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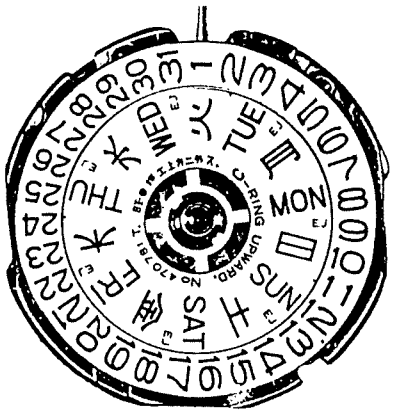
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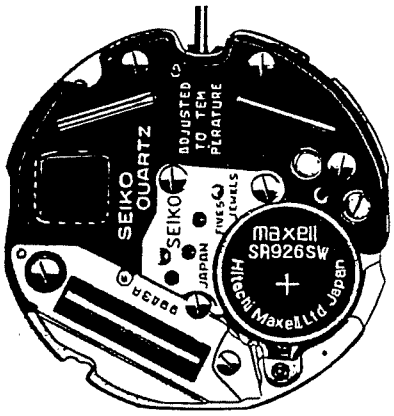
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Quartz Crystal Oscillator Watch
SEIKO Twin Quartz Cal. 9943A & 9940A

SEIKO Twin Quartz Cal. 9943A & 9940A with two crystal oscillators are high accuracy quartz watches whose annual time loss or gain has been reduced to approximately 10 seconds.





Movement

I. SPECIFICATIONS AND FEATURES

1. Specifications

Item \ Code No. / Cal.No.	99GQW / 9943A	99GQ / 9940A
Time indication	Hour, minute & second hands	
Additional mechanism	Calendar (day & date)	–
	Bilingual change-over system for the day of the week	–
	Instant day and date setting	–
	Electronic circuit reset switch Second setting device (Stops at every second) Battery life indicator	
Crystal oscillator	32,768Hz (Hz = Hertz . . . Cycle per second)	
Loss/gain	Annual rate of loss and gain under normal temperature range is approximately less than 10 seconds. (The monthly time loss or gain may not be 1/12th of the annual rate depending upon the circumstances in which the watch is used.)	
Casing diameter	ϕ 25.6mm	
Height	3.7mm without battery	3.4mm without battery
Operational temperature range	−10°C~+60°C (14°F~140°F)	
Driving system	Step motor system (2 poles)	
Regulation system	Trimmer condenser	
Battery power	Silver oxide battery SEIKO SB-AP, Maxell SR926SW Battery life is approximately 2 years. Voltage 1.55V	
Jewels	5 jewels	

2. Features

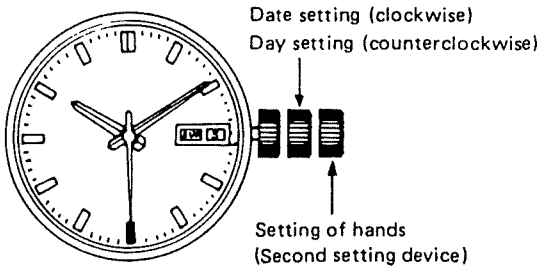
(1) A pair of crystal oscillators having different temperature characteristics are used in the circuit block. Each crystal oscillator is oscillated independently and detects temperature change, which is compensated through the micro computer. The influence of temperature change on the time accuracy is thus reduced to the minimum and extra-high accuracy is achieved.

(2) Although Cal. 9943A & 9940A are adopting the instant day and date setting and equipped with the battery life indicator, they are neat in design because of the ultra thin movements.

3. How to set the time and calendar

Crown position

- Normal position: Free
- 1st click: Date change (clockwise)
  Day change (counterclockwise)
- 2nd click: Hand setting, second setting and reset switch
  When measuring time accuracy by the Quartz Tester

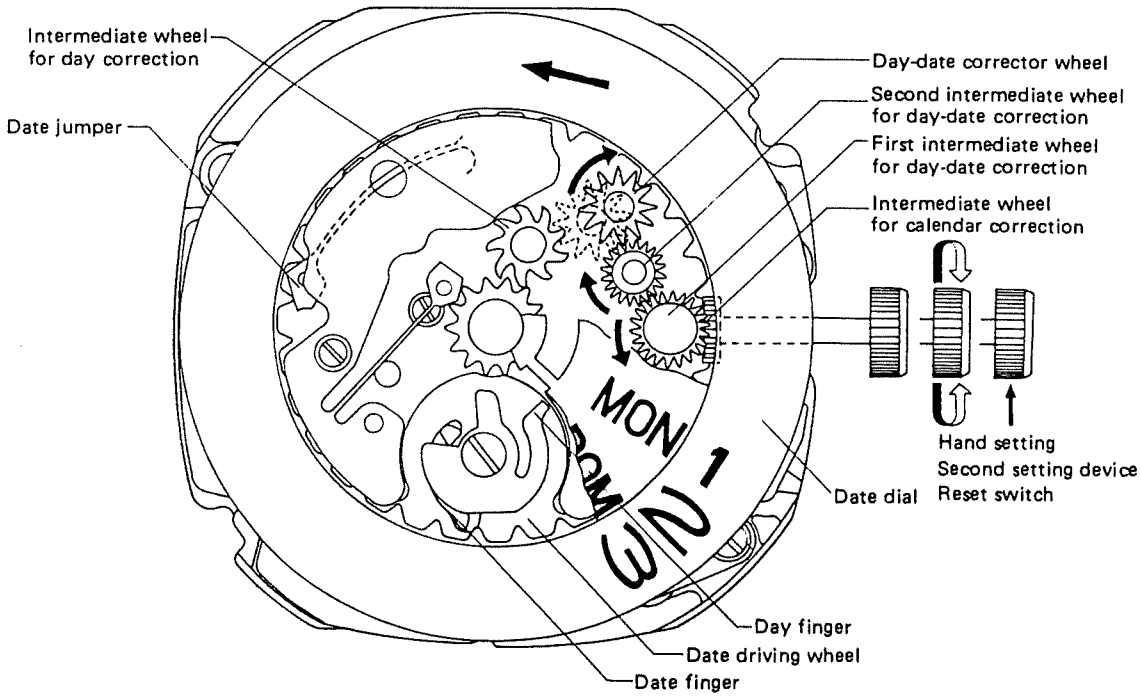


(1) To set the time

1. Pull out the crown to the second click position.
   The second hand stops on every second scale.
   Pull out the crown to the second click position when the second hand comes on 0-second position.
2. Turn the crown and set the time
   - Be sure to check if it is set in the A.M. or P.M. period. Turn the hour hand past 12 o'clock position to check if it is set in the A.M. or P.M. period.
     If it is the P.M. period, the date will change.
   - As the torque of the gear train is transmitted reversely, the time is set accurately by turning the hands about 5 or 10 minutes ahead and then turning it back to the desired time.
3. Push the crown in accordance with a time signal, and the time is set accurately to the second.

(2) To set the calendar

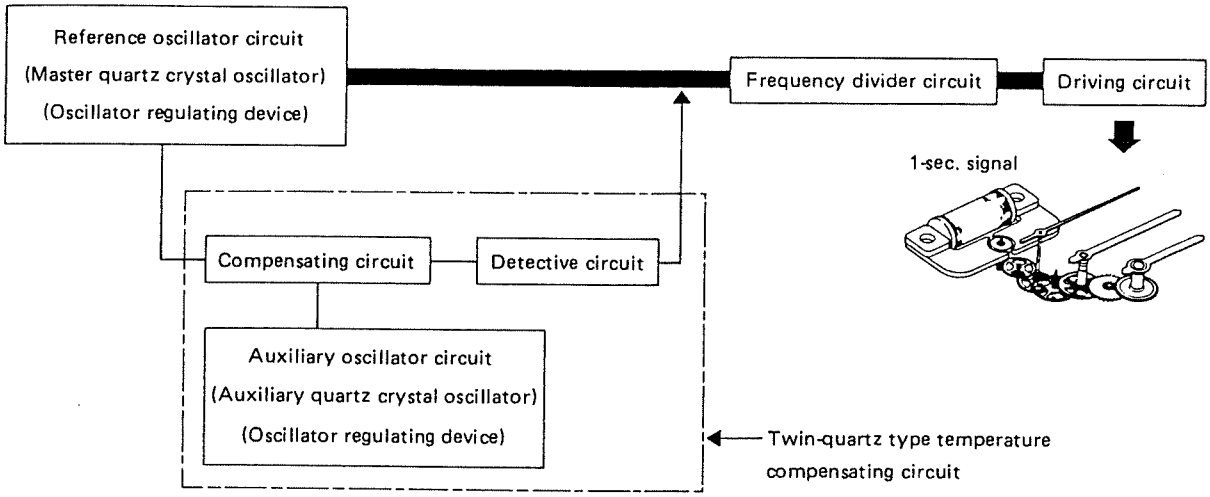
1. Pull the crown out to the first click.
2. Turn the crown clockwise and set the date. Turn the crown counterclockwise and set the day.
   - If the setting of the calendar is made when the hour and minute hands are pointing to the time between 10:30 p.m. and 3:30 a.m., sometimes the calendar will not change the next day. The setting must therefore be made before or after this time period.
   - Select the desired language as two languages appear alternately when setting the day of the week.



4. Outline of functioning

(1) Operating principles

Cal. 9943A & 9940A are extra-high precision watches which are equipped with a twin-quartz type temperature compensating circuit, in addition to the oscillator circuit, frequency dividing circuit and driving circuit usually found on other analogue quartz watches.



(2) Temperature compensating circuit

1) Arrangement

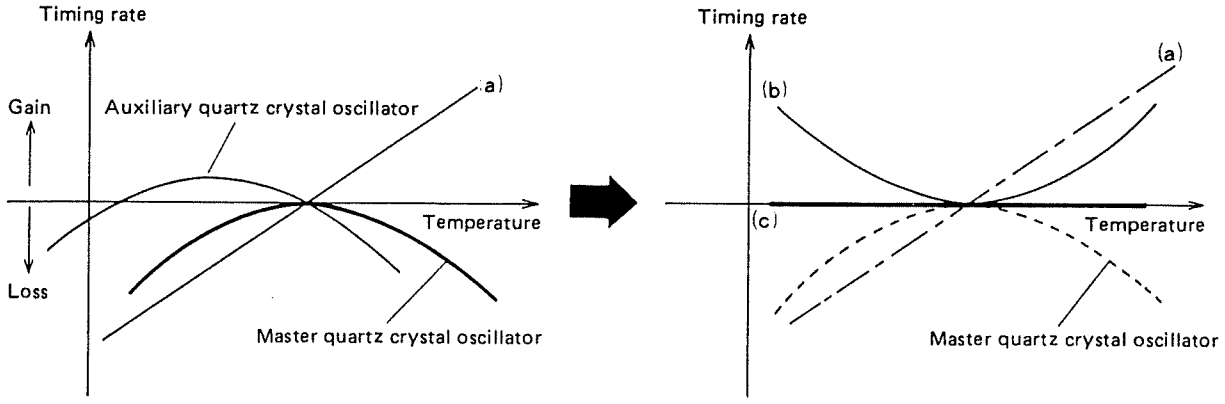
The temperature compensating circuit consist of the following components.

A. Compensating oscillator circuit equipped with an auxiliary quartz crystal oscillator and a oscillator regulating device

B. Detective circuit which computes the watch temperature according to the difference in oscillating frequency between the master and auxiliary quartz crystal oscillators

C. Compensating circuit which corrects the timing rate according to the detected temperature

2) Method of Temperature compensation



Step 1. The difference in oscillating frequency between the master and auxiliary quartz crystal oscillator is computed .... Line (a)

Step 2. The straight line (a) obtained by computation in step 1 is squared and compensated through a microprocessor in the circuit .... Curve (b)

Step 3. The sum of the curve (b) and the characteristic curve for the master quartz crystal oscillator is computed to form a straight line (signal) which is not affected by temperature change.

1. Disassembling, Reassembling and Lubricating

- Disassembling and reassembling
  Disassembling procedures Figs.: ①~㊺
  Reassembling procedures Figs.: ㊺~①

- Lubricating
  The following marks in the diagrams for disassembling and reassembling indicate the types and quantities of oil to be applied and the lubricating portions. Be sure to lubricate according to the marks.

Type of oil		Oil quantity	
●▬	Moebius A	○○○	Liberal quantity
○○	SEIKO watch oil S-6	○○	Normal quantity
⊗	Never lubricate the portions marked ⊗	○	Extremely small quantity

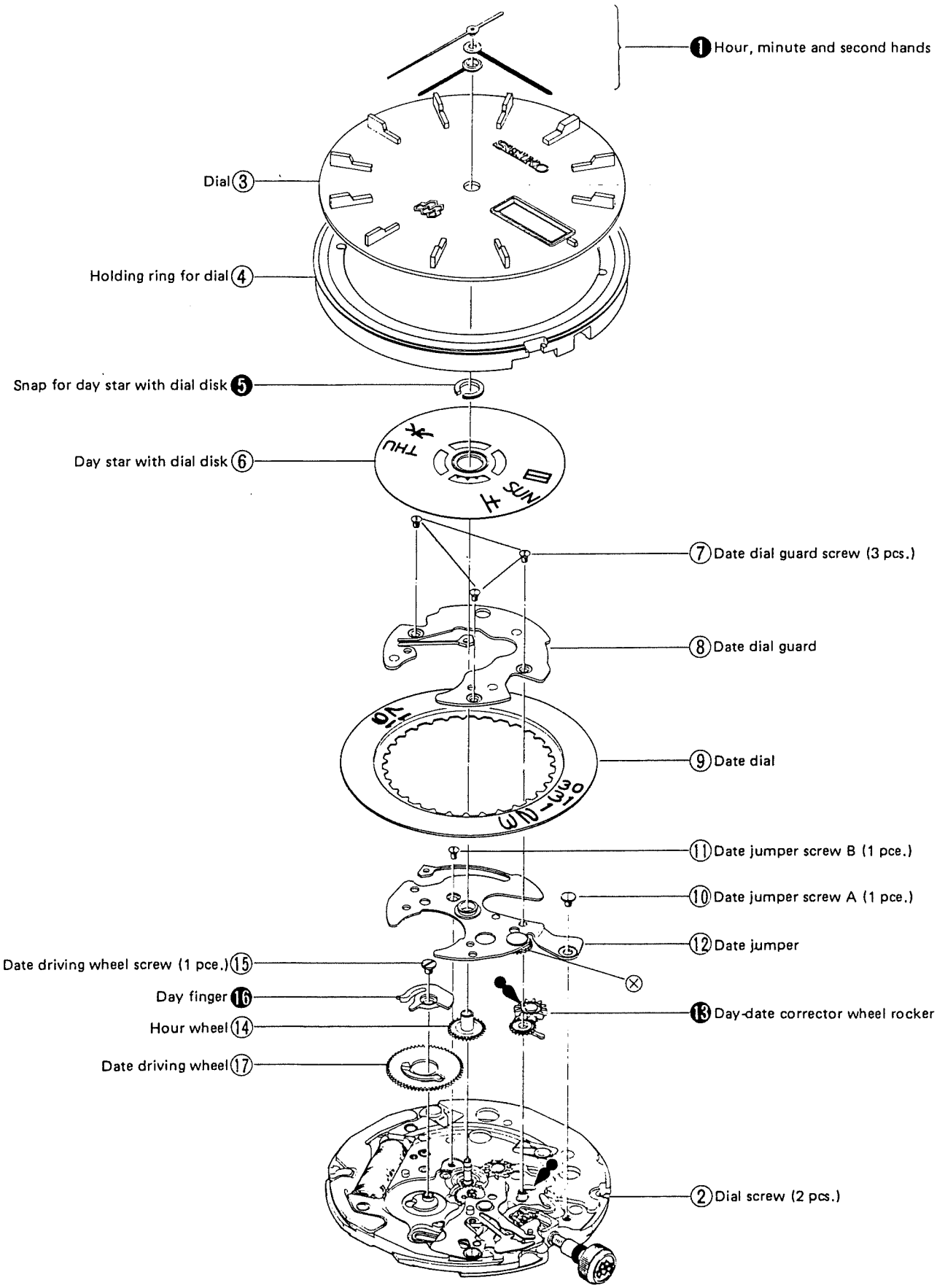
- Movement holder
  Use the movement holder S-651 when disassembling and reassembling.

List of screws used

The four types of screws used in Cal. 9943A & 9940A are listed below.

Shape	Parts No.	Name	Shape	Parts No.	Name
	022 764	Dial screw (2 pcs.)		022 491	Day finger screw (1 pce.) Setting lever spring screw (2 pcs.) Date jumper screw A (1 pce.)
	022 468	Circuit block screw (3 pcs.) Center wheel bridge screw (1 pce.) Third wheel bridge screw (3 pcs.) Anti-magnetic shield plate screw (2 pcs.)		022 754	Date dial guard screw (3 pcs.) Date jumper screw B (1 pce.)

(1) Disassembling, reassembling and lubricating of the calendar mechanism



❶ Hour, minute and second hands

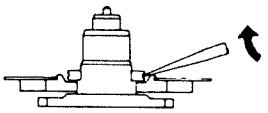
Remarks for disassembling and reassembling

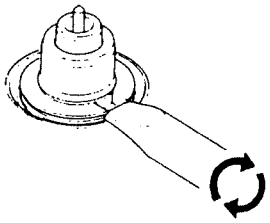
- Pull the crown out to the second click for disassembling and reassembling.
- Be sure to reassemble the second hand exactly on the second mark. (Both odd and even second marks will do.)
- When reassembling, be careful that the hands do not touch each other as the watch is so thin that the clearance between the hands is less than for ordinary type watches. Also be careful that the glass, hands and dial do not touch each other.

❺ Snap for day star with dial disk

Remarks for disassembling

Put the tip of a screw driver into the groove of the snap for day star with dial disk, and pry it open in the arrow marked direction.

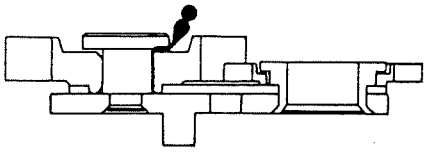




⓭ Day-date corrector wheel rocker

Remarks for reassembling

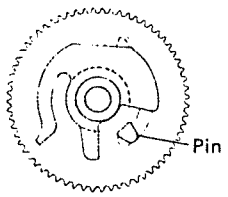
- Lubricate the day-date corrector wheel as shown in the illustration on the right.
- Pull out the crown to the first click position and reassemble.



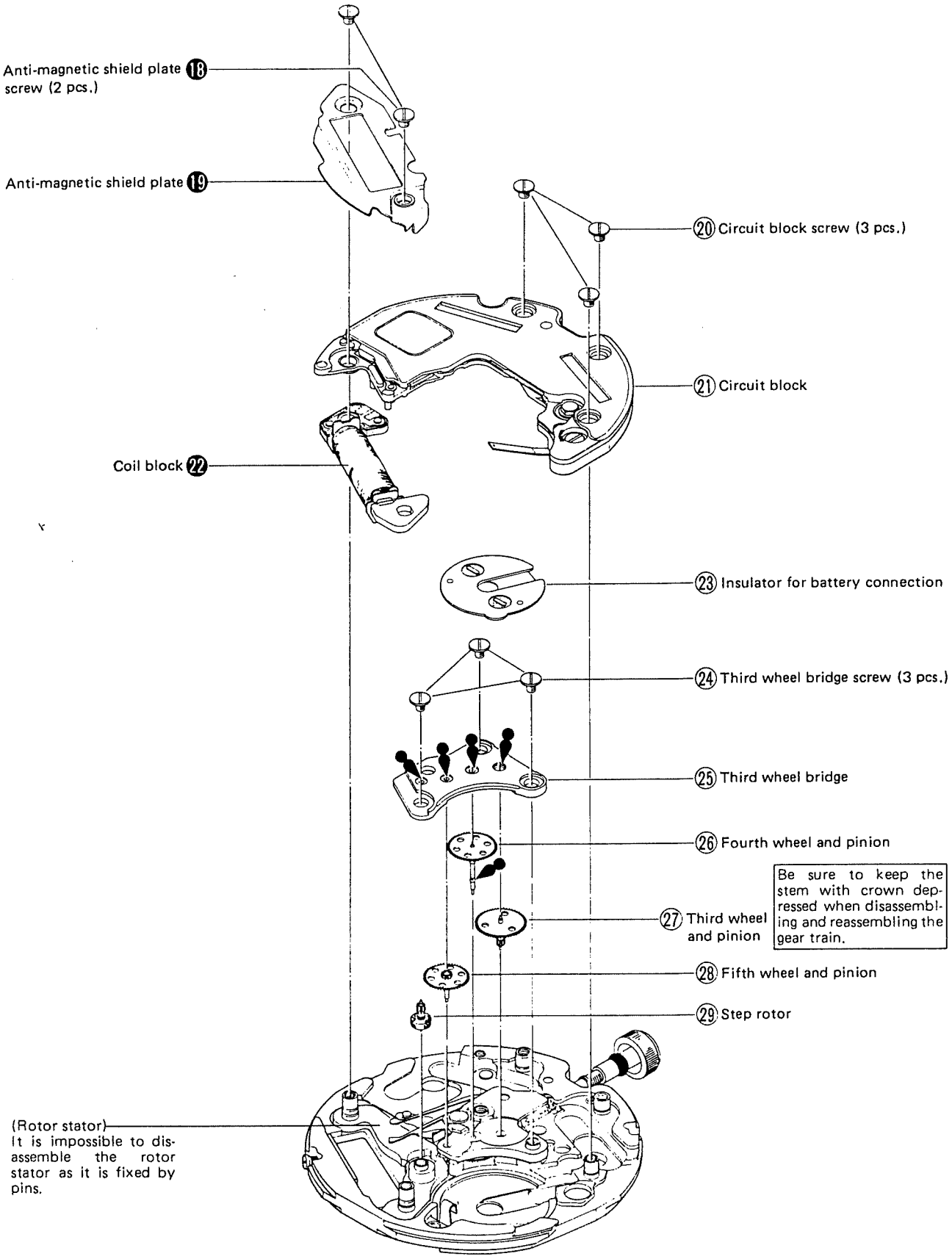
⓰ Day finger

Remarks for reassembling

- Reassemble so that the date driving wheel pin is positioned as shown in the illustration on the right.



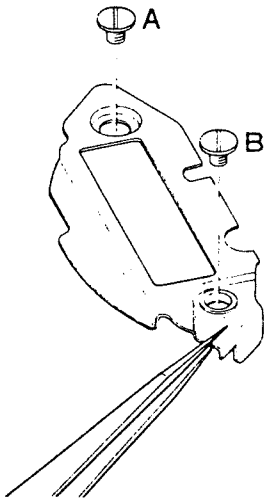
(2) Disassembling, reassembling and lubricating of the circuit block, coil block and gear train



⑲ Anti-magnetic shield plate

Remarks for disassembling and reassembling

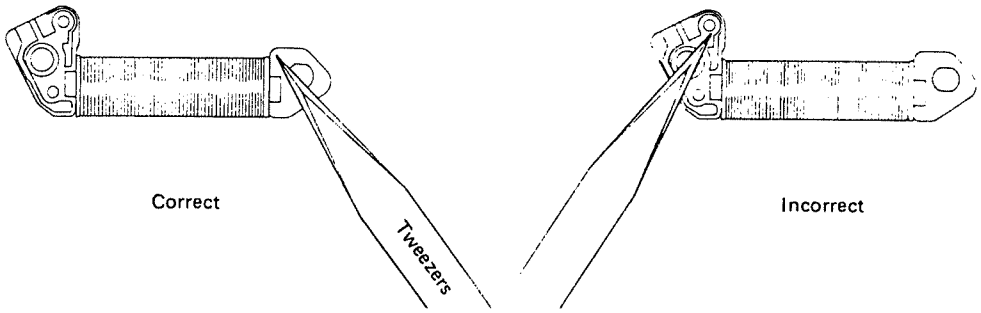
- Disassemble by holding with tweezers as shown in the illustration on the right.
- Be careful in handling as the anti-magnetic shield plate is easy to bend.
- Be sure to tighten the anti-magnetic shield plate screw A first and then B next. (If B is tightened first, it will be difficult to tighten A as A portion of the anti-magnetic shield plate lifts up.)



㉒ Coil block

Remarks for disassembling and reassembling

- Be careful not to damage the coil wire and the lead terminal. Handle them as shown in the illustration below.

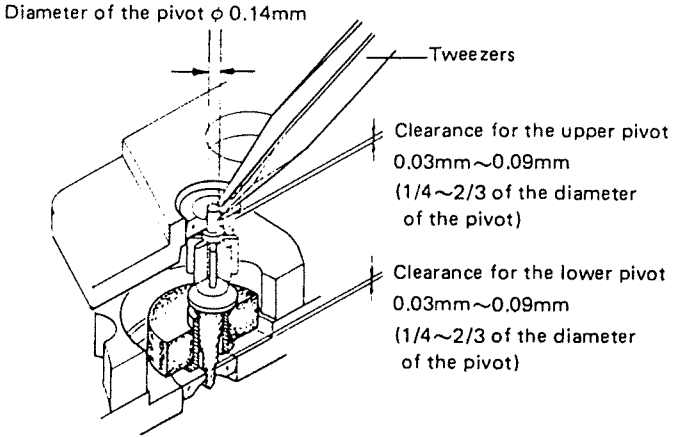


⑱ Anti-magnetic shield plate screw (2 pcs.)

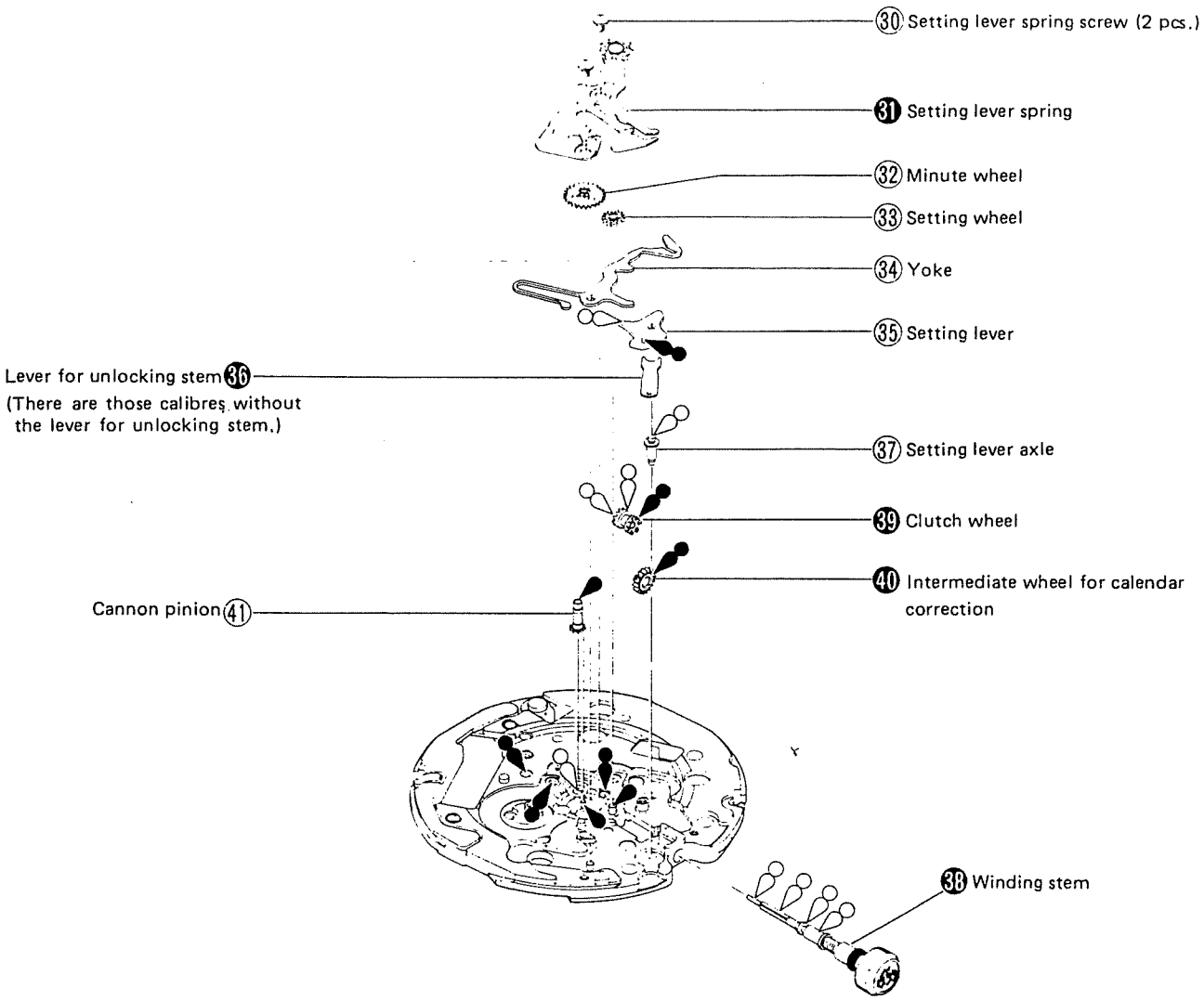
Remarks for reassembling

- Check the clearances for the upper and the lower pivots for the step rotor after reassembling the anti-magnetic shield plate screws.
  Check the clearance for the lower pivot by depressing the upper pivot by tweezers.

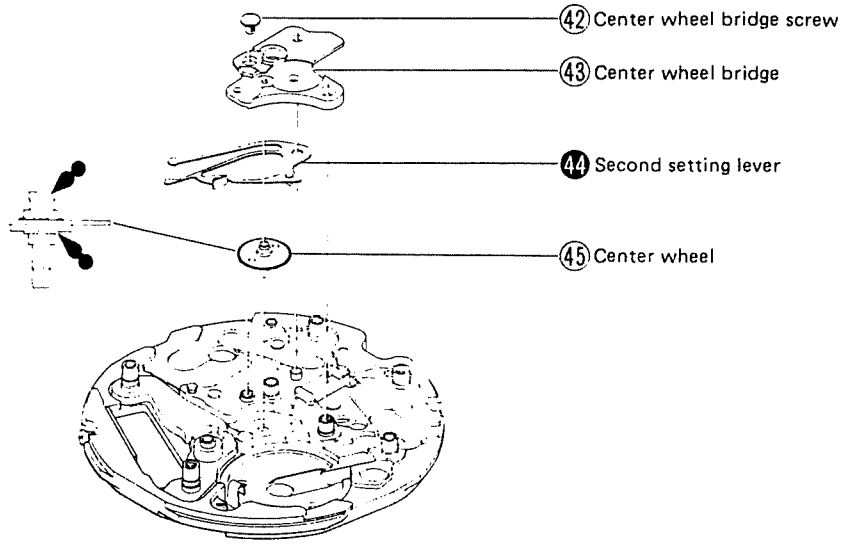
  Check the clearance for the upper pivot by depressing the lower pivot by tweezers.
  Check the clearances by using the diameter of the pivot as a guide.



(3) Disassembling, reassembling and lubricating of the setting mechanism



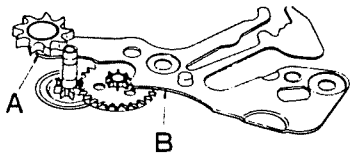
(4) Disassembling, reassembling and lubricating of the center wheel bridge ~ the center wheel and pinion



㉛ Setting lever spring

Remarks for disassembling

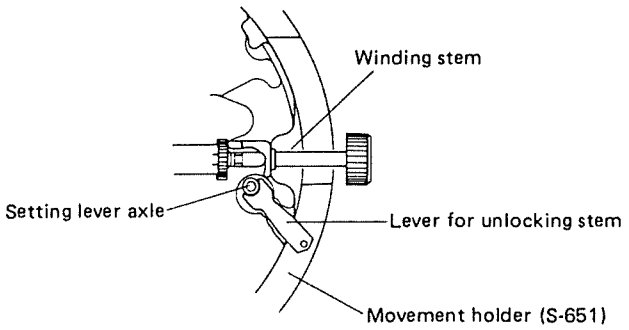
- Pry up the arrow-marked portion A slightly and remove the arrow-marked pin B (positioned under the setting lever spring.
  Then pry up the setting lever spring for disassembling by holding the portion A.



㊱ Lever for unlocking stem

Remarks for reassembling

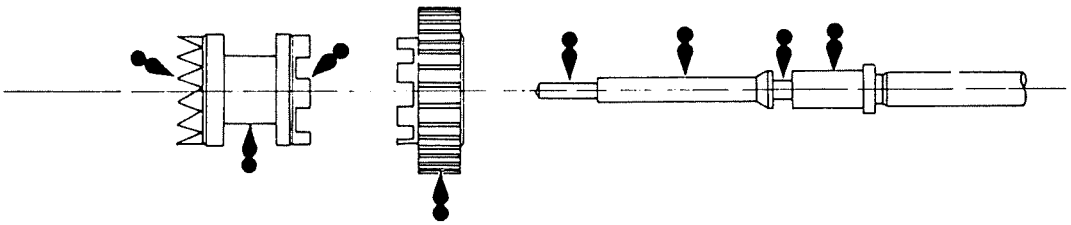
Use the circumference of the movement holder as shown in the illustration on the right to surely reassemble the lever for unlocking stem.



㊳ Winding stem
㊴ Clutch wheel
㊵ Intermediate wheel for calendar correction

Remarks for reassembling

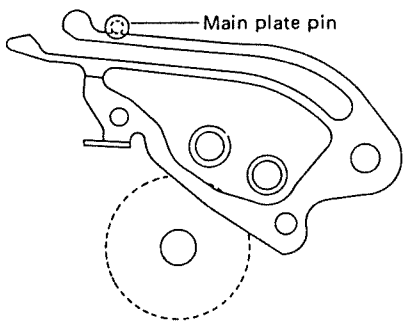
- Reassemble after reassembling the center wheel bridge. (It is difficult to reassemble the clutch wheel and the intermediate wheel for calendar correction if the center wheel bridge is not reassembled.)
- Refer to the illustration below for the direction of reassembling and the lubricating.



㊹ Second setting lever

Remarks for reassembling

- Hook the spring portion to the main plate pin as shown in the illustration on the right.
- Be sure to pull out the winding stem all the way and then reassemble the second setting lever when the setting mechanism is already reassembled.



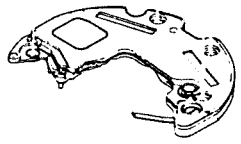
Position of the second setting lever

2. Cleaning

1) HOW TO CLEAN

Name of parts	Cleaning	Drying	Solution	Remarks
Main plate 	Rinse or scrub with a soft brush.	Cool air	Benzine, alcohol	• Be careful not to remove the parts fixed to the main plate.
Step rotor 				• Use a clean solution as the step rotor is magnetized. Any foreign matter which cannot be removed by cleaning should be removed with rodico or adhesive tape.
Plastic parts Date driving wheel Insulator for battery connection				• When cleaning with benzine, the cleaning time should be minimized.
Others (excluding the circuit block and the coil block)	Clean with the cleaner, rinse or gently scrub with a soft brush.	Cool or hot air	Benzine, alcohol, trichloro-ethylene	• Be careful not to bend the anti-magnetic shield plate.

2) PARTS THAT MUST NOT BE CLEANED



Circuit block

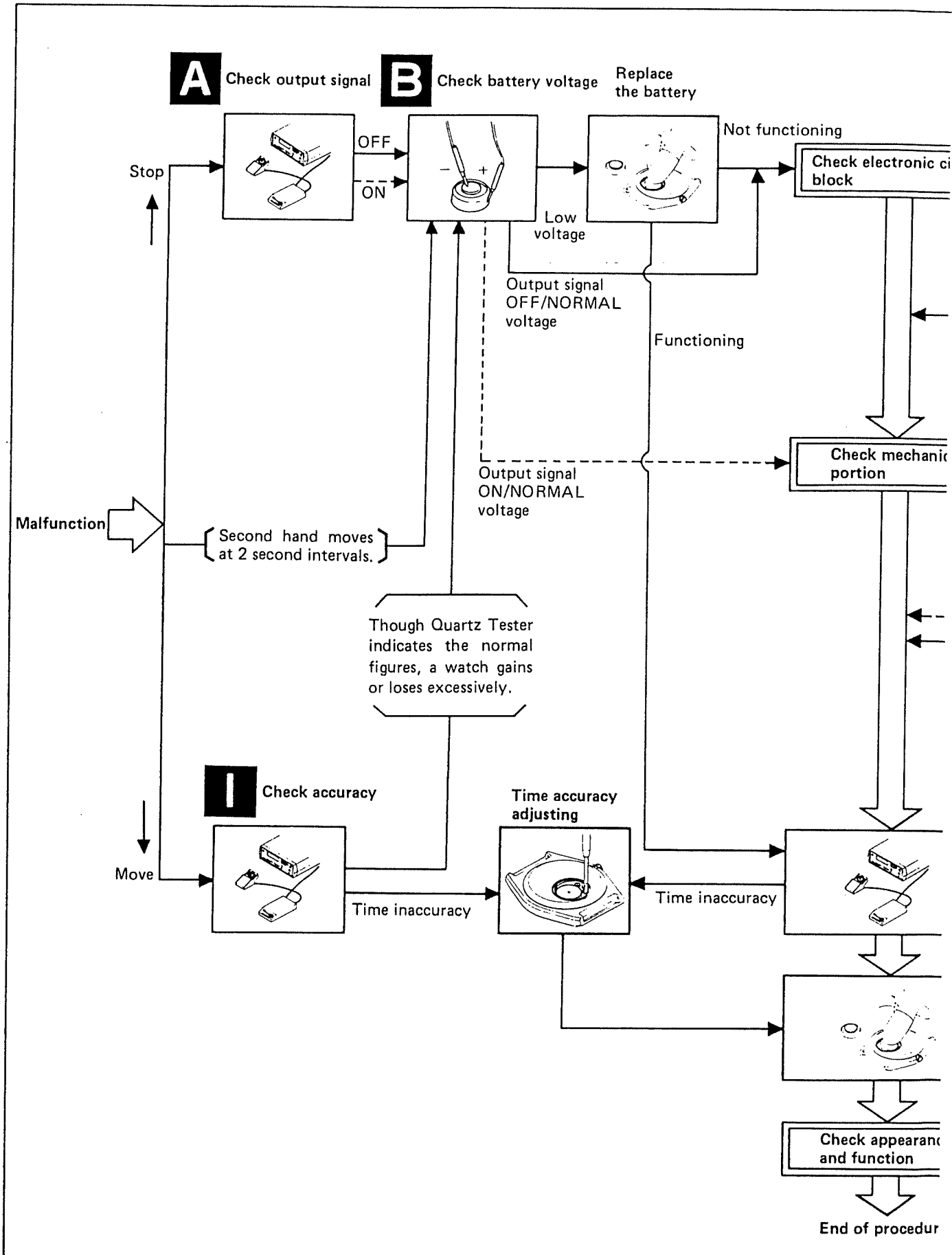


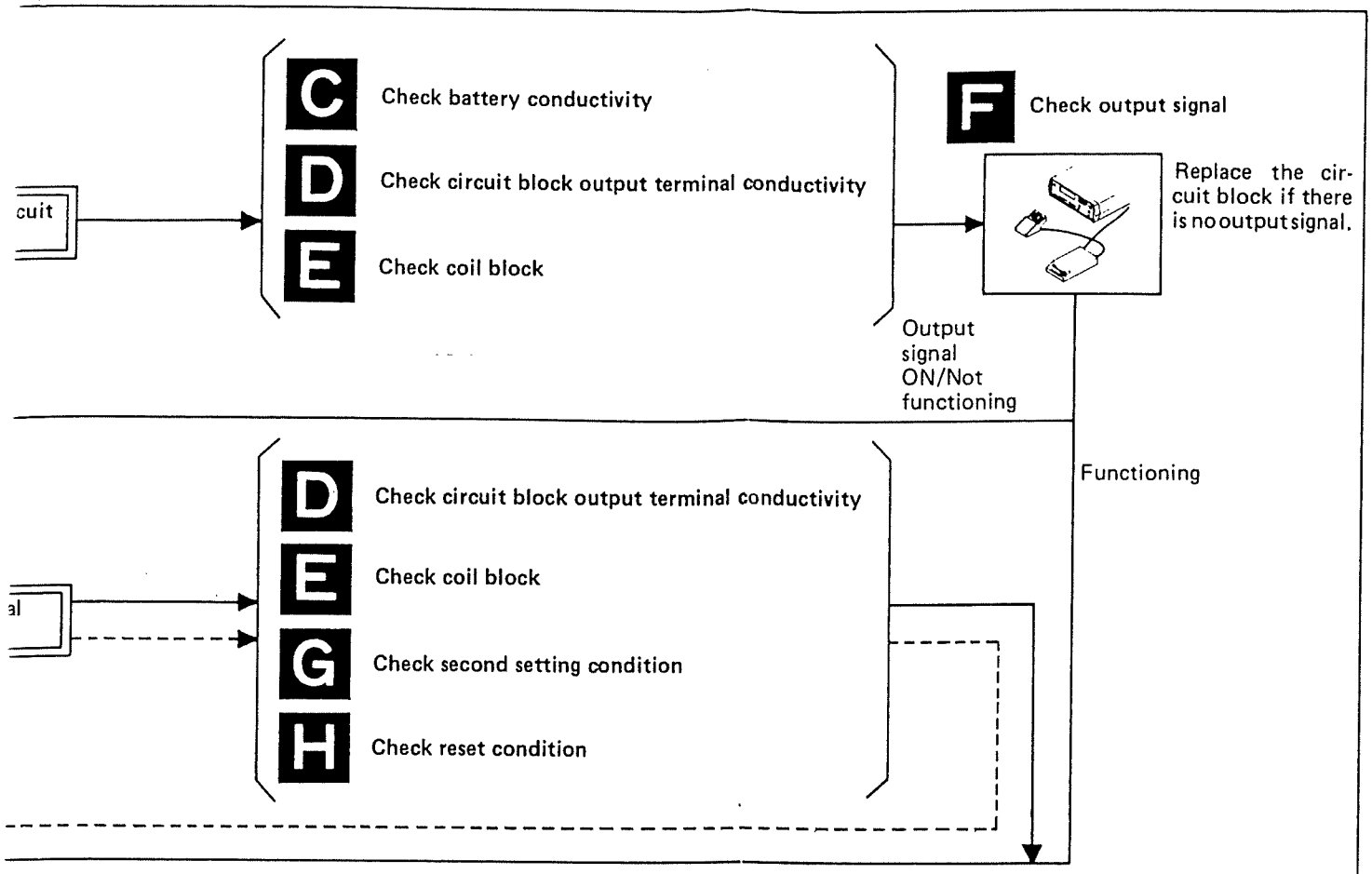
Coil block

• Be sure to clean only stains on the conductive portions with a cloth moistened with alcohol and dry them with cool air.

III. CHECKING AND ADJUSTMENT

1. Guide table for checking and adjustment





I Check accuracy

Replace the battery
It is not necessary to replace the battery when the battery has already been replaced during repair.

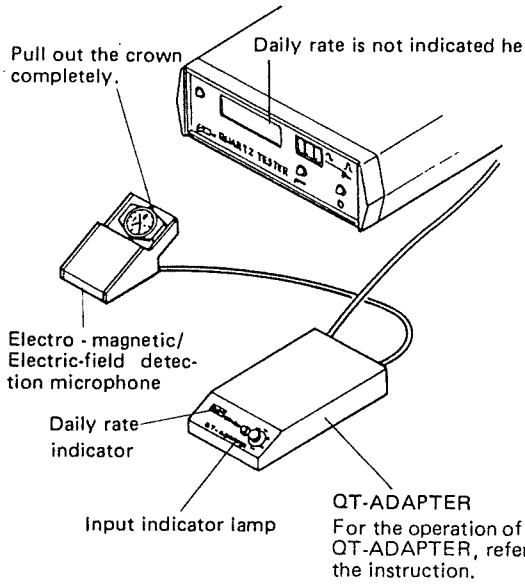
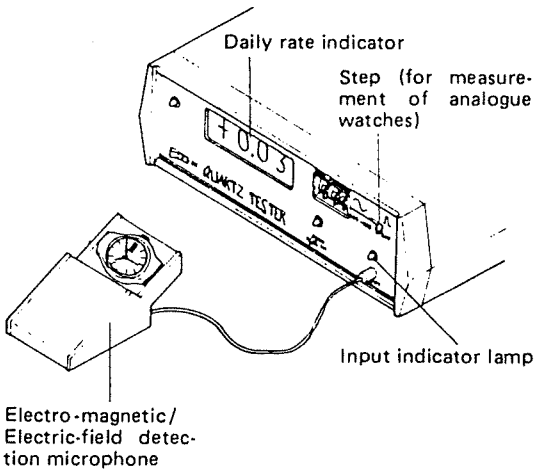
Notes:

- In cases where a frequent battery change is required, a current consumption test is recommended. (See page 26 for measurements.)
- After completing any major repair, it is preferable that a wear test for several days be made to insure that the watch is operating satisfactorily.

How to check time accuracy of Cal. 9943A & 9940A and the existing analogue quartz watches

For time accuracy adjusting, refer to page 23.

1. Difference in measurement between Cal. 9943A & 9940A and the existing analogue quartz watches

Cal. 9943A & 9940A	Existing analogue quartz watches
	

Note: When the Quartz Tester QT-99 is used, the QT-Adapter is not necessary.

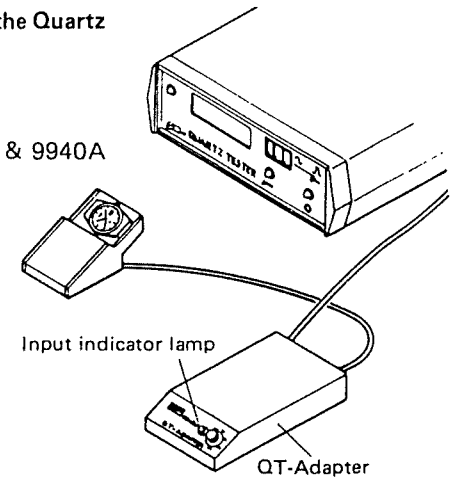
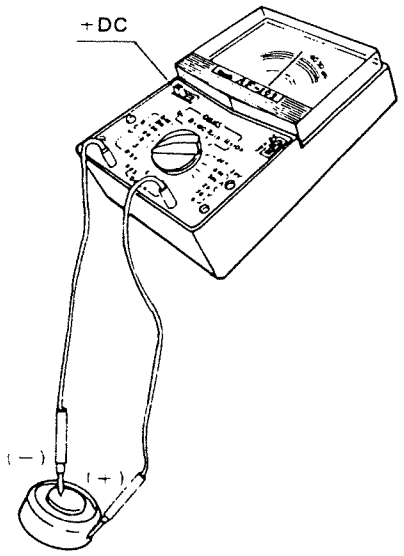
2. Remarks for measuring Cal. 9943A & 9940A

(1) Use the QT-Adapter.
Cal. 9943A & 9940A employ a pair of quartz crystal oscillators to produce an extra-high timing accuracy that hampers the measuring efforts in an ordinary way using the conventional timing instruments. Because in measuring its accuracy, the detection and computation of the signals from twin quartz crystal oscillators are needed.

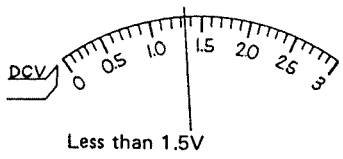
(2) Pull out the crown completely.
When the crown is pulled out to the second click position, Cal. 9943A & 9940A watches give signals which will be computed by the QT-ADAPTER. While the watches are operating, it is impossible to measure their daily rates accurately.

Notes: If Cal. 9943A & 9940A are measured in the same way as the existing analogue quartz watches;
- There will be scatter in measurable value.
- The value displayed does not indicate the correct daily rate.

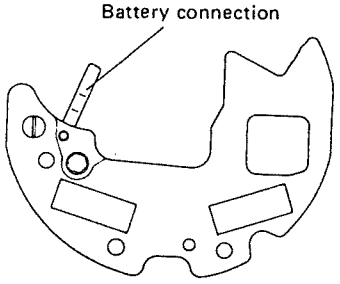
2. Checking and adjustment

	Procedure
A CHECK OUTPUT SIGNAL	**Check output signal.** **1. Set up the Quartz Tester together with the QT-Adapter or set up the Quartz Tester QT-99.** (Set up the QT-Adapter properly according to the instruction.) **2. Pull out the crown completely.** **And then place the watch on the microphone.** (When the crown is pulled out to the second click, Cal. 9943A & 9940A give signals for time accuracy measurement.) **3. Check output signal by blinking of the input indicator lamp.** (Unlike the existing analogue quartz watches, Cal. 9943A & 9940A give signals on an irregular cycle.)  When the Quartz Tester QT-99 is used, the QT-Adapter is not necessary.
B CHECK BATTERY VOLTAGE	Use the following procedures to check battery voltage. **1. Set up the Volt-ohm-meter.** Range to be used: DC 3V **2. Measuring** ●Probe Red (+) . . . . . Battery surface (+) ●Probe Black (–) . . . .Battery surface (–) **Note:** When handling the battery, be sure to use non-metallic tweezers or fingercots. When there is battery electrolyte leakage, refer to "How to repair battery electrolyte leakage" below, for repairing. 
HOW TO CHECK BATTERY ELECTROLYTE LEAKAGE AND REPAIR	1. Remove the movement from the case. 2. Disassemble the movement. 3. Wipe off battery electrolyte on the circuit block. (1) Wipe off battery electrolyte with a cloth moistened with distilled water. (If distilled water is not available, use tap water.) **Note:** Do not expose the trimmer condenser to water or alcohol. If it is exposed, there may be a change in its condenser capacity and eventually in the time accuracy.

Result	Adjustment and Repair
Blinking — Normal No blinking — Defective →	Proceed to **B**
More than 1.5V — Normal →	Proceed to Check mechanical portion if blinking is found. Proceed to Check electronic circuit block if blinking is not found. Replace circuit block if the second hand moves at two second intervals.
Less than 1.5V — Defective →	Proceed to Replace the battery. • If the watch operates after battery replacement, proceed to **I** • If the watch does not operate after battery replacement, proceed to Check electronic circuit block.



Be sure to wipe off battery electrolyte on the battery connection.



(2) Wipe them with a cloth moistened with alcohol.
(If the cleaned portions remain wet with water, they will corrode with rust.)
(3) Dry with cool air by using a dryer.

4. Wipe off battery electrolyte on the other parts by following the procedures on page 12.
(Rinse the insulator for battery with water.)
5. Reassemble the movement.
(Replace the battery with a new one.)
6. Check to see if the time setting functions and the current consumption are normal.

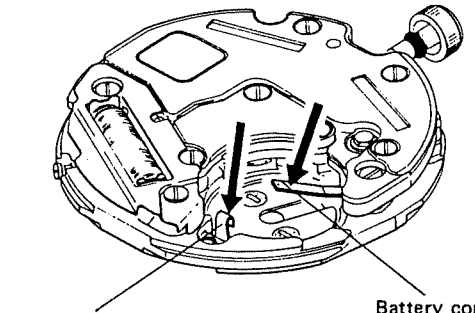
Note: Replace parts with new ones if they are rusted to the extent that they are impossible to use.

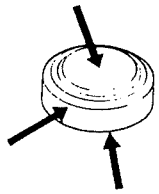
Procedure

C CHECK BATTERY CONDUCTIVITY

Check to see if the battery current flow to the circuit is normal.

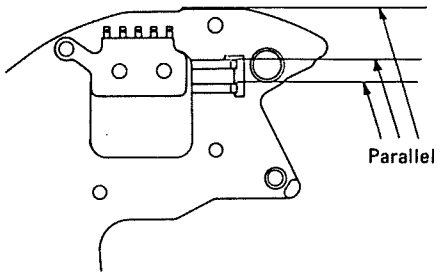
1. Check for any stain on the connecting portions of the battery, the battery connection for plus terminal and the battery connection.



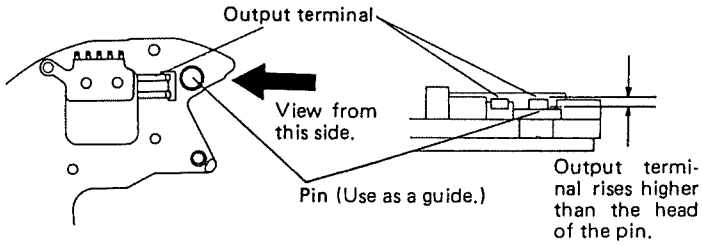


D CHECK CIRCUIT BLOCK OUTPUT TERMINAL CONDUCTIVITY

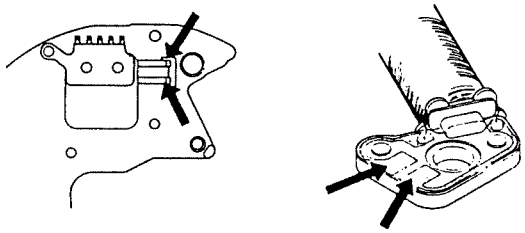
Check the connecting portions of the circuit block and the coil.



1. Check to see if the two output terminals are parallel to the edge of the circuit board when the circuit block is viewed from the back side as shown in the illustration on the left.



2. Check to see if the circuit block output terminal rises higher than the head of the pin for circuit block screw when viewed from the side.



3. Check for any contamination on the circuit block output terminal and the coil lead terminal.

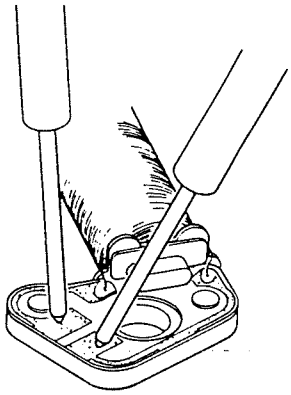
Result			Adjustment and Repair
Uncontaminated	—	Normal →	Proceed to **D**
Contaminated	—	Defective →	• Wipe off carefully. **Note:** Be careful not to bend the plus terminal of battery connection and the battery connection.
Parallel	—	Normal →	Proceed to **D** 2
Bent	—	Defective →	• Correct the bend of the output terminal.
Higher	—	Normal →	Proceed to **D** 3
Not higher	—	Defective →	• Raise the output terminal.
Uncontaminated	—	Normal →	Proceed to **E**
Contaminated	—	Defective →	• Wipe off the contamination.

Procedure

E CHECK COIL BLOCK

Check for broken coil wire and short circuit of the coil block.

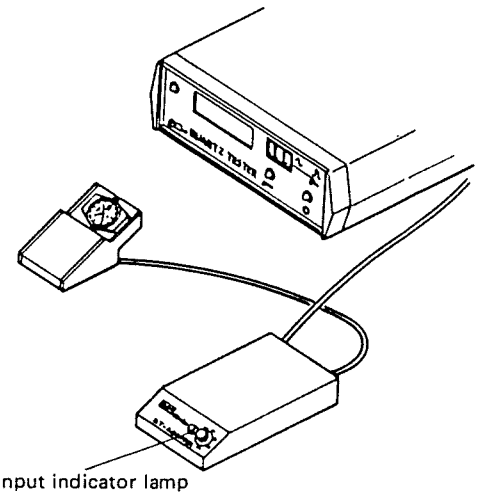
1. **Set up the Volt-ohm-meter.**
   Range to be used: OHMS R x 100
2. **Checking**
   Apply the red and black probes of the Volt-ohm-meter to the two lead terminals of the coil.
   Pointer of the Volt-ohm-meter swings



F CHECK OUTPUT SIGNAL

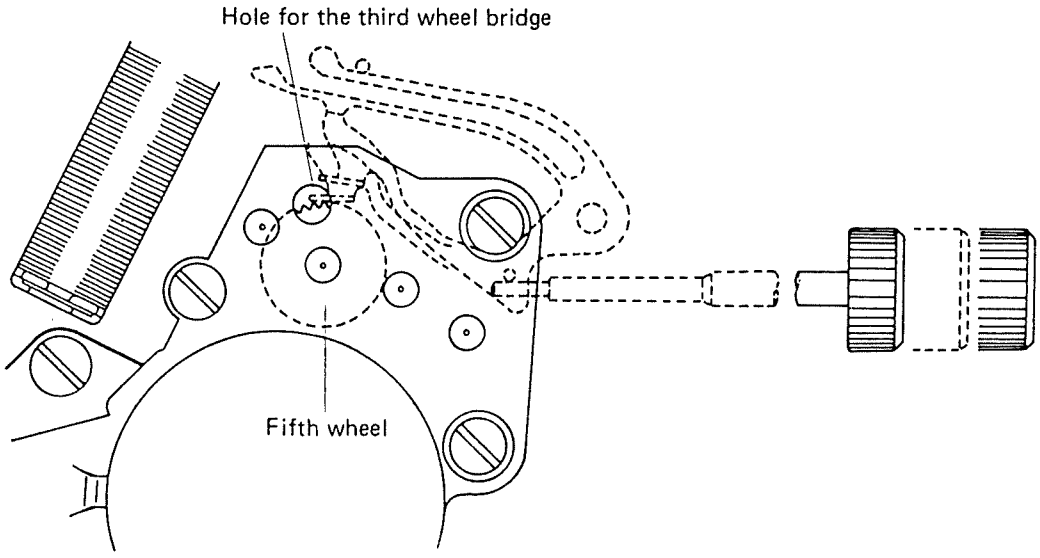
Check for output signal

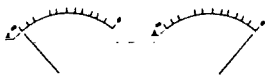
1. **Set up the Quartz Tester and the QT-Adapter.**
2. **Checking**
   Follow the same procedures as in A



G CHECK SECOND SETTING CONDITION

Check the second setting condition.
Check to see if there is clearance between the second setting lever and the fifth wheel when the crown is in the normal and the first click positions. Also, check to see if the second setting lever touches the fifth wheel when the crown is in the second click position.
(Check through the hole for the third wheel bridge by using a microscope.)



Result	Adjustment and Repair
Normal → 	Proceed to **F** if Electronic circuit block must be checked. Proceed to **G** if Mechanical portion must be checked.
Broken coil wire (Pointer of the Volt-ohm-meter hardly swings) / Short circuit (Pointer of the Volt-ohm-meter swings excessively.) → Defective 	Replace the coil block with a new one.
Blinking → Functioning	Proceed to **I**
Blinking → Not functioning	Check Mechanical portion **G**
No Blinking → Defective	• Replace the circuit block with a new one.
Pull out the crown completely.	
Function → Normal	Proceed to **H**
Do not function → Defective	• Correct the bend of the second setting lever.

Procedure

H CHECK RESET CONDITION

Check the reset condition after the circuit block and the battery are reassembled.

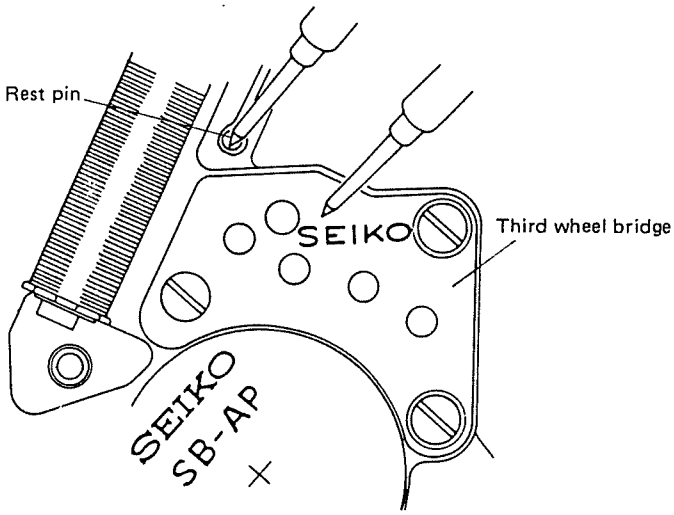
1. Check to see if the second hand stops immediately when the crown is pulled out completely and if it starts promptly after one second when the crown is pushed in to the normal position.
2. Check to see if the conductivity between the reset pin and the main plate is normal when the crown is pulled out completely.
   1. **Set up the Volt-ohm-meter.**
      Range to be used: **OHMS R x 1**

   Note: Be careful not to use the range other than R x 1. The circuit might be damaged if another range is used.

   2. Disassemble the anti-magnetic shield plate.
      (If the probes have sharp tips, it might be possible to check without disassembling the anti-magnetic shield plate. But if the probes touch the anti-magnetic shield plate, the checking result is unreliable.)

   3. **Checking**
      Apply the probes of the Volt-ohm-meter to the third wheel bridge and the reset pin.

      Either red or black probe will do.

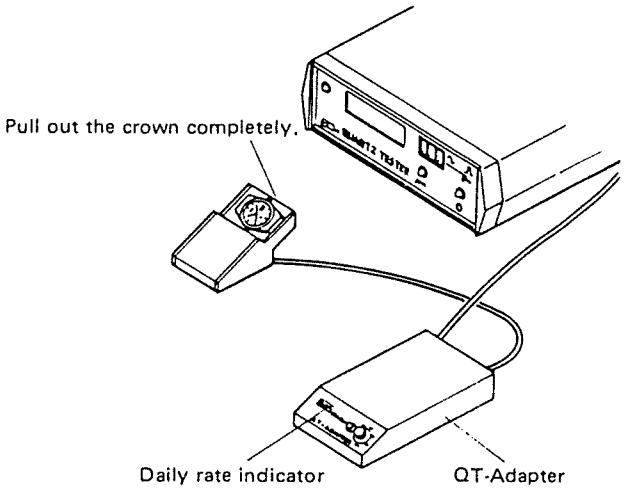


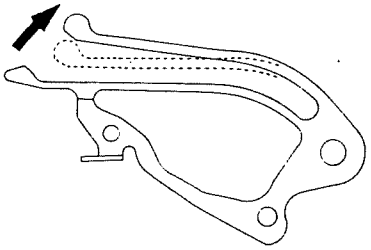
I CHECK ACCURACY

Check gain and loss of time.

1. **Set up the Quartz Tester and the QT-Adapter.**
   Be sure to measure the time accuracy without disassembling the watch case.
2. **Follow the same procedure as in** 

Note: At around 25°C* the daily rate measured by the QT-Adapter (or QT-99) may change slightly. In this case, take an average of several measurements.
*This is the temperature at which the characteristics of the two quartz crystal oscillators agree with each other.



Result			Adjustment and Repair
Stops completely and starts moving after one second	Normal	→	Proceed to I
Does not stop or moves irregularly	Defective	→	Proceed to H 2
Less than 10Ω	Normal	→	• Replace the circuit block with a new one.
More than 10Ω	Defective	→	• Correct the bend of the second setting lever, or replace the second setting lever with a new one. Be sure to correct the shape so that enough resilience is obtained. 
Measured value is; Within ±0.03	Normal	→	Follow the procedures on page 13.
±0.03~±0.01	Defective	→	Proceed to Time accuracy adjusting
More than ±0.01	Defective	→	Proceed to Time accuracy adjusting after replacing the circuit block.
When the user indicates the extent of loss or gain, follow the instructions shown on the next page.			**Note:** When adjusting time accuracy, be sure to follow the instructions shown on the following pages.

BEFORE ADJUSTING TIME ACCURACY

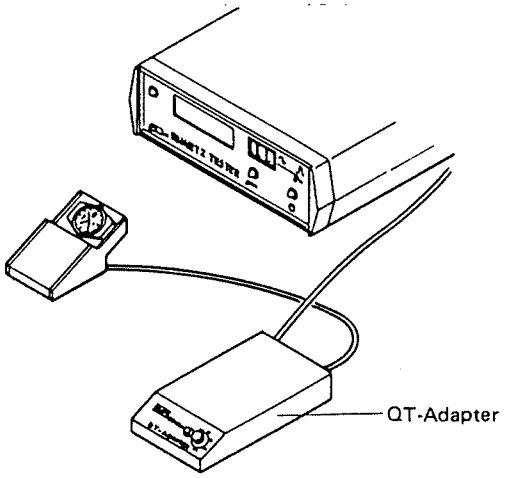
Procedure

Cal. 9943A & 9940A require their time accuracy to be adjusted by far the more strictly than the existing analogue quartz watches. When adjusting the time accuracy of Cal. 9943A & 9940A, be sure to follow the procedures below.
Check to see if which case applies to the watch among the following three.

I. The user indicates the monthly loss or gain of 3 to 5 seconds.

II. The customer indicates the monthly loss or gain of more than 5 seconds.
Check time accuracy by using the QT-Adapter.
(See page 14 for details.)

Be sure to place the watch on the microphone after reassembling the watch case and pulling out the crown completely.

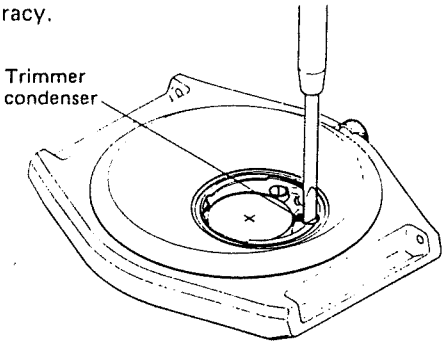


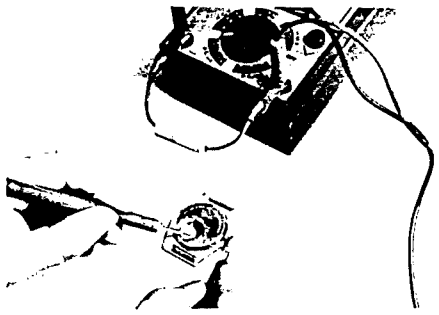
III. The watch loses or gains after the watch case is disassembled or reassembled.
Usually, the daily rate changes slightly after disassembling or reassembling the watch case. Before measuring the time accuracy of Cal. 9943A & 9940A after repair, be sure to reassemble the watch case.

Result	Adjustment and Repair
Loses or gains slightly	Proceed to **Time accuracy adjusting**. *1
QT-Adapter indicates; More than ±0.10 sec./day	1. Check for any dust and lint on the gear train, check to see if the gear train is properly lubricated and repair a malfunctioning portion. 2. **Replace the circuit block** with a new one. *2 3. Proceed to **Time accuracy adjusting**. *1
Less than ±0.10 sec./day	Check for any dust and lint on the gear train, and check to see if the gear train is lubricated properly. • If a malfunctioning portion is found, repair it and proceed to **Time accuracy adjusting**. *1 • If malfunctioning portion is not found, **replace the circuit block** and proceed to **Time accuracy adjusting**. *1, 2
QT-Adapter indicates; ±0.03~±0.01 sec./day	Proceed to **Time accuracy adjusting**. *2
More than ±0.10 sec./day	**Replace the circuit block** and proceed to **Time accuracy adjusting**. *1, 2

*1 Be sure to adjust time accuracy by following the instructions on the next page after reassembling the watch case and pulling out the crown completely.

*2 Even if the QT-Adapter does not indicate the daily rate of ±0.10 sec./day after the circuit block is replaced, proceed to **Time accuracy adjusting**.

	Procedure
TIME ACCURACY ADJUSTING	• Be sure to use the QT-Adapter when adjusting time accuracy. • Adjust the time accuracy of Cal. 9943A & 9940A after disassembling the battery hatch as shown in the illustration on the right. But be sure to adjust the time accuracy with the case back reassembled. (If the time accuracy is adjusted with the case back disassembled, the daily rate changes slightly. This affect the time accuracy of Cal. 9943A & 9940A greatly, although the change can be ignored for the existing analogue quartz watches.  • While watching the value indicated by the QT-Adapter, adjust the time accuracy by following the procedures below. When the user indicates the extent of loss or gain of the watch. Ex. The watch gains 3 seconds a month. Step 1. Reduce the gain to a daily rate. 3 sec. ÷ 30 days = +0.10 sec./day Step 2. Read the daily rate indicated by the QT-Adapter. +0.08 sec./day Step 3. Calculate the difference between the gain (in daily rate) and the measured daily rate. +0.08 – (+0.10) = –0.02 sec./day Then adjust the trimmer condenser so that the QT-Adapter indicates the daily rate of –0.02 sec./day. When the user complaints of loss or gain, but does not indicates how much. Or when time accuracy adjusting is required after the watch case is reassembled or replaced with a new one. Adjust the trimmer condenser so that the QT-Adapter indicates 0.00. Adjust to within ±0.03 sec./day. **Note:** For Cal. 9943A & 9940A, time accuracy must be adjusted to a hundredth of a second. So the trimmer condenser must be turned most carefully.

	Procedure
CHECK CURRENT CONSUMPTION	In case where a frequent battery change is required, make a current consumption test by following the procedures below. Use the Micro Test or the Volt-ohm-meter for measuring current consumption. In the following case, the Volt-ohm-meter S-831 is used. 1) Set up the Volt-ohm-meter. ● Range to be used: DC 12μA (blue) ● Set up the condenser kit of 200~500μF as shown in the photo. 2) Prepare the watch ● Place the battery on the third wheel bridge with its – surface up. (Be careful not to touch the battery to the reset pin.) 3) Measuring Probe Red (+) . . . . . Battery connection Probe Black (–) . . . .Battery surface (–)  **Note)** Be sure to measure the current consumption with the crown in the normal position. If the pointer of the Volt-ohm-meter swings over the maximum value, turn the rotary switch to DC 30mA and turn it back to DC 12μA with the probes touched to the specified portions. Remarks: Current consumption would be measured more accurately if the current supplier is used instead of using the above procedure. (For the operation of the current supplier, refer to its instruction.)

Result		Adjustment and Repair
Less than 2.5μA	Normal →	Current consumption is normal.
More than 2.5μA	Defective →	Replace the circuit block with a new one.

All procedures of Disassembling, Reassembling, Cleaning and Adjustment are completed.