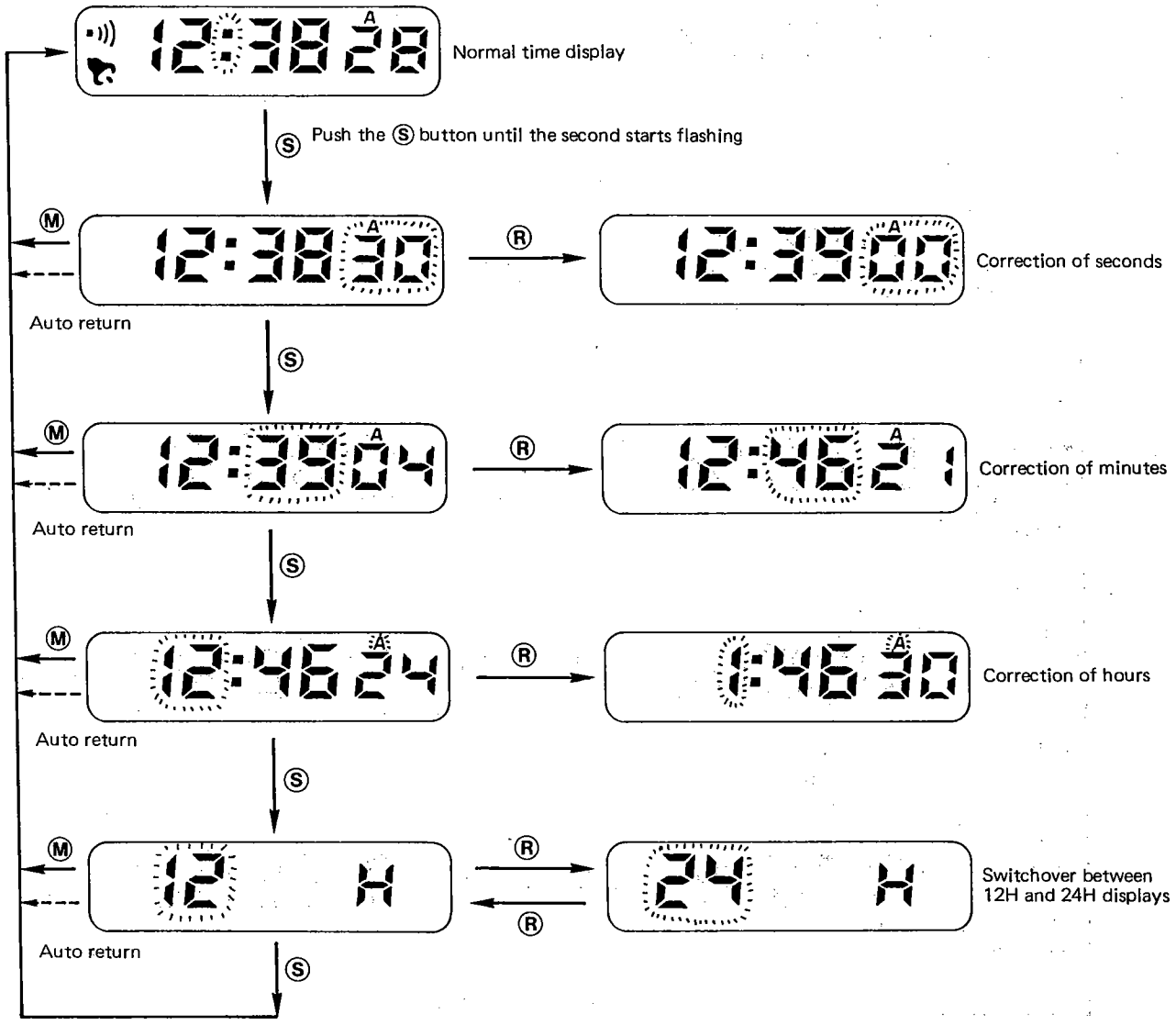
3. Mode switching procedure

The "▒▒" mark indicates flashing



4. Correction of digital part

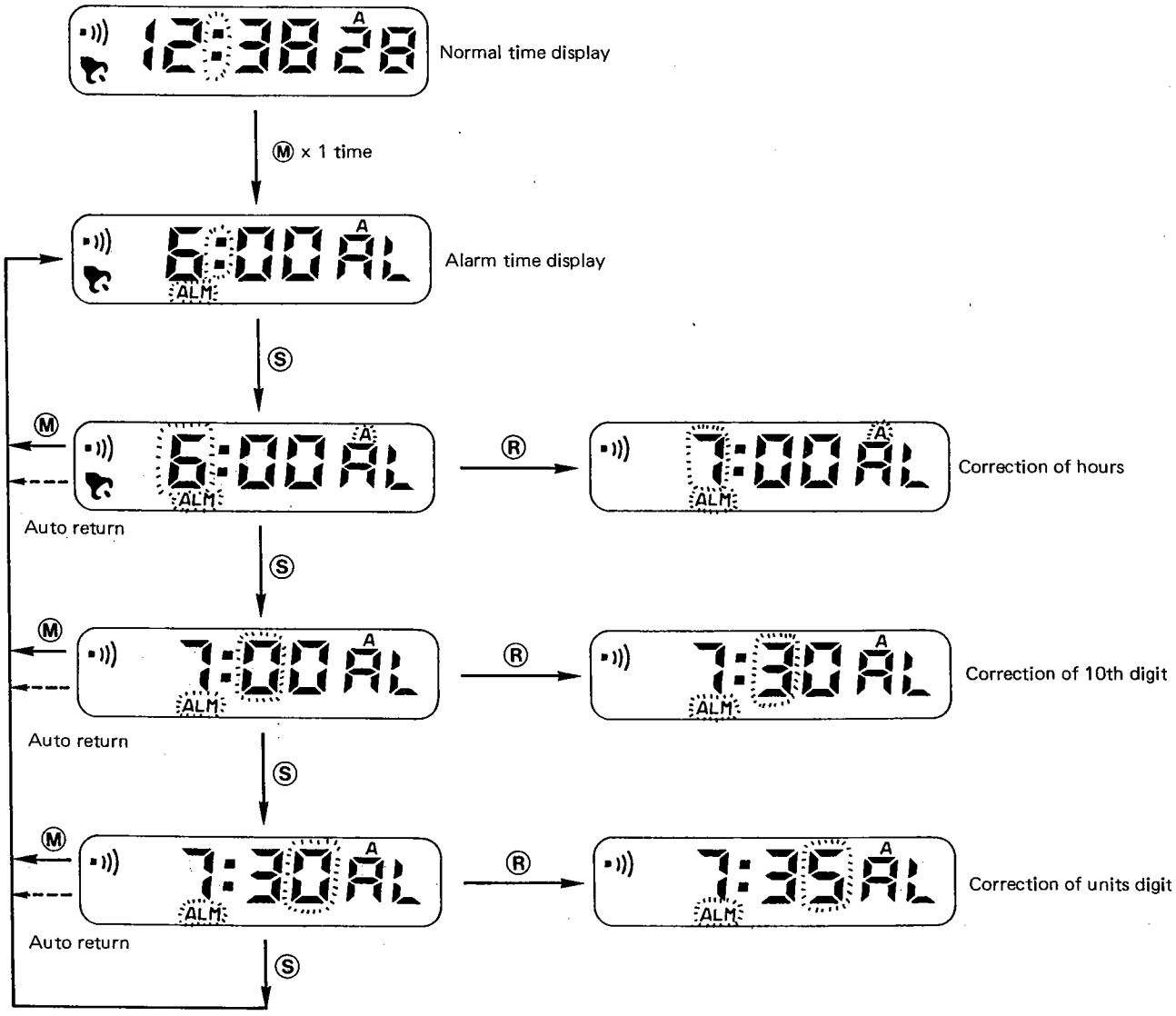
(1) Correction of normal time



Notes:

- If any correction mode is left as it is for approximately one minute. It will be automatically return to the normal time display (Auto return).
- If correction of seconds is made between 00 and 29 on display, the second display will be corrected to "00".
  If it is made between 30 and 59 on display, the minute display will increase by one minutes.
- The watch can be returned from any correction mode to the normal time display mode by pushing the Ⓜ button (Instant manual return).

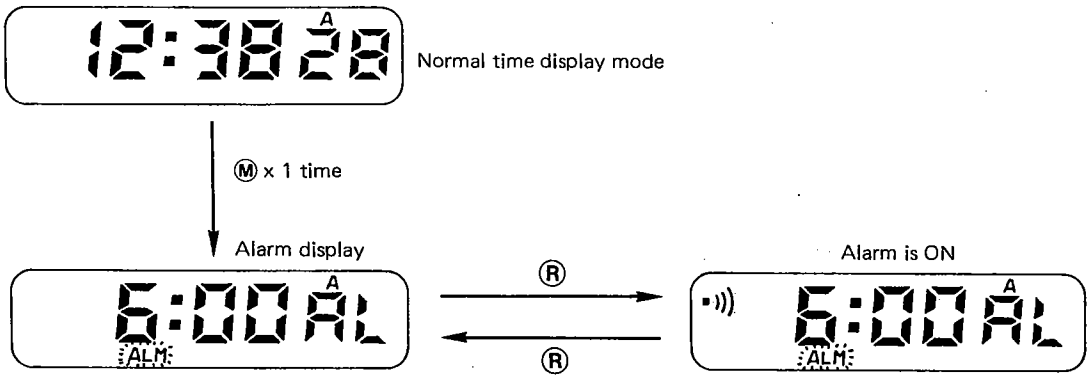
(2) Correction of alarm time



Notes:

- Hour of alarm time is set in accordance with the 12H/24H of the normal time display mode.
- Each minute digit can be corrected separately.
- If any correction mode is left as it is for approximately one minute, the alarm display will automatically return. (Auto return)
- The watch can be returned from any correction mode to the normal alarm time display mode by pressing the Ⓜ button (Instant manual return).
- Alarm sounds for 20 seconds.

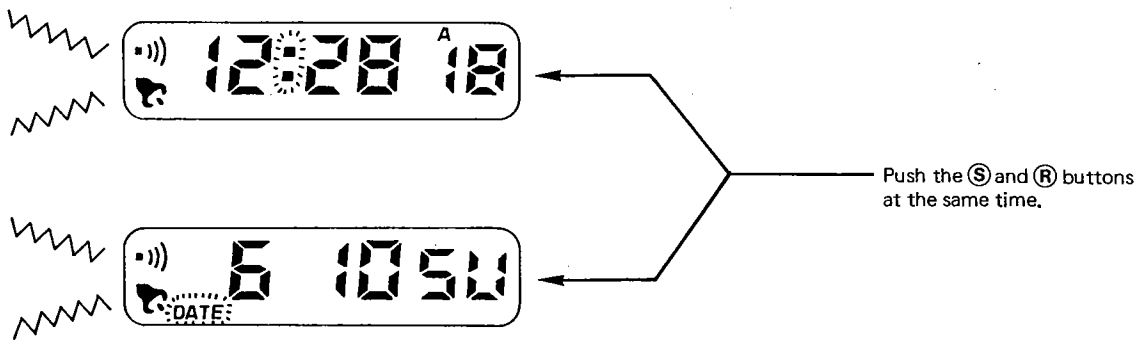
(3) Alarm setting and release



- Alarm sounds for 20 seconds.
- Alarm stops sounding with a push of any button with the exception of the crown.

Alarm ON	The " •)) " mark lights
Alarm OFF	The " •)) " mark ceases to lights.

(4) Setting and release of hourly chime and alarm monitor

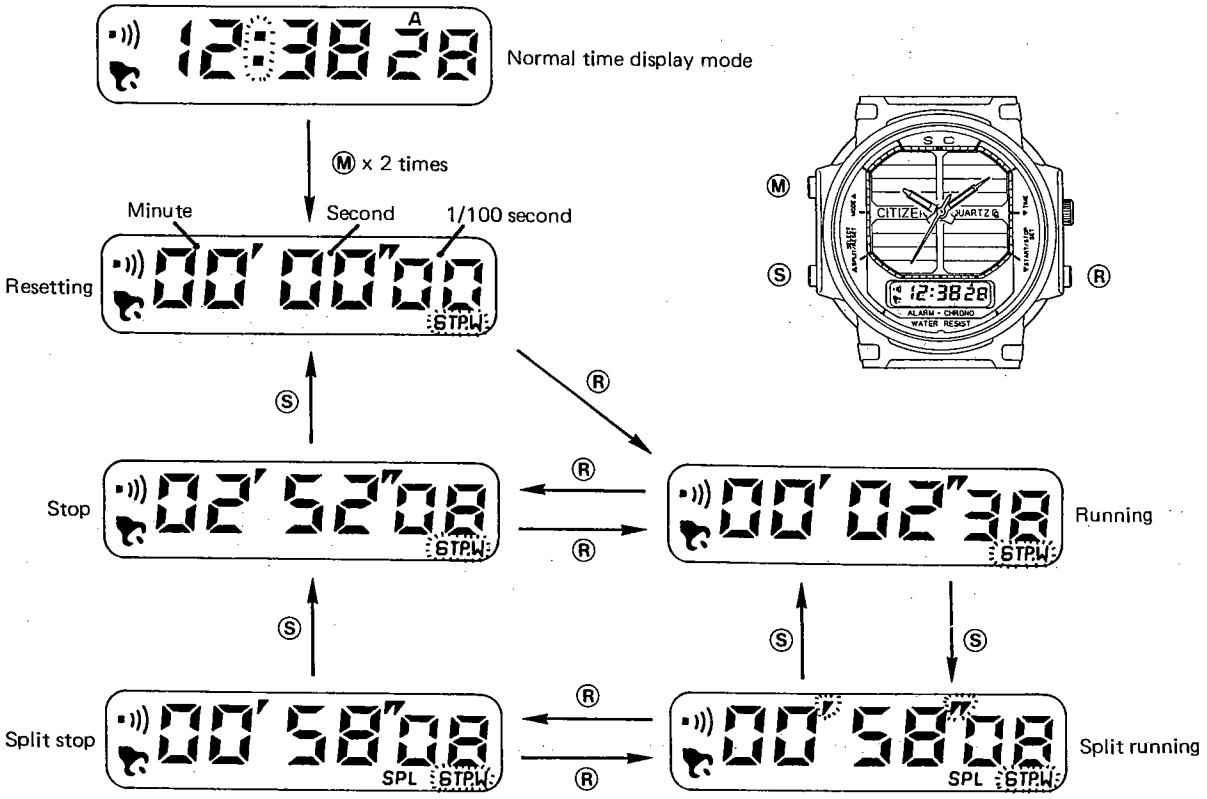


Notes:

- If the Ⓢ and Ⓡ buttons are pushed at the same time in the normal time and calendar display mode, the watch is set to the sound monitor mode and the hourly chime can be set. If these buttons are pushed again, this mode is released.
- If the hourly chime is turned on in the normal time display mode, the colon flashes at frequency of 1 Hz, and if the former is turned off, the colon lights up.
- If the sound is monitored, the confirmation sound of "pip pip, pip pip, pip pip ..." comes out.
- If the chime is turned off, the colon does not flashes.

Hourly chime ON	mark turned on
Hourly chime OFF	mark turned off

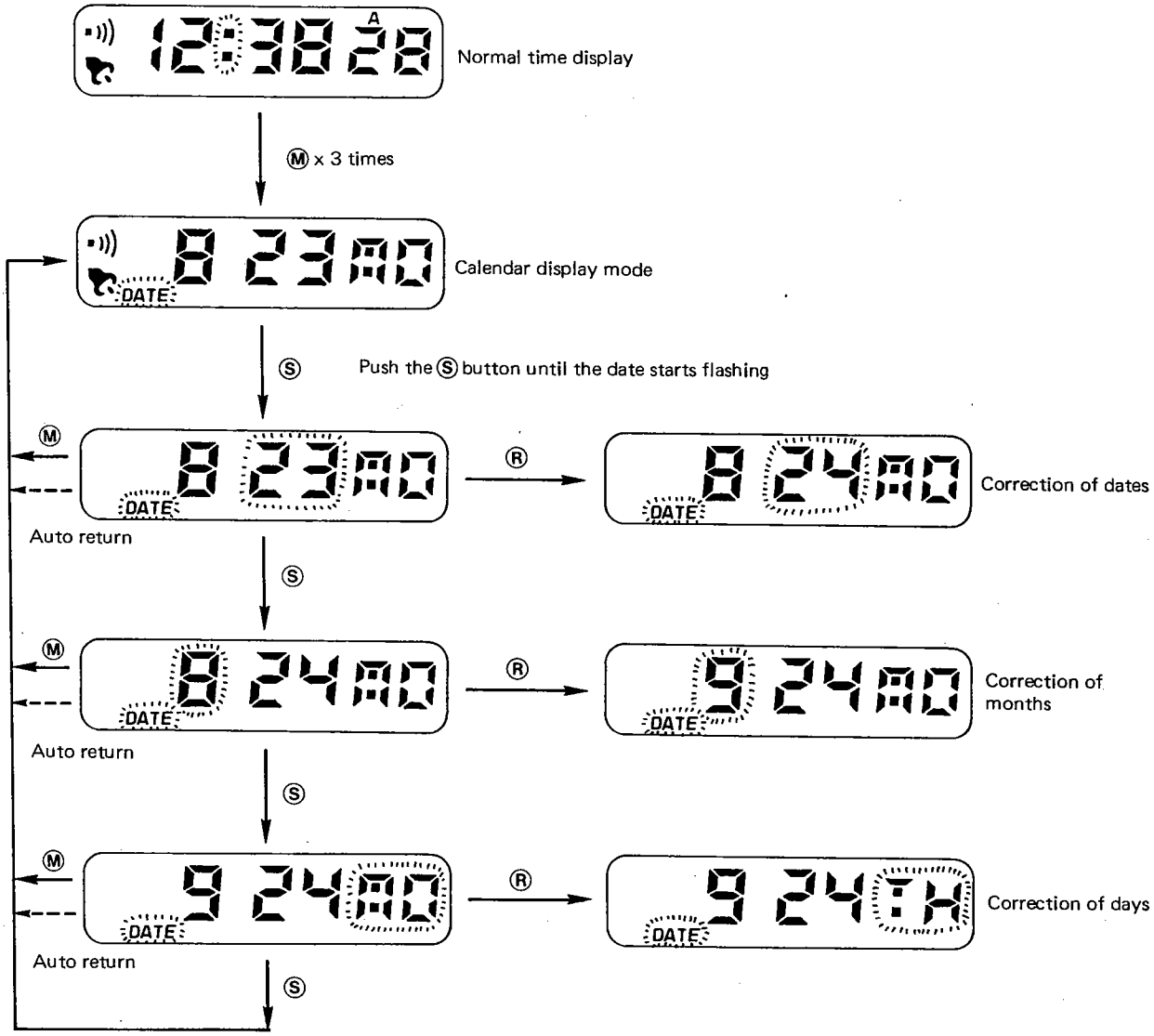
(5) Stopwatch operation procedure



Notes:

- Time can be measured from 00 minute, 00 second, 00 to 59 minutes, 59 seconds, 99.
- If the hourly chime is turned on, the confirmation sound comes out every time the Ⓢ button or Ⓡ button is pushed.
- While the watch is running as a stopwatch, even if it is set to another mode, it keeps measuring time. However, while the watch is in the split running condition, if it is set to another mode, it is set to the running condition.
- While the watch in the stopwatch mode is under the split stop condition, if it is set to another mode and then set to the stopwatch mode again, it indicates the split stop time.
- If the Ⓜ button is pushed under any condition in the stopwatch mode, the watch is set to the date mode.

(6) Correction of calendar



Notes:

- If any correction mode is left as it is for approximately one minute, the calendar display will automatically return (Auto return).
- Instant manual return and auto return system will activate in the same manner as described in the normal time or alarm time adjustment.
- If the non-existing date is set, the first day of the following month will be displayed when the calendar display returned or is restored.
  (Example: Feb. 30 → Mar. 1)
- In this watch, February ends on the 28th. Date correction is necessary during a leap year.
- If the watch is set to a correction mode, the alarm set mark and hourly chime set mark go off.

■4. HANDLING OF SOLAR CELL AND SECONDARY BATTERY

This watch is a combination quarts watch which has an amorphous solar cell.

- Since the secondary battery is used, the watch can continue the operation without receiving light as long as the battery energy remains (for about 1.5 years)
- This watch can continue the operation for about five years without replacing the battery if a slight light is given it (See Table 1).

(Types of light and standard charging time)

This watch receives the energy necessary for the operation through a year. (For example, if the watch is irradiated with the light of 100,000 lux for about 37 hours, it can continue the operation for one year. That is, if the watch is exposed to the strong sunlight during the summer for about 25 minutes everyday for three months, it will operate for one year.)

Table 1 Charging time table

Intensity of illumination (Lux)	Environment	(1) Charging time necessary for one-day operation	(2) Charging time necessary for one-year operation	(3) Charging time necessary for after analog section starts (for one day operation)
700	General office	Approx. 3.5 hours	Approx. 53 days	Approx. 10.5 hours
1,000	Fluorescent lamp (15W x 2 pieces, 60–70 cm)	Approx. 2.5 hours	Approx. 38 days	Approx. 7.5 hours
3,000	Fluorescent lamp (15W x 2 pieces, 20 cm)	Approx. 50 minutes	Approx. 13 days	Approx. 2.5 hours
10,000	Cloudy day	Approx. 15 minutes	Approx. 4 days	Approx. 45 minutes
100,000	Direct sunlight	Approx. 6 minutes	Approx. 37 hours	Approx. 18 minutes

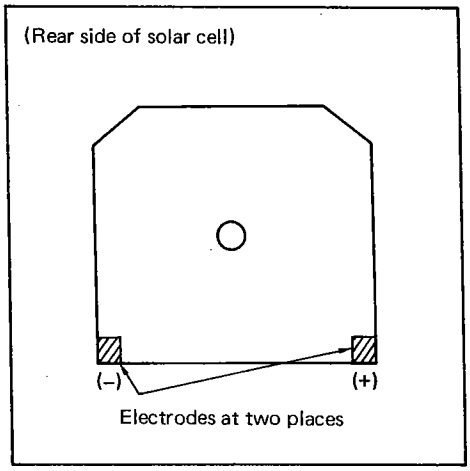
Notes:

1. Columns (1) and (2) are applied while both digital and analog sections are operating, and (3) is applied while only the digital section is operating.
2. The above charging time is shown for only reference, and it depends on the condition of each watch and environment.

▪6. PRECAUTION FOR DISASSEMBLY AND ASSEMBLY

(1) Handling of solar cell

- The solar cell is included in the group of a dial (appearance part). Note this point when ordering the solar cell.
- The solar cell is a thin glass board. It can be broken, if a large force is applied to it. Sufficiently take care not to damage the solar cell when installing and removing the hands and replacing the solar cell itself.
- The circuit and the solar cell are connected by two connecting springs between them. When installing them, be sure to confirm that those springs are fitted in the correct positions.
- If the solar cell is broken, its charging capacity is lowered. If it is broken or cracked, replace it.
- If the two electrodes on the rear side of the solar cell are stained or their surface film is removed, their conductivity and charging capacity are lowered. Take care not to stain or break them when handling the solar cell.



(2) Measurement of time rate

- The range of the time rate measuring unit is two seconds.
- The time rates of the analog section and digital section can be measured independently. However, when measuring the digital section, be sure to set the indicator to the full-segment glow condition (The indicator can be set to the full-segment glow condition by pressing and holding the Ⓢ button for about two seconds in the stopwatch mode.)

■5. SPECIFICATIONS OF SWITCHES

		Calendar mode	Time mode	Alarm mode	Stopwatch mode
Crown (One-step pulled)		Second hand stops	←	←	←
Ⓡ	Normal state			ON/OFF changeover	Starting and stopping. Restoration from full-segment glow.
	Correcting state	Correction	←	←	
Ⓜ	Normal state	Transfer to time mode.	Transfer to alarm mode.	Transfer to stopwatch mode.	Transfer to calendar mode. Restoration from full-segment glow.
	Correcting state	Instant manual return	←	←	
Ⓢ		Selection of column to be corrected.	←	←	Split reset. Transfer to full-segment glow (Pressing for two seconds or more.) Restoration from full-segment glow.
Ⓡ, Ⓢ		Alarm ON/OFF changeover and sound monitor.	←		
Ⓡ, Ⓜ, Ⓢ		All reset of digital section.	←	←	←

All reset operation

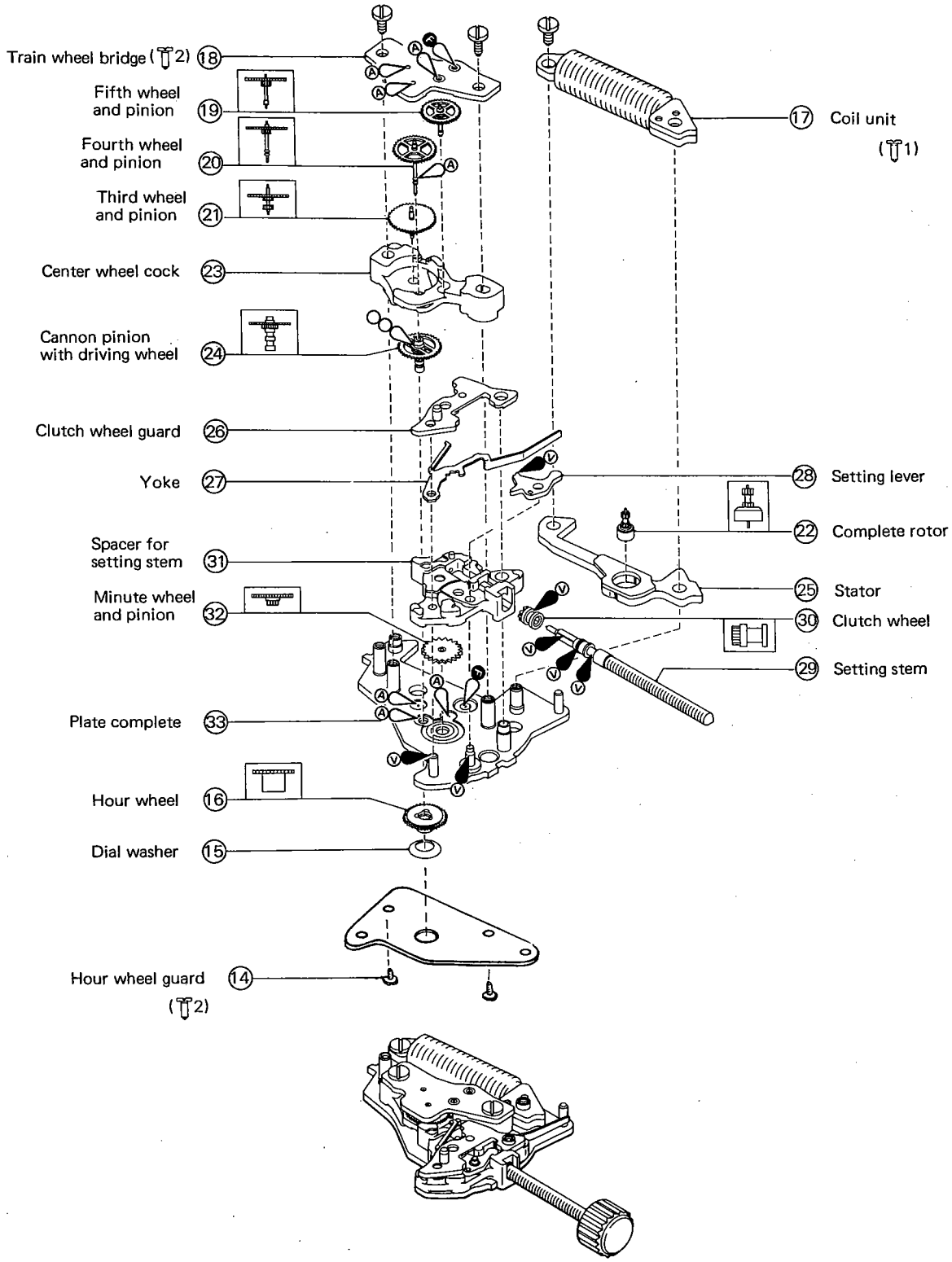
All the functions of the digital section are reset by pressing the Ⓡ, Ⓜ and Ⓢ buttons at the same time. At this time, the analog section is stopped. All the segments are not turned on. After all the functions are reset, the following are indicated.

- Normal time mode: 12:00 AM
- Alarm mode: 12:00 AM, OFF
- Stopwatch mode: 00' 00" 00
- Calendar mode: Jan 01 Sun

Full-segment glow

If the Ⓢ button is pressed and held (for about two seconds) in the stopwatch mode, all the segments are turned on.

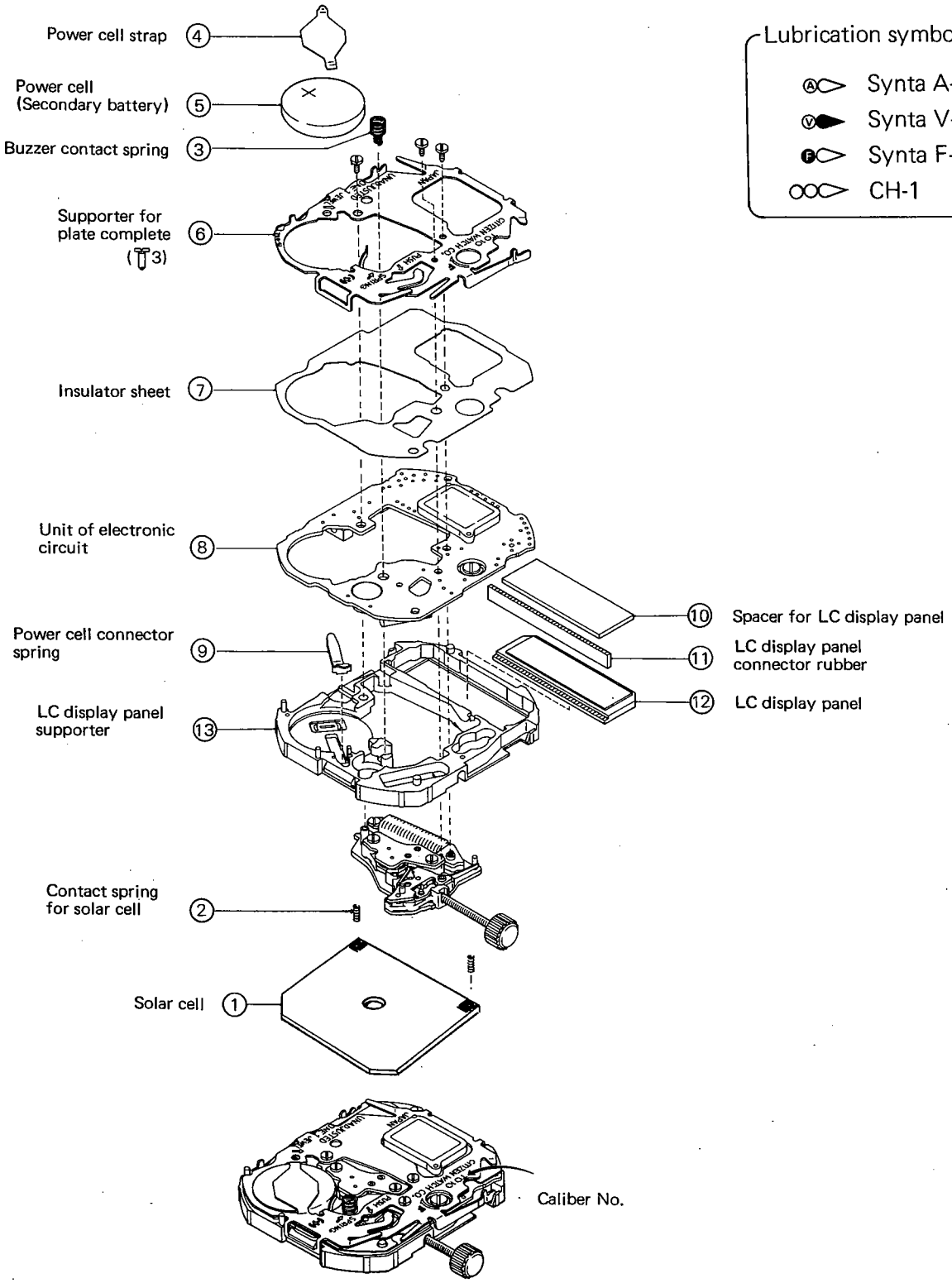
The full-segment glow can be released by pressing any button.

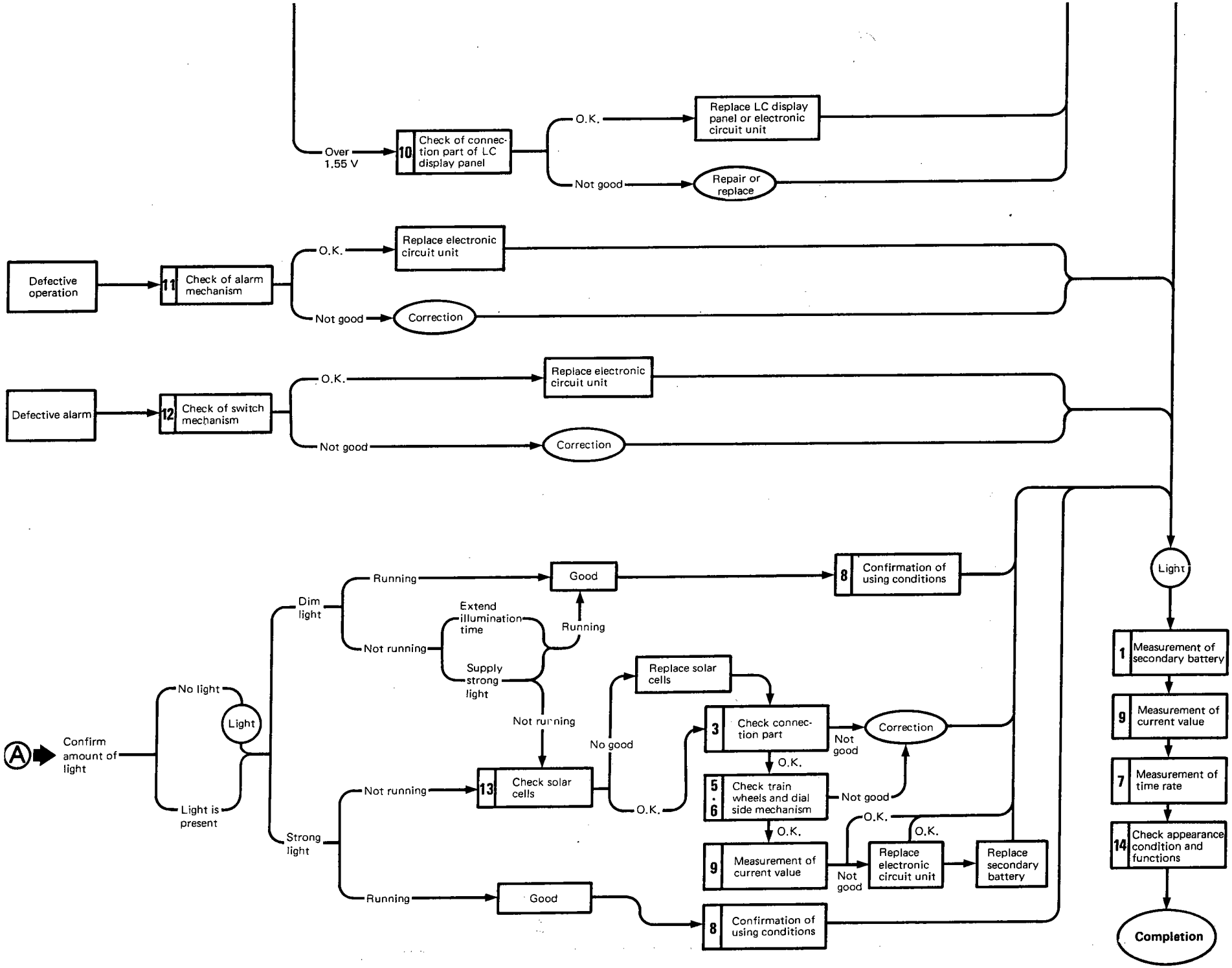

Train wheel bridge (T2) 18
Fifth wheel and pinion 19
Fourth wheel and pinion 20
Third wheel and pinion 21
Center wheel cock 23
Cannon pinion with driving wheel 24
Clutch wheel guard 26
Yoke 27
Spacer for setting stem 31
Minute wheel and pinion 32
Plate complete 33
Hour wheel 16
Dial washer 15
Hour wheel guard 14 (T2)
17 Coil unit (T1)
28 Setting lever
22 Complete rotor
25 Stator
30 Clutch wheel
29 Setting stem

■7. DISASSEMBLY AND ASSEMBLY OF MODULE

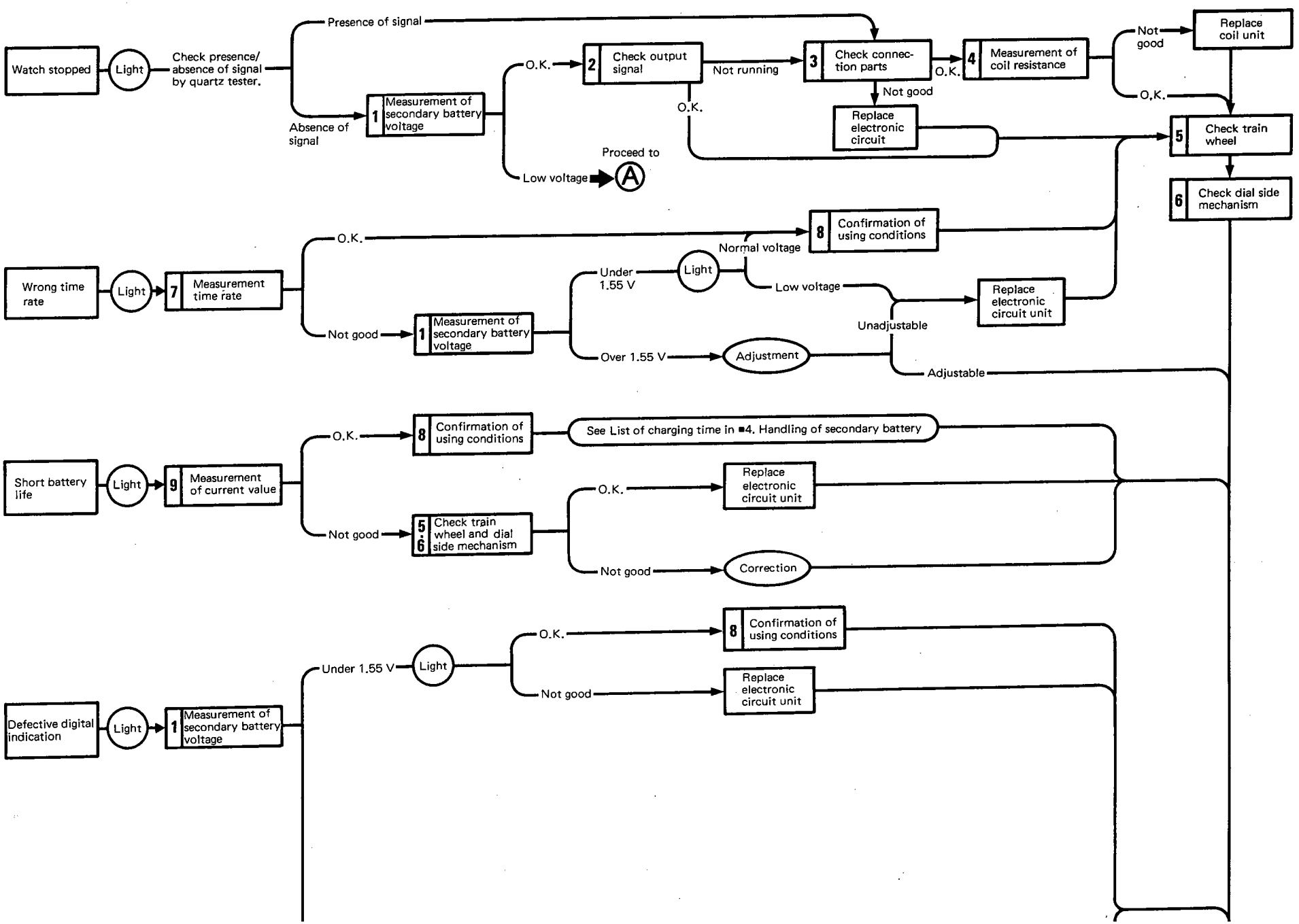
Disassembling procedure : ① → ㉝

Assembling procedure : ㉝ → ①

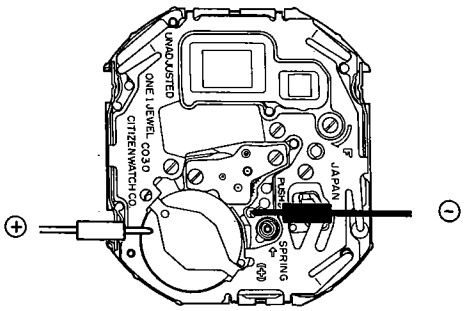
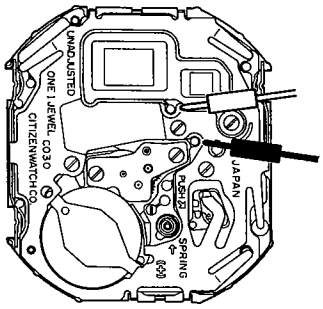


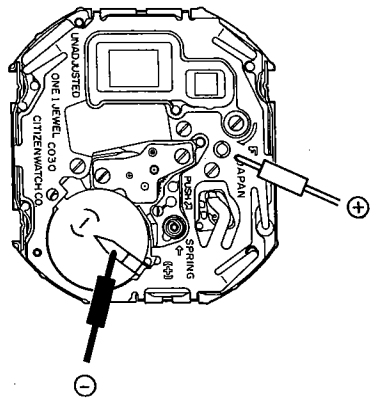

Over 1.55 V
10 Check of connection part of LC display panel
O.K.
Replace LC display panel or electronic circuit unit
Not good
Repair or replace
Defective operation
11 Check of alarm mechanism
O.K.
Replace electronic circuit unit
Not good
Correction
Defective alarm
12 Check of switch mechanism
O.K.
Replace electronic circuit unit
Not good
Correction
Light
1 Measurement of secondary battery
9 Measurement of current value
7 Measurement of time rate
14 Check appearance condition and functions
Completion
A
Confirm amount of light
No light
Light
Light is present
Dim light
Running
Good
8 Confirmation of using conditions
Not running
Extend illumination time
Supply strong light
Running
Not running
Replace solar cells
No good
3 Check connection part
Not good
Correction
O.K.
5 · 6 Check train wheels and dial side mechanism
Not good
O.K.
9 Measurement of current value
Not good
Replace electronic circuit unit
Replace secondary battery
O.K.
O.K.
Strong light
Not running
13 Check solar cells
O.K.
Running
Good
8 Confirmation of using conditions

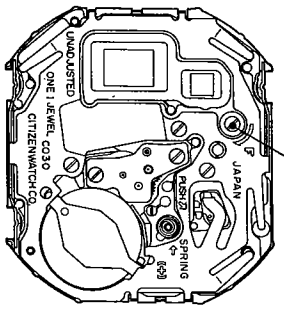
■8. TROUBLESHOOTING AND FLOWCHART

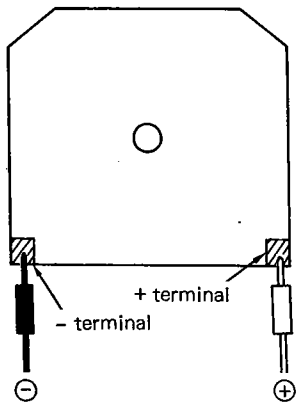


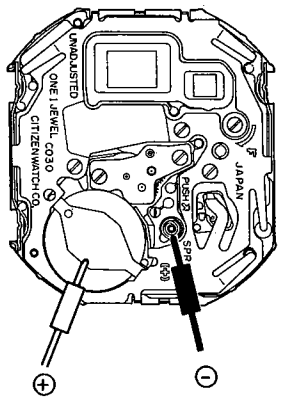
Check Items	Check Method	Result and Treatment
❸ Check connection parts	[Refer to Technical Manual, Basic Course Ⅱ-2-a.] Confirm that there are no loose screws or dust or stains present. a) If the mounting screws of the electronic circuit unit are loosened, the drive signal may not be transmitted. b) If the patterns of the coil or electronic circuit unit are stained, may impair functioning of the circuit. c) The connecting spring of the solar cell is removed or deformed, its conductivity is lowered and the secondary battery is not charged sufficiently.	
❹ Measurement of coil resistance	[Refer to Technical Manual, Basic Course Ⅱ-1-c.] ●Remove the electronic circuit unit and measure its resistance. ●The probes have no polarity. (Tester range: R x 10Ω)	**2.8 ~ 3.4kΩ** → Normal **Out of 2.8 ~ 3.4kΩ** → Replace coil unit
❺ Check train wheel	[Refer to Technical Manual, Basic Course Ⅱ-2-b.] ●Check the appropriate clearance of each wheel and rotor for dust. ●Since the low-load design is applied to this CAL, the proper type of oil must be applied and supply of too much oil must be avoided. Confirm that the oil is not flowing.	

Check Items	Check Method	Result and Treatment
❶ Measurement of secondary battery voltage	[Refer to Technical Manual, Basic Course Ⅱ-1-a.] ●This battery is a secondary battery. Its voltage depends on the charging level.  <Tester range: DC•V 3V>	**Under 0.5V** → Replace battery **0.5V ~ 1.55V** → Apply light to charge the battery **Over 1.55V** → Normal
	Note: If the battery voltage is under 0.5V, it may not rise to a sufficient level even if the solar cell is irradiated with sufficient light. In this case replace the secondary battery. (See ■4. HANDLING OF SOLAR CELL AND SECONDARY BATTERY.)	Analog section stops and digital section operates → Apply light to charge the battery
❷ Check output signal	[Refer to Technical Manual, Basic Course Ⅱ-1-b.]  <Tester range: DC•V 0.3V>	Pointer of tester swings every second → Normal Pointer of tester does not swing → Inspect connection parts No abnormalities in connection parts → Replace electric circuit unit
	Since the watch swings second by seconds, the pointer of the tester swings every second to the right and left. (The probes have no polarity.)	

Check Items	Check Method	Result and Treatment
⑨ Measurement of current valve	[Refer to Technical Manual, Basic Course Ⅱ-1-f.] ●If the secondary battery is used for measurement, the current may not be measured correctly because of the fluctuation of the voltage. To prevent this, set a silver oxide battery (Primary battery of 1.55V) for measurement.  <Tester range: DC•A 12μA> (Effects of light) Do not measure the current consumption in a place which is irradiated with the light of glow lamp or direct sunlight. If the current is measured in such place, it may be increased. It may not be increased by a fluorescent lamp.	●Current consumption by module **Under 3μA** → Normal **Above 3μA** → Check train wheel and dial side mechanism ↓ ●If module consumes current more than 3μA, measure current consumption by circuit unit. **Under 2μA** → Normal **Above 2μA** → Replace electronic circuit unit ↓ ●Current consumption by whole circuit is normal, but current consumption by module is high → Check parts for deformation, dirt, oil, etc.
⑩ Check of connection parts of LC display panel	[Refer to Technical Manual, Basic Course Ⅱ-2-a.] ●Press and hold the Ⓢ button in the stopwatch mode to turn on all the segments for defects. Check the segments for defects. <Full-segment glow condition>  	

Check Items	Check Method	Result and Treatment
❻ Check dial size mechanism	[Refer to Technical Manual, Basic Course II-2-c.] ●Confirm that the parts are not deformed or scratched, the watch may lose or stop.	
❼ Measurement and adjustment of time rate	[Refer to Technical Manual, Basic Course II-2-d.]  Trimmer capacitor <Measuring gate: 2 sec> ●Turn the trimmer capacitor to right or left to adjust the time.	The watch loses or gains substantial time, and cannot be adjusted with trimmer capacitor → Replace electronic circuit unit
❽ Confirmation of using conditions	[Refer to Technical Manual, Basic Course II-2-e.] ●Since this watch has a solar cell, it is necessary to direct the customers to expose the watch to light as long as possible. (See Section ■4.)	

Check Items	Check Method	Result and Treatment
	2. If the alarm output is normal, perform the following check. (1) Check the piezo-electric element of the vibrating plate for cracks and breakage. (2) Check the buzzer contact spring for bend and deformation, and confirm it is assembled normally. (3) Check the pattern of the electronic circuit unit for dust, stain, etc.	Crack or breakage → Replace case complete Bend or deformation → Replace buzzer contact spring Dust or stain → Clean
⓭ Check solar cells	●The solar cell is made on a glass plate. Check it for cracks, stain on the pattern, etc. <Rear side of solar cell>  ●Set the tester to DC 30μA range and apply the ⊕ and ⊖ probes as shown above, and throw light onto the solar cell and see if the pointer of the tester moves. (If a strong light is applied, the pointer moves widely.) ↓ If the pointer of the tester moves, the solar cell is normal.	Crack → Replace solar cell Stain on pattern → Clean with dry cloth etc.
⓮ Check appearance conditions and function	[Refer to Technical Manual, Basic Course II-2-f.] ●After completing the watch, check the indication and operation of the push buttons for abnormalities, and check the surface of the solar cell for stain, etc.	

Check Items	Check Method	Result and Treatment
⓫ Check of switch mechanism	1. Check of movement ● Push the switch actuating spring with tweezers to bring it contact with the pattern of electronic circuit and confirm the function of the switch. ● Check the electronic circuit for removal of pattern, deformation of switch actuating spring, etc. 2. Check of push buttons ● Check the push buttons of the case for deformation, stain, etc. Note: Be sure to apply silicone oil to the packings of the push buttons for the maintenance of waterproofness and smooth operation of push buttons.	Normal switching function → Check push buttons Abnormal switching function → Remove dirt and stain from each contact Removal of pattern → Replace electronic circuit Deformation of switch actuating spring → Repair or replace
⓬ Check of alarm mechanism	[Refer to Technical Manual, Baisc Course Ⅱ-1-d.] 1. Set the module to the case and remove the case back, then check the alarm output. (1) Set the watch to the normal time display mode or calendar mode. (2) Apply the ⊕ probe to the battery surface and the ⊖ prove to the buzzer contact spring, then press and hold the Ⓡ and Ⓢ buttons to set the watch to the alarm monitor mode to check the alarm mechanism.  <Tester range: DC•V 0.3V>	Pointer swings → Electronic circuit unit is normal Go to ⑫•2 Pointer does not swing → Replace electronic circuit unit

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