SMITHS CAR CLOCK REPAIR KIT

Fitting instructions for clocks with front adjustment

Version 1

Introduction

These instructions explain how to repair a Smith's or Jaeger electric car clock movement 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.

Two sets of instructions are available to cover the two types of mechanism commonly used in these clocks. These instructions cover "Front Adjusting" clocks i.e. those with a knob on the front of the clock for setting the time. If your clock has the time setting on the rear or underneath the clock , or uses a cable then please see the "Standard" instructions which can be also be downloaded at http://www.clocks4classics.com/downloads

The instructions are based around the repair of a clock from a Vauxhall Victor which is typical of the type of clock which can be repaired. Slight differences will be evident in clocks from other vehicles, particularly in respect of the removal of the bezel and dial, however, the internal mechanisms are very similar and should be easily recognisable from these instructions.

Kit Contents

- Printed Circuit board with Microcontroller and Infra red sensor
- Brass bush
- 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.

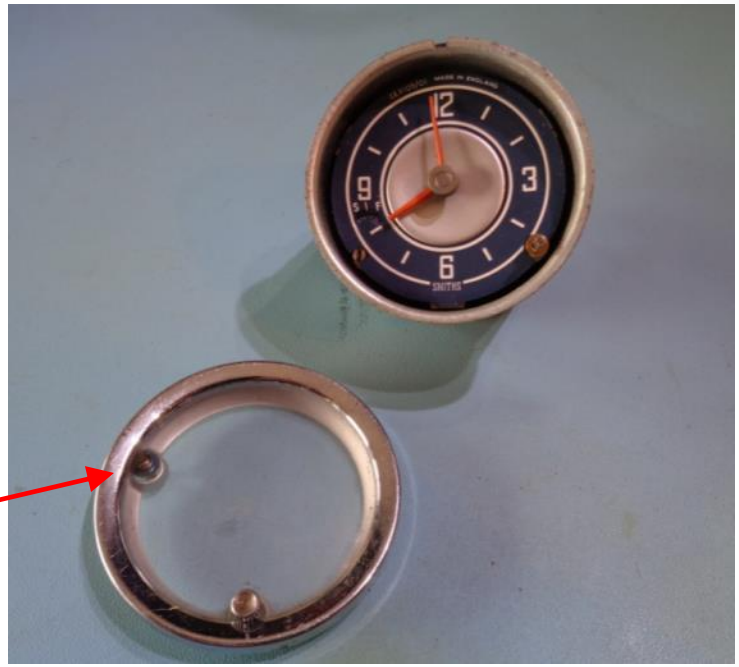
PCB Polarity

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.

Disassembly

The following slides detail the disassembly of the clock. It is recommended that you find a comfortable area to work with good lighting and that you place the disassembled parts a small containers so that they are not lost (the top from old aerosol cans are useful for this purpose). Be particularly careful with the dial face as these are easily marked.

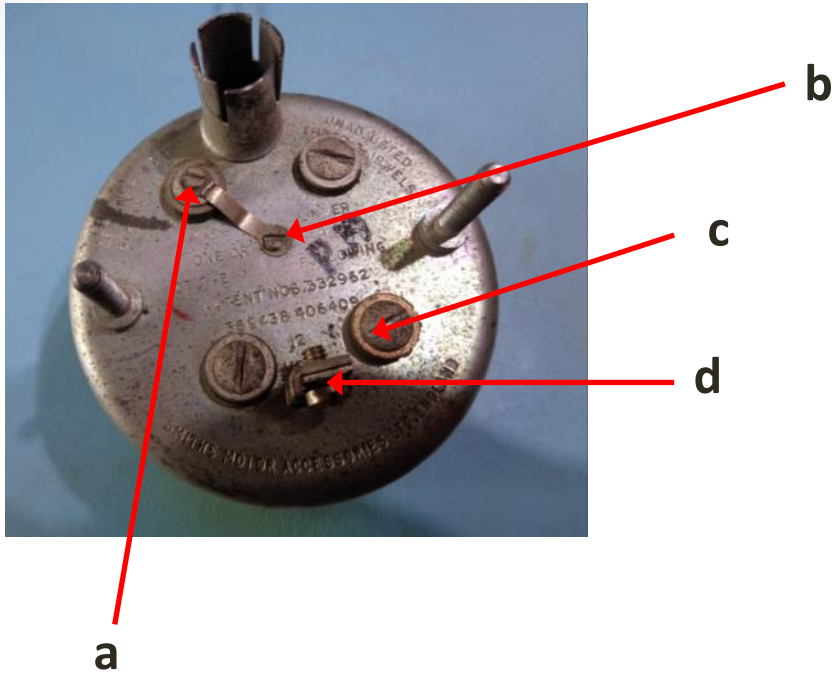
Retaining tab

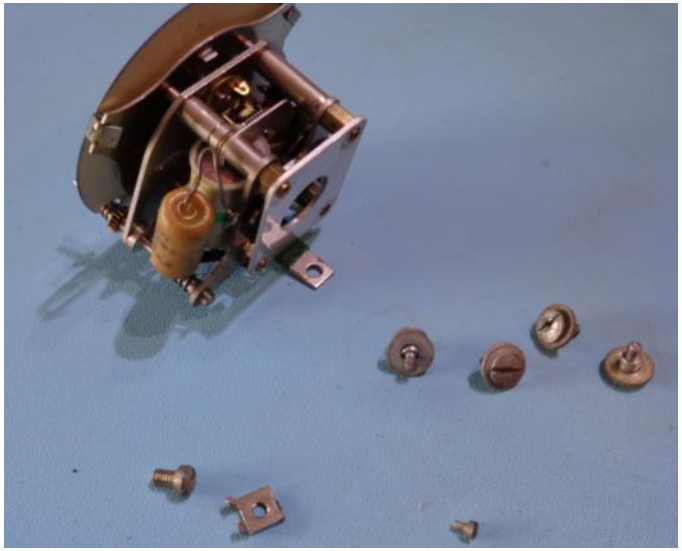


Bezel

Gently lever back retaining tabs on bezel and remove bezel from clock case

(Note: It is only necessary to bend the tabs back part way – the bezel can then be `sprung' off the case. Take care not to bend tabs too far or they may break.)



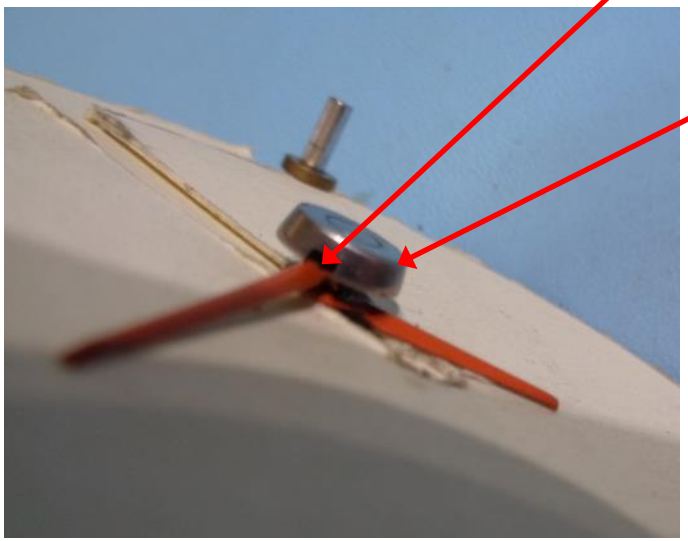


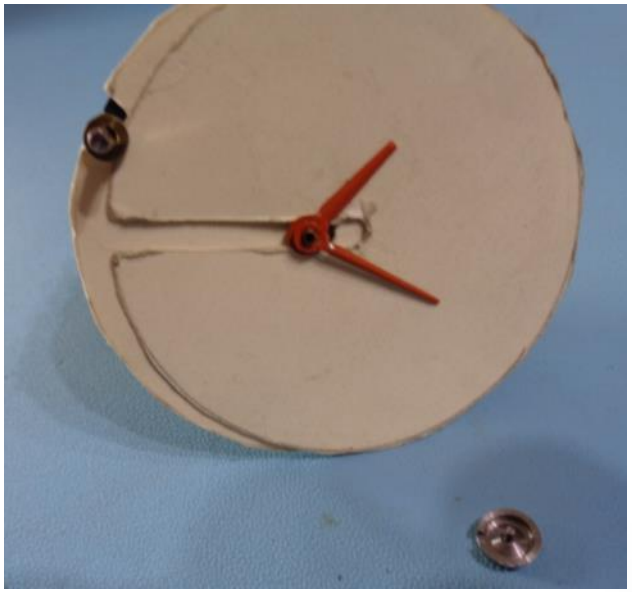
1. Remove small screw (a)

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

3. Remove 4 case securing screws (c) and connector screw and pate (d).

4. Remove mechanism from case.

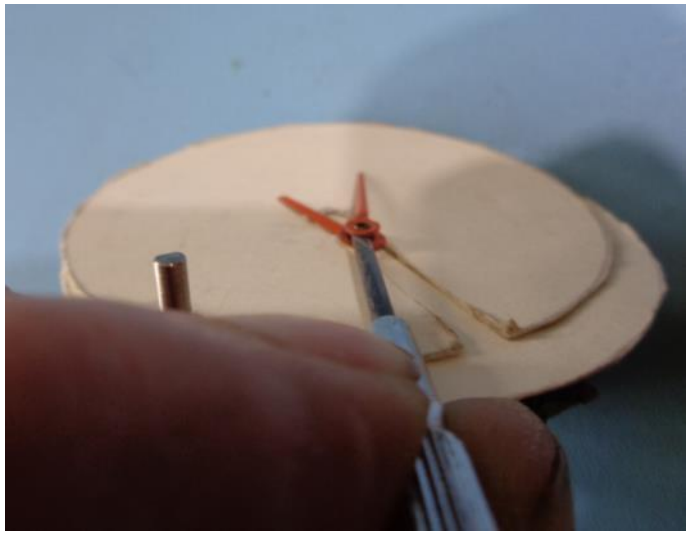




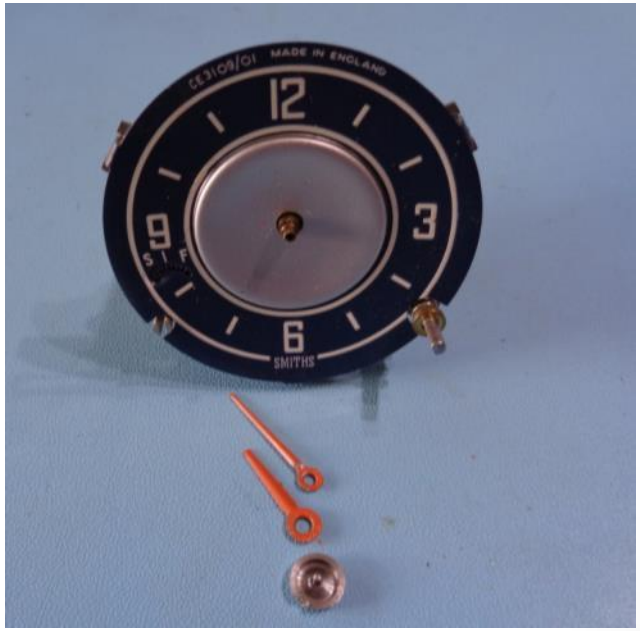
1. Protect clock face with thin cardboard.

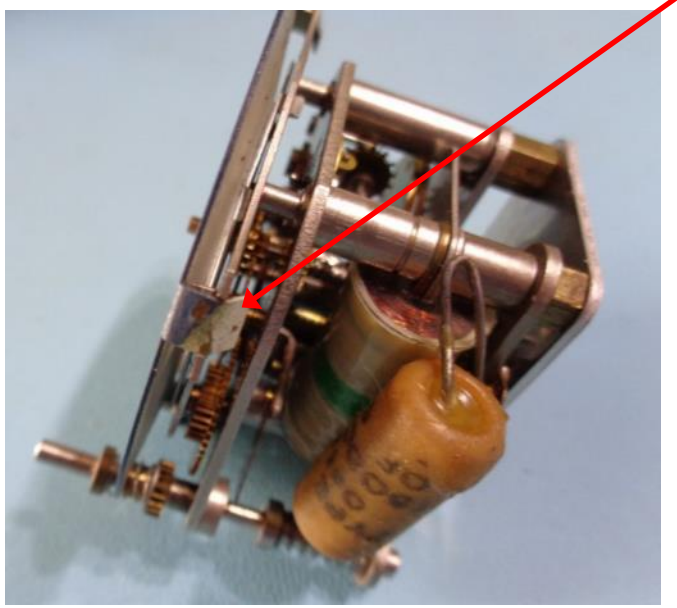
2. Place small jeweller's screwdriver in slot shown and carefully lever off the cap.

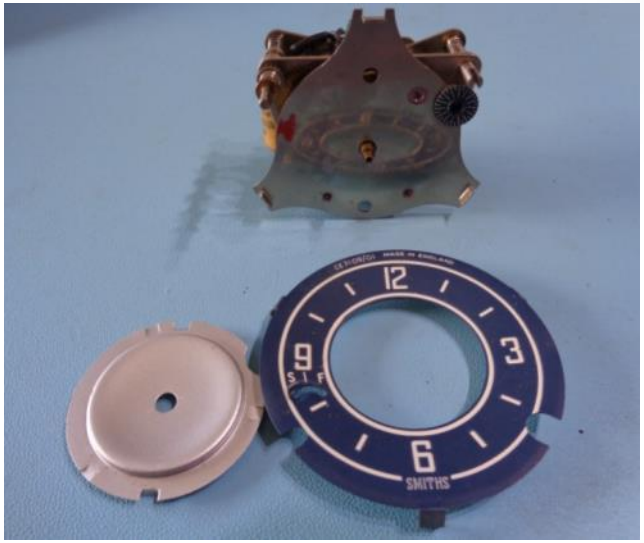
Note: The cap can be quite stiff to remove. Work slowly and do not apply too much force. As the gap between the cap and the hands starts to open up you can move the screwdriver to other points around the edge of the cap so that it the force is applied evenly.



Use a Jeweller’s screwdriver as shown to carefully lever off the hands



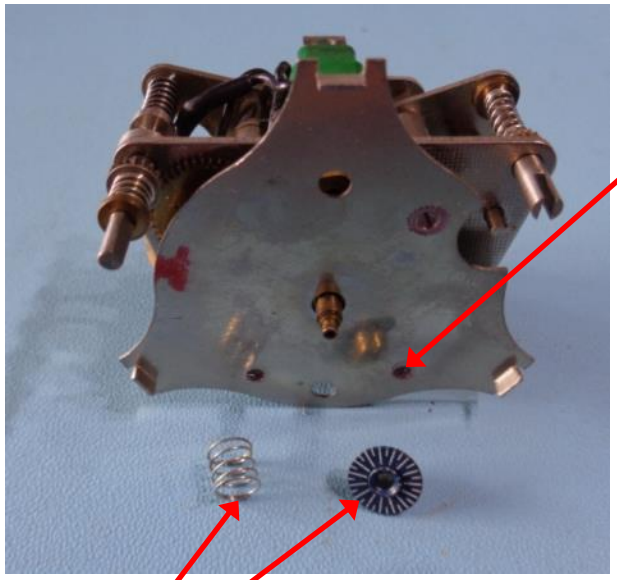




1. Carefully bend back tabs securing the dial.

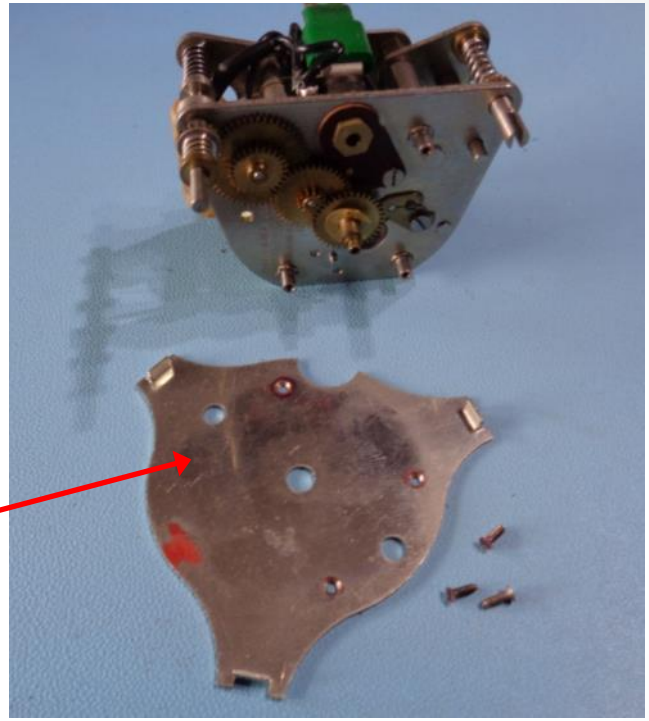
2. Remove dial parts as shown.

Note: On some clocks the dial is secured by small screws rather than tabs.



Retaining Plate Screw

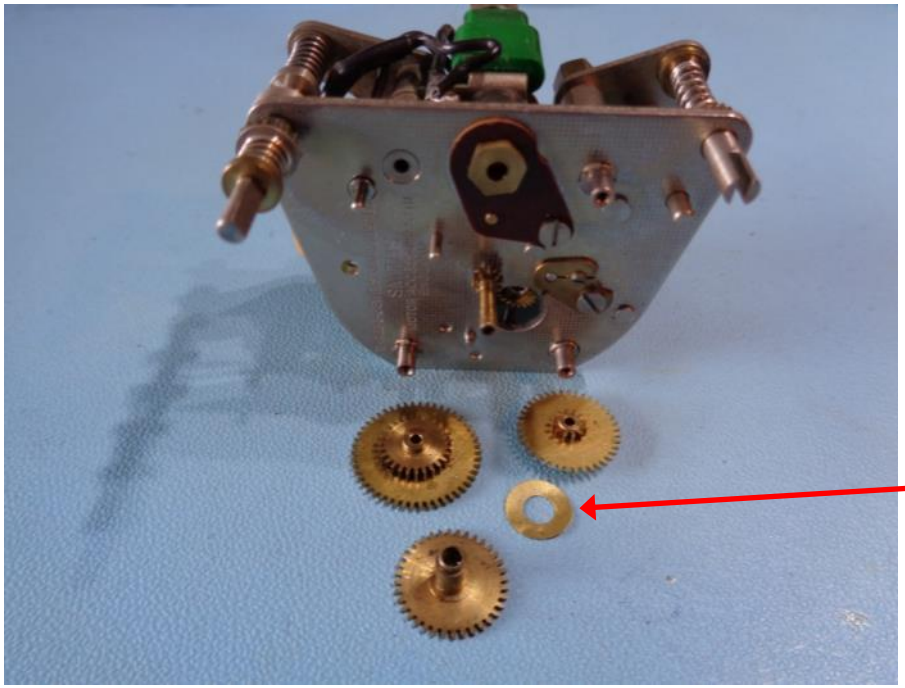
Regulation Disc and Spring



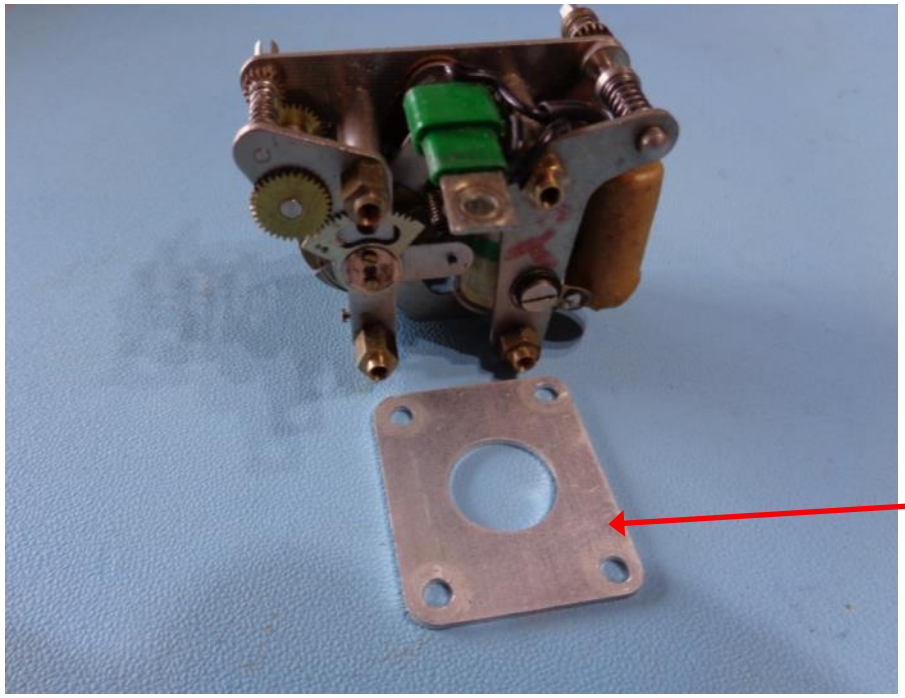
Retaining Plate

1. Pull off Regulation Disc and spring.
2. Undo Retaining Plate screws and remove Retaining Plate.

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

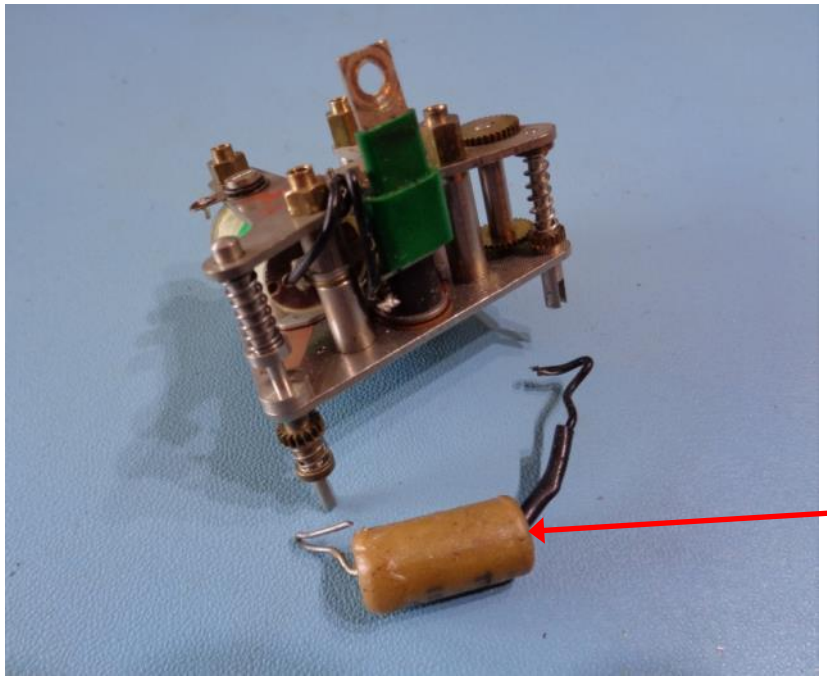


Remove 3 gear wheels being careful not to loose brass dial washer



Remove backplate.

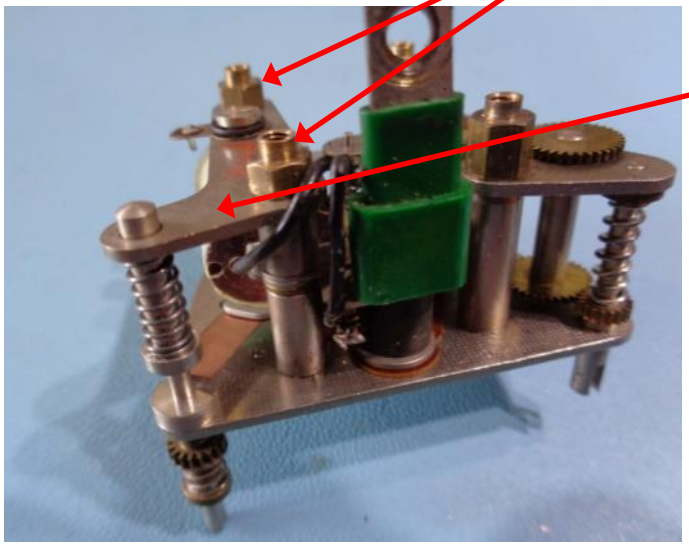
Note: The backplate usually lifts off easily but sometimes it is stiff and you will need to lever it gently with a small screwdriver.



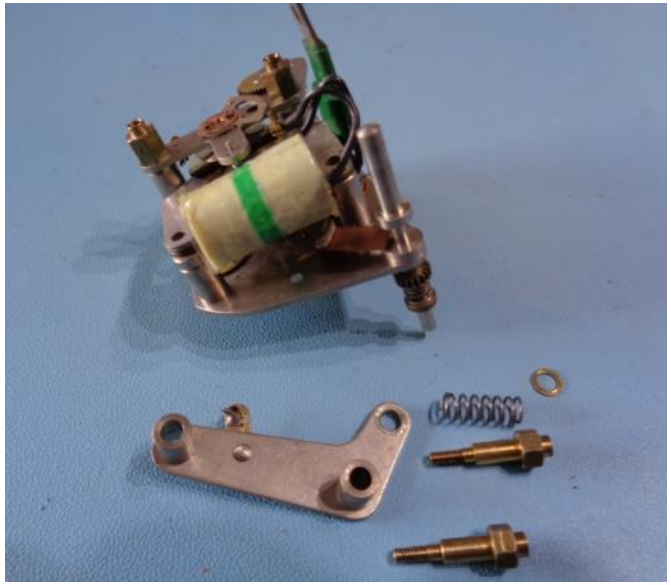
If the mechanism has a capacitor fitted then cut the wires to the capacitor and remove it. The capacitor will not be required for the rebuild and can be discarded.

Note: Some mechanisms are not fitted with a capacitor.

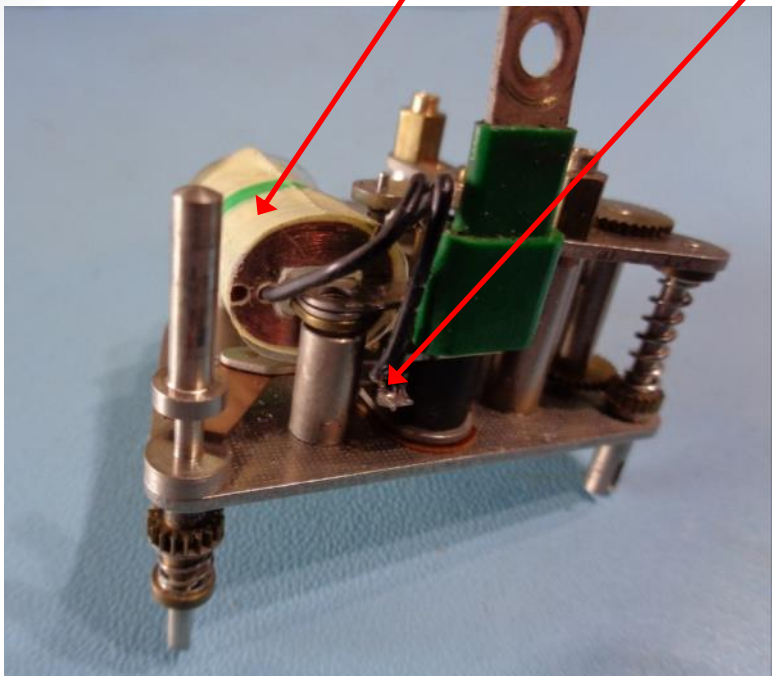
Solenoid
Retaining Pillars

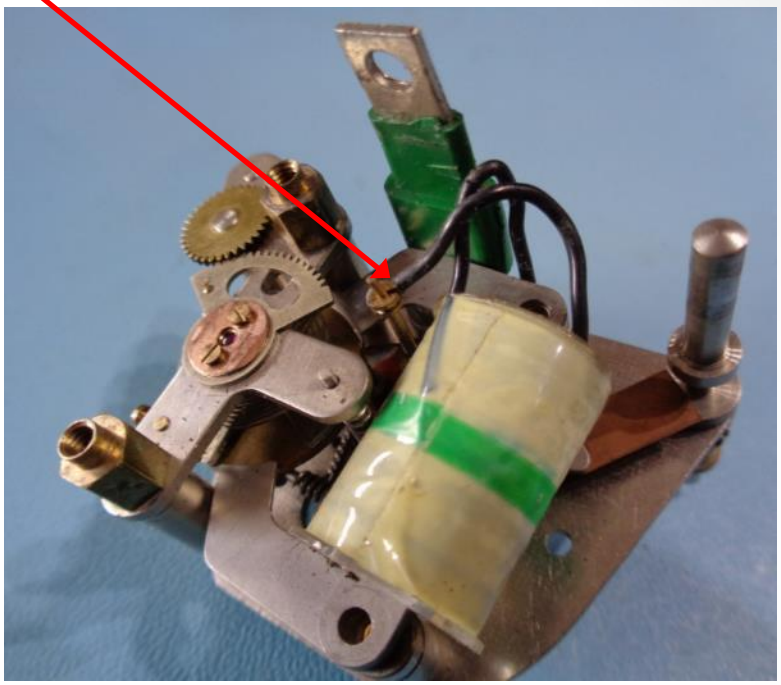


Setting Support
Plate



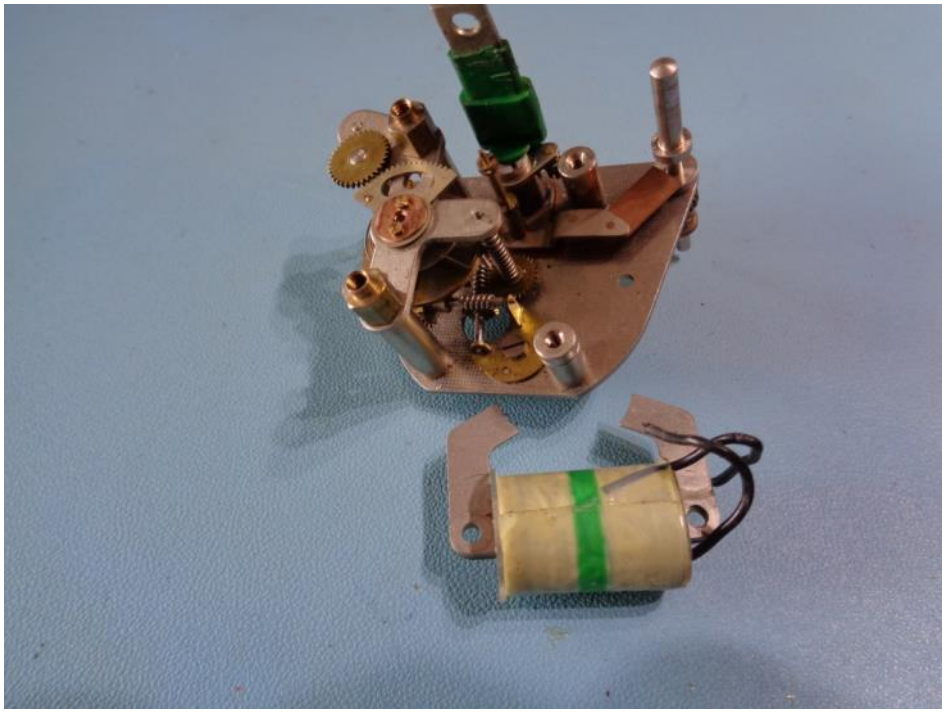
1. Remove two solenoid retaining pillars
2. Remove Setting Support Plate
3. Remove spring and washer from Setting Spindle.





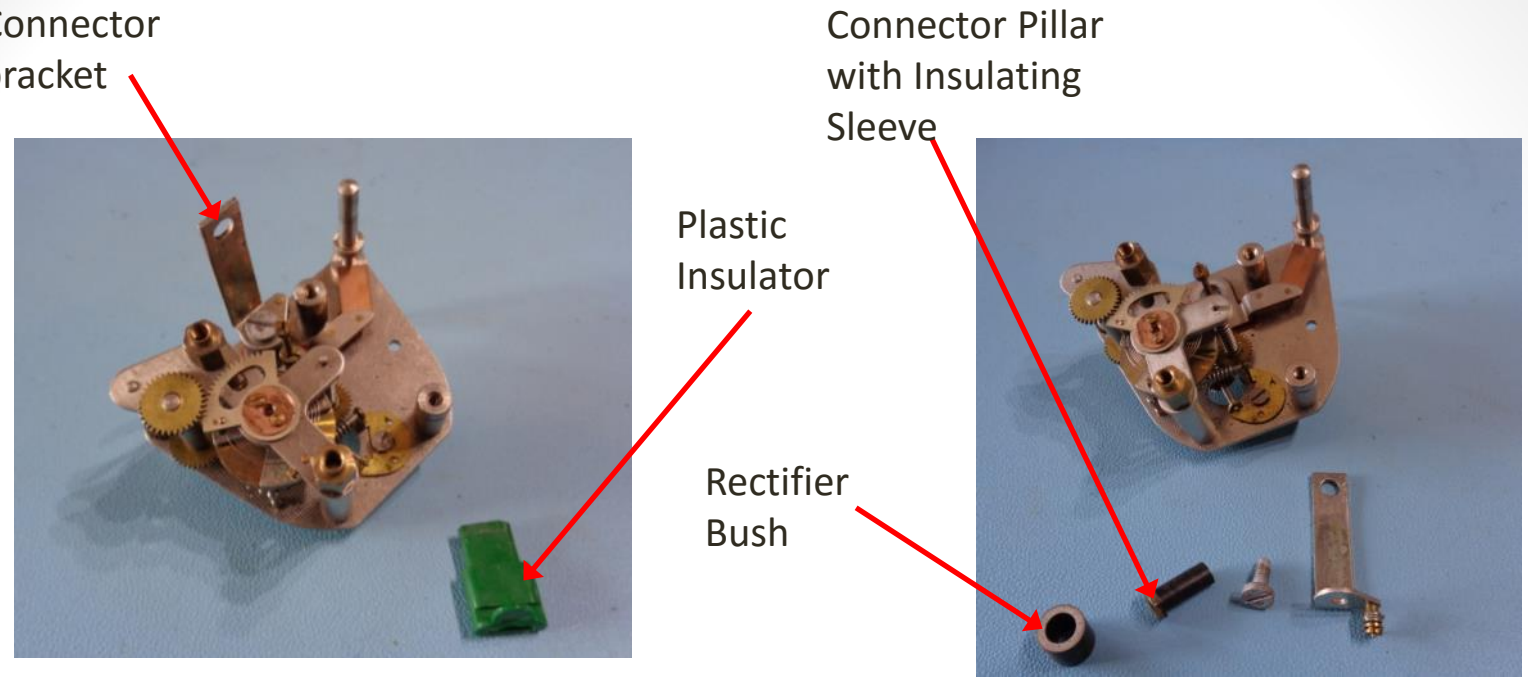
Cut Solenoid wire leaving as much wire as possible attached to solenoid.

Note. It is important not to stress the wires as this can break the connection inside the solenoid.



1. Lift Solenoid from mechanism.

2. Apply glue to solenoid wires at the point where they enter the solenoid body and allow to dry before handling solenoid further. This protects the internal solenoid windings from stress if the wires are moved. Gel type superglue works well for this purpose.



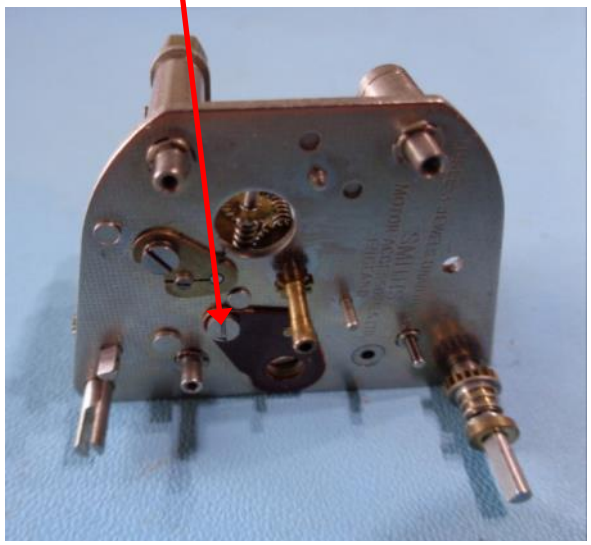
1. Remove plastic insulator from Connector Bracket.

2. Undo connector bracket screw and remove connector bracket ,rectifier bush and brass connector pillar. The brass connector pillar is covered with a plastic insulator sleeve which must be left in place.

Notes:

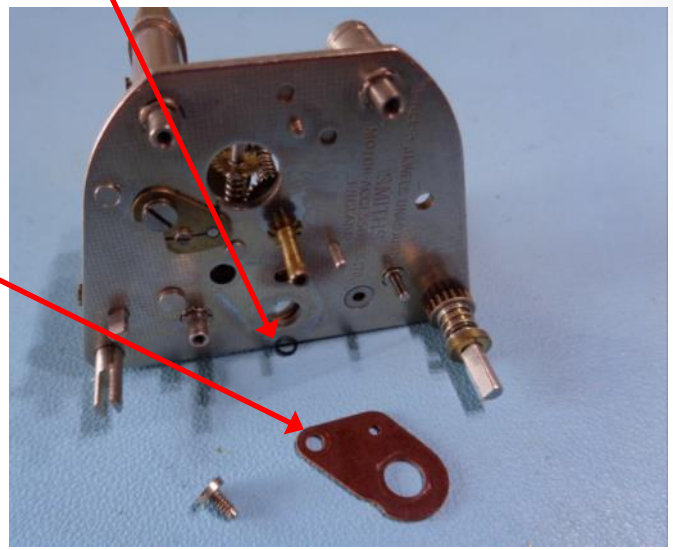
1. The rectifier bush is not required and can be discarded. It will be replaced by the brass bush from the kit
2. If the insulating sleeve on the connector pillar is missing or damaged it can be replaced with the heat-shrink tubing supplied in the kit – use a heat gun or hair dryer to shrink the sleeving onto the pillar.

Contact Assembly retaining screw



Insulating O Ring

Lower Insulating Plate



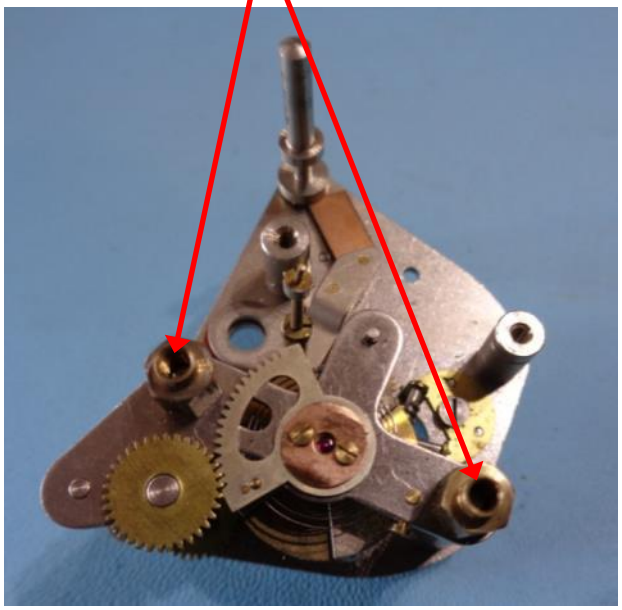
1. Remove Contact Assembly Retaining screw.

2. Remove Lower Insulating Plate.

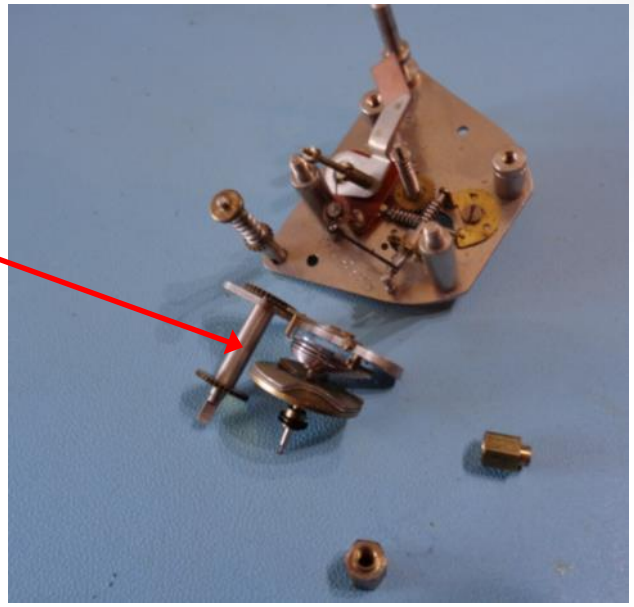
Notes:

1. When the insulating plate is removed you may find that an insulating O ring is also present. This is not required and can be discarded.

Balance Wheel Support retaining nuts



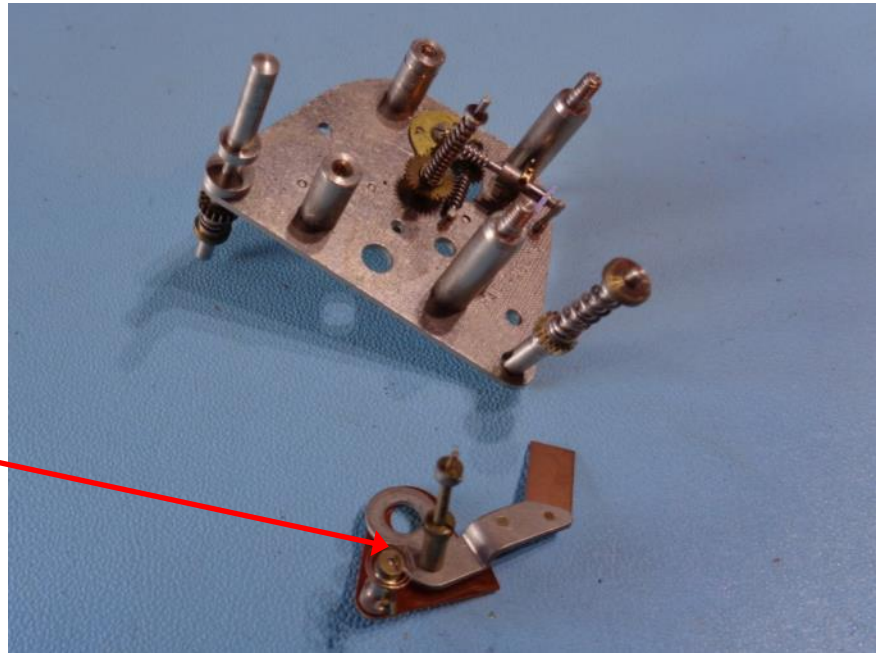
Balance Wheel Assembly



1. Remove Balance Wheel Support retaining nuts.

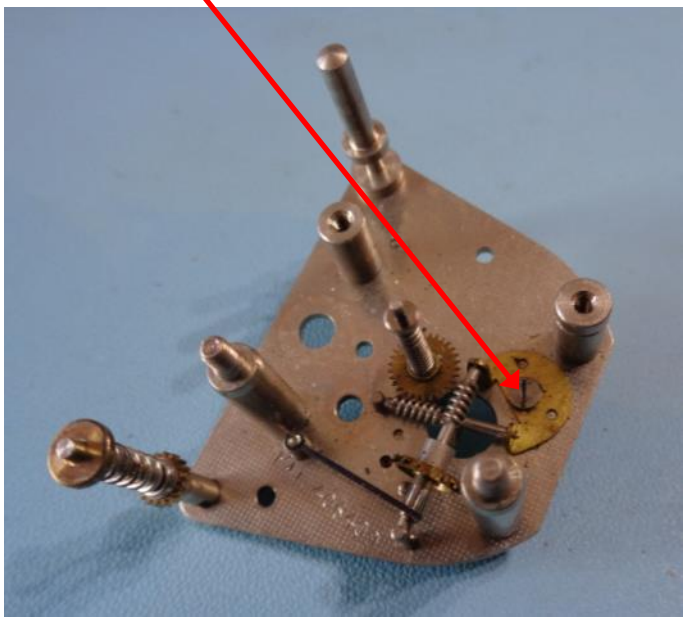
2. Carefully lift off the balance wheel support and balance wheel assembly. Note that this assembly is quite delicate - be careful to support the hair spring as you lift off the assembly.

Contact Assembly



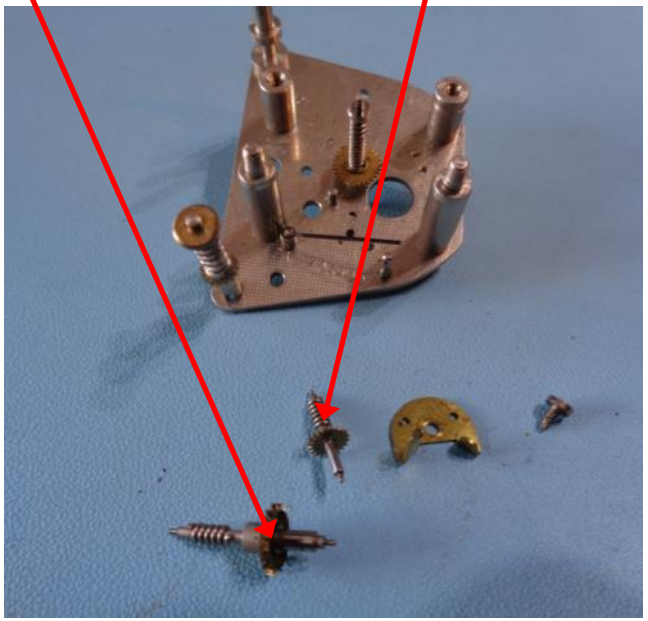
Lift off the Contact Assembly. This will be replaced by the circuit board and is no longer required.

Support Plate Retaining Screw



Escape Wheel assembly

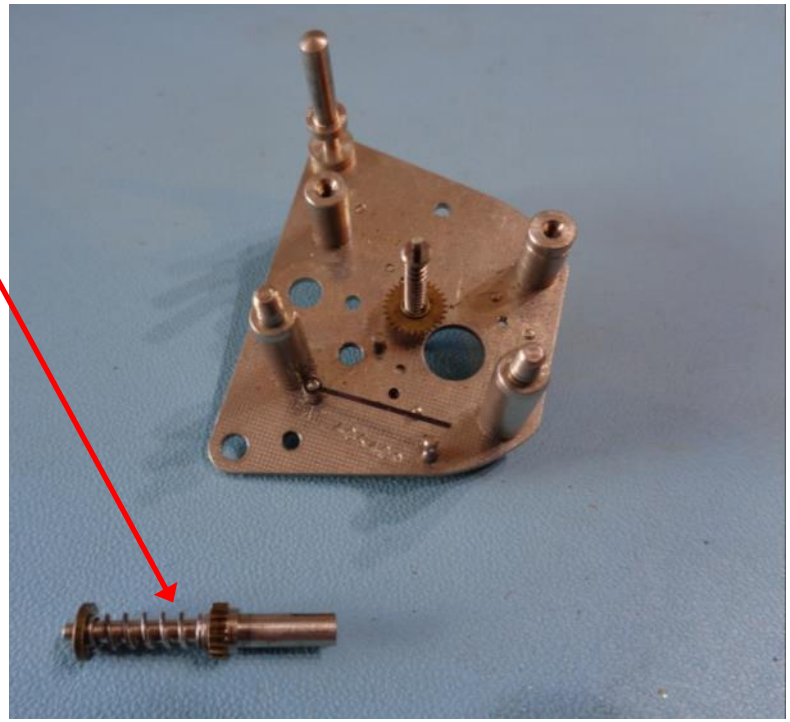
Transverse Wheel assembly



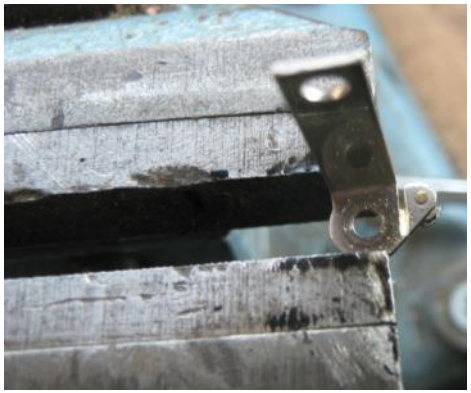
1. Remove Support Plate retaining screw .

2. Remove the Support Plate and Escape and Transverse wheel assemblies

Regulation
Spindle



Remove the Regulation Spindle.



Modify connector bracket by removing side `ear’ as shown

Cleaning and Oiling

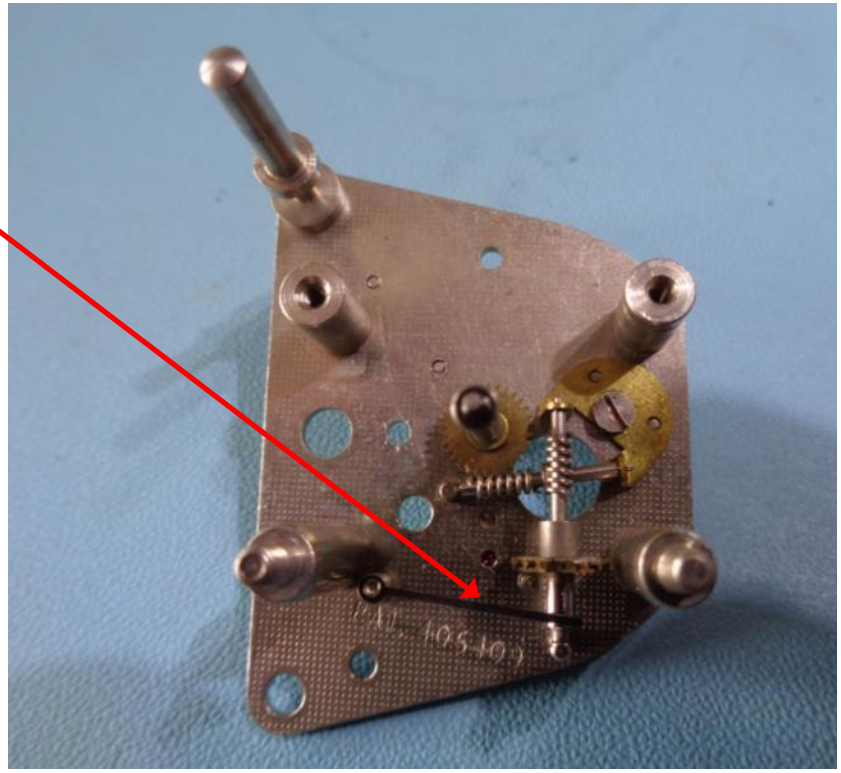
- At this point you should clean and oil the mechanism of your clock. This will help to ensure correct operation and will extend the life of the mechanism. Parts can be cleaned in isopropyl alcohol. Bearings should be cleaned out very carefully using isopropyl and a cocktail stick. Take particular care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

- Once you have cleaned your clock you should 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.

Re-Assembly and Testing

The following slides cover the re-assembly and testing of the clock.

Damper Spring

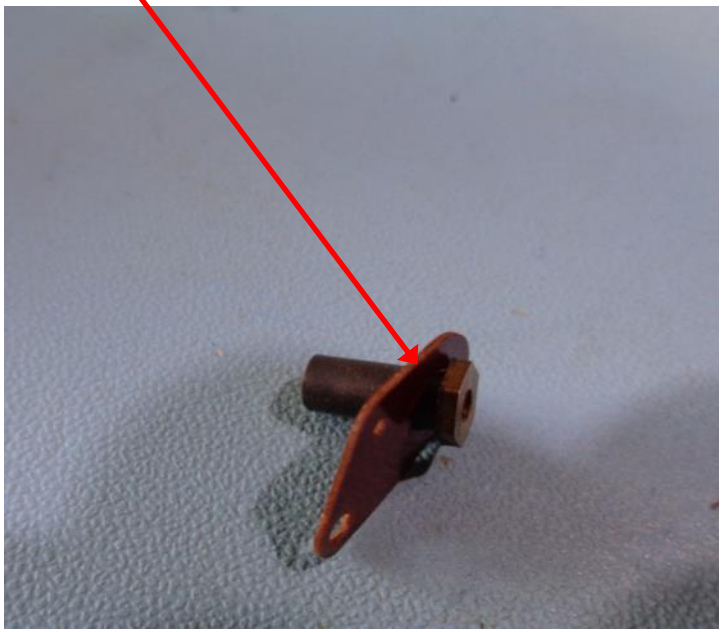


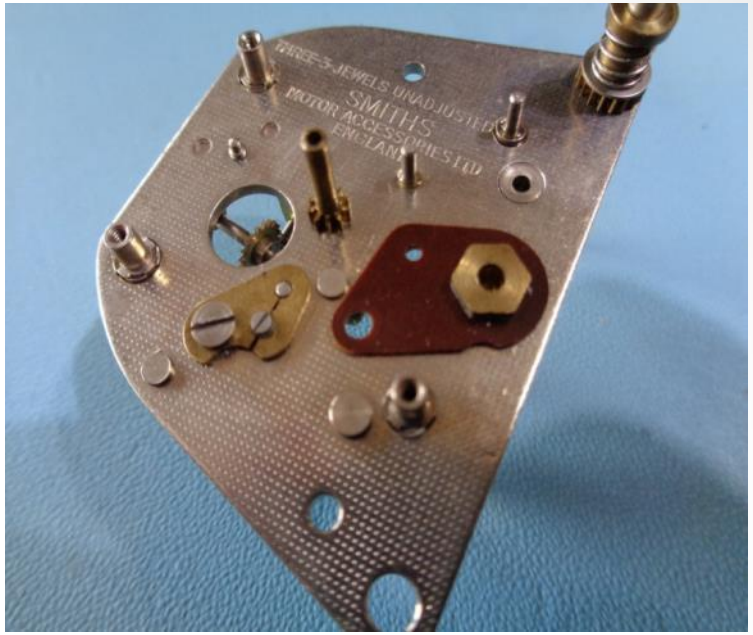
Refit Escape and Transverse wheel assemblies and support plate to the clock baseplate. Make sure that the damper spring is on top of the Escape Wheel shaft.

Note

Use tweezers to help position the parts into place.

Connector Pillar with Insulating sleeve inserted into Insulating Plate



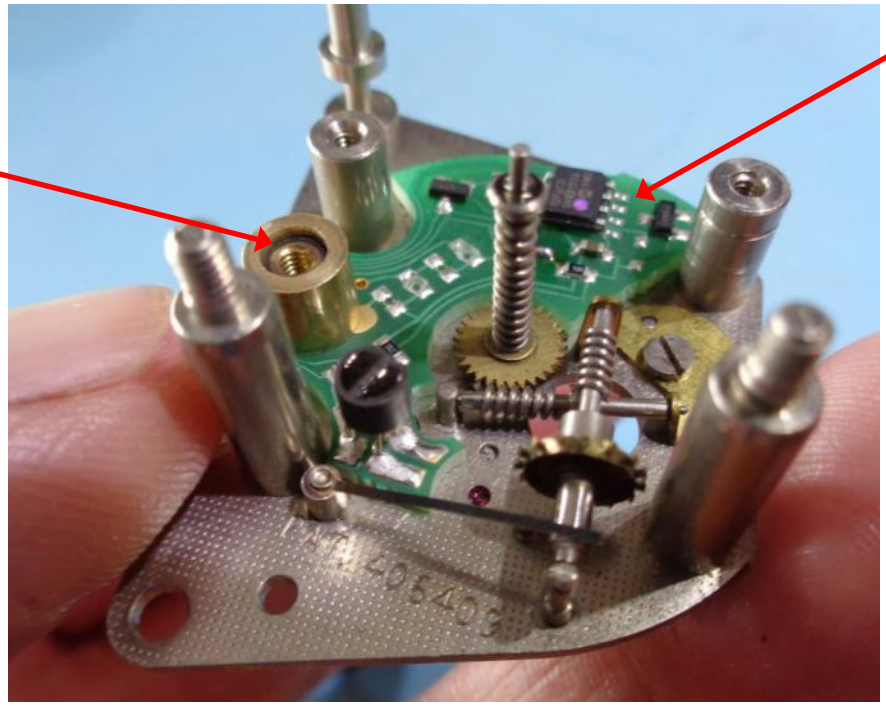


1. Make sure that the brass Connector Pillar has its insulating sleeve in place and insert it into the lower insulating plate as shown.

2. Insert the Connector Pillar into its hole on the underside of the baseplate and position the insulating plate as shown.

Note

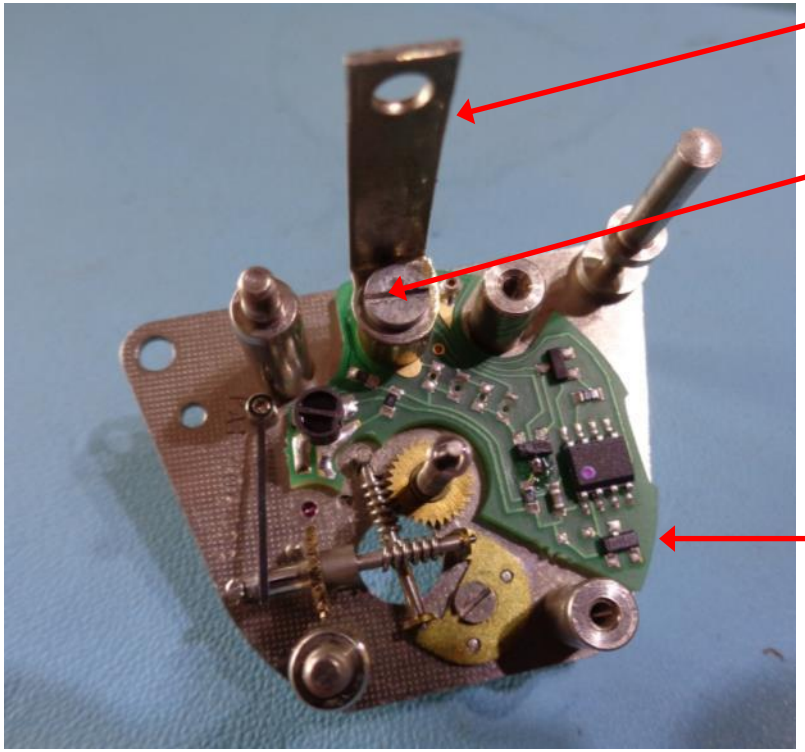
The insulating sleeve should be pushed fully onto the connector pillar.



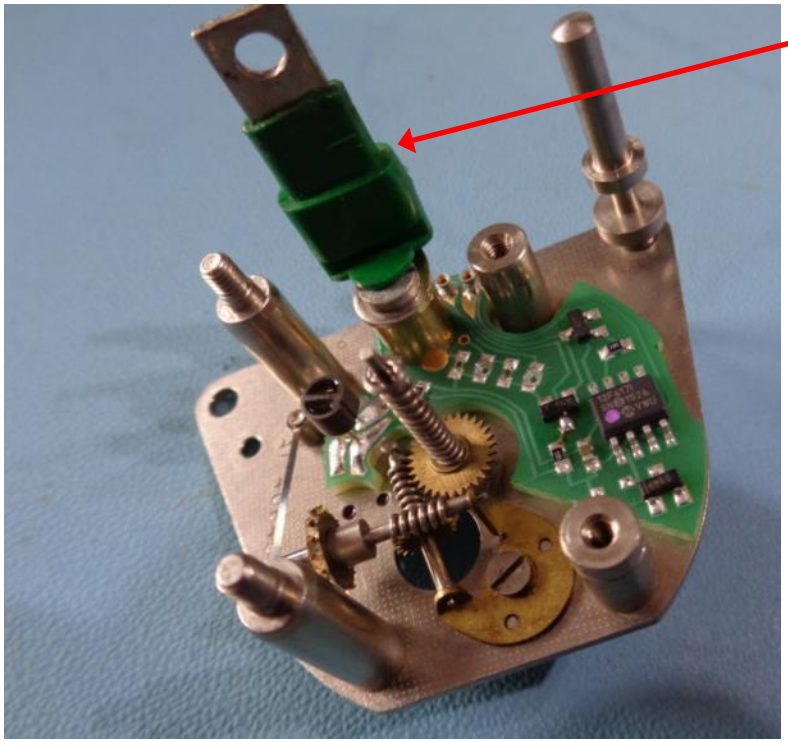
1. Position PCB on clock base plate as shown with hole over connector pillar.

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

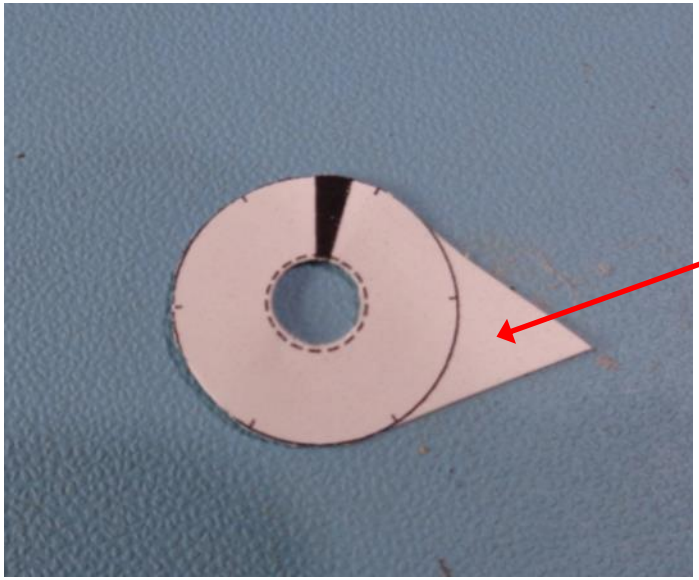
Note: On some clocks the insulating sleeve around the connector pillar is made of thick material and may be difficult to pass through the brass bush. In this case replace the insulating sleeve with heat shrink sleeving supplied with the kit. Shrink the sleeving onto the pillar using a heat gun or hair dryer.



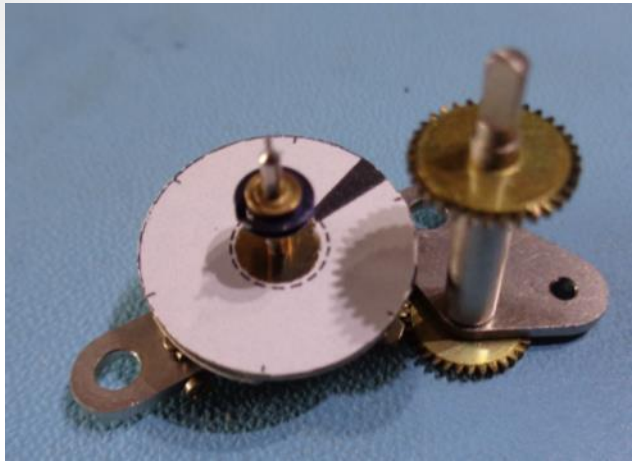
Place the connector bracket on top of the brass spacer and secure the bracket to the connector pillar with the retaining screw. Make sure that the curved edge of the PCB lines up closely with the clock baseplate as shown .

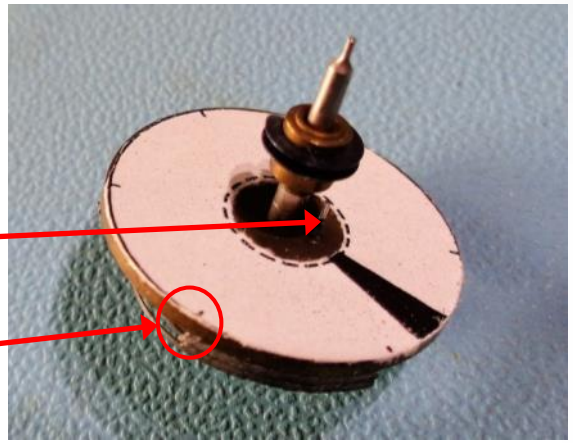


Fit Plastic Insulator over connector bracket as shown .



Use scissors to cut out one of the balance wheel stickers from the sheet (the sheet includes 2 spares). Leave a ‘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.

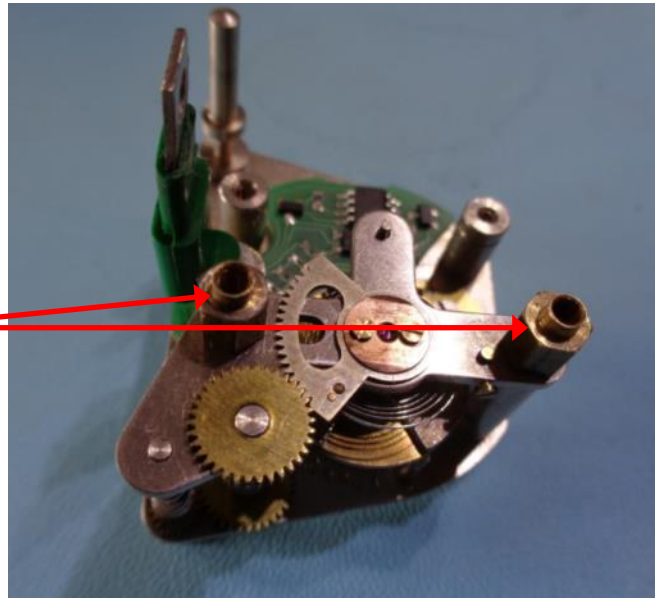




1. Locate Pin on underside of Balance wheel.

2. Carefully clean underside of balance wheel with Isopropyl alcohol and a Q-tip.

3. Peel the backing off the sticker and position it on the underside of the balance wheel so that the black strip is close to the balance wheel pin and the alignment marks (circled) line up with the edge of the balance wheel segments on opposite side of balance wheel. Smooth down the sticker and trim off any excess which overhangs the edge of the balance wheel with a sharp craft knife.

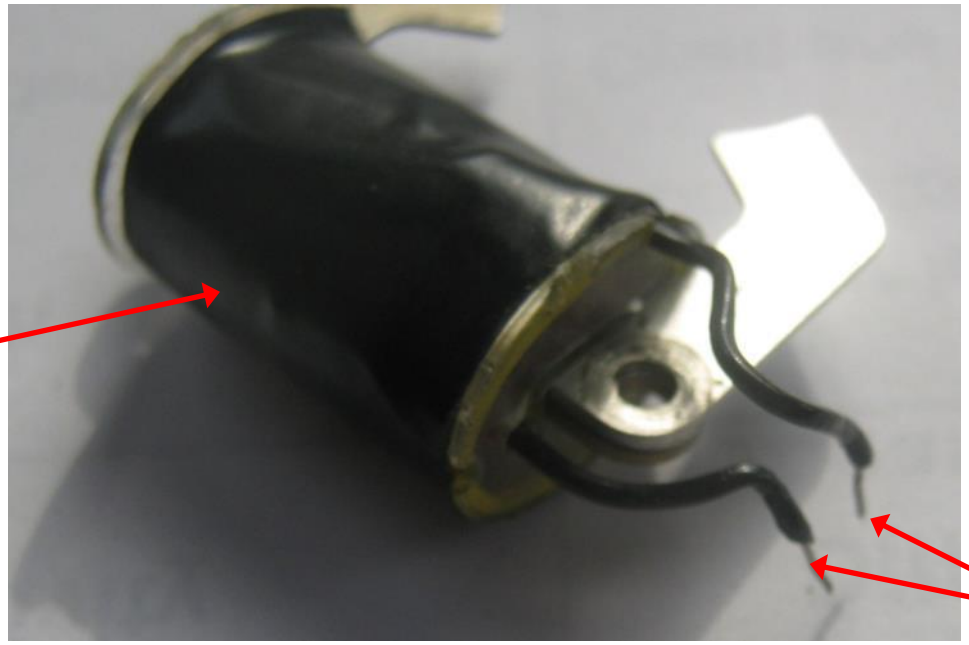


1. Place the balance wheel assembly loosely in place and use tweezers to position the spindles into their bearing holes.

2. Once all the spindles are in their holes push the assembly gently into place and check that the balance wheel rotates freely.

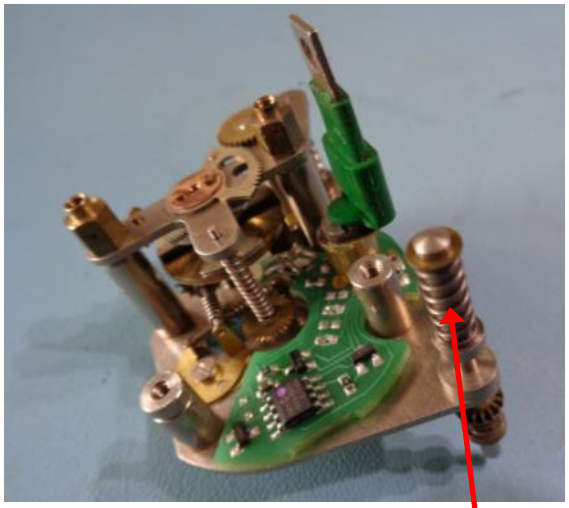
3. Secure the balance wheel support with the two retaining nuts and check again that the balance wheel turns freely.

Note:
Sometimes the regulation gears can prevent the balance wheel assembly from being pushed fully into place. In this case turn the regulator spindle a little to bring the gears into mesh.



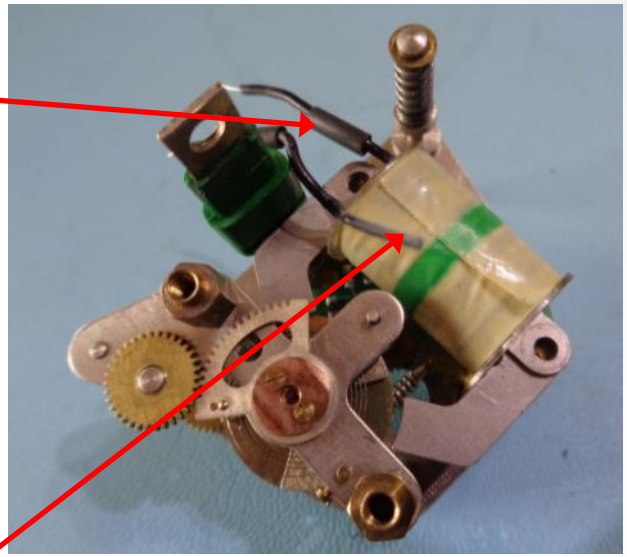
Using wire strippers, strip approx. 3mm from the ends of each solenoid wire. If the tape around the solenoid body looks worn, wrap this with a couple of turns of new insulation tape.

Notes:
Be careful not to flex or pull on the wires as this can break the connection inside the solenoid. 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.



Setting Spindle with Spring and Washer

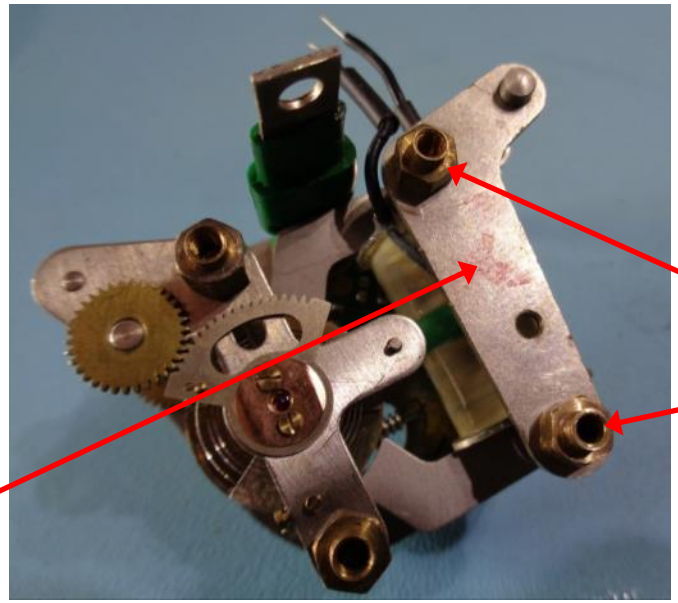
heat-shrink Sleeving



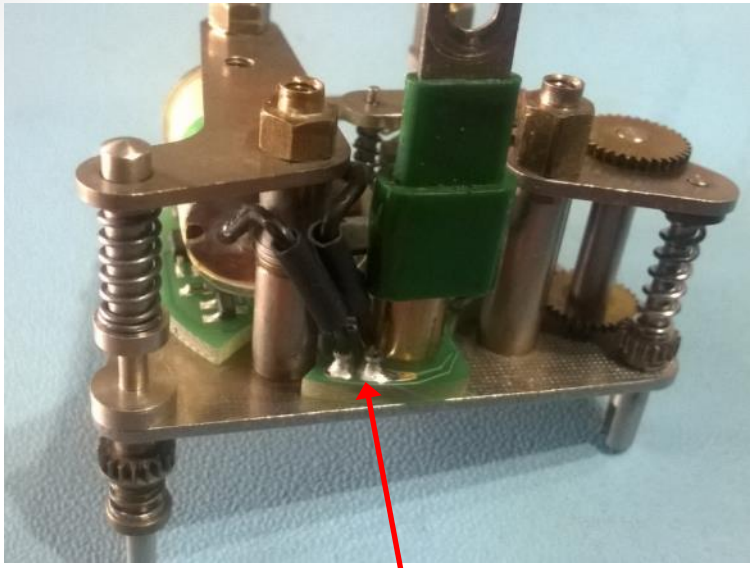
Solenoid

1. Fit Setting Spindle, spring and washer.

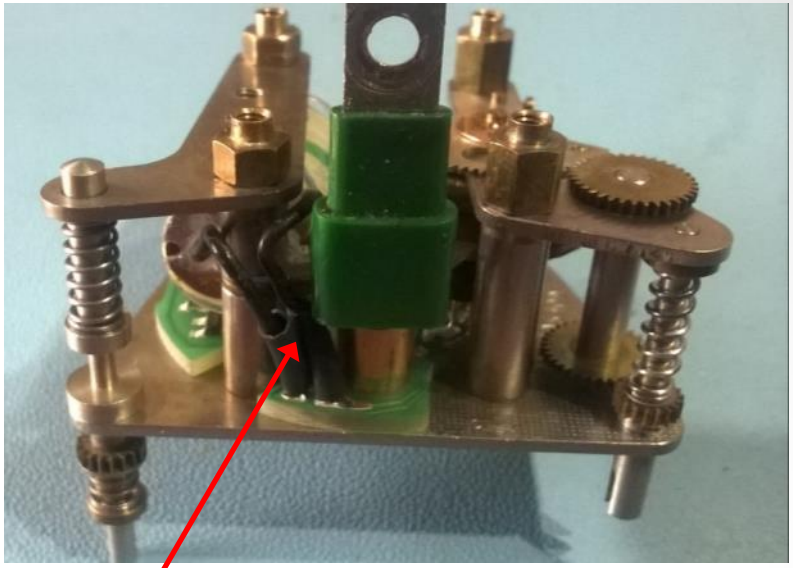
2. Fit the solenoid and place a small piece of heat-shrink sleeving over each wire



1. Re fit Setting Support Plate and loosely do up the retaining nuts.
2. Check that solenoid pole pieces are evenly spaced around balance wheel and that balance wheel moves freely.
3. Tighten retaining nuts.



Wires fitted into
Push fit Sockets



Heat-shrink sleeving
over sockets

1. Use tweezers to push the solenoid wires into the two push fit sockets on the PCB.
2. Once the wires are in place slide the heat-shrink sleeving over the sockets as shown

Notes:

1. The sockets are designed to provide a push fit connection. Do not solder the wires into the socket as this will melt the solder on the PCB and may cause a short circuit.
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 you should 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.

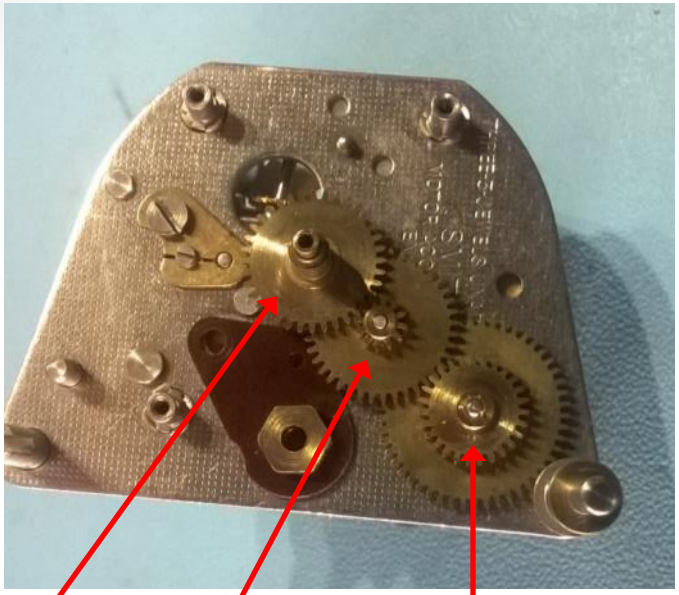
If the balance wheel does not oscillate please see the trouble shooting section at the end of these instructions.

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.

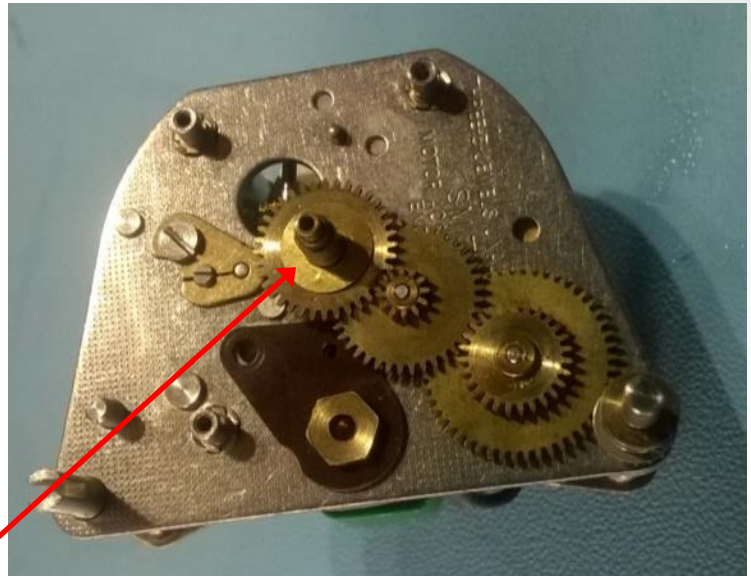
Using a battery charger when the clock is installed in the car does not generally cause a problem as the battery smooths out the voltage fluctuations.



Hour Wheel

Minute Wheel

Setting Wheel

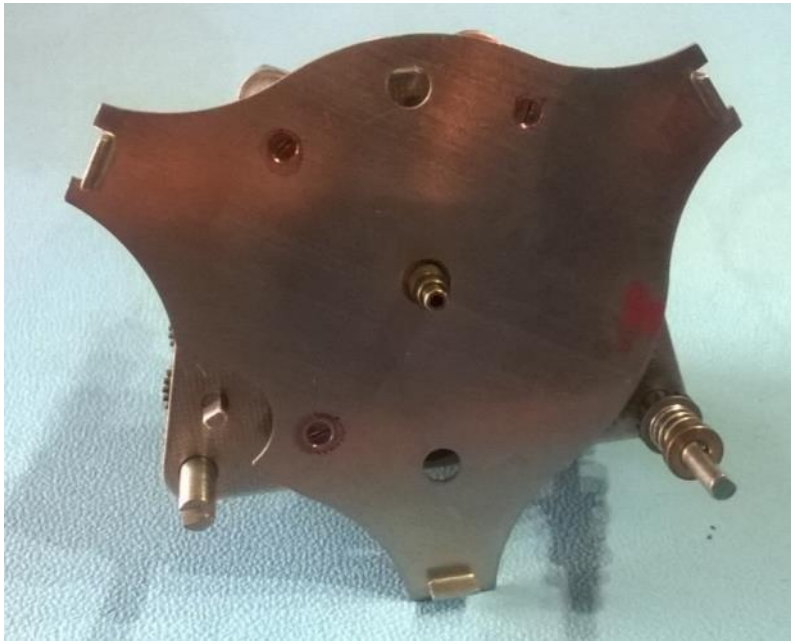


Dial Washer

1. Replace three gear wheels Starting with the Setting Wheel, then Minute Wheel and finally Hour Wheel.
2. Fit Dial Washer as shown.

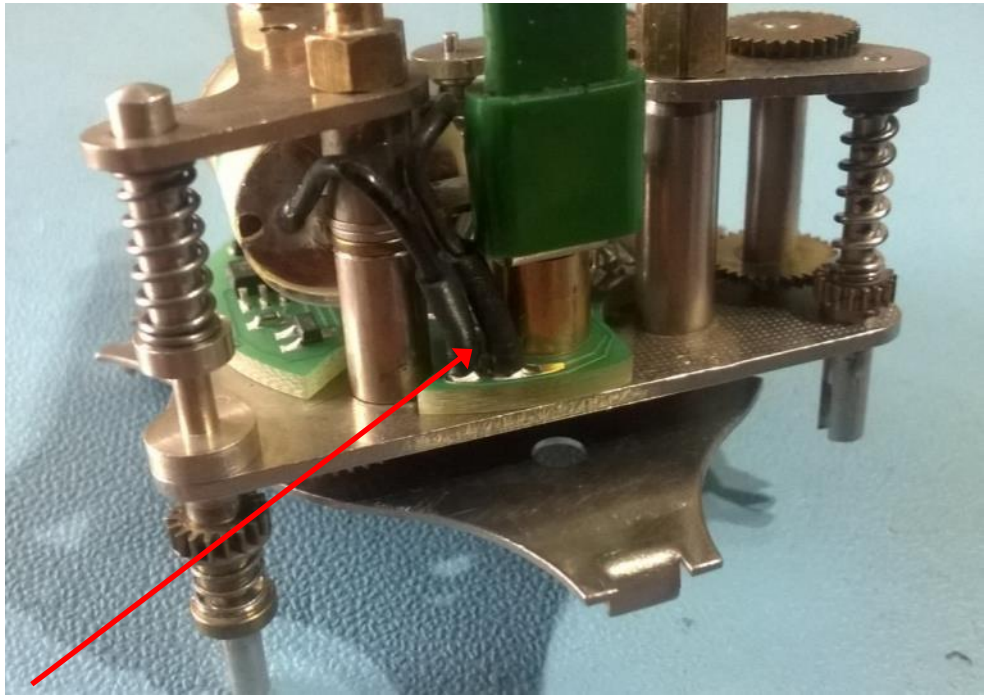
Notes:

Before fitting place a small drop of clock oil on the shaft of each gear wheel and also on each side of the dial washer.



Re fit retaining plate (3 screws)

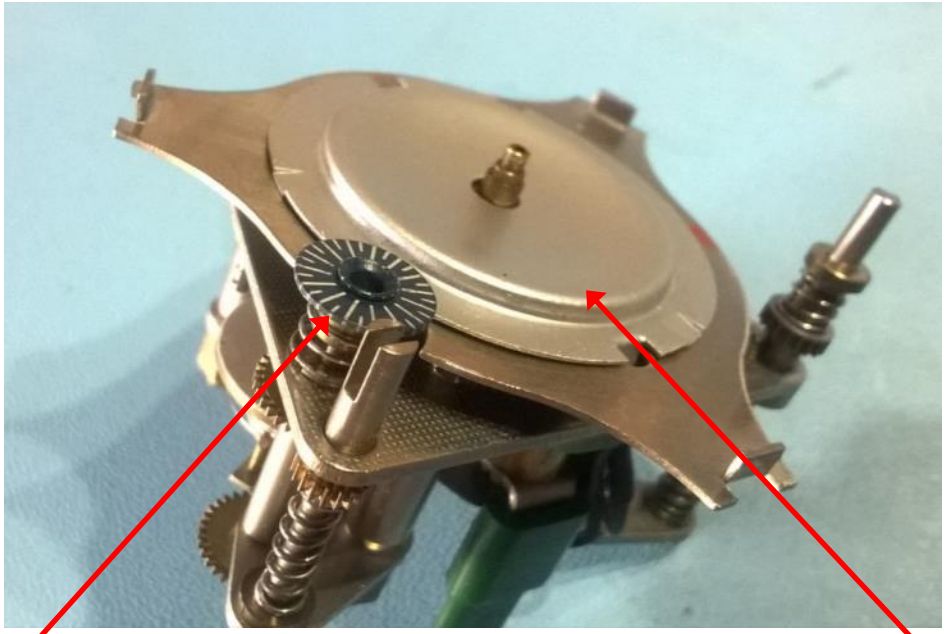
Notes:
The back of the retaining plate must be clean so that it doesn't cause friction against the dial washer. If necessary polish with metal polish before fitting.



Heat-shrink tubing shrunk
over solenoid wires

1. Re-connect the movement and check again that it is running properly. If it does not run properly but did run previously this is probably because of extra friction caused by fitting the retainer plate – make sure that the back of the plate is clean. In some cases it may be necessary to adjust the damper spring (see troubleshooting section).

2. If the movement runs correctly use a hot air gun or hair dryer to shrink down the heat-shrink sleeving around the solenoid wires.



Regulation Disc and Spring

Dial Centre piece

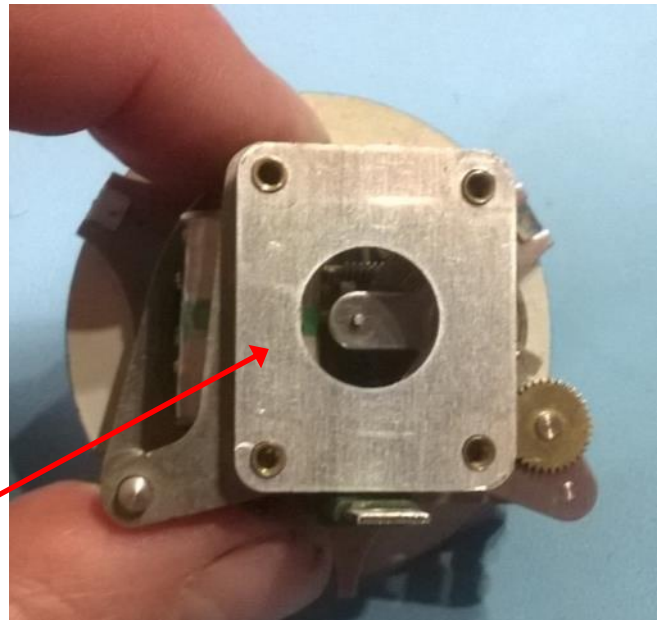
1. Fit regulation disc and spring.
2. Fit Dial centre piece (not present on all clocks)

Fit dial plate and secure in place by bending back tabs on retainer plate.

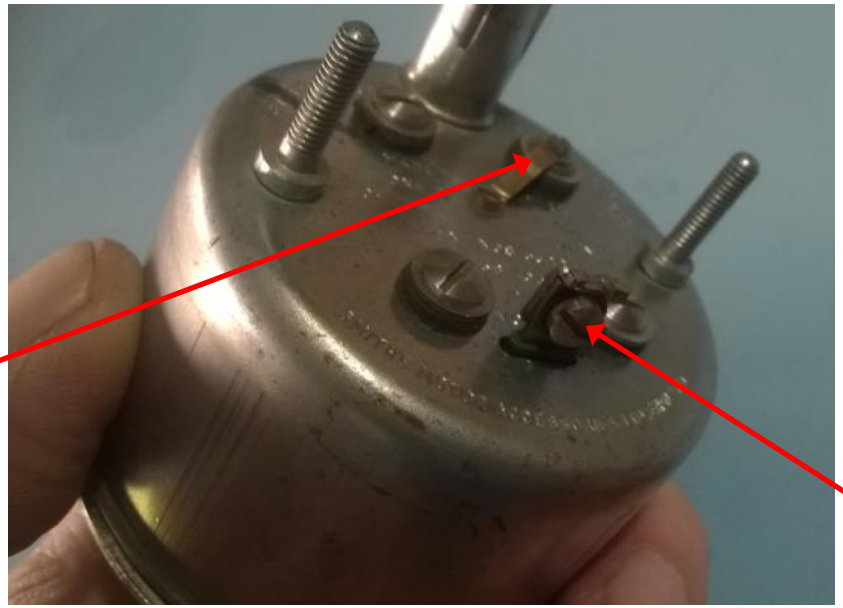
1. Fit hour and minute hands making sure that they align at the 12 O'clock position.
2. Turn the Setting spindle and make sure that the hands do not touch the dial or each other.
3. Fit the Cap over the centre of the hands

Notes:

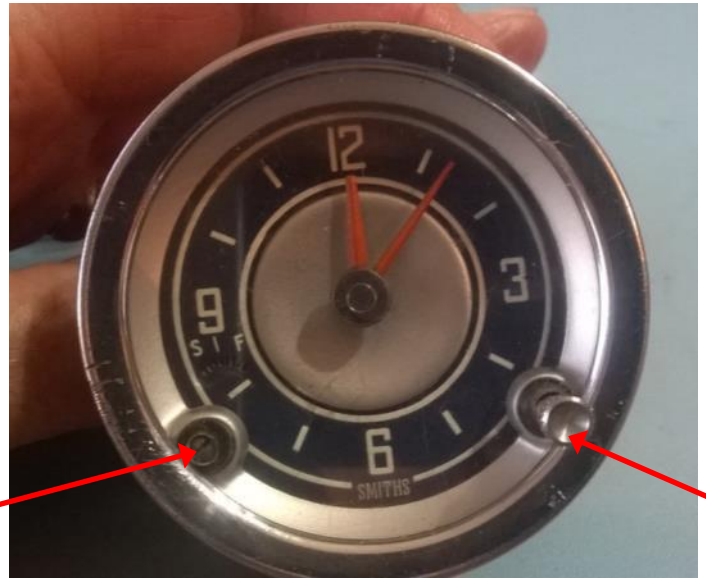
1. To aid fitting the hands it is useful to make a "hands pusher" tool. This consists of a small piece of dowel with a hole drilled through the middle to clear the spindle. The tool should be made of a material that will not mark the dial e.g. wood or nylon.



Re- fit Backplate



1. Fit mechanism into case and secure with case screws making sure that the screw with the tapped hole is in the correct position for the fused link.
2. Fit fused link
3. Fit connection screw and plate



1. Fit the bezel making sure that the setting knob and regulation screw engage with their corresponding spindles.

1. Secure bezel in place by carefully bending back tabs.

Regulating the Clock

- Before fitting the clock to the car you should adjust the timekeeping using the regulation screw on the front of the clock.
- 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.
- 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.

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 (following trouble shooting section)

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 escape 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

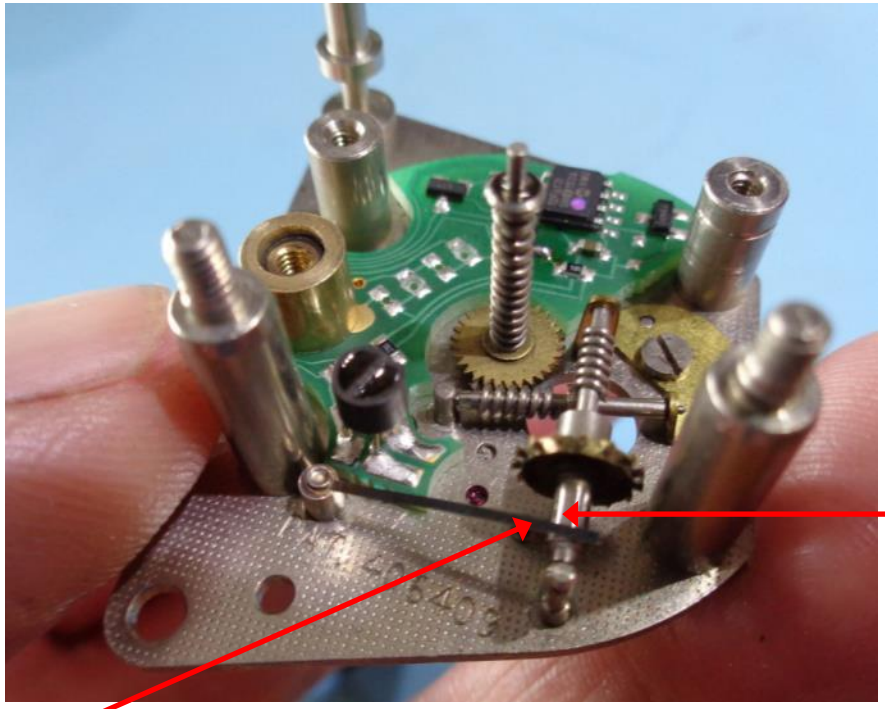
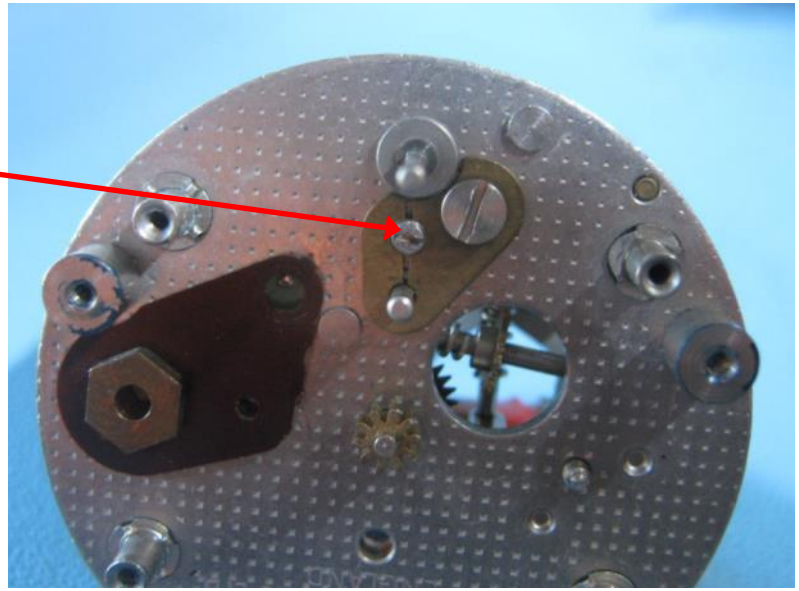


Photo showing location of Damper Spring and Escape Wheel shaft

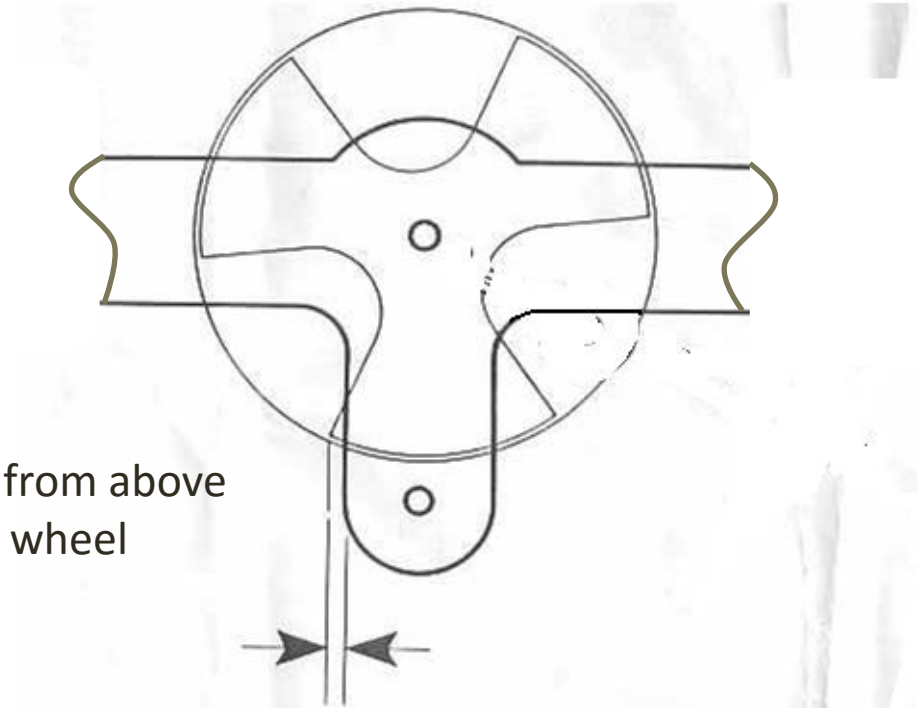
Adjusting the Balance Wheel Bearing

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.

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.