

***TECHNICAL
INFORMATION***

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CITIZEN QUARTZ

Cal. No. 22※※※

 **CITIZEN**

■ 1. OUTLINE



This is a high-grade quartz crystal watch (with no center second hand) for ladies, attaining a miniature and thin-gage movement with use of the world first miniature-size power cell.

The concept of this new caliber is based on the precedent Cal. No. 1500 featuring the world smallest capacity of movement.

And a lifetime of about three years is attained for just a miniature power cell thanks to the highly effective use of the current consumption in the circuits and a converter.

Furthermore the location of the setting stem is drifted toward the dial in order to realize a thin-gage appearance structure.

■ 2. FEATURES

- 1) High-grade quartz crystal watch (with no center second hand) for ladies

Owing to the compact and miniature movement, no variety of designs is possible for the watch.

Size of movement:	Short dia.	9.0mm
	Long dia.	13.2mm
	Move dia.	13.5mm ϕ (Maximum dia. 14mm ϕ)
	Thickness	1.87mm (Power cell part 1.9mm)

- 2) DFC (Digital Frequency Control) by nonvolatile memory system

For the ordinary DFC, four to five control terminals are patterned to a substrate and the frequency is set in the blanking process.

With this caliber, however, a writing is carried out to constitute an electrical memory within an IC and then the oscillation frequency of quartz crystal is adjusted.

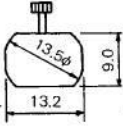
The control terminal for market use is excluded from this caliber since a thorough adjustment is already given to the time rate in the process of production at a factory.

- 3) 20-second step movement of minute hand

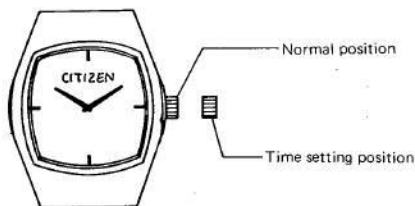
The minute hand advances with every 20 seconds. When measuring the time rate, the "MEASURE TIME" must be set at "10 SEC" since the signal of measurement is applied with every 10 seconds.

(The minute hand moves in 32Hz with a single unit of movement by a quick advance terminal. This enables you to confirm the drive of watch.)

■ 3. SPECIFICATIONS

Caliber No.	2200E-06	
Type	Analog quartz crystal watch (with no center second hand)	
Size of movement	Short dia. : 9.0mm Long dia. : 13.2mm Move dia. : 13.5mm ϕ Thickness : 1.87mm (Power cell part: 1.90mm)	
Accuracy	± 15 sec./month at normal temperatures	
Oscillation	32,768Hz	
Converter	Bipolar step motor (20-second step movement of hand)	
Integrated circuit	C/MOS-LSI (1 unit)	
Effective temperature range	$-10^{\circ}\text{C} \sim +60^{\circ}\text{C}$ ($14^{\circ}\text{F} \sim 140^{\circ}\text{F}$)	
Adjustment of time rate	DFC by nonvolatile memory system Unit of measurement: 10 seconds Provided with no control terminal for market use	
Additional function	Hour/minute hand stopping device	
Power cell (Silver peroxide)	Parts No. : 280-107 (1 unit) Cell code : TR516HSW Size : 5.8mm ϕ x 1.6mm Nominal voltage : 1.5V Capacity : 10mAh Lifetime : About 3 years	

■ 4. HANDLING INSTRUCTIONS



- 1) The time is set by pulling out the crown one step from the normal position of the crown as shown in the above diagram.
- 2) The crown is turned to adjust the time. The time can be set down to a second by first setting the time with a counterclockwise turn of hands and then pushing the crown synchronously with a time signal through a radio, telephone or the like. The minute hand starts in the lapse of 20 seconds since the minute hand of this caliber moves with every 20 seconds.

■ 5. NONVOLATILE MEMORY

1) Outline

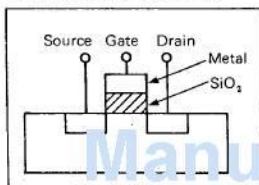
An IC used in this caliber is based on a C/MOS-LSI, and a part of the IC (i.e., M-NOS) is used for a memory circuit.

This memory circuit functions to electrically store a specific state when the function of DFC is set active.

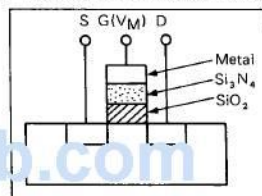
For this purpose, the M-NOS (metal-nitride film-oxide film-silicon) is used. The storage of memory is possible by applying a proper level of voltage to a gate, and the re-programming is possible with this M-NOS with no destruction. In other words, the silicon nitride functions as a condenser of a large capacity.

2) Structure

1. Normal MOS transistor



2. M-NOS to be used as a nonvolatile memory



The voltage of about +40V is applied to a gate, $G(V_M)$ in the diagram, and thus the information given at that time is stored. While the memory is erased with application of about -40V.

3) Features

a) Merits

- The size of an IC chip can be minimized owing to a reduction of number of wiring terminals.
- In the conventional mechanical memory system, four to five terminals are patterned on a substrate. While just two terminals, a write terminal and a power supply terminal, suffice for a nonvolatile memory.
This is an advantage for the pattern designing of calibers developed for ladies in particular.
- The reproduction is possible with a nonvolatile memory even in case some mistake arises in the punching process. This reproduction is impossible with a mechanical memory.

b) Demerits

- The manufacturing processes of an IC are increased to increase the production cost.
- The lifetime of memory is reduced by a disturbance. (This demerit may be avoided with a complete watch.)
- A new device is needed to set a nonvolatile memory. (At the factory)

4) Future use of nonvolatile memory

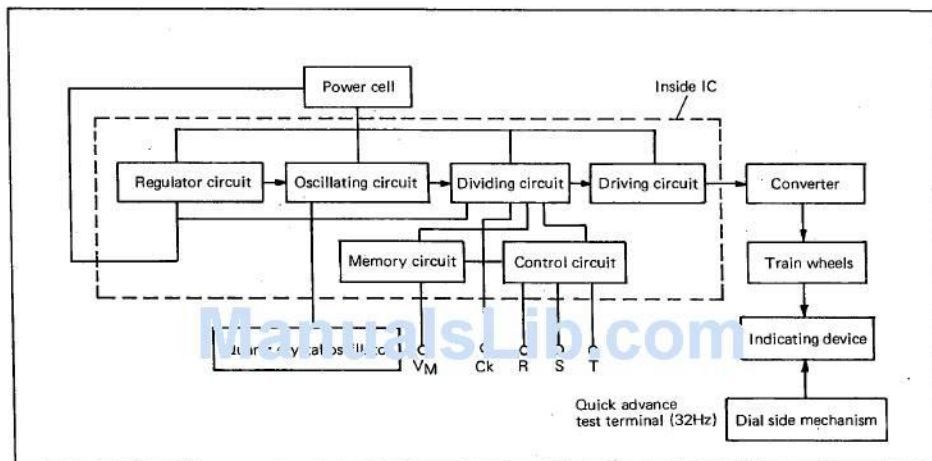
A nonvolatile memory will be used in future to a wristwatch as long as the users demand a small-size and thin-gage structure of watch and although an overall cost increases due to the production process of an IC. This is due to one of the biggest merits of a nonvolatile memory: the size of an IC chip can be minimized by a reduction of number of wiring terminals.

6. STRUCTURE OF MOVEMENT

With use of a silver peroxide power cell of voltage non-control type, the output voltage of the cell is made constant through a regulator circuit to be applied to an oscillating circuit as well as a part of dividing circuits.

The output voltage of the cell is directly applied to and after the middle stage of a dividing circuit.

A memory circuit and a control circuit are newly added to this caliber compared with other analog watches.

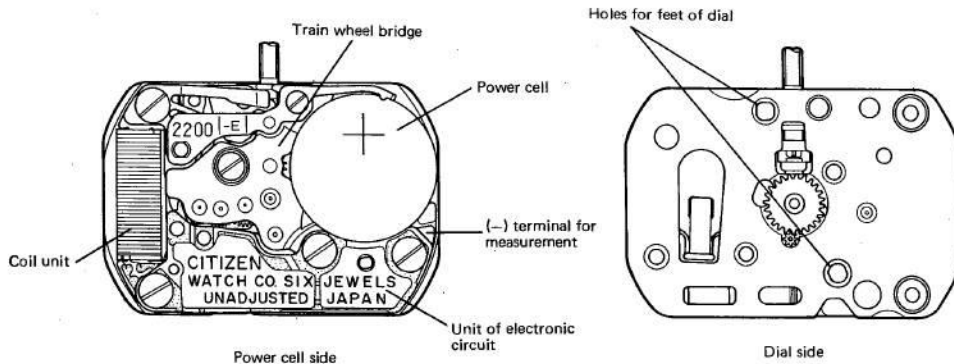


V_M : Writing/erasing power supply terminal of memory circuit

Ck : Writing terminal of memory circuit

R (reset terminal), T (quick advance test terminal) and terminal S are combined to perform a test at a factory.

External view of movement



■ 7. POWER CELL

The power cell used in this caliber has a new size:

Outer diameter: 5.8mmφ

Thickness : 1.6mm

At present just two Japanese maker supplies the power cell to us for the exclusive use to this caliber.

In this respect, please decide the ordering quantity of this power cell in careful consideration of your sales achievement and a long lifetime of about three years of the power cell.

■ 8. DISASSEMBLY/ASSEMBLY OF MOVEMENT

Disassembling procedure : ① → ②④

Assembling procedure : ②④ → ①

Marks of lubrication:

◀⊗ Synt-A-Lube oil

◀⊙ Synta-V-Lube oil

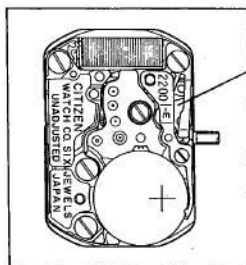
◀∞ CH-1 Citizen watch oil

Note 1. Take the meticulous care when handling a plate since its thickness is very small.

Note 2. Use a movement holder bearing "2200".

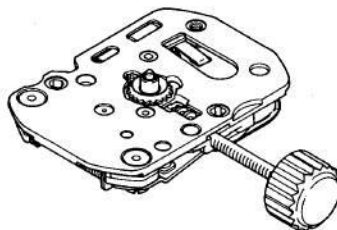
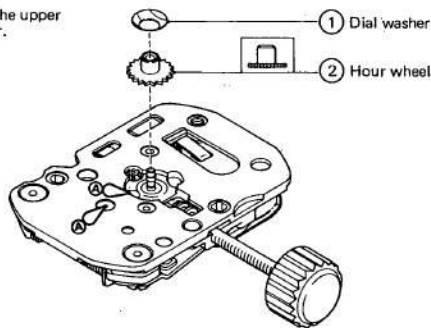
Note 3. The cell is fixed into a space for setting stem and thus removed with use of a driver or the lifer in the case, or the crown, both of them, clockwise or counter-clockwise directions.

Note 4. The crown can be pulled out at either the first click stop position or the normal pushed-in position and while pushing the setting lever part as shown in the following diagram.

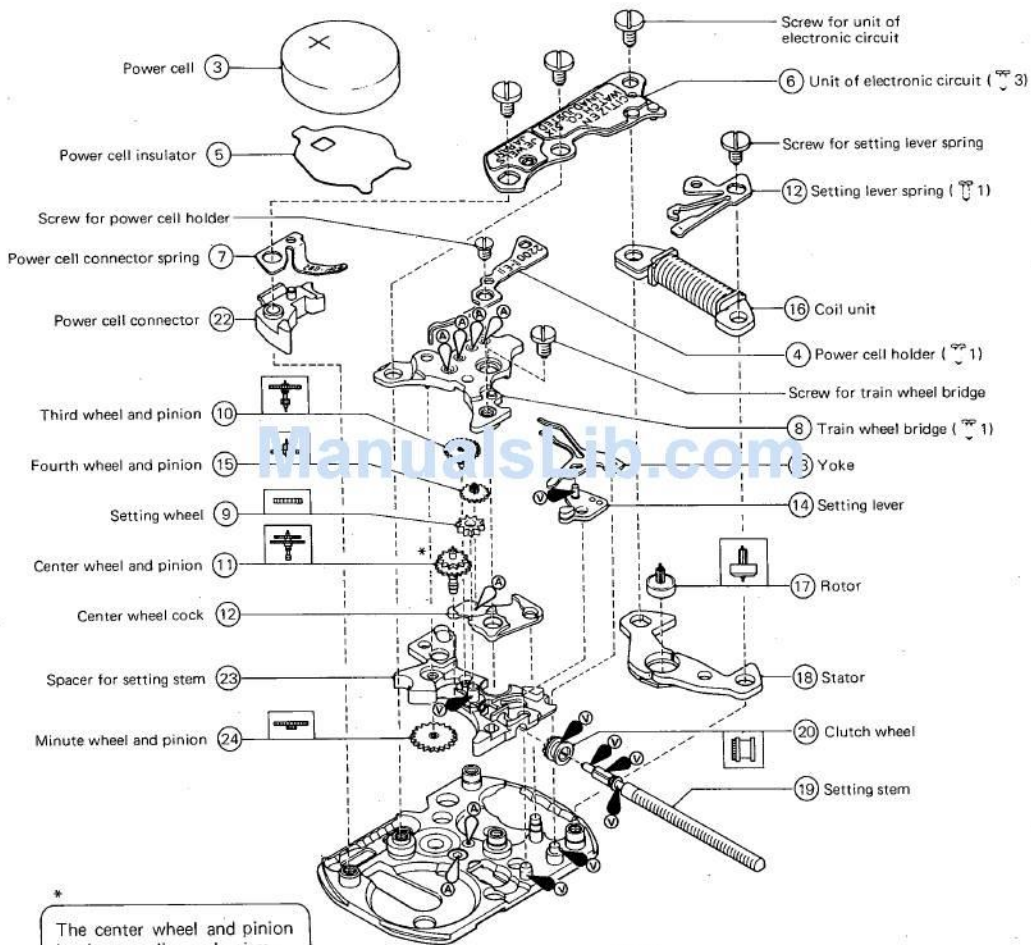


Push V groove on the upper face of setting lever.

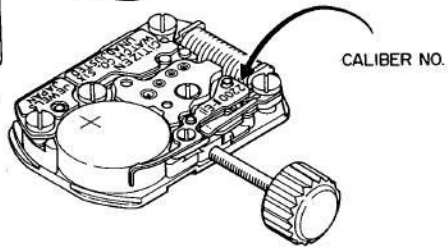
1) Dial side



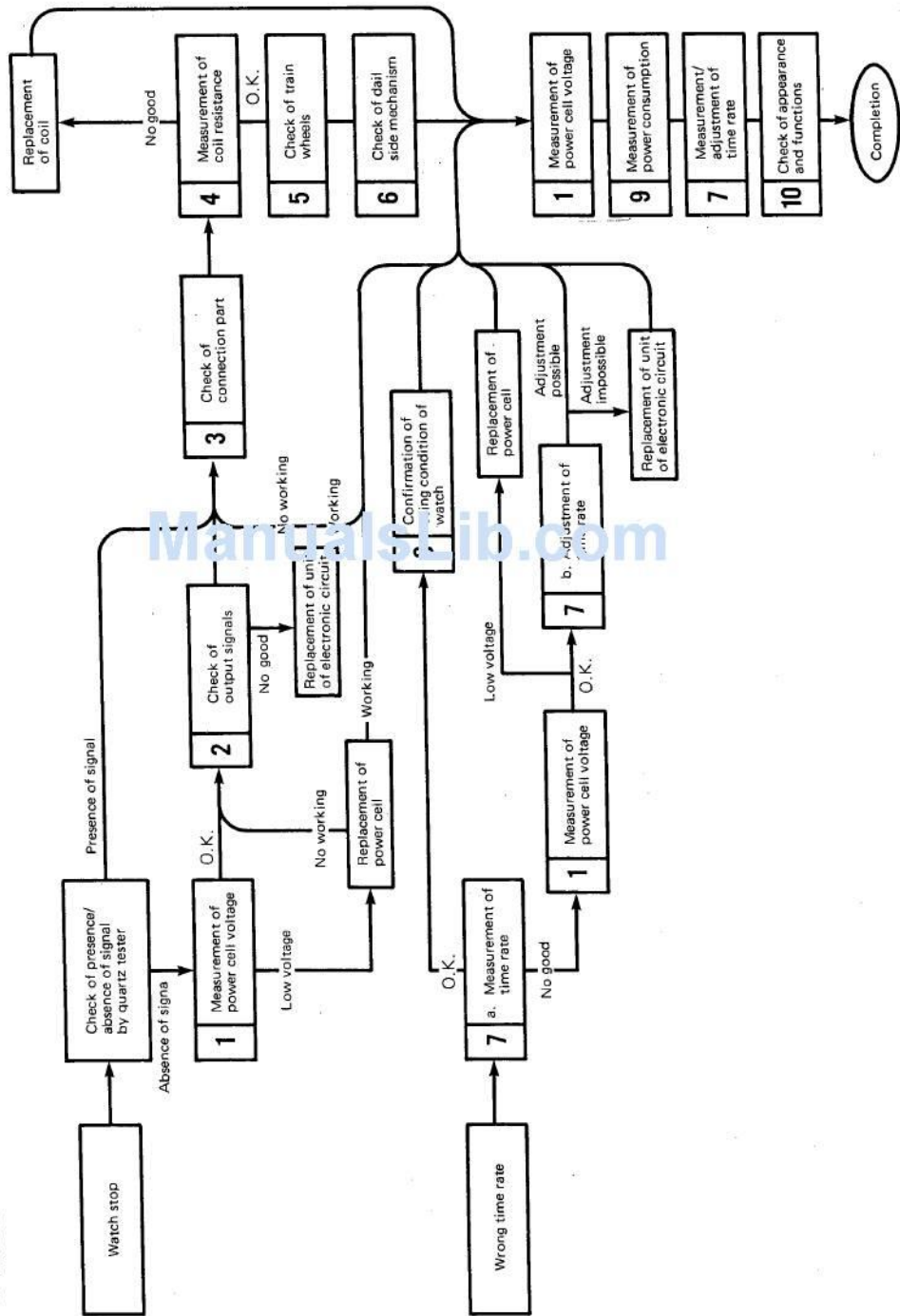
2) Power cell side

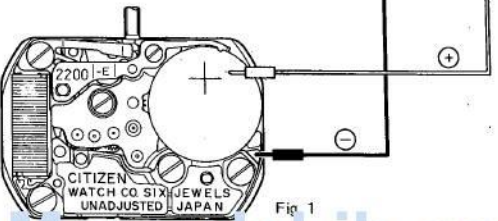
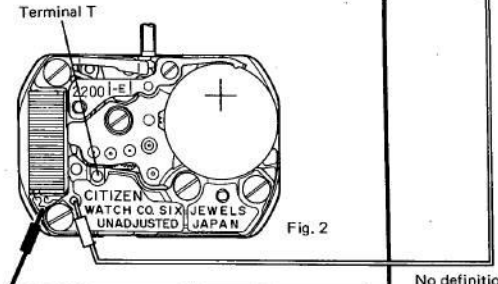


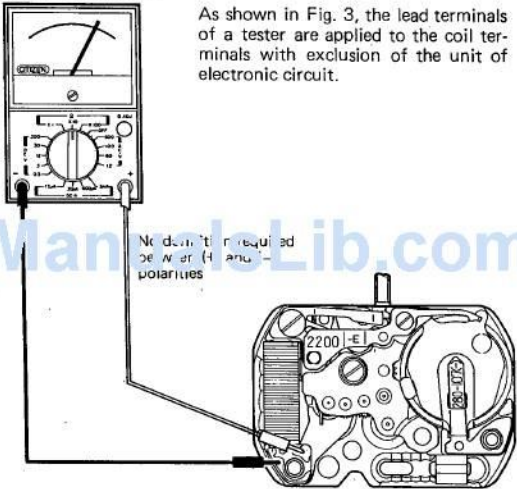
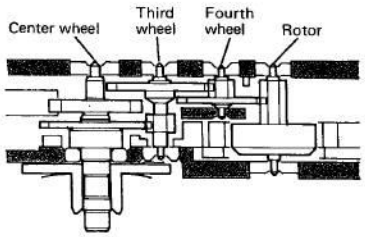
* The center wheel and pinion has its own slip mechanism. Thus the CH-1 oil is supplied from the side of pinion.



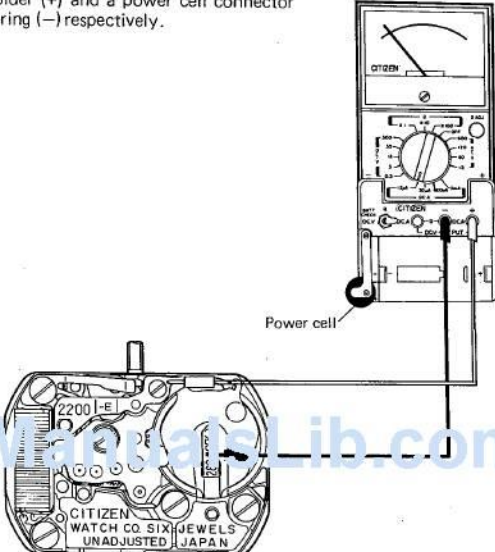
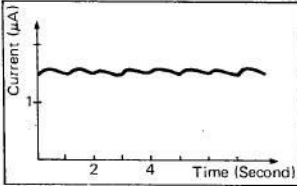
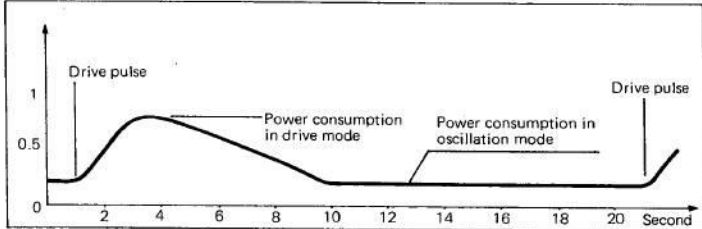
■ 9. TROUBLESHOOTING AND ADJUSTMENT

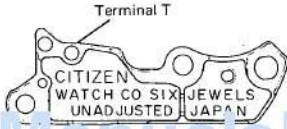


Checking items	How to check	Results and treatment
<p>1 Measurement of power cell voltage</p>	<p>As shown in Fig. 1, the lead terminals of a tester are applied to the watch movement.</p> <p>(Tester range DC 3V) Result of measurement:</p>  <p>Fig. 1</p> <p>* This power cell may sometimes show an output of about 1.8V at the first stage owing to its non-control type of voltage.</p>	<p>Over 1.5V → Good</p> <p>Under 1.5V → Replacement of power cell</p>
<p>2 Check of output signals</p>	<p>As illustrated in Fig. 2, the lead terminals of a tester are applied to a coil terminal and a hole of measurement of the unit of electronic circuit with a complete movement.</p> <p>(Tester range DC 0.3V) Results of measurement:</p>  <p>Fig. 2</p> <p>No definition required between (+) and (-) polarities</p> <p>• Check of quick advance drive When a conduction is secured between the upper face (V_{DD}) and terminal T by means of a tweezers or the like, the rotor turns in a speed of 32Hz. It is recommended to check beforehand the above drive of rotor to save total 40 seconds (20 sec. plus 20 sec.).</p>	<p>Tester pointer deflecting right and left with every 20 sec. centering on 0V → Good</p> <p>No deflecting of tester pointer → Replacement of unit of electronic circuit</p>

Checking items	How to check	Results and treatment
<p>3 Check of connection part</p>	<p>1) Make sure that no dust is attached to the part of connection between the upper face of a coil terminal and the lower face of a unit of electronic circuit.</p> <p>2) Make sure that the screws for unit of electronic circuit are completely driven.</p>	<p>Dust or stains attached to part of connection → To be cleaned off</p> <p>Screws driven incompletely → To be driven tight</p>
<p>4 Measurement of coil resistance</p>	<p>(Tester range x10Ω) Results of measurement:</p>  <p>As shown in Fig. 3, the lead terminals of a tester are applied to the coil terminals with exclusion of the unit of electronic circuit.</p>	<p>1.7 ~ 2.1kΩ → Good</p> <p>Outside above range of resistance → Replacement of coil unit</p>
<p>5 Check of train wheels</p>	<p>1) Check both the clearance and the state of lubrication of each gear.</p> <p>2) Make sure that no dust nor foreign matters are mixed into gears.</p> <p>3) The center wheel and pinion has its own slip mechanism. And make sure that the CH-1 oil is supplied to the center wheel.</p> 	<p>Insufficient lubrication → Washing and relubrication</p> <p>Dust or foreign matters attached → To be cleaned or washed away</p> <p>High slip torque → Relubrication</p>

Checking items	How to check	Results and treatment
<p>6 Check of dial side mechanism</p>	<p>1) Check the following function of a yoke: the tip of one side of the yoke touches a reset pin on the lower face of the unit of electronic circuit to secure a reset mode when the crown is pulled out one step; and the other tip of the yoke touches the rotor pinion to stop the movement of train wheels.</p> <p>2) The click-stopping state of the crown may be affected by the form of a setting lever or the state of setting of the spacer for setting stem. In this respect, an inspection must be given to the state of setting of the said spacer.</p>	
<p>7 Measurement of time rate</p>	<p>a. Measurement of time rate</p> <p>The time rate is measured with use of the CQT-101 timing machine. In this case, the "MEASURE TIME" must be set at "10 SEC" or its integer-fold value since the pulse for adjustment of time rate is fed with every 10 seconds due to the DFC system using a nonvolatile memory.</p> <p>b. Adjustment of time rate</p> <p>As mentioned above, this case adapts the DFC system using a non-volatile memory and a continuously non-adjustment of time rate is carried out on the market.</p> <p>However, an adjustment on the market is possible with use of a special tool. With this tool, the memory mode is cleared for writing. And the use of this tool is effective when the lifetime of a memory ends for some factor or other.</p> <p>For the time being, however, the production of such tool is not planned since the reliability is highly appraised for a non-volatile memory.</p>	
<p>8 Confirmation of using condition of watch</p>	<p>1) The using condition of a watch must be confirmed. A magnet, a sudden change of temperatures, an impact or the like factors will cause a temporary error of time.</p> <p>2) Make sure how long it passed since the last adjustment of time.</p> <p>3) Check whether a watch was put in an intensive beam or an electromagnetic wave, etc.</p>	

Checking items	How to check	Results and treatment
<p>9 Measurement of power consumption</p>	<p>As shown in Fig. 5, the lead terminals of a tester are applied to a power cell holder (+) and a power cell connector spring (-) respectively.</p> <p>(Tester range DC 12μA) Results of measurement:</p>  <p>Fig. 5</p> <p>The drive signal is applied with every 20 seconds with this caliber. And the current value is different between the oscillation mode and the drive mode although the tester pointer is steady at a certain value with a caliber having the 1-second step movement of second hand.</p>  <p>1-second step movement of hand</p> <p>As shown in the left diagram, the current value varies and then becomes steady with about 1.5 ~ 1.6μA because the next pulse arrives immediately.</p>  <p>Note: This graph shows the movement of hand through Citizen Multi-Tester. The movement of hand differs according to the internal capacity of the tester.</p>	<p>About 0.2μA in oscillation mode → Good</p> <p>About 0.8μA in drive mode → Good</p>

Checking items	How to check	Results and treatment
	<p>20-second step movement of hand (Cal. No. 2200E)</p> <p>The power consumption is about $0.2\mu\text{A}$ and steady in the oscillation mode and varies to $0.8\mu\text{A}$ or so in the drive mode.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>The power consumption in the reset mode is about $0.2\mu\text{A}$ and equal to that in the oscillation mode.</p> </div> <p>● Power consumption in quick advance mode</p> <div style="text-align: center;">  </div> <p>The train wheels turn in a speed of 32Hz by connecting terminal T to a + pole and while measuring the power consumption.</p> <p>In this case, the value of power consumption is about $90\mu\text{A}$. This value will be a standard for the fact that an acceleration will be given to the speed of train wheels if some stains attach to a converter and its subsequent parts.</p> <p>Note: A quick advance drive is effective to confirm the functioning of watch mechanism. However, the life of a power cell will be out in 110 hours or 4.5 days if a quick advance drive is given continuously since the speed becomes 640-fold ($\frac{1}{20} \rightarrow \frac{32}{1}$).</p>	<p>Over $0.3\mu\text{A}$ in oscillation mode → Replacement of unit of electronic circuit</p> <p>Over $1\mu\text{A}$ (max.) in drive mode → Measurement to be carried out after overhaul and lubrication</p>
<p>10 Check of appearance and functions</p>	<p>The following points are checked with a complete watch.</p> <ol style="list-style-type: none"> 1) The minute hand starts in the lapse of 20 seconds after the hand is set and the crown is pushed. 2) The dial face is free from any dust or stain. 3) The feet of dial are set in a correct way to avoid the rubbing of hands which is easily caused due to a narrow space between the hands. 	