TECHNICAL INFORMATION

CITIZEN QUARTZ

Cal. No. 087※

CITIZEN

Contents

§1. OUTLINE

This is a multi-hands analog solar power watch with alarm and chronograph functions, and a solar power function as its base which provides the power source for the watch's hands movement and alarm sound by converting solar energy into electrical power with the solar cell fitted on its face.

§2. SPECIFICATIONS

Caliber number	**0870/0875**
Type	Multi-Hand Analog Solar Power Watch
Module size (mm)	ø29.0 x 5.3t
Time accuracy	Within ±20 Sec/month (Normal temperature range of 5°C/41°F~35°C/95°F)
Watch operational temperature range	–10°C/14°F~+60°C/140°F
Time adjustment	Non
Measurement time	10 Second
Display functions	Time .....Hour, Minute, Second and 24-Hour hands Calendar .....Date, Month (Second hand) Alarm.....Hour, Minute and 24-Hour hands, alarm ON/OFF Chronograph.....Minute, Second, 1/20 (0.05) second hands
Additional functions	Alarm.....Daily alarm (Sounds for about 15 seconds) Alarm monitor (Sounds for about 5 seconds) Chronograph .....Measurement is taken in 1/20 seconds and for 60 minutes max. (A beep for start/stop/split confirmation will sound when the associated button is pressed.) Insufficient charge warning function Stop warning function Hands setting warning function Over-charging prevention function
Battery used	Secondary battery (Parts number 295-29)

* CAL.0875 is equivalent to CAL. 0870, except that the cover of 0875 is bezel open type while cover of 0870 is case back open type. Accordingly, an unlocking lever for switch stem is added to 0875. The operation methods and specifications of these two models are the same.

§3. BEFORE USING

When the watch does not operate according to the handling instruction, it is insufficiently charged. Charge the secondary battery of the watch for more than 6 hours, approximately 20 cm away from the fluorescent lamp or incandescent lamp (30W) as light sources.
When charging the secondary battery, do not put it too close to the light source.

* When charging the watch under direct rays of the sun, charge more than an hour.

A secondary battery is used in this watch to store electrical energy.
This secondary battery is a clean energy battery which doesn't use any toxic substances such as mercury. Once fully charged, the watch will continue to run for about 80 days (using the alarm sound for 15 seconds/day and the chronograph measurement 60 minutes/day) **without further charging**.

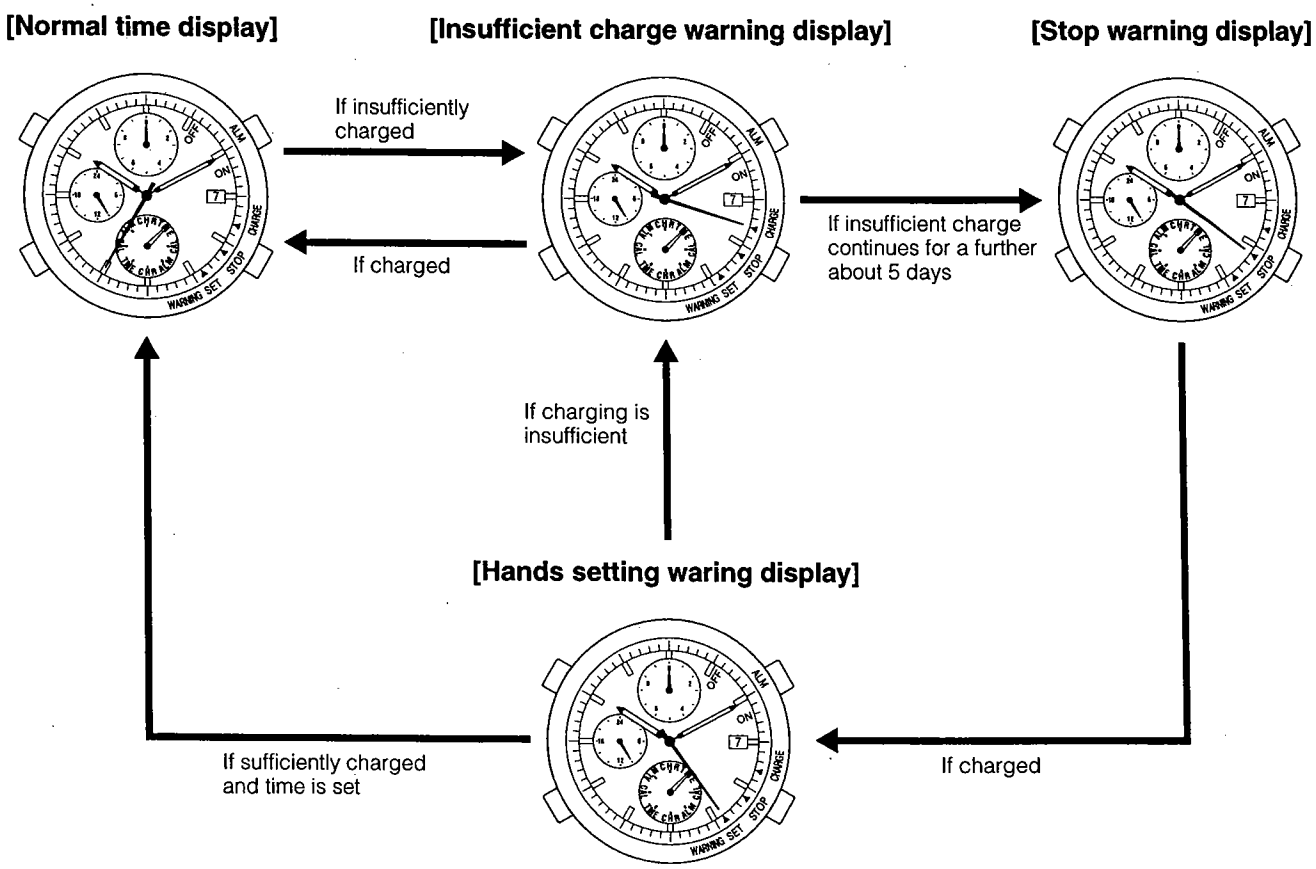
How to use this watch properly

For the comfortable use of this watch and its additional alarm and chronograph functions, take care to keep it sufficiently recharged.

There is no concern for over-charging this watch. (Over-Charging Prevention Functions is included) We recommend that you recharge the watch everyday.

§4. SPECIAL FUNCTIONS OF THE SOLAR POWER WATCH

If this watch becomes insufficiently charged, a warning function comes into operation and the display changes, as below.



Insufficient Recharging Warning Function (Refer to page 9 **"IN THESE CASES"**)

If the watch is put in the undercharged state during any display mode, it switches to the time display when in other display modes, then the second hand moves to the ▲ CHARGE position, indicating the shortage of electricity. (Electric power shortage warning display) Even then, the time (hour, minute and 24-hour hands) runs accurately.

- The alarm does not ring even if it is set.
- If the chronograph is being used, measurement stops and it is reset.
- The push button does not function.

Stop Warning Function (Refer to page 9 **"IN THESE CASES"**)

If the watch is left intact in the undercharged state, about 5 days later the second hand will move to the ▲ STOP position, indicating that the watch has stopped due to Electric power shortage. (Stop warning display) The other hands (hour, minute and 24-hour hands) also stop.

* In this condition, all function stop.

Hands Setting Warning Function (Refer to page 9 **"IN THESE CASES"**)

When the watch is recharged by exposing it to light after once stopped, the second hand moves to the ▲ SET position, indicating that the watch does not keep correct time. (Hands setting warning display)

* The hours, minute and 24-hour hands run at the incorrect time.

Over-Charging Prevention Function

You can recharge without worry.

When the secondary battery is fully recharged, the over-charging prevention function works so that the secondary battery is not overcharged.

§5. NOTES ON USE

⚠ Warning

Never use another battery apart from the secondary battery used in this watch.

The watch structure is so designed that a different kind of battery other than the specified cannot be used to operate it. However, in case a different kind of battery such as a silver oxide battery is used by some chance, there is a danger that the watch will be overcharged to burst, causing damage to the watch and even to the human body.

When you replace the secondary battery, be sure to use a designated secondary battery. (Parts No. 295-29)

§6. NOTES ON RECHARGE

⚠ Caution

* The watch will be damaged during recharging if it gets too hot (Over 60°C/140°F). Avoid recharging at high temperatures (Over 60°C/140°F).

  (eg) Charging the watch near a light source that easily become hot, such as an incandescent lamp or a halogen lamp.
  Charging in a place that easily becomes hot, such as a dashboard.

- Note that full charging is difficult in a place irradiated by only weak light.
- When you charge the watch by an incandescent lamp, take a distance about 50cm from the light source to prevent extremely high temperature.

§7. TIME REQUIRED FOR RECHARGE

Time required for recharge may vary according to the design (color of the dial, etc.) and operating environment. The following table will serve you as rough reference.

* The recharging time is the time when the watch is continuously exposed to radiation.

Illuminance (lux)	Environment	Time required		
		From the stop state to the one second movement	One day usage	Empty to full
500	Inside an ordinary office	28 hours	2 hours 30 minutes	220 hours
1000	60–70cm under a fluorescent light (30W)	13 hours	1 hour	105 hours
3000	20cm under a fluoresent light (30W)	4 hours 30 minutes	25 minutes	34 hours
10000	Exterior, cloudy	1 hour 30 minutes	8 minutes	10 hours
100000	Exterior, summer, sunny	50 minutes	2 minutes	3 hours

Full recharging time .....The time from when the watch is stopped to when it is fully recharged. (Empty to full)
One day usage .....The recharging time required for the watch to run for one day.

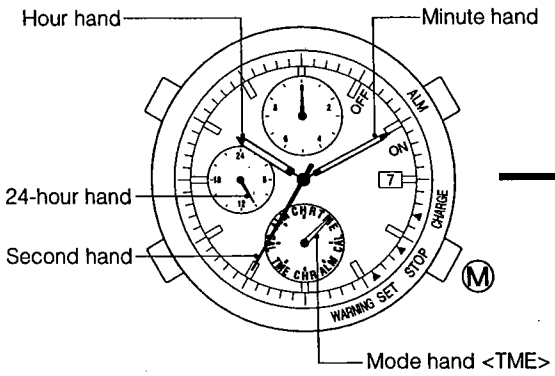
§8. HANDLING INSTRUCTION

1) CHANGING THE MODE

Other than the time display, this watch has alarm and chronograph main display functions. Each press of the Ⓜ button changes Time <TME> → Calendar <CAL> → Alarm <ALM> → Chronograph <CHR>. Confirm the change with the mode hand.

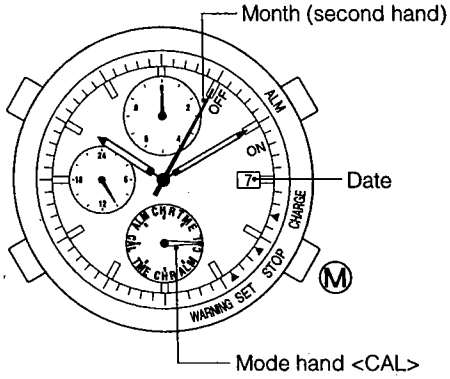
After that returns to the time mode <TME> display.

[Time mode]



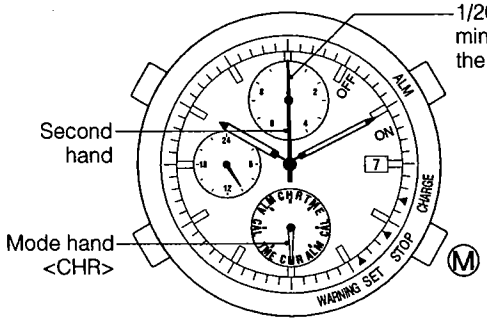
Display present time in hours, minutes, seconds and 24-hours.
Use the 24-hour hand to confirm am/pm.

[Calendar mode]



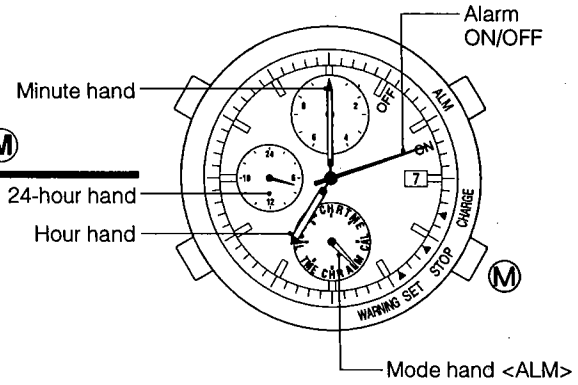
Displays current date by second hand (Month) and Date. Since the date and function hand are synchronized with each other, the function hand will turn at when correcting the date.

[Chronograph mode]



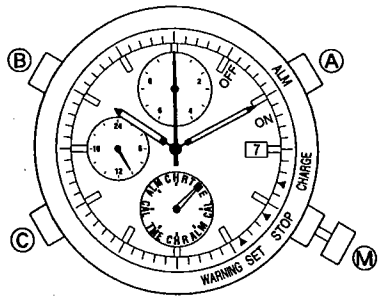
Measures up to a maximum 60 minutes in 1/20 seconds, and display split times.
A confirmation sounds when you start/stop or measure a split time

[Alarm mode]



Display alarm set time. The alarm setting is in 1 minute. Confirm of am/pm with the 24-hour hand.
If the alarm is ON, it will ring at the set time for 15 seconds once every day.

2) TIME SETTING



Check that the mode hand is indicating <TME> and the watch is in time mode.

1) Pull the button Ⓜ out, so that the second hand stops at the "0" position.
When the watch is adjusted by button operation, the time setting is completed by electromagnetic correction.
Time setting synchronize the minute hand → hour hand → 24-hour hand
When adjusting the hour hand, check the 24-hour hand position (am/pm)

2) Set the time by pressing button Ⓑ or button Ⓒ.

Each time button Ⓑ is pressed.....The watch advance 1 minute in a clockwise direction.

Each time button Ⓒ is pressed.....The watch turns back 1 minute in a counter-clockwise direction.

Depress button Ⓑ or Ⓒ continuously, the hands move rapidly.
Turn the hands in the direction that is closest to set the time.

3) After setting the time, push the button Ⓜ to the normal position and the watch will start at the correct time.

If the minute hand shows incorrect position

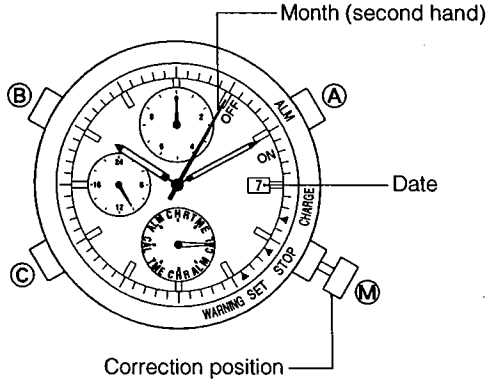
a. Pull button Ⓜ out to the first click.

b. Once button Ⓑ or Ⓒ is pressed with button Ⓐ depressed, the minute hand moves each 20 seconds.

Note: Do not press three buttons Ⓐ, Ⓑ and Ⓒ simultaneously. If all the buttons are pressed simultaneously, "0" Position Adjustment (page 10) and all other functions be set again.

3) SETTING THE CALENDAR

Press button Ⓜ to switch to the calendar mode <CAL>



1) Pull button Ⓜ out.

2) Press button Ⓐ to correct the month number.
Correction can be made by advancing by one month each time button Ⓐ is pressed.
The month number can be read directly from the normal hour positions.
(Example: 3:00 → March, 1:00 → January)
Correction can be made rapidly by holding button Ⓐ down.

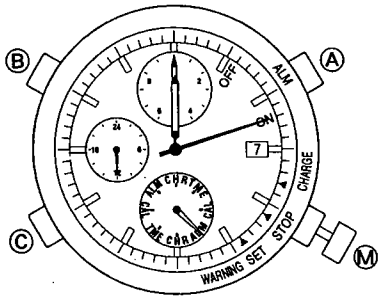
3) Press button Ⓑ to correct the date.
Correction can be made by advancing one day each time button Ⓑ is pressed. The date advances one day when the function hand makes four turns. Correction can be made rapidly by holding button Ⓑ down.

4) Push button Ⓜ in to the normal position

* Since the date and function hand are synchronized with each other, the function hand will turn at when correcting the date.
* Date correction at the end of each month is not required. However, since February is set at 28 days, date correction must be performed for February only in leap years.

4) USING THE ALARM

The alarm sounds once a day for 15 seconds at the alarm time set.
Pressing any of buttons Ⓐ, Ⓑ or Ⓒ stops the alarm ringing.



Setting the alarm

Alarm setting is on a 24-hour system in 1 minute. The hands are moved thus: minute hand → hour hand → 24-hour hand.

1) Press button Ⓜ to set the mode hand to <ALM> and switch to the alarm mode.
2) Pull button Ⓜ out to the alarm set time adjusting state.
3) Press buttons Ⓑ or Ⓒ to set the minute, hour and 24-hour hands to the desired time.

* Each time button Ⓑ is pressed.....The watch advance 1 minute in a clockwise direction.
* Each time button Ⓒ is pressed.....The watch turns back 1 minute in a counter-clockwise direction.

Depress button Ⓑ or Ⓒ continuously, the hands move rapidly.

After setting the alarm time, push the Ⓜ button. The hour, minute and 24-hour hands move rapidly automatically to the present time. If those hands do not stop moving, push the Ⓜ button again.

Switching the alarm ON and OFF

Each time button Ⓐ is pressed in the alarm mode, the alarm switches ON and OFF.

Alarm sound monitor

On the alarm mode (button Ⓜ in the normal position), press button Ⓐ and the alarm will sound for 5 seconds.

Note

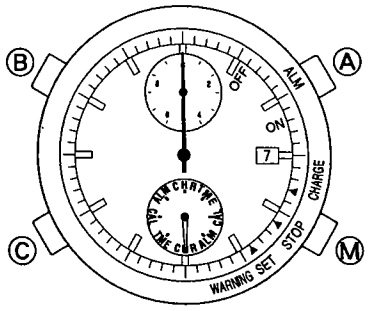
* There may be some variation in the volume of the alarm sound, depending on how much the secondary battery is charged.
* The alarm sound volume gets rather lower in the display other than the time display (alarm, chronograph, "0" position confirmation, and each display's adjustment state).

Once the alarm time has been set, use the watch normally in time display mode.

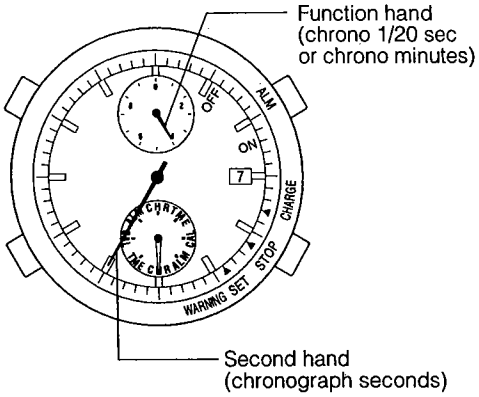
5) USING THE CHRONOGRAPH

Chronograph measurement is taken in 1/20 (0.05) seconds and can continue for 60 minutes max. Over 60 minutes, the watch enters the chronograph reset state.

Chronograph reset



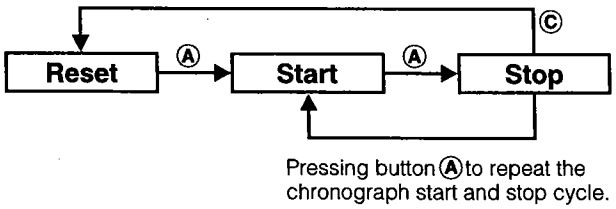
Chronograph measurement



[Read the chronograph hands]

Second hand → Chronograph second hand

Function hand → Chronograph 1/20 second hand or Minute hand.



[Chronograph measurement]

Chronograph standard or accumulated elapsed time measurement.

1) Press button Ⓜ to set the mode hand <CHR> and get the chronograph display. At this time, the second hand and the function hand will return to the "0" position.

* The hour, minute, and 24-hour hands show the present time.

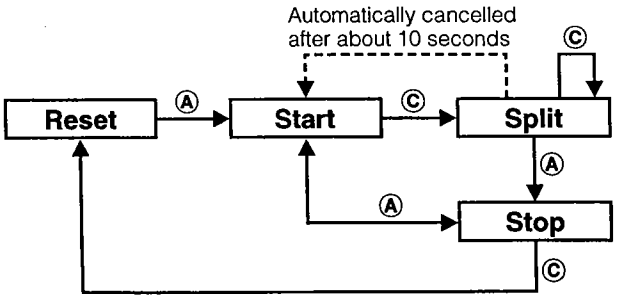
2) Each time button Ⓐ is pressed, it repeatedly starts or stop the chronograph, along with a confirmation sound.
How to read each chronograph hand if the measured time when the chronograph is stopped is over 1 minute.

a. Read the number of minutes with the function hand.

b. Read the number of seconds with the second hand.

c. While pressing button Ⓑ continuously, the function hand switches to 1/20 (0.05) second hand measurement, so read the value at that time.
When button Ⓑ is released, the function hand resumes showing chronograph minutes.

3) While the chronograph is stopped state, pressing button Ⓒ reset the function hand and the second hand to the "0" position.



[Chronograph split measurement]

Pressing button Ⓒ during chronograph measurement causes the chronograph split time to appear on display with a beep for confirmation.

Press button Ⓒ again, the next chronograph split time is displayed, along with a confirmation sound. The split time display is automatically cancelled after about 10 second, and the chronograph return to the measurement state.

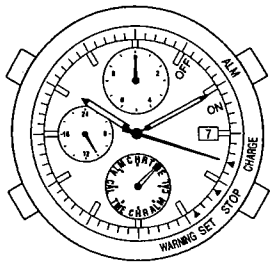
During either chronograph split time display or measurement, pressing button Ⓐ causes the chronograph stop to appear on display.

In the chronograph stop state, pressing button Ⓒ causes the chronograph reset.

* During split time measurement or while split time display, each time you press button Ⓒ the next split time is displayed.

6) IN THESE CASE

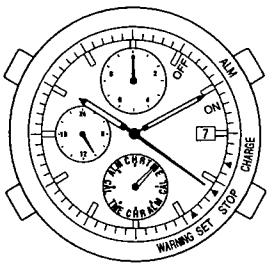
When shown the insufficient charge warning display



If the watch is put in the undercharged state during any display mode, it switches to the time display when in other display modes, then the second hand modes to the ▲ CHARGE position, indicating insufficiently charged. In such a case, expose the watch to sufficient light for the warning state to be cancelled. (The second hand return to 1 second movement)

It takes about 30 minutes to complete charging, from starting to expose the watch to light until this warning state is cancelled. The charging time varies depending on the light (light source) that radiates over the watch.

When shown the stop warning display



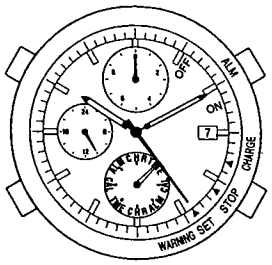
If the watch is left intact in the undercharged state, about 5 days later the second hand will move to the ▲ STOP position, indicating that the watch has stopped due to insufficient recharge.

* All function are stopped in this state.

In such a case, expose the watch to sufficient light for the warning state to be cancelled.

After carrying out sufficient charging, it is necessary to reset the alarm time.

When shown the hands setting warning display



If you expose a watch which has stopped once to light and recharge it, the second hand will move to the ▲ SET position to let you know that the time is incorrect.

In such a case, readjust the hour, minute and 24-hour hands to keep correct time.

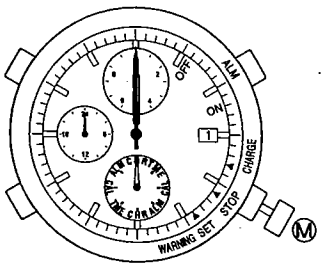
Without adjusting the time hands after the watch fully recharged, you cannot use such functions as alarm, chronograph, etc. properly.

* Be careful because if the watch is not sufficiently charged during the Hands Setting Warning Display State, and if light is blocked from it, the second hand will change to the r STOP position and the watch will stop running.

§9. CHECKING AND ADJUSTING EACH HAND'S "0" POSITION

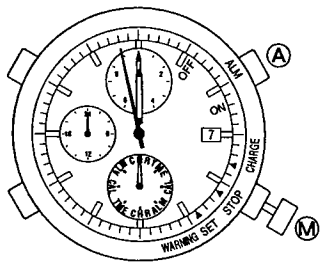
The watch's display may go wrong due to the effect of static electricity, strong shock, etc. In such a case, check and adjust the "0" position of each of the following hands.

"0" Position Checking



1) Press button Ⓜ to set the mode hand at <CHR> position for chronograph function.
2) Pull out button Ⓜ by one click and check to see if each of hour, minute, second, 24-hour and function hands quickly moves to "0" position (12 o'clock position) while date hand quickly moves to "1" position.
   If any hand returns worng out of the correct position "0" or "1", the watch needs ["0" position adjustment].

"0" Position Adjustment



1) For adjusting second hand to "0" position:
   • Press button Ⓐ.
2) For adjusting hour, minute and 24-hour hands to "0" position:
   • Press button Ⓒ.
3) For adjusting date and function hand to position "1" and "0" respectively:
   • Press button Ⓑ.
   • "0" position for function hand is equivalent to the 12 o'clock position just after date has been set at "1" position.

• With four turns of function hand, date indication is adjusted by a day.
• If button Ⓐ, Ⓒ or Ⓑ is continuously pressed, the hand corresponding to the button moves quickly.

4) When "0" position adjustment is complete, push button Ⓜ into the origitanl position.

* Make sure to reset time, calendar, alarm time correctly following "0" position adjustment.

§10. REPLACEMENT OF SECONDARY BATTERY

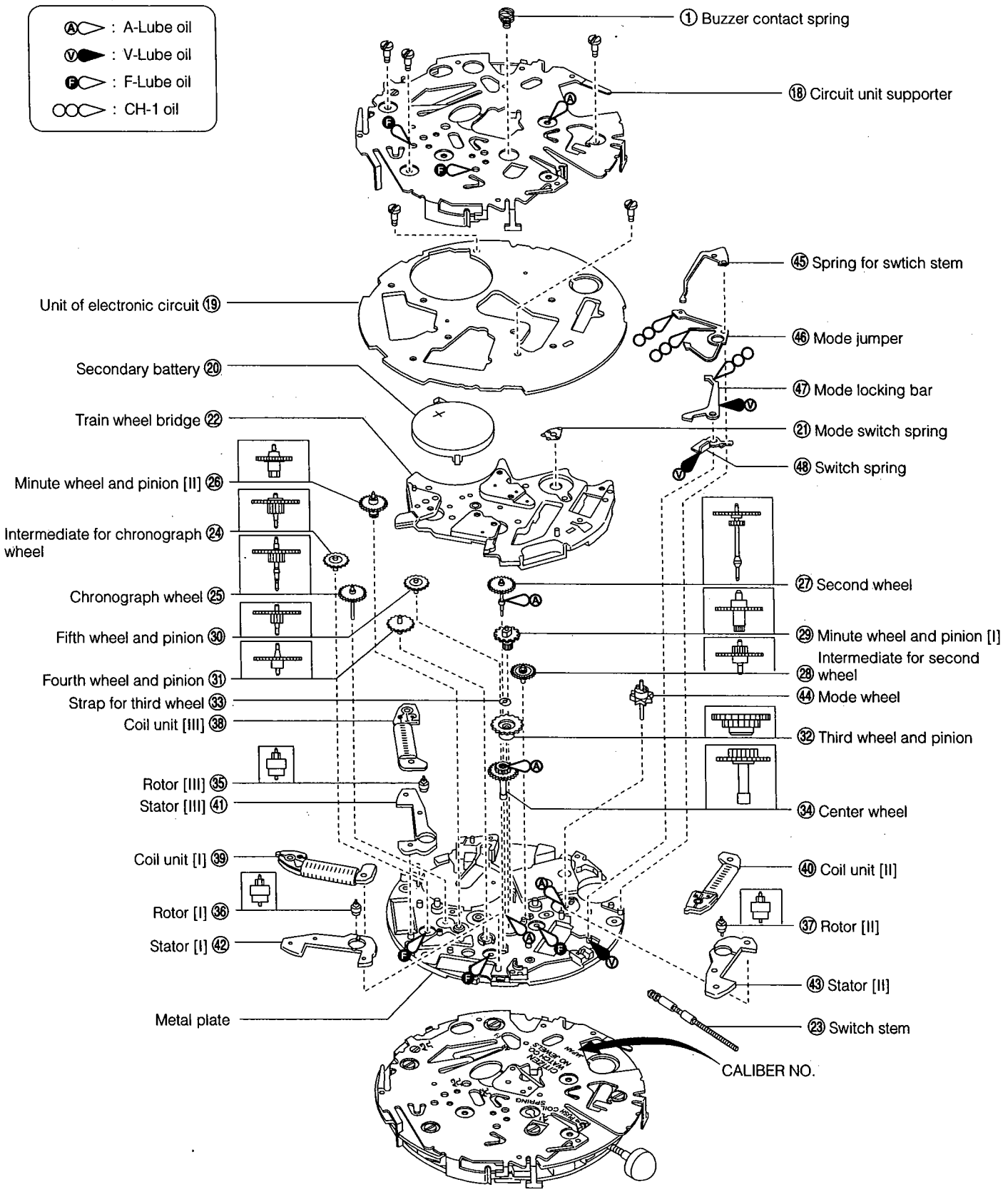
Since the secondary battery used in this watch is rechargeable, it does not need to be replaced periodically as a silver oxide battery.

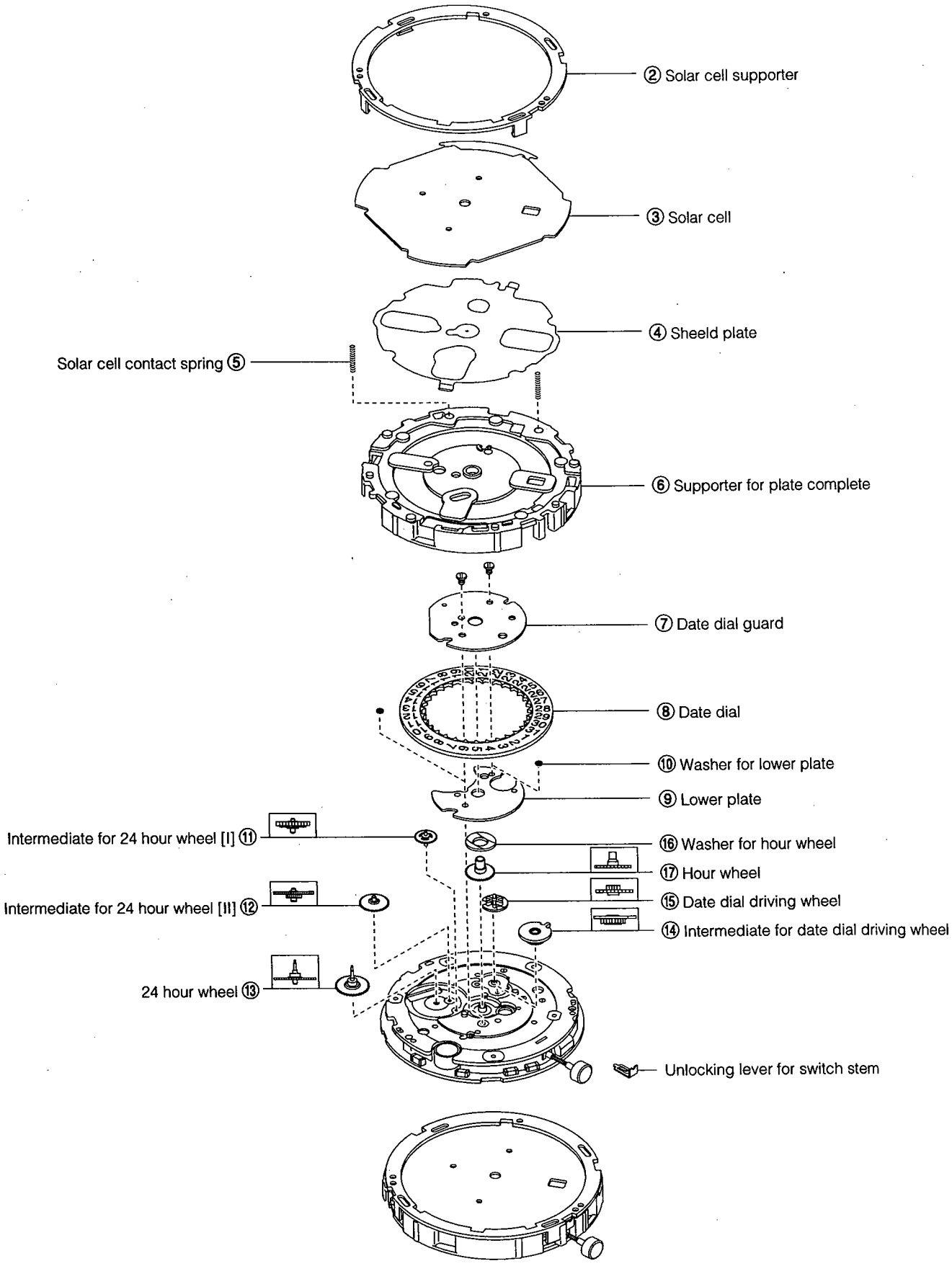
§11. DISASSEMBLY AND ASSEMBLY FOR MOVEMENT

Disassembly procedure: ① → ㊽
Assembling procedure: ㊽ → ①

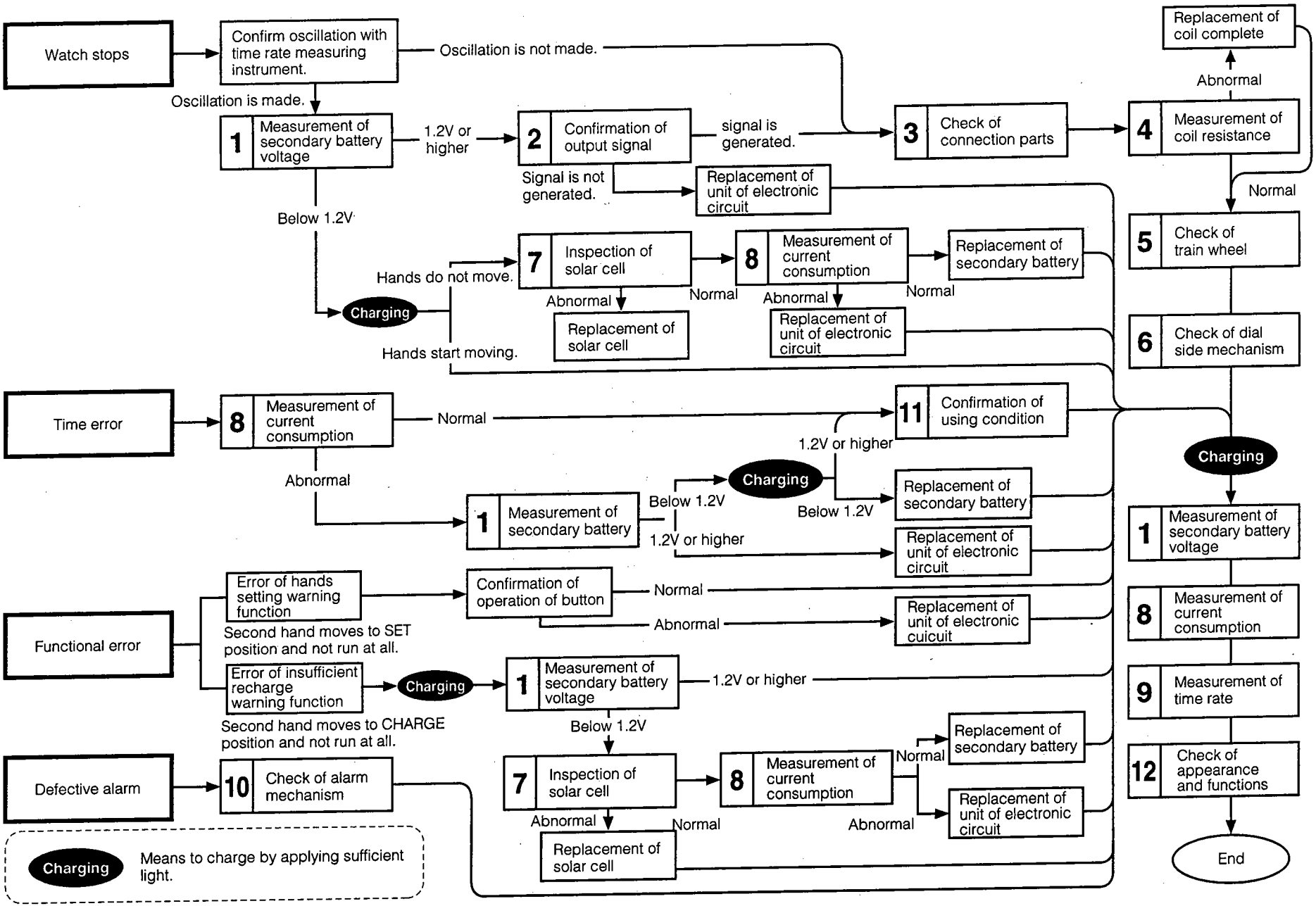
● Lubrication mark

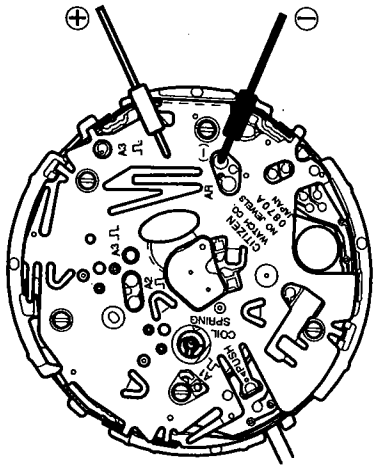
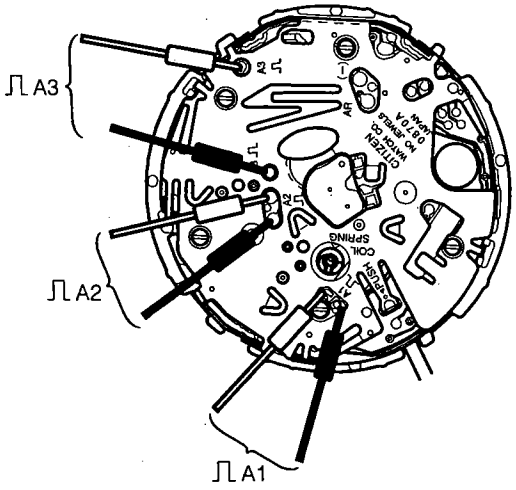
Ⓐ : A-Lube oil
Ⓥ : V-Lube oil
Ⓕ : F-Lube oil
CH : CH-1 oil



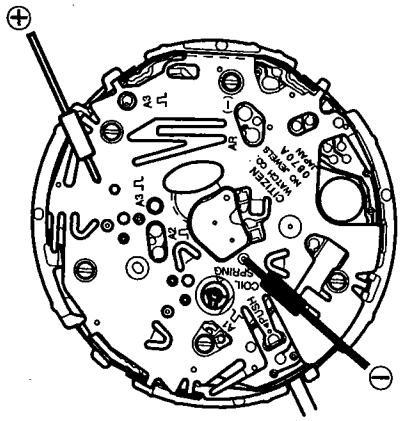

② Solar cell supporter
③ Solar cell
④ Sheeld plate
Solar cell contact spring ⑤
⑥ Supporter for plate complete
⑦ Date dial guard
⑧ Date dial
⑩ Washer for lower plate
⑨ Lower plate
Intermediate for 24 hour wheel [I] ⑪
⑯ Washer for hour wheel
⑰ Hour wheel
Intermediate for 24 hour wheel [II] ⑫
⑮ Date dial driving wheel
⑭ Intermediate for date dial driving wheel
24 hour wheel ⑬
Unlocking lever for switch stem

§12. TROUBLESHOOTING AND ADJUSTMENT



Check Items	How to Check	Results and Treatment
❶ Measurement of secondary battery voltage	* Refer to Technical Manual Basic Course II-1-a. <Tester range 3V> 	**Over 1.3 V** → Non defective **Under 1.3 V** → Recharging.
❷ Confirmation of output signal	* Refer to Technical Manual Basic Course II-1-b. <Tester range: D.C. 0.3V>  This watch output the signals as following. • Output signals (⎍ A1) of the time system (Second). • Output signals (⎍ A2) of the time system (Minute, hour, 24 hour). • Output signals (⎍ A3) of the chronograph system.	Check the output signal ⎍ A1. The tester pointer swings every second → Non defective The tester pointer does not swings → Check the connection parts Check the output signal ⎍ A2. The tester pointer swings every 20 second → Non defective The tester pointer does not swings → Check the connection parts. Check the output signal ⎍ A3. The tester pointer swings every 1 minute → Non defective The tester pointer does not swings → Check the connection parts The connections are normal → Replace the circuit
❸ Check of connection part	* Refer to Technical Manual Basic Course II-2-a.	

Check Items	How to Check	Results and Treatment
❹ Measurement of coil resistance	* Refer to Technical Manual Basic Course II-1-c. <Tester range: R x 10Ω>	• Coil unit [I], [III] **1.0 kΩ ~ 1.4 kΩ** → Non defective • Coil unit [II] **1.8 kΩ ~ 2.4 kΩ** → Non defective • Outside range of above value. → Replace the coil unit
❺ Check of train wheels	* Refer to Technical Manual Basic Course II-2-b. • Check the appropriate clearance of each wheel and rotor for dust.	
❻ Check of dial side mechanism	* Refer to Tchnical Manual Basic Course II-2-c.	
❼ Check of solar cell	• Check the solar cell for breakage and stain, and check its electrode for stain and flaking.	Breakage of solar cell → Replace solar cell. Stain → Remove stain. Flaking of electrode → Replace solar cell.
❽ Measurement of current consumption	* Refer to Technical Manual Basic Course II-1-f. When measuring current consumption, be sure to perform all-reset operation. 1. Pull the Ⓜ button out. 2. Set the test lead to the module, then press the Ⓐ, Ⓑ, and Ⓒ buttons, and the all functions are reset. 3. Push the Ⓜ button to the normal position. 4. Under this condition, measure the current consumption. Without Secondary battery ⊖ ⊕ <Tester range: DC 10μA> Influence of light Avoid measuring current consumption under an incandescent lamp of the direct rays of sun, because it may cause the current value to increase.	• Current consumption of the movement **Under 1.8 μA** → Non defective **Over 1.8 μA** → Check train wheel → Remove dirt. Module is non defective, but current consumption is over 1.8 μA. ⇩ Replace of unit of electronic circuit

Check Points	How to Check	Results and Treatments
⑨ Measurement of time rate	* Refer to Technical Manual Basic Course II-2-d.	
⑩ Check of alarm mechanism	* Refer to Technical Manual, Basic Course: II-1-d. 1. Set the movement in the case, and check output of alarm with the case back removed. a. Press Ⓜ button to switch to the alarm mode. b. Apply ⊕ lead pin to circuit unit supporter surface and ⊖ lead pin to buzzer contact spring (flat part), then press Ⓐ button. <Tester range: D.C. 3 V>  2. If the output of alarm is normal, perform the following inspection. • Check the piezo-electric element of vibrating plate for cracks and breakage. • Check the buzzer contact spring for bend and deformation. • Check the pattern of electronic circuit unit for dust and stain.	• The tester pointer swings → Non defective. • The tester pointer does not swings → Replace of unit of electronic circuit
⑪ Confirmation of using condition	* Refer to Technical Manual Basic Course II-2-e.	
⑫ Check of appearance and function	* Refer to Technical Manual Basic course II-2-f. • Make sure that there is no dust or dirt inside the watch. • Make sure that each button functions correctly. • Make sure that the alarm monitor operates in an expected manner.	