SMITHS CAR CLOCK REPAIR KIT

Version 13

Introduction

These instructions explain how to repair a Smith's electric car clock mechanism using the Clocks4Classics repair kit. This kit uses a specially developed printed circuit board to replace the balance wheel contacts which are the usual cause of failure in these clocks. The Clocks4Classics kit is unique in that it uses a solid state sensor and microcontroller chip to replace the contacts thus providing a permanent repair.

The instructions are based around the repair of a Jaguar Mk2 clock, however, many other vehicles use the same Smiths mechanism and the Clocks4 Classics kit can also be used to repair these clocks. In most cases the basic fitting method will be very similar although the removal of the case and dial mechanisms may differ. Please note that for some clocks (e.g. MG Magnette) it is necessary to remove the hands in order to gain access to the mechanism.

Examples of clocks which have been successfully repaired using the Clocks4Classics kit include:

- Alvis TD21
- Bristol 406
- Daimler V8 Saloon
- Jaguar Mk 2
- Jaguar E-Type (Ser 1)
- Jaguar XK120, XK 140, XK150
- Jaguar Mk IV
- MG TD, MG TF, MG Magnette

Please note that this is not an exhaustive list – if you are unsure whether the kit is suitable for your clock please contact us at clocks4classics@gmail.com

Kit Contents

- Printed Circuit board with Microcontroller and Infra red sensor
- Brass spacer
- Balance wheel sticker
- Heat shrink sleeving

Important

Do not remove the circuit board from its anti-static packaging until you have read the anti-static precautions on page 5.

Things you will need

For fitting the Circuit board :

- Jewellers screwdrivers
- Small pair of long nosed pliers (electronics type)
- Wire strippers
- Small pair of wire cutters (electronics type)
- Hair dryer or heat gun (for shrinking the heat-shrink sleeving)
- Junior hacksaw and file (for modifying connector bracket)

For cleaning & Oiling :

- Clock oil
- Cocktail sticks
- Isopropyl alcohol (available from computer and camera shops etc).

Anti- Static Precautions - Important

As with any electronic parts, the circuit board can be damaged by static electricity. To avoid damage to the circuit board it is important to take the following precautions when handling the circuit board:

- Keep the circuit board in its anti-static packaging until you are ready to fit it.
- Before you open the anti-static packaging, discharge yourself by touching some grounded metalwork such as a water pipe or radiator pipe.
- Handle the circuit board by the edges and avoid touching the components on the board.
- Avoid contact with materials such as synthetic fibres or wool which generate static electricity. If you have been walking on carpet or rubbing against materials such as a chair cover, then discharge yourself again before handling the circuit board. Also be aware that office chairs with wheels can generate static electricity.

Cleaning and Oiling

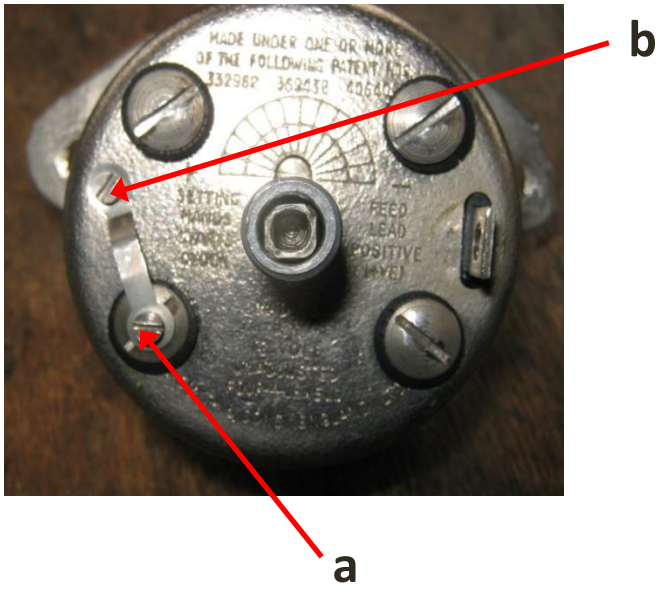
- It is recommended that you use this opportunity to clean the mechanism of your clock. This will help to ensure correct operation and will extend the life of the mechanism. Parts can be cleaned in isopropyl alcohol. Bearings should be cleaned out very carefully using isopropyl and a cocktail stick. Take particular care with the two jewelled bearings.

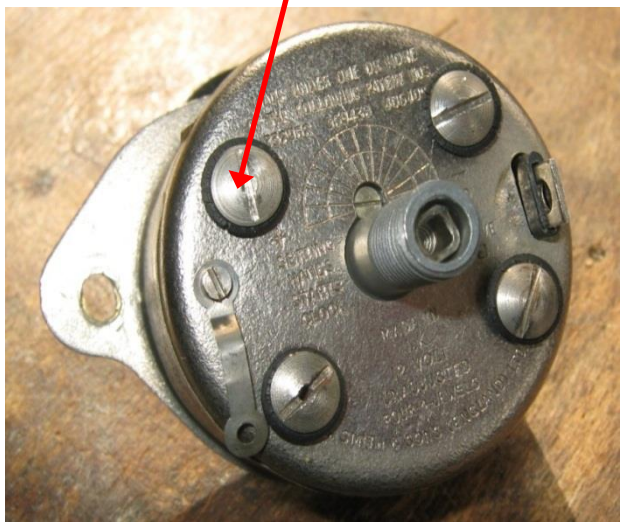
- Once you have cleaned your clock you can oil the bearings with a very small amount of clock oil. This is best applied using a pin or thin piece of wire. For the jewelled bearings the aim should be to use just enough oil to fill the dip in the bearing. Do not be tempted to use any oil other than other clock oil. Do not oil the gear trains.

PCB Polarity

Before Fitting your PCB, please check that you have the correct polarity for your vehicle. The packet containing the PCB will be marked with a “P” or an “N” to indicate Positive or Negative Earth. Please contact Clocks4Classics if you have the wrong polarity for your vehicle.

Fitting Instructions

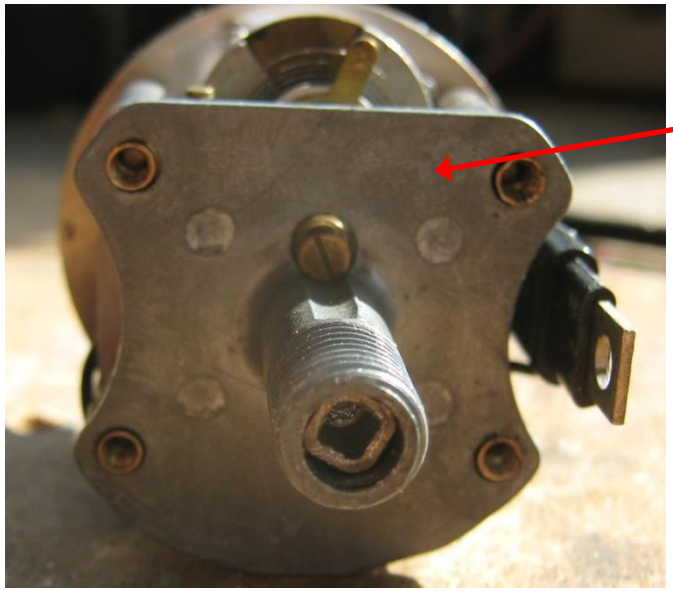




1. Remove small screw (a)

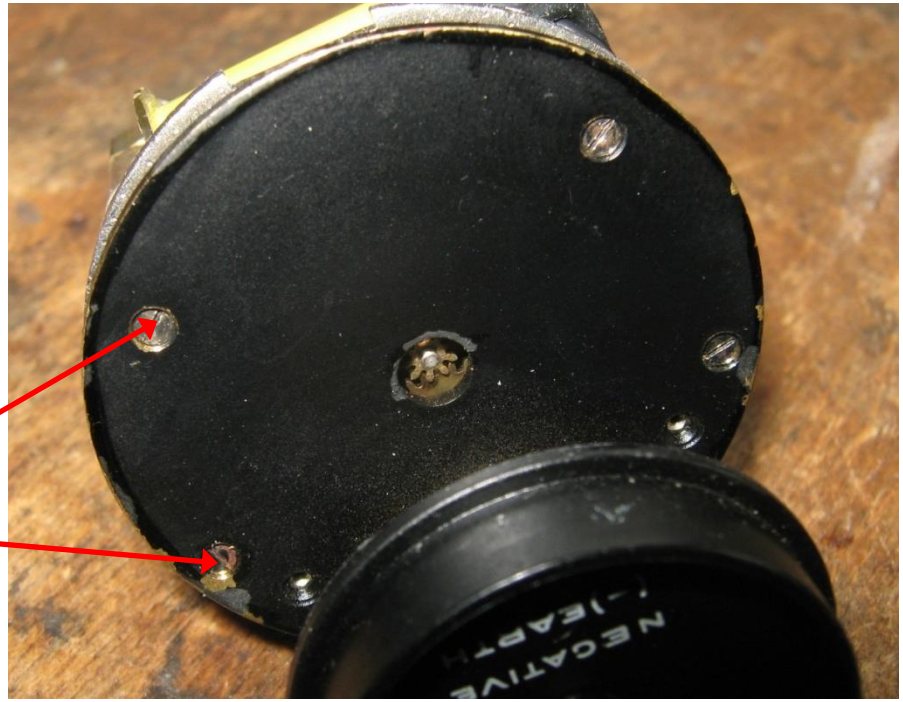
2. Loosen small screw (b) and swing fuse to one side.

3. Remove 4 case securing screws (c) and slide case backwards off mechanism.



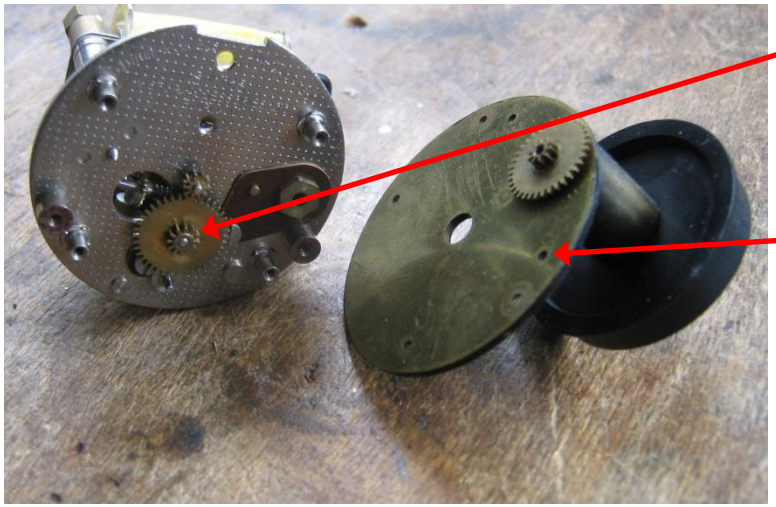
Back-plate

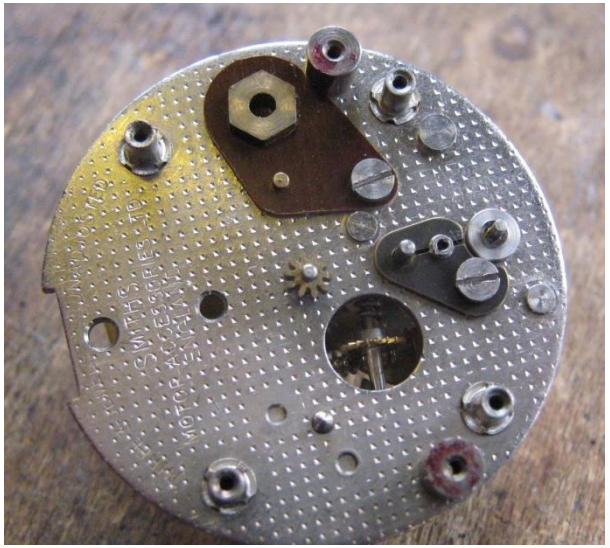
Lift off back-plate to leave mechanism as shown



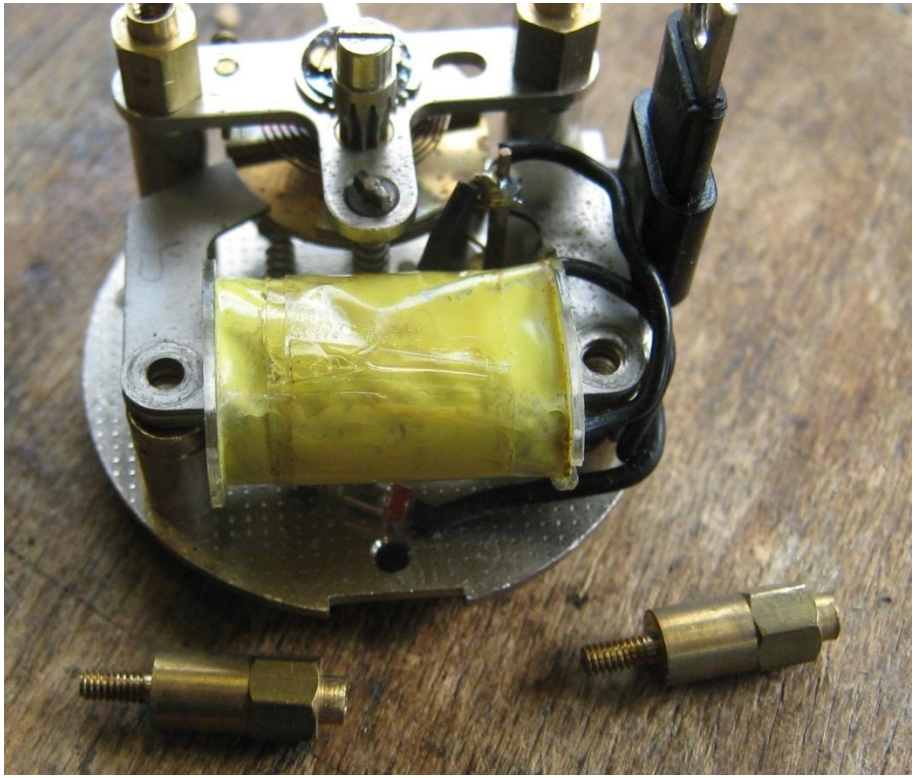
Remove 4 (sometimes 6) screws securing front dial mechanism.

NB. If screws will not move do not use force. Apply cellulose thinners to the screw heads and leave for a few hours to loosen paint around screw heads. You can also apply thinners to the back of the screws. Be patient – this almost always works!

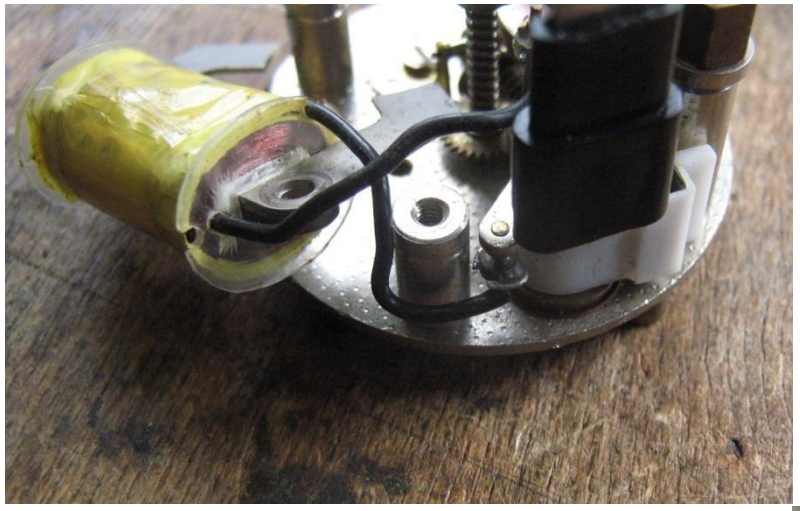


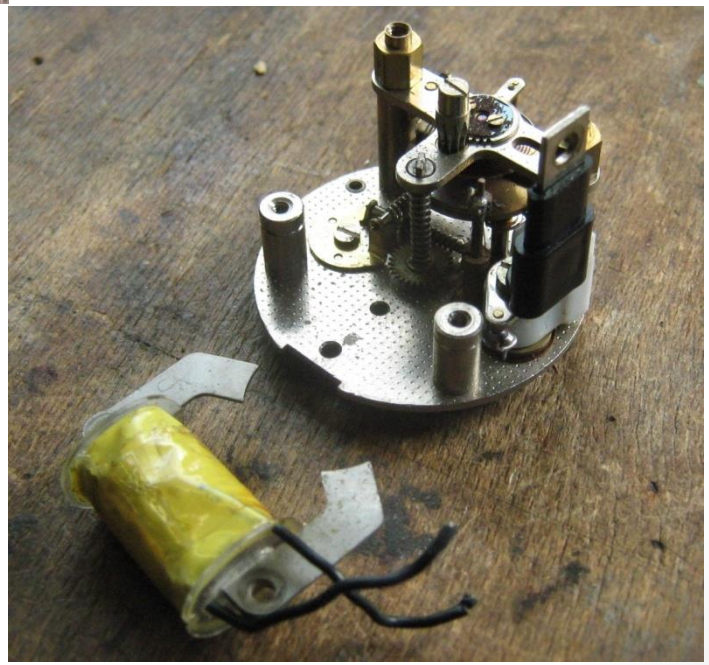


1. Lift off Front Dial mechanism.
2. Lift off Gear Wheel



Remove 2 solenoid retaining pillars

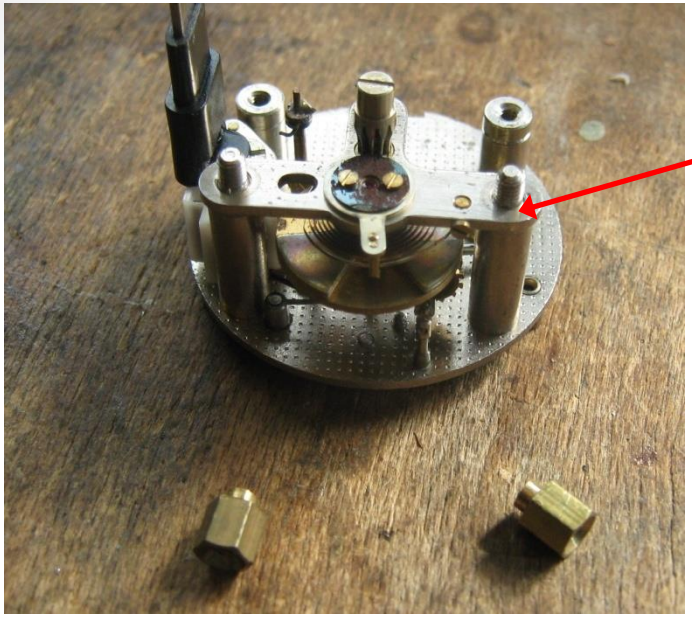




1. Lift Solenoid from mechanism.

2. Snip solenoid wires leaving as much wire as possible attached to solenoid.

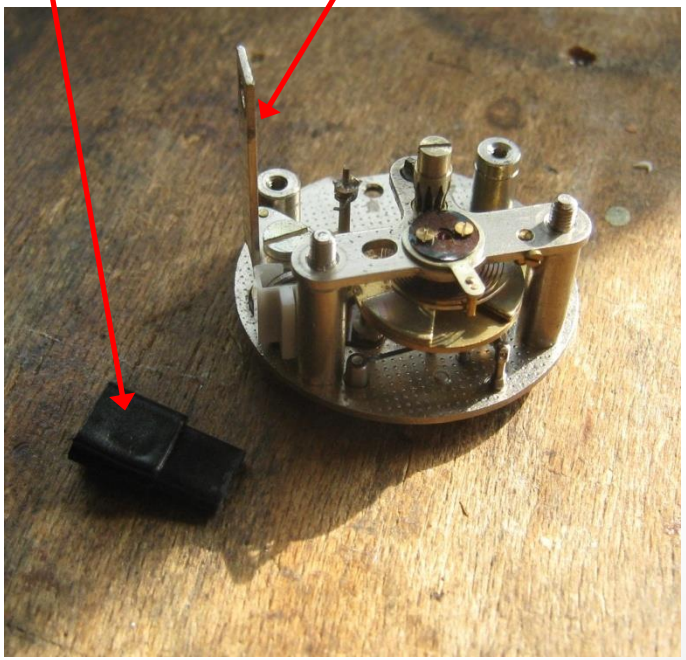
Note. It is important not to stress solenoid wires as this can break the connection inside the solenoid. Once the solenoid is removed it is a good idea to add some extra support to the wires by adding some epoxy, super glue or hot melt glue to the wires at the point where they enter the solenoid body.



Balance Support

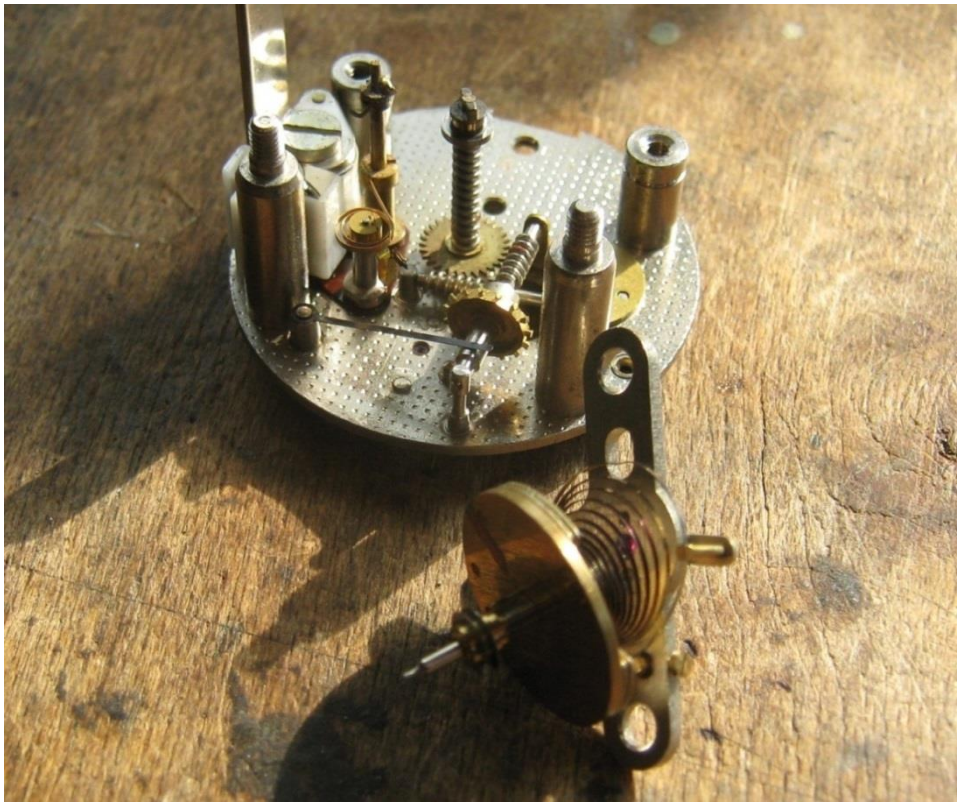
Insulating Sleeve

Connector Bracket



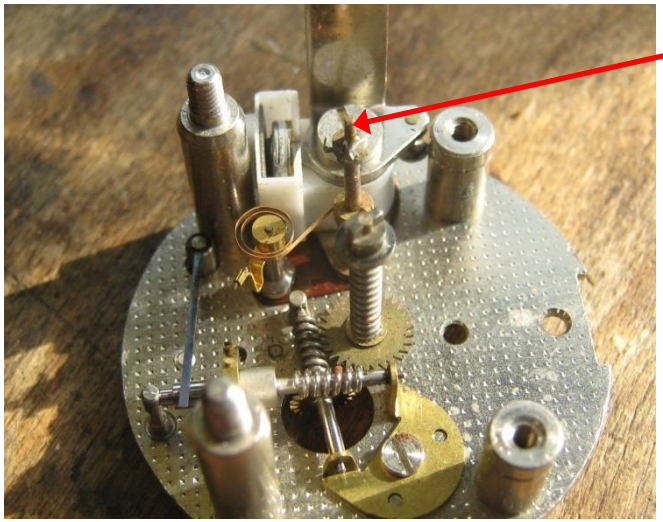
1. Remove two nuts securing balance support.

2. Remove Insulating sleeve from connector bracket.



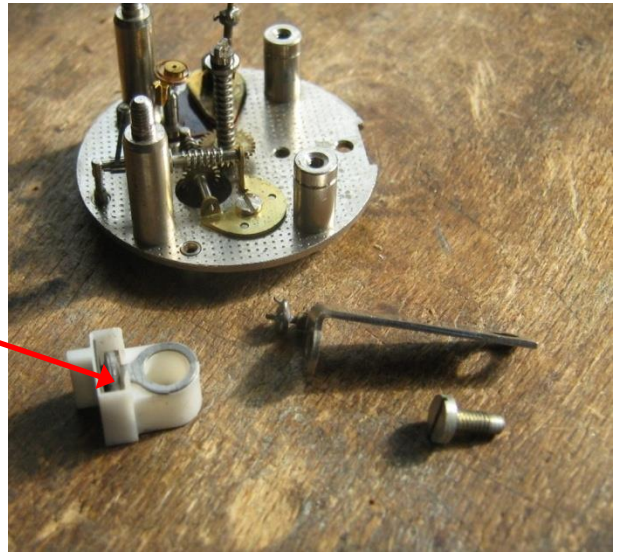
Carefully lift off the balance support and balance wheel assembly. Note that this assemble is quite delicate – do not hold the assembly just by the bridge piece as this may damage the hair spring.

[**NB**. On some clocks (e.g. Jaguar Mk IV, XK140), there is an adjustment gear on the top of the balance support which prevents removal of the balance wheel assembly. In these cases this gear must be removed – please see slide labelled “Removal of Adjustment Gear” at the end of these instructions.]

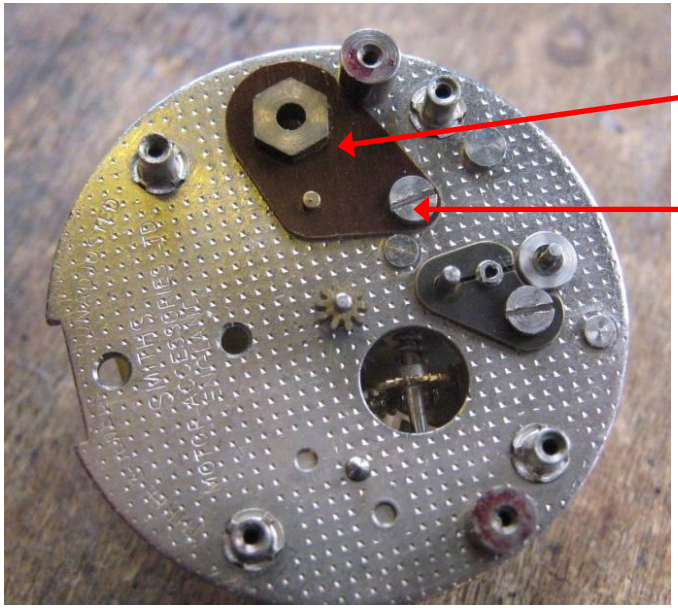


Connector bracket retaining screw.

Connector Bracket Support



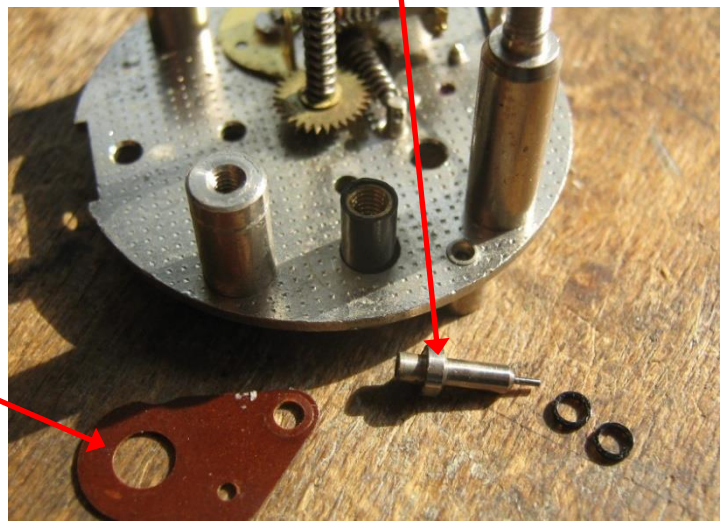
Undo connector bracket retainer screw and remove connector bracket and plastic connector bracket support. Note that the plastic connector bracket support is no-longer required and should not be refitted.



Lower insulating plate

Contact pillar retaining screw

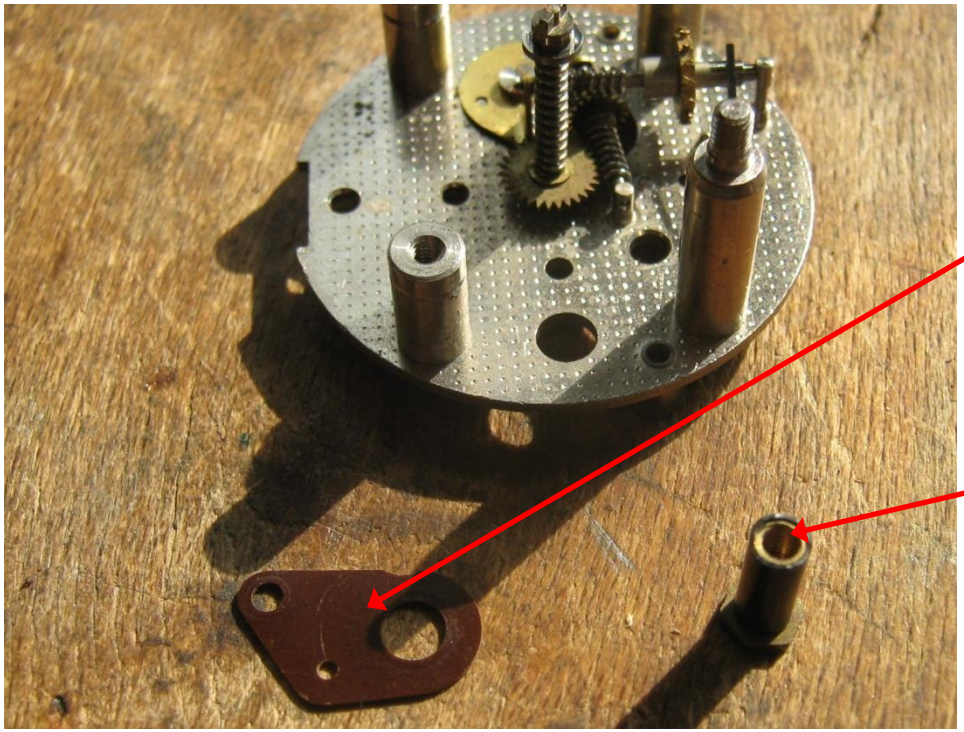
Contact pillar



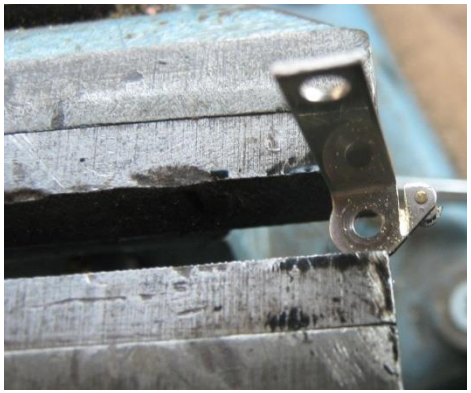
Upper insulating plate

Undo contact pillar retaining screw and remove contact pillar upper insulating plate , contacts (not shown) and insulating `O' rings.

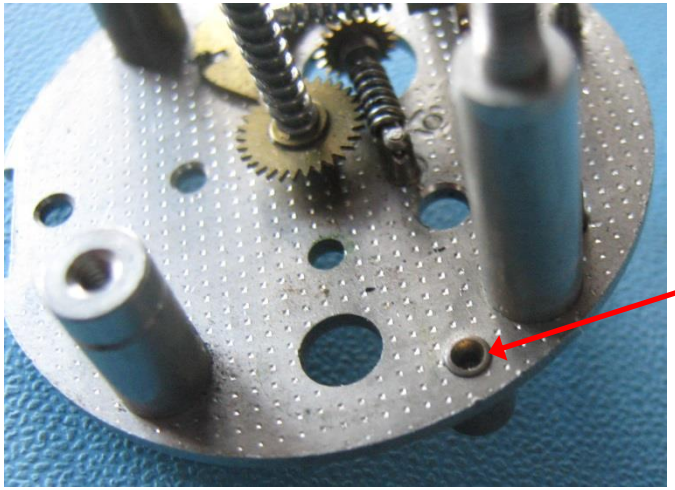
NB: Contacts, contact pillar and insulating `O' rings are no longer required and should not be refitted.



Remove connector pillar (with insulating tube) and lower insulating plate.

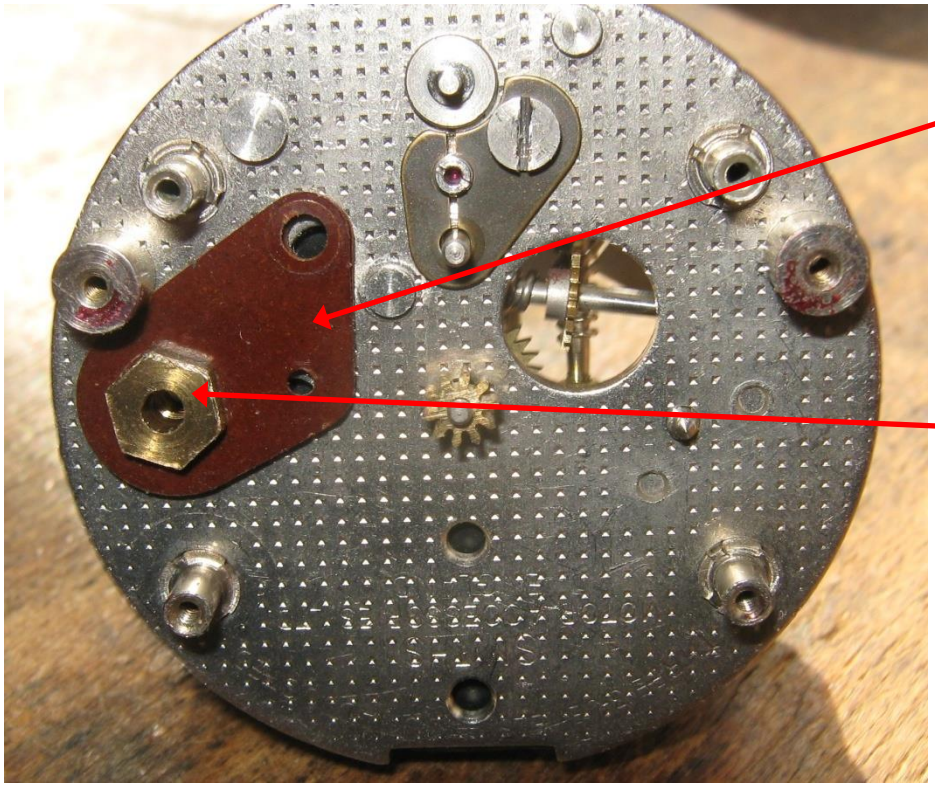


Modify connector bracket by removing side `ear’ as shown



Check that the PCB fits flat against the base plate. Some older PCBs may foul on the rivet head shown. If necessary, use a small file to file the rivet head flush so that the PCB can sit flat against the baseplate.

Note: The latest PCBs have been re-designed to avoid this rivet so that this operation is not necessary.

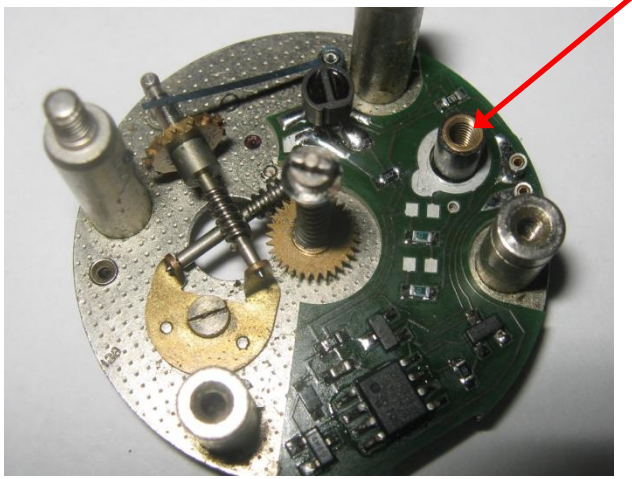


Fit one of the insulating plates to connector pillar and insert into clock baseplate from front as shown. Ensure that insulating tube is in place around connector pillar.

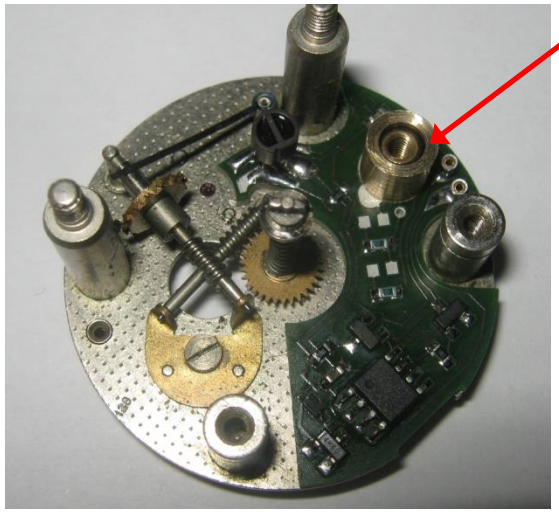
Note

The insulating plate must be fitted on the underside of the baseplate as shown. Do not place an insulating plate between the baseplate and the circuit board.

Connector Pillar (with insulating tube)



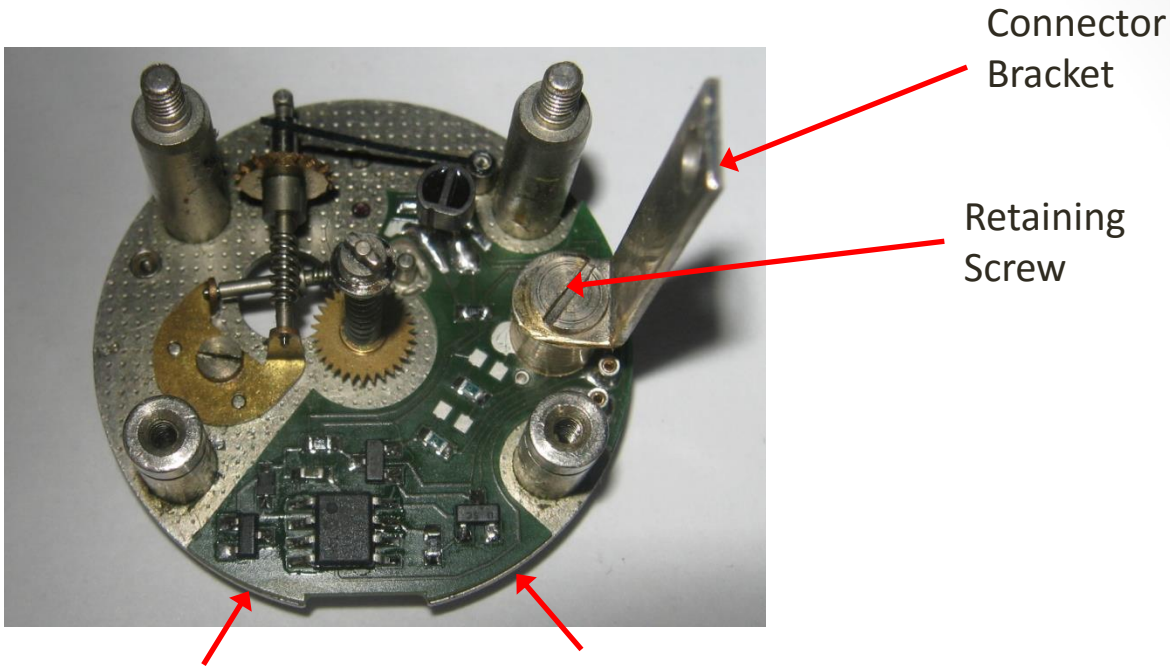
Brass Spacer placed over Connector Pillar



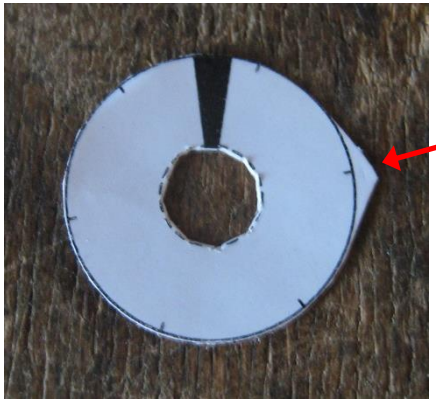
1. Position PCB on clock base plate as shown with hole over connector pillar.

2. Fit brass spacer (supplied) over connector pillar.

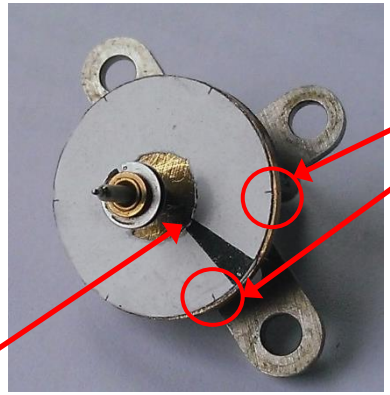
Note: On some clocks the insulating sleeve around the connector pillar is made of thick material and may be difficult to pass through the brass bush. In this case replace the insulating sleeve with insulating tape or heat shrink tubing.



Place the connector bracket on top of the brass spacer and secure the bracket to the connector pillar with the retaining screw. Make sure that the curved edge of the PCB lines up closely with the clock baseplate (arrowed).



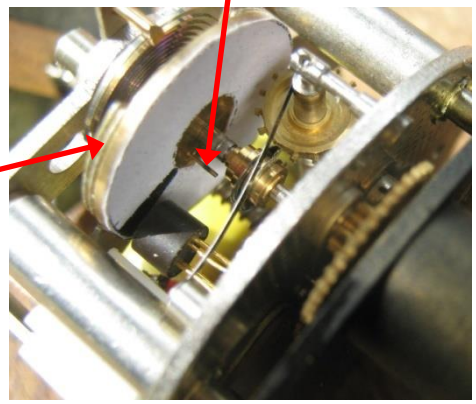
Use a sharp craft knife to cut out one of the balance wheel stickers from the sheet (the sheet includes 2 spares). Leave a small ‘tab’ on the edge of the sticker to help with removing the backing when fitting. This tab can also be used to help hold the sticker when positioning it on the balance wheel. The tab can be trimmed off once the sticker is fitted.



Alignment Marks (line up with segments on back of balance wheel)

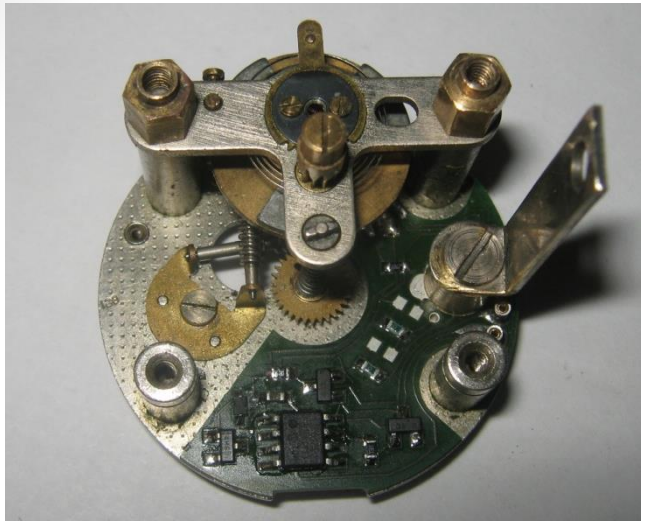
Balance wheel pin Position

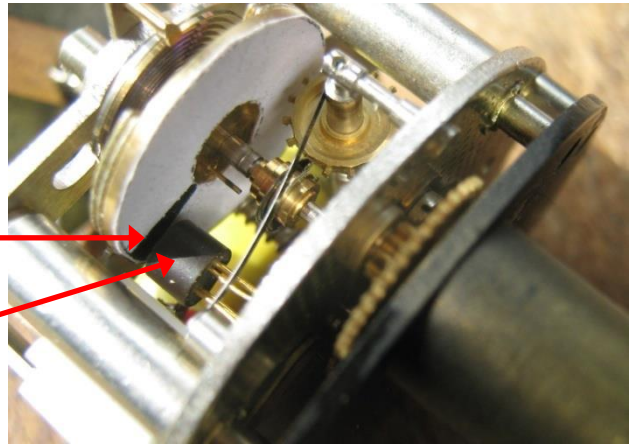
Balance wheel pin



Balance wheel Segment

Carefully clean underside of balance wheel with Isopropyl alcohol and a Q-tip. Peel the backing off the sticker, position it on the underside of the balance wheel and smooth down carefully. The sticker should be positioned so that the balance wheel pin is close to the black stripe and the alignment marks (circled) line up with edge of balance wheel segments on opposite side of balance wheel. If any parts of the sticker overhang the edge of the balance wheel carefully trim these with a sharp craft knife.

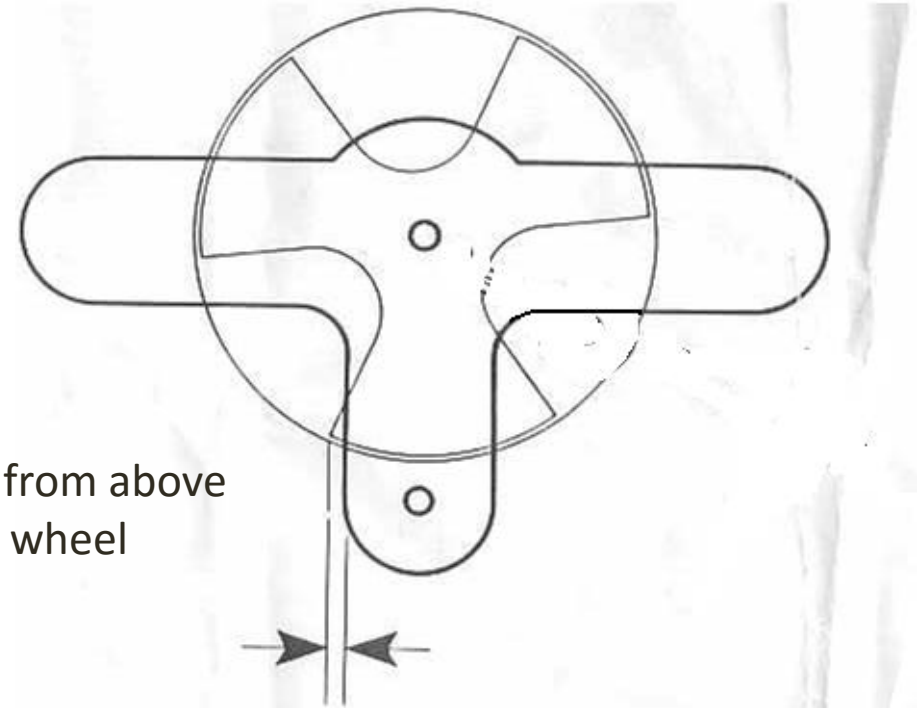




Carefully re-fit the balance wheel taking care not to damage the jewelled bearings.

When the balance wheel is at rest, the black marker stripe should sit just a little clockwise of the sensor (when viewed from the sensor side of the balance wheel). If the marker stripe does not appear to be in the correct place, check that the label is correctly applied and then check the at-rest position of the balance wheel (see next slide).

Balance Wheel At-Rest Position

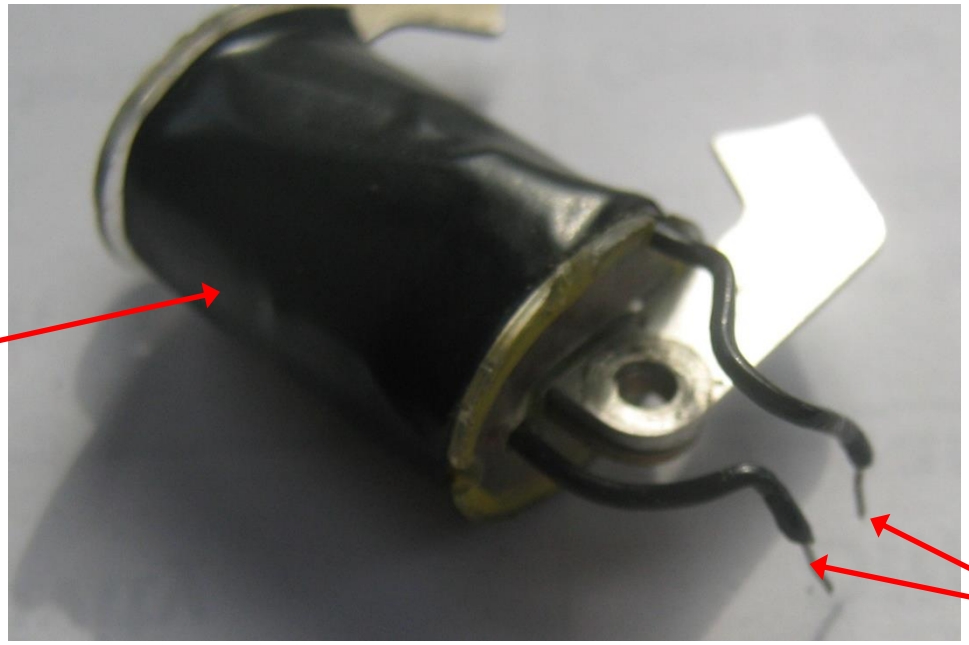


Viewed from above
balance wheel

Approx
0.75 mm

The above diagram shows the at-rest position of balance wheel. Note that this is factory set and should NOT need to be adjusted. The exact measurement of 0.75 mm is not critical but the balance wheel should be slightly offset from the symmetrical (as shown). If the position is clearly wrong, it can be adjusted by gently turning the balance wheel whilst holding the hairspring collet still by using a jeweller's screwdriver in the slit of the collet.

New Insulation Tape

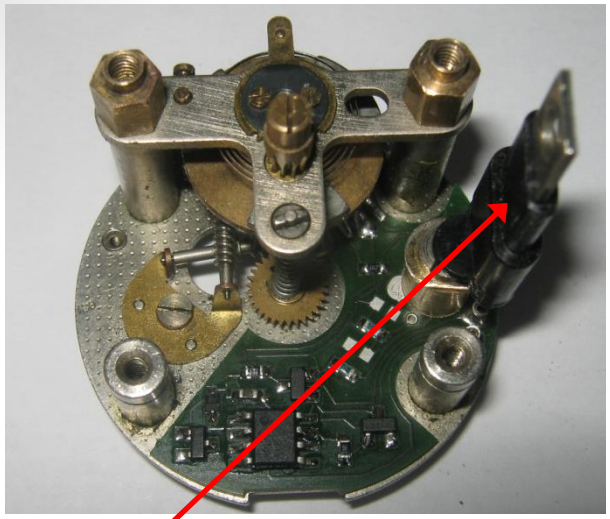


Ends of Solenoid wires stripped

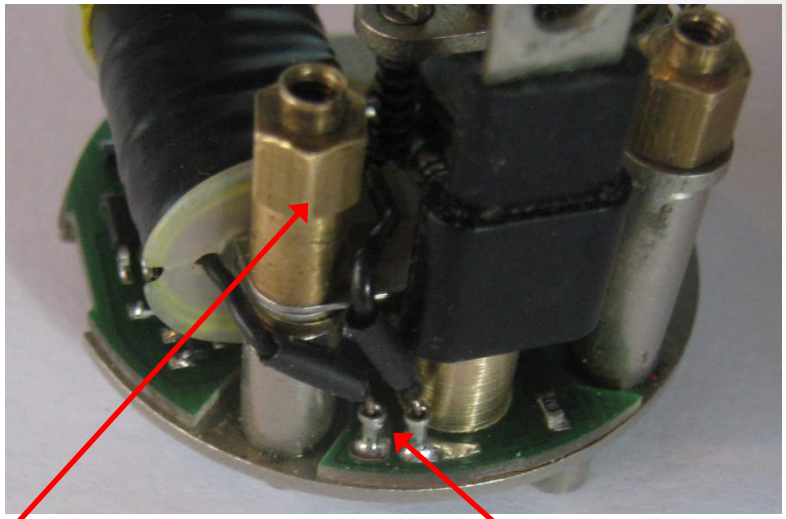
Using wire strippers, strip approx. 3mm from the ends of each solenoid wire. If the tape around the solenoid body looks worn, wrap this with a couple of turns of new insulation tape.

Notes:

Be careful not to flex or pull on the wires as this can break the connection inside the solenoid. If the wires look loose where they enter the body of the solenoid it is a good idea to secure them with some hot melt or epoxy glue. To avoid straining the wires, use a small pair of pliers to hold the wire end near to the solenoid body whilst using the wire strippers.



Insulating Sleeve



Solenoid retaining pillar

Solenoid wires pushed into socket posts

1. Fit insulating sleeve over connector bracket.

2. Re-fit the solenoid and screw solenoid retaining pillars into place. Place two pieces of heat-shrink over solenoid wires and carefully push the two solenoid wires into the socket posts as shown.

Notes:

1. The socket posts are designed to provide a push fit connection. Do not solder the wires into the socket posts as this will melt the solder on the underside of the PCB and may cause a short circuit onto the base-plate.

2. Do not shrink the heat-shrink tubing until mechanism has been tested (see later slide)

Heat-shrink sleeving shrunk over damaged insulating sleeve

If the top of the plastic insulating sleeve is damaged, cover the damaged part with the heat-shrink sleeving supplied and use a hair dryer or heat gun to shrink the sleeving over the plastic insulating sleeve

Testing the movement

At this point it is a good idea to test the operation of the movement.

Connect the clock to a **fused** 12V battery supply (For negative earth cars connect the `+' terminal to the connector bracket and the `–' terminal to the body of the clock. For positive earth cars connect the `-' terminal to the connector bracket and the `+' terminal to the body of the clock).

The balance wheel should first move to a starting position and remain there for approximately 3 seconds.

Following this it should start to oscillate back and forth. The amplitude of oscillation will build up over a minute or so until the wheel is oscillating steadily.

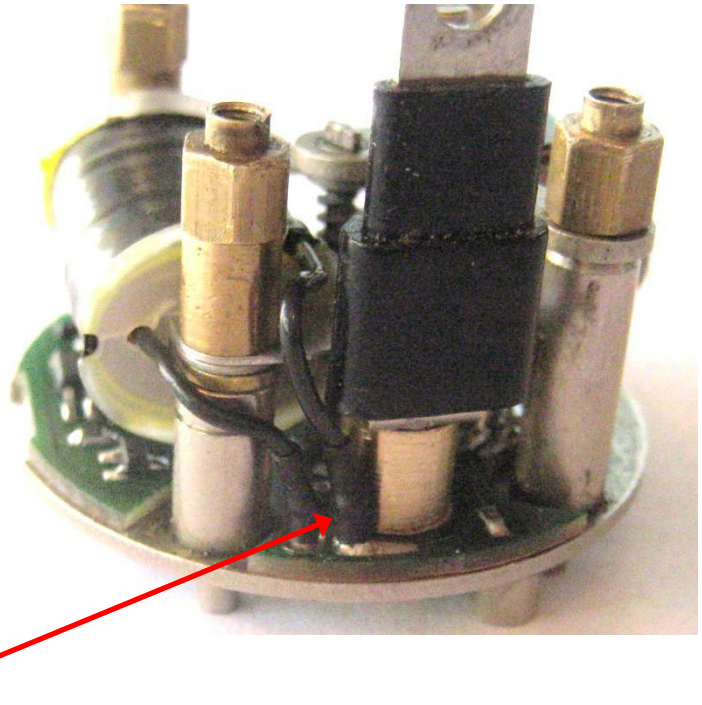
If the balance wheel does not oscillate please see the trouble shooting section at the end of these instructions.

Note

For testing the clock you must use a 12V battery or a **regulated** 12V power supply. Car battery chargers are not designed for use without a battery in the circuit and are unsuitable for powering the clock as they produce a very "noisy" output under these circumstances.

Similarly, wall mounted power supplies (such as those used for used for powering consumer electronic equipment etc.) are often unregulated and will not produce necessarily produce a suitable output.

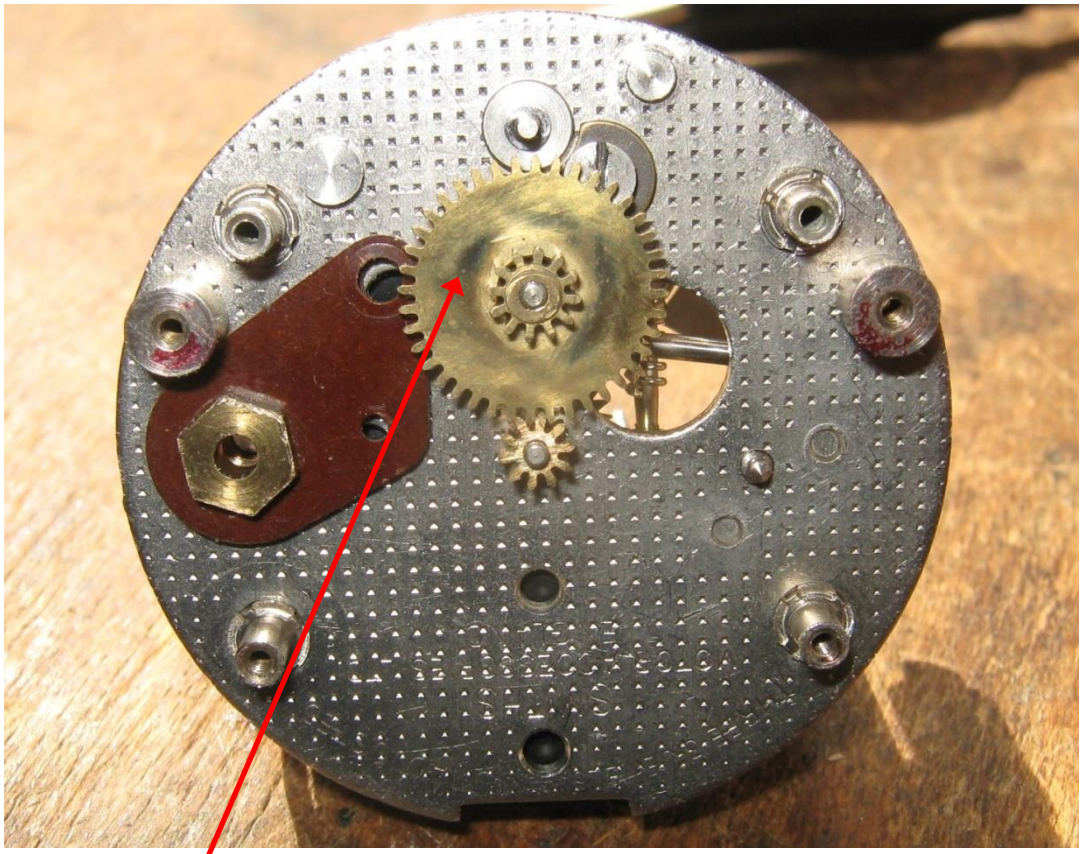
Using a battery charger when the clock is installed in the car does not generally cause a problem as the battery smooths out the voltage fluctuations.



Heat-shrink tubing shrunk
over socket posts

Push heat-shrink tubing down over socket posts and then use a hairdryer or heat gun to shrink the tubing over the posts. Be careful not to use too much heat as this may melt the insulation on the wires.

Tip: A pair of tweezers can be useful to tease the heat-shrink tubing over the socket posts.

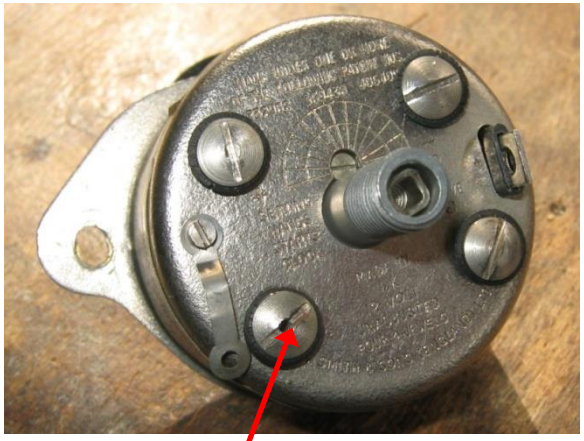


Place a small drop of clock oil in the mounting hole of the gear wheel and refit as shown.

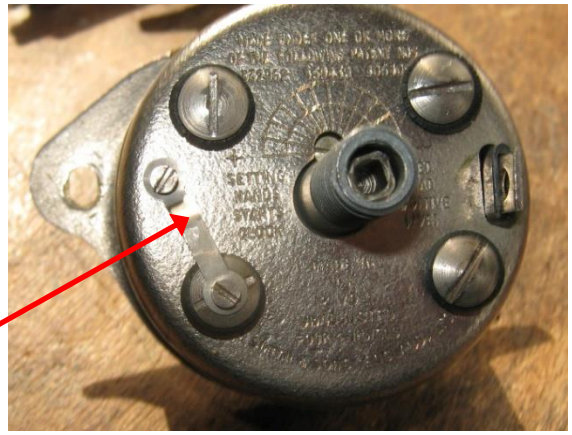
1. Fit front dial mechanism being careful that hands align correctly (check alignment at 12 o-clock position).

2. Re fit back plate to rear of clock.

Note:
When fitting the dial plate tighten diagonally opposite screws so that the plate is pulled down evenly.



Screw with threaded hole



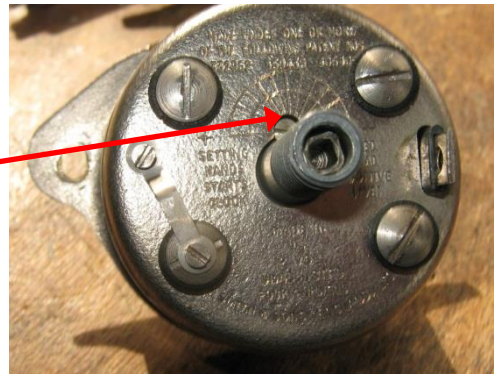
Fused Link

Refit case and 4 retaining screws. Ensure screw with threaded hole is in position shown.

Refit fused link and tighten both screws

Adjusting the Clock

Regulator Screw



- Before fitting the clock to the car you should adjust the timekeeping using the regulator screw on the back of the case.
- First set up the clock on the bench in its normal orientation and connect it to a fused 12V supply (e.g. an old car or motorcycle battery).
- Allow the clock to run for an hour or so before attempting any adjustments.
- Turning the screw anticlockwise makes the clock run faster, turning it clockwise makes it run slower.
- Be aware that the adjustment is quite sensitive – small movements of the screw can make a big difference.
- Bear in mind that this is still a mechanical movement and will be affected by temperature etc.
- **NB**. There is often quite a lot of backlash in the dial mechanism so it can take some time for the mechanism to `catch up’ before the hands begin to move. The best way to overcome this is simply to set the hands a couple of minutes fast when first setting the clock.

Troubleshooting

#	Symptom	Possible Cause	Investigations / Actions
1	Balance wheel does not move when 12V supply is connected.	12V Supply not correctly connected	Check that the connections to clock are clean and secure Check that the 12V fuse to the clock has not blown Make sure that the supply is battery or regulated 12V supply – (NOT a battery charger) Use a voltmeter or test bulb to check that 12V is present at the supply to the clock. Check that the polarity of the 12V supply is correct. Check that the clock case is earthed (ring terminal on clock mounting screw) Check that the fused link on the back of the clock case is in place.
		Unsuitable Power Supply	Make sure that the supply is a 12V battery or a **regulated** 12V power supply. Do not use a battery charger (see note under "Testing the Movement")
		Bad connection to clock solenoid	Check that wires to the solenoid are fully pushed home into the connectors on the PCB.
		Balance wheel stuck	Check that the balance wheel can move freely. If not check that it is correctly located in its bearings and is not touching any other part of the mechanism.
		Solenoid Pole pieces bent	Check that the pole pieces (the flat strips of metal which stick out of the solenoid coil) are not bent. If necessary, gently bend them back into place.
		Solenoid Coil Broken	If all of the above points are OK then it is possible that the solenoid coil has failed. This is unusual but can happen if the wires to the solenoid have been stressed. If you have a multi-meter you can check the resistance of the solenoid which should be around 850 Ohms. Damaged solenoid coils can often be repaired – please ask for details.
2	Balance wheel moves when 12V supply is first applied but does not oscillate.	Unsuitable Power Supply	Make sure that the supply is a 12V battery or a **regulated** 12V power supply. Do not use a battery charger (see note under "Testing the Movement")
		Bright light on Sensor	Bright light can affect the operation of the sensor when testing the mechanism. Normal indoor lighting is normally fine but bright lights or florescent lights can cause a problem. This is not a problem when the clock is in its case but it may be necessary to move the mechanism to a more shaded area for testing.
		Dirt or grease on Sensor	Clean sensor with Isopropyl alcohol or similar
		Excess Friction	See under "Excess Friction" below
		Solenoid Pole pieces bent	Check that the pole pieces (the flat strips of metal which stick out of the solenoid coil) are not bent. If necessary, gently bend them back into place.
		Balance wheel sticker incorrectly positioned	Check that the balance wheel sticker is in the correct position (see earlier slide). If necessary remove the sticker and apply one of the spare stickers in the correct position.
		Balance Wheel At-Rest position incorrect	See slide on checking and adjusting balance wheel At-Rest position.

Troubleshooting - continued

#	Symptom	Possible Cause	Investigations / Actions
3	Balance wheel starts to oscillate but stops after a short time	Bright light affecting sensor	See under “Bright light on sensor” above
		Clock hands touching	See “Clock hands touching” above
		Excess Friction due to damper spring	The damper spring is the thin leaf spring which bears on the transverse wheel shaft. This is shown in the photo below. Use a cocktail stick or jeweller’s screwdriver to *gently* lift the damper spring away from the shaft. Do not lift the spring too far as it is easily broken. If the clock then runs the underside of damper spring may be dirty or rusty. You can clean the damper spring by carefully slipping a piece of very fine wet and dry paper between the spring and the shaft (with the abrasive towards the spring) and pulling it free. If this does not cure the problem then it may be necessary to bend the spring slightly so that it puts less pressure on the shaft. To do this grip the spring in the middle with a pair of tweezers and gently twist the tweezers anti clockwise (i.e. towards the fixing point of the spring). Do not hold the spring too close to the fixing point as this may break it. The object is to lessen the friction due to the damper spring but it should still touch the shaft.
		Excess friction in dial mechanism	Remove the dial from the clock – if the clock then runs the problem is due to friction in the dial mechanism clean the shaft etc. Clean the area behind the gear wheel on the back of the dial using a piece of paper soaked in Isopropyl alcohol. If necessary you may also need to remove the hands to clean the hour and minute hand shafts.
		Excess friction in balance wheel bearings	The balance wheel should move very freely. If necessary clean and re-oil the jewelled bearings.
		Play in balance wheel bearing	Excessive play in the balance wheel bearings can also cause the balance wheel to stop. If the play is in the vertical direction, use the adjusting screw on the underside of the baseplate to adjust the bearing (see separate slide below).
		Solenoid Pole Pieces bent	Check that the solenoid pole pieces have not become bent or twisted and that they align with the balance wheel. If necessary use a small pair of pliers to bend them back into position.
4	Clock runs too fast or too slow (and cannot be adjusted to run correctly)	Hair spring coils stuck together.	If the clock is running much too fast, check that the hair-spring coils are not stuck together – if they are clean the hair-spring with isopropyl alcohol.
		Excess friction	See under “Excess Friction” above

Troubleshooting - continued

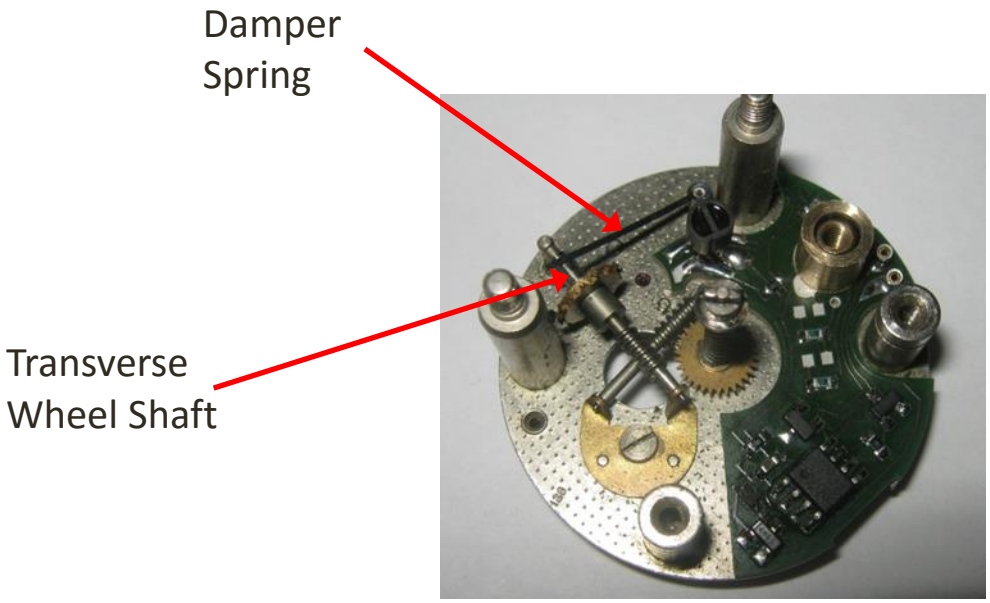
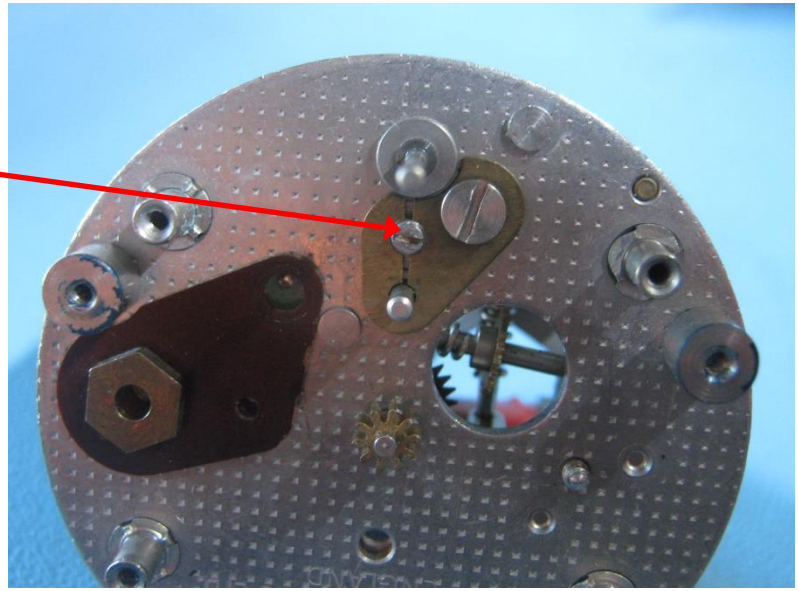


Photo showing location of damper spring and transverse gear shaft

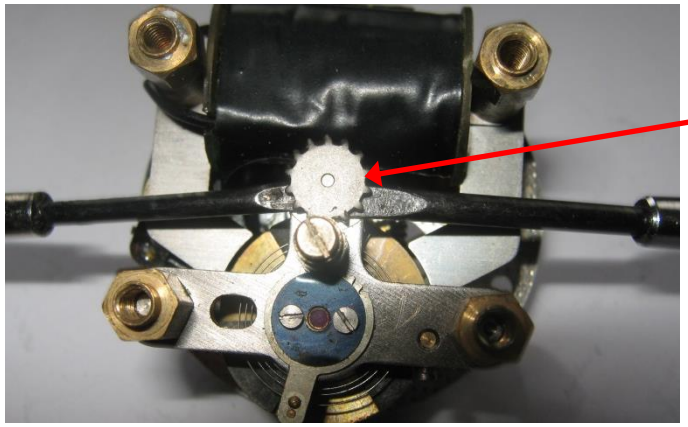
Adjusting the Balance Wheel Bearing

Bearing Adjustment Screw



To adjust the balance wheel bearing use the screw on the underside of the baseplate as shown. The bearing should be adjusted so that there is still a very small amount of vertical play.

Removal of Adjustment Gear



Some clocks (e.g. Jaguar Mk IV, XK140) have an adjustment gear on top of the balance support which prevents removal of the balance wheel mechanism.

The gear can be removed by using two Jeweller's screwdrivers to gently lever between the gear and the balance support. Lever very gently using both screwdrivers simultaneously with the screwdrivers positioned opposite each other. Periodically rotate the gear wheel so that the force evens out around the gear. Sometimes the top of the shaft is peened over in which case it will be necessary to use a needle file to remove the peening prior to removing the gear.

To replace the gear tap it back on making sure that the bottom of the shaft is well supported. Replacing the gear will be made easier if you gently warm it first so that the hole expands slightly. It is recommended that you do not replace the gear until after the mechanism has been tested.