COMMISSIONING A MURDAY TYPE CLOCK

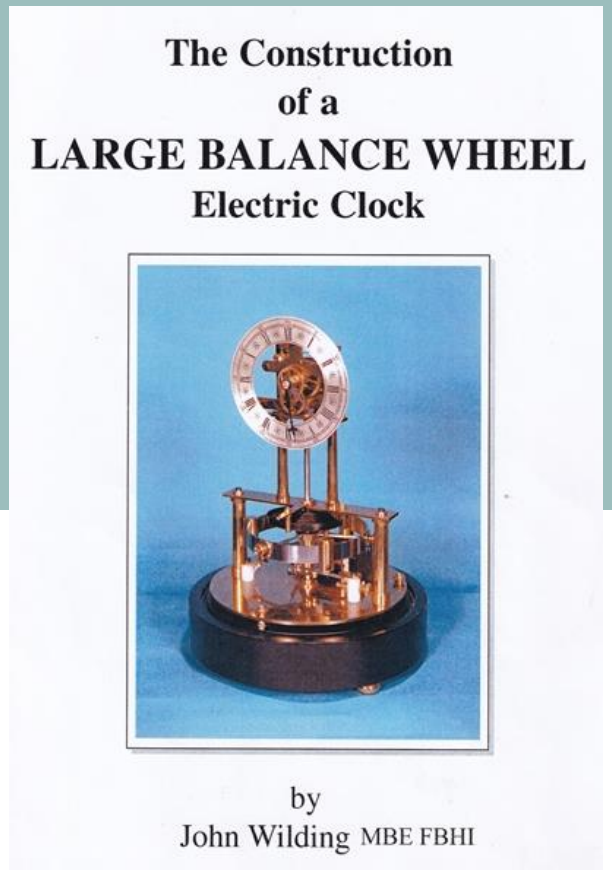
DESIGNED BY JOHN WILDING
BUILT BY JEAN-PAUL DELABY

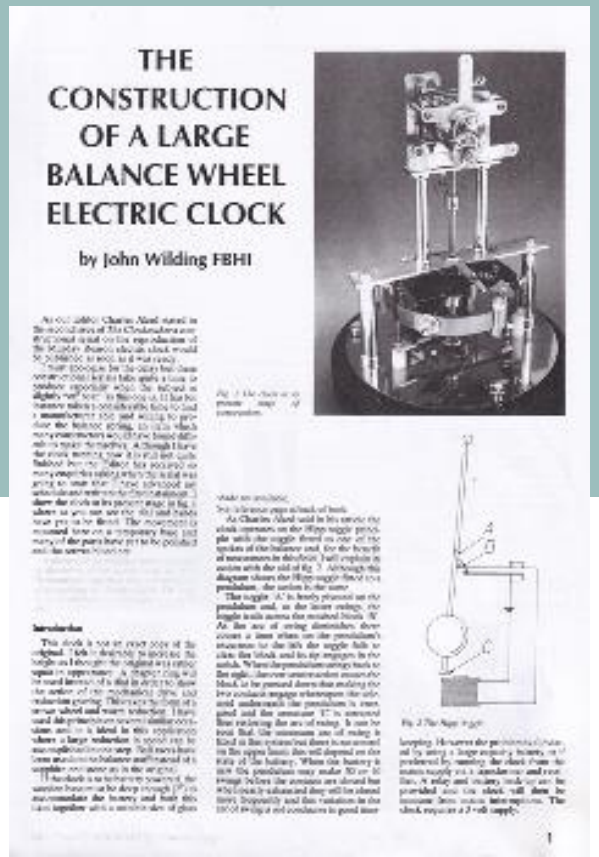
A symphony
of movement

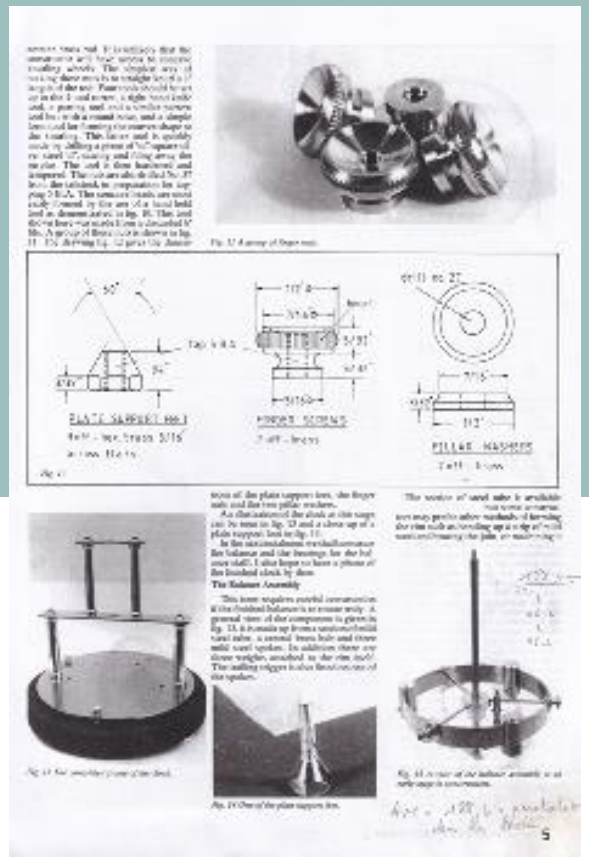
Owned by Georges TESSOT
Commissioned by Brian Scott

John Wilding detailed the clock design and construction in a series of 8 articles in “The Clockmaker” magazine from the early 1990’s.
It is not an exact Murday replica - the difference include

- The balance running on ball races rather than Murday’s jewelled bottom bearing
- A simplified mechanical drive train to the hands and a taller frame.
- Some modifications to the solenoid activated balance pusher





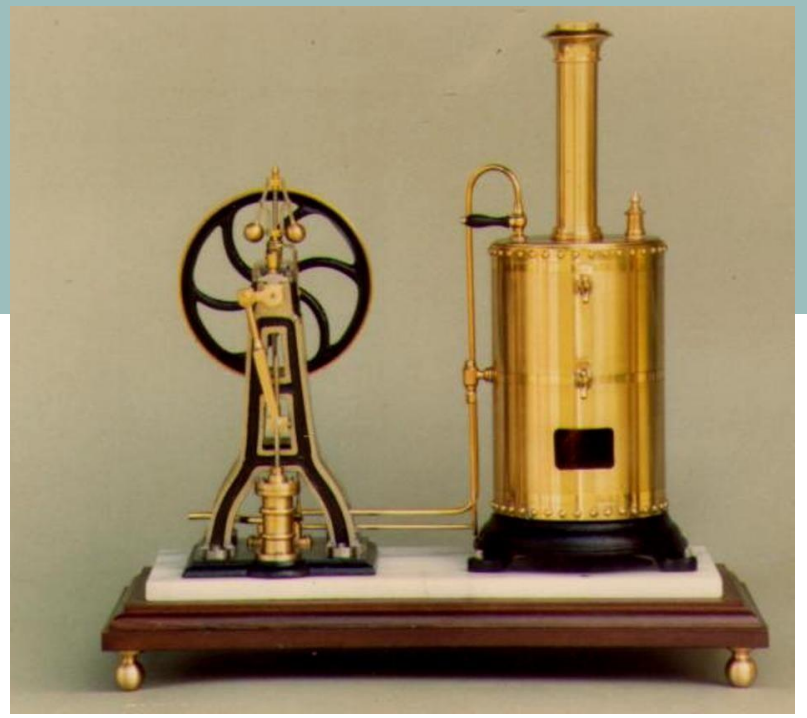


COMMISSIONING A MURDAY TYPE CLOCK

Jean-Paul DELABY

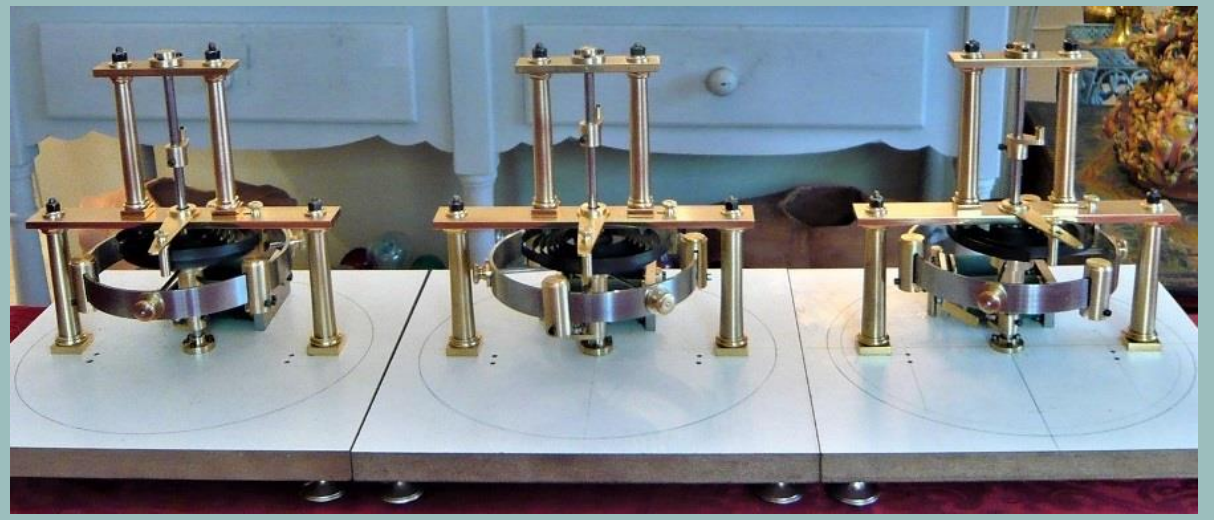
The Clock was constructed based on the design by John Wilding and was made by a French Master Craftsman, Jean-Paul DELABY, who has had extensive experience making steam and electromechanical model devices.

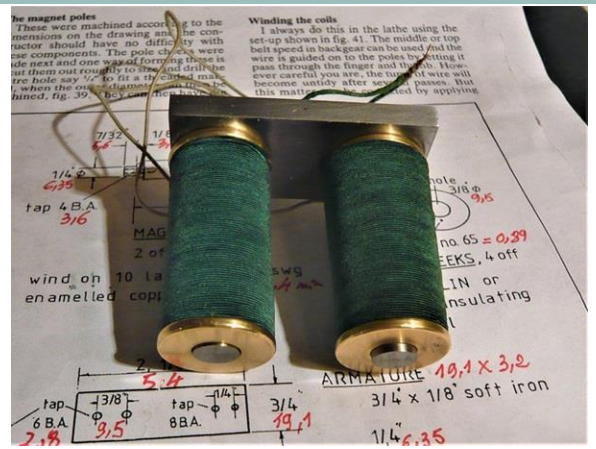
https://www.vapeuretmodelesavapeur.com/jeanpauldelaby/index.html



COMMISSIONING A MURDAY TYPE CLOCK

Jean Paul DELABY constructed three clocks based on the Wilding design. The clock detailed in this presentation was made for Georges TESSOT, a French clock collector. One of the other two is owned by Jean-Paul DELABY and the other is owned by a French Steam Engine Collector. The commissioning of the clock owned by Georges was carried out by Brian Scott in Australia.





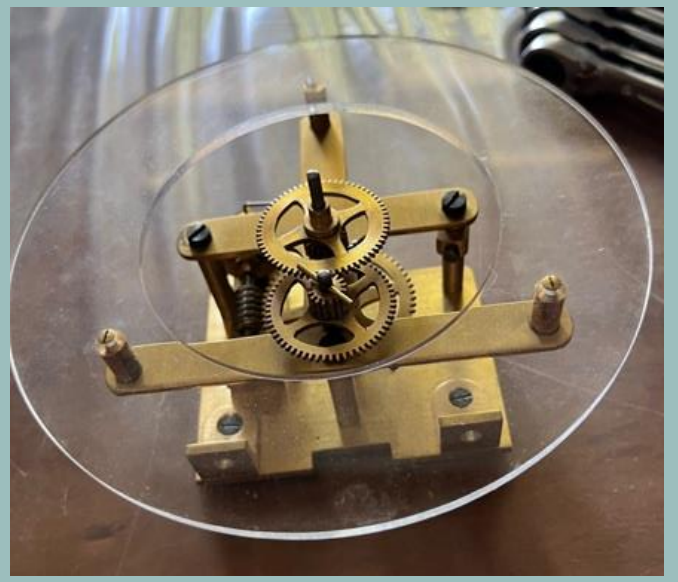
Photographs of the construction by Jean-Paul DELABY from his Facebook page.

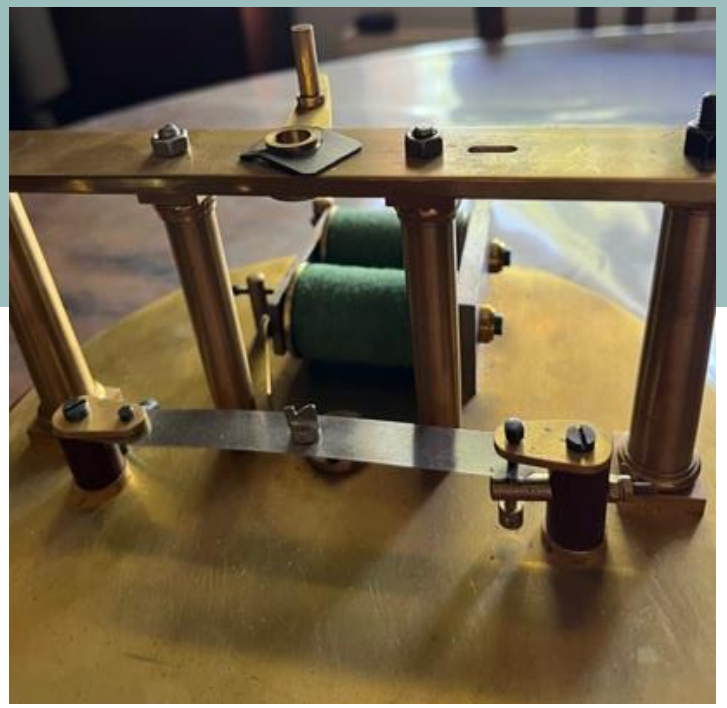
COMMISSIONING A MURDAY TYPE CLOCK

1 Condition as received and assembly method

The clock was shipped from France to Australia in an Australian made wood box in a partially disassembled state to minimise the chance of breakage.

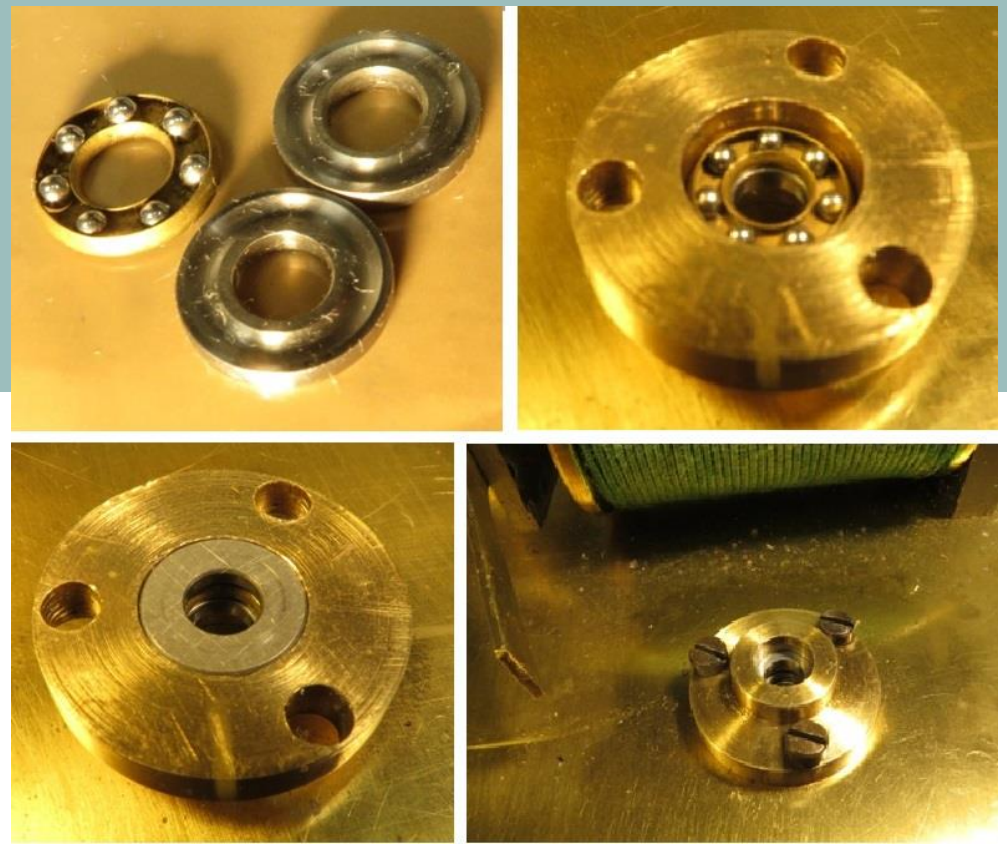
This presented the opportunity to start assembly from scratch and allow testing of the functioning of the movement as assembly progressed





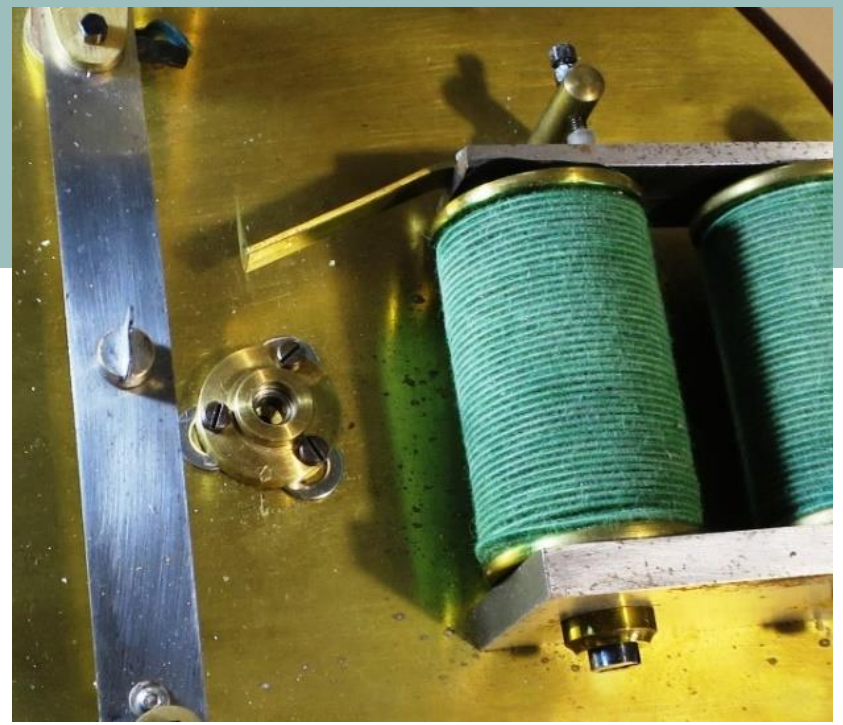
2 The Balance and its bearings

- On fitting of the balance with its two bearings into the frame a problem became immediately apparent.
- The balance was not freely rotating when a manual spin was given to it. It would stop rotating in just a few turns.
- The main problem with the thrust bearing is that it has a high variable friction as the thrusts balls continually skid in their shallow groove.



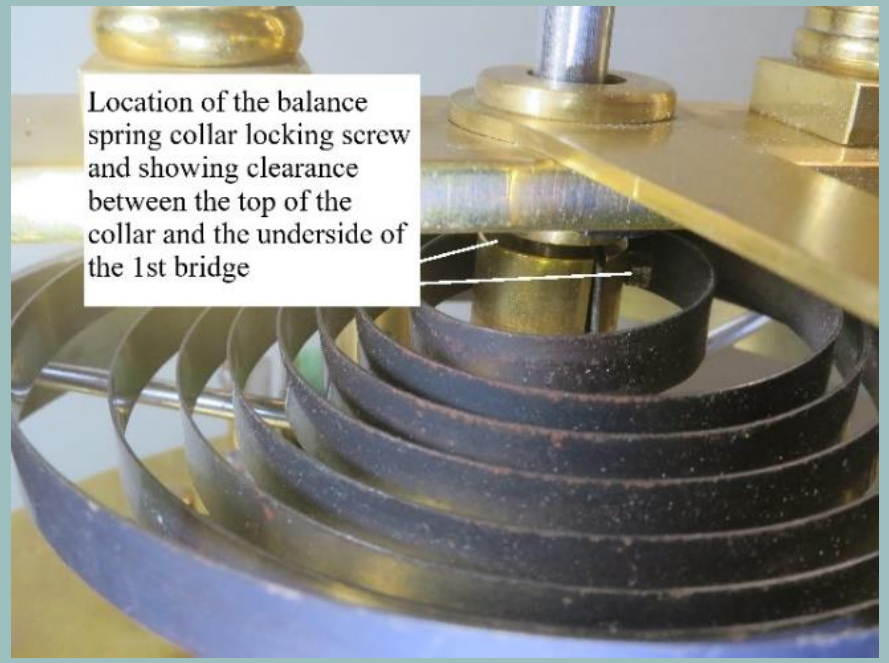
3 New Bottom Bearing Fitted

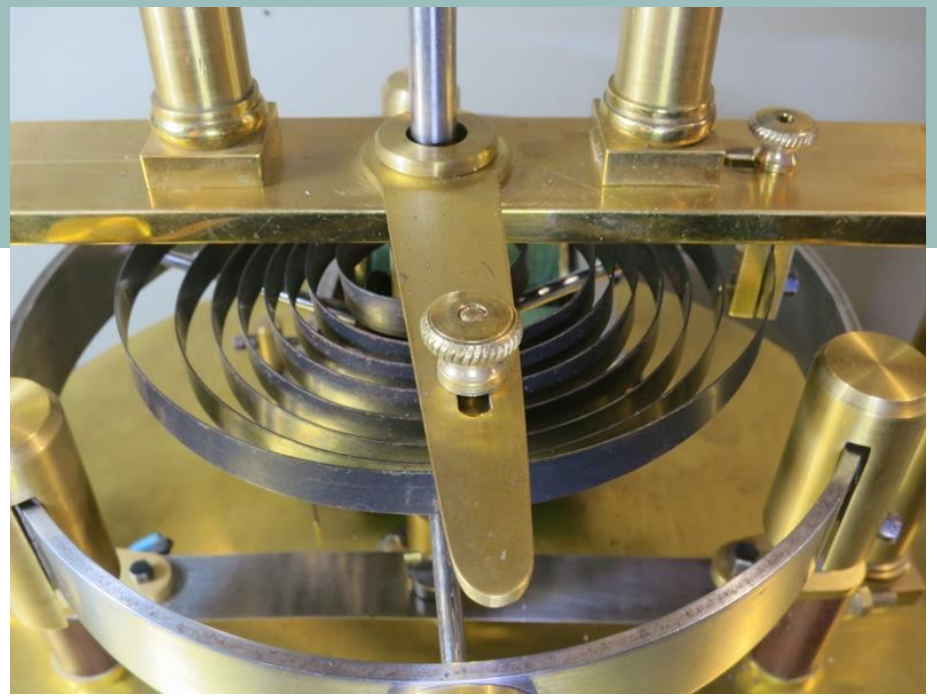
- A new bottom bearing was purchased, the grease removed with alcohol and lubricated with 5W40 motor oil. The same cleaning treatment was applied to the top bearing.
- The results were not immediately satisfactory as the bearing was mounted directly on the clock base plate and so the inner part of the ball race rubbed on the base plate due to the weight of the balance pushing it down.
- As a temporary measure 3 spacing washers were put under the periphery of the ball race and this solved the problem.
- After the re-installation of the bearings a manually operation of the solenoid resulted in 55 turns of the balance before it stopped

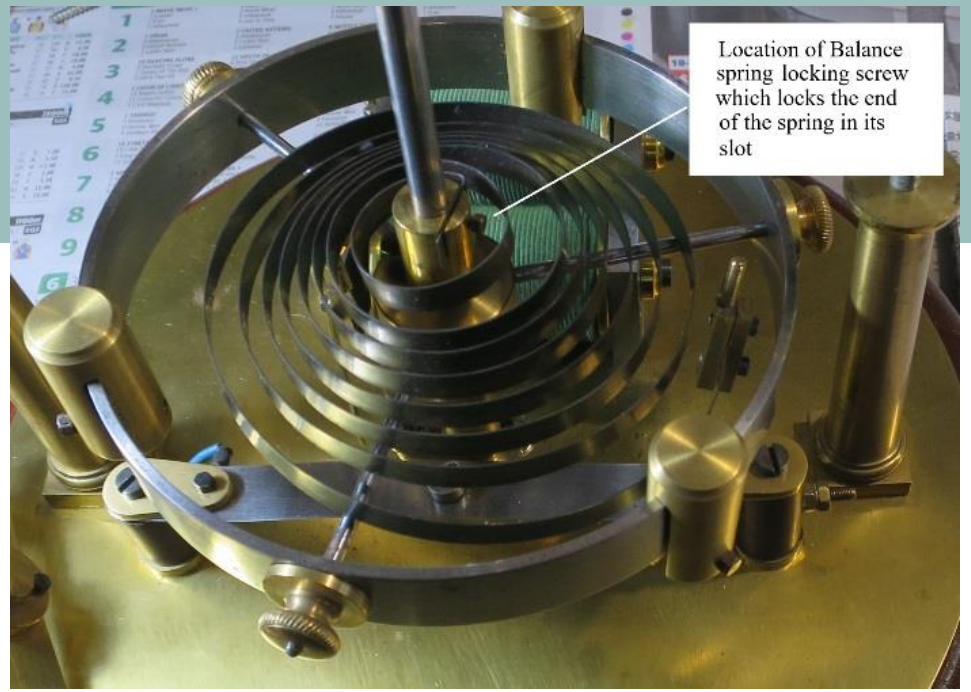


4 Balance Spring Fitted

- The balance spring was fitted and tested with a manual impulse to the balance wheel.
- An estimated 8 to 10 rotations would occur in the typical range where the Hipp toggle would act.
- The balance spring has the inner end fixed in a collar using a screw. A lower screw on the spring collar locks it onto the balance staff
- The other end of the spring is anchored to a post that fits in a slot on the lower bridge.

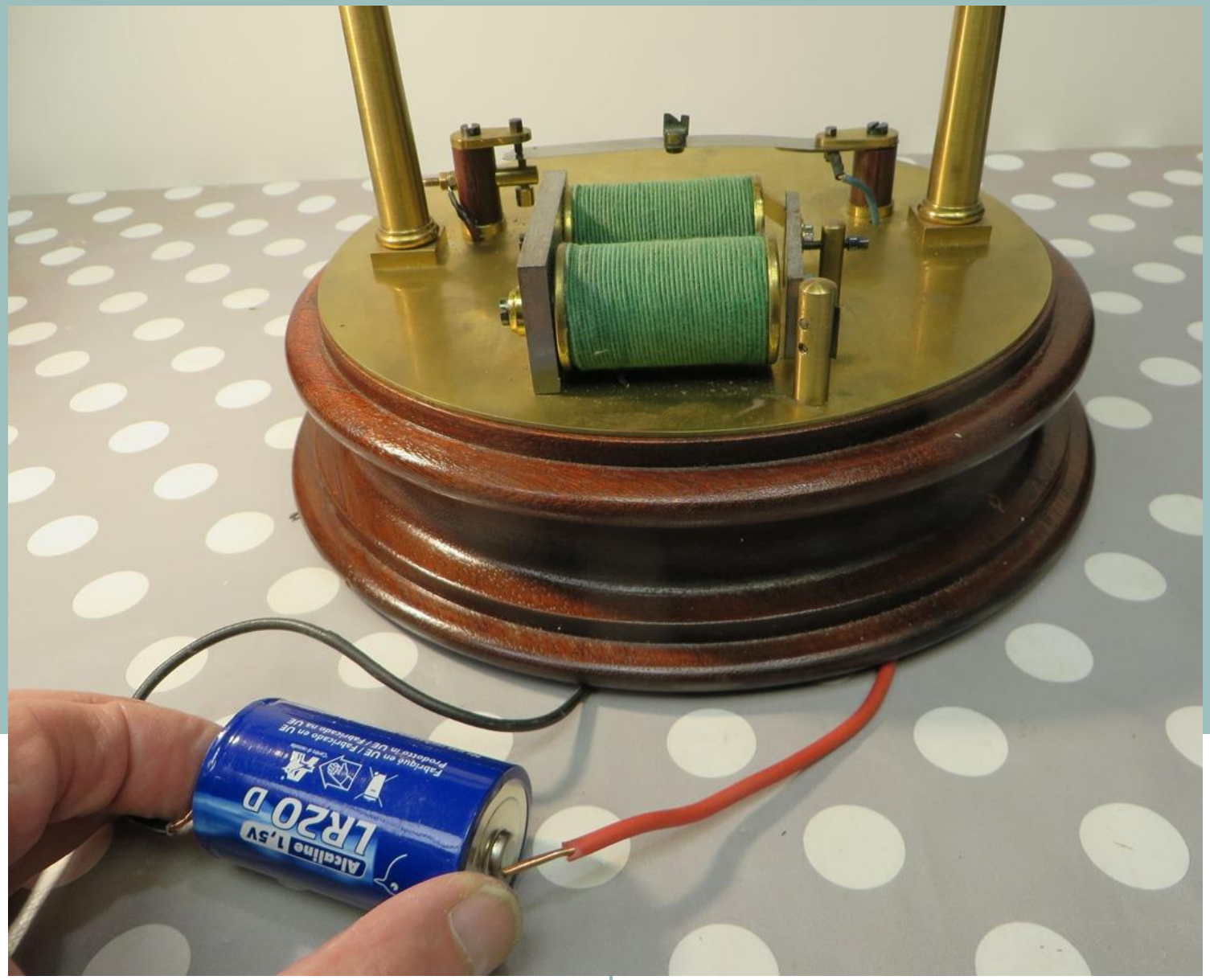






5 Solenoids

- Two solenoid pairs came with the clock. The one that came installed in the clock was very low resistance at 1.8 ohms . The other pair was 18.6 ohms.
- Normal Murday solenoid pairs are usually 20 to 30 ohms and run at 3 volts.
- For the initial phase of testing the 1.8 ohm pair of coils were used at 1.5 volts and 1.15 volts
- The much higher current consumption would be a good test of the contacts as the calculated current would be 833 ma at 1.5 volts whereas the calculated current for the 18.6 ohm coil would be 161 ma at 3.0 volts

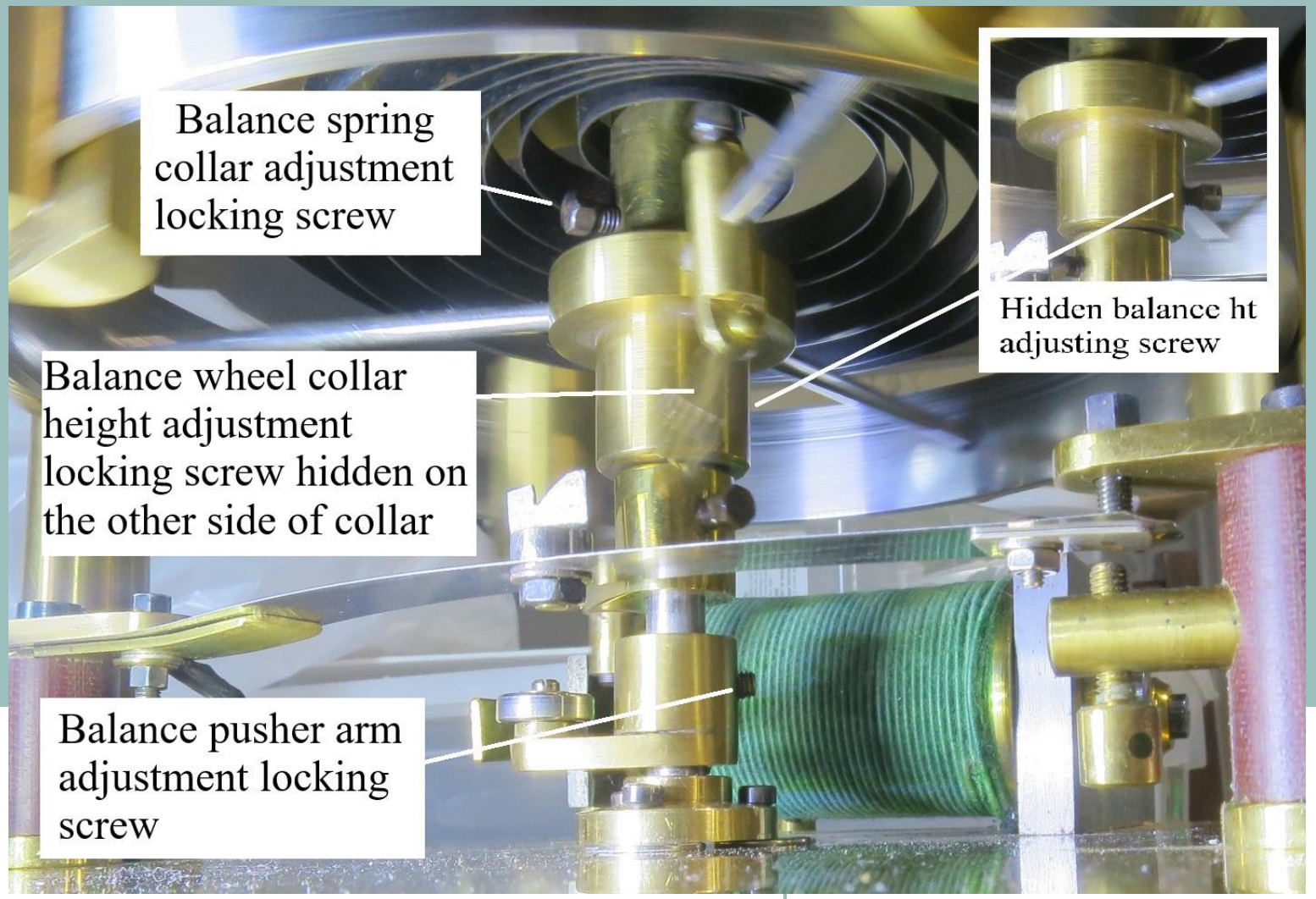


6 Hipp Toggle adjustments

Three adjustments impact the Hipp toggle/solenoid firing sequence.

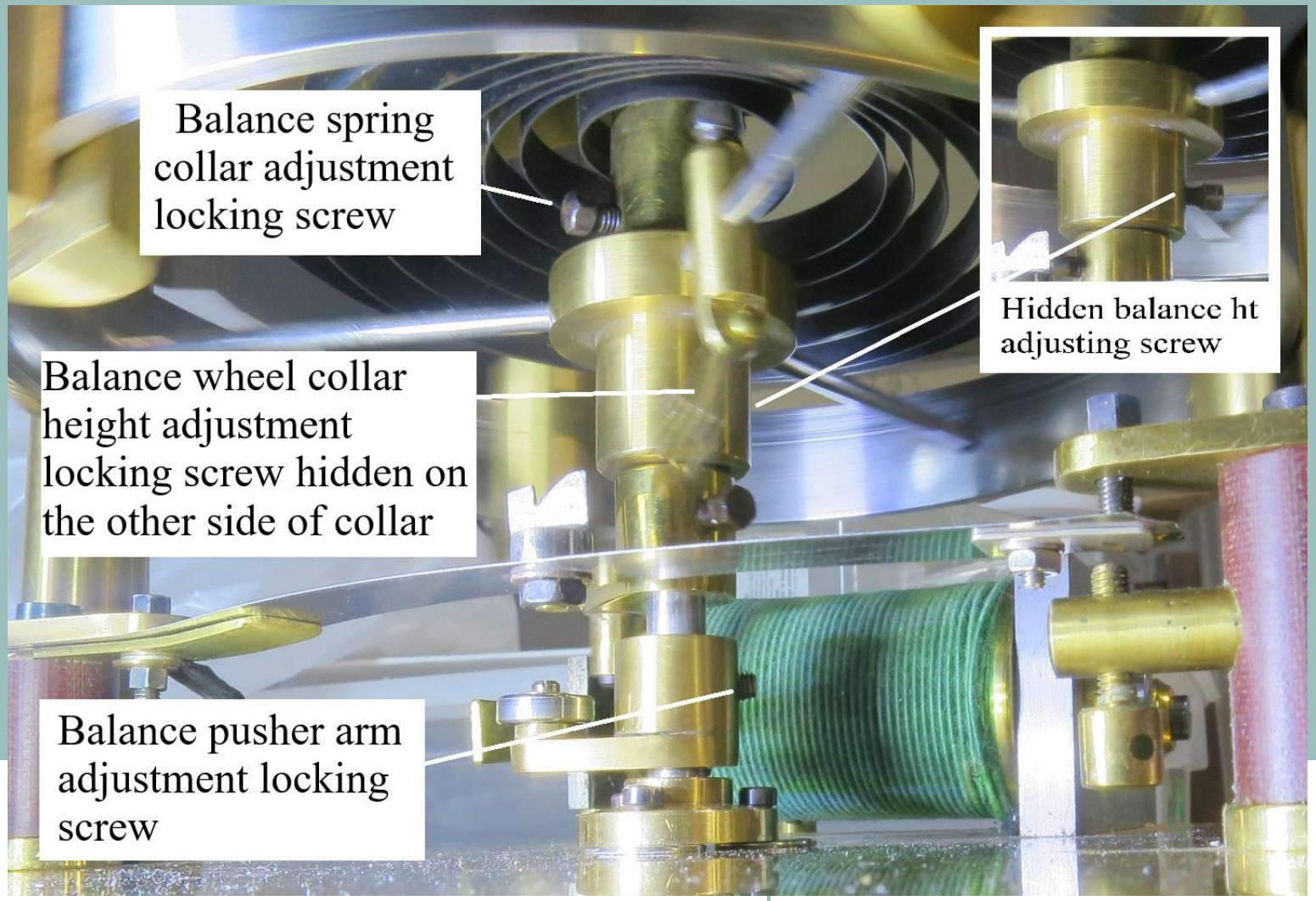
The first adjustment is the balance spring collar.

- It is adjusted so that the rest point of the balance is about 70 degrees to the left from where the Hipp toggle engages.
- This ensures there is always driving force to push the balance into the toggle groove



The second Hipp Toggle adjustment
is the height of the balance wheel collar.

- The Hipp toggle is located on one spoke of the balance wheel and so the height of the balance wheel influences how deeply the toggle engages.
- It effects how far and hard the toggle pushes the blade and contacts.
- It also effects the duration of the time the contacts are closed.
- Fine adjustment of the depth the toggle pushes into the Hipp anvil can be made by adjusting the angle of the toggle arm where it is mounted on the balance spoke.

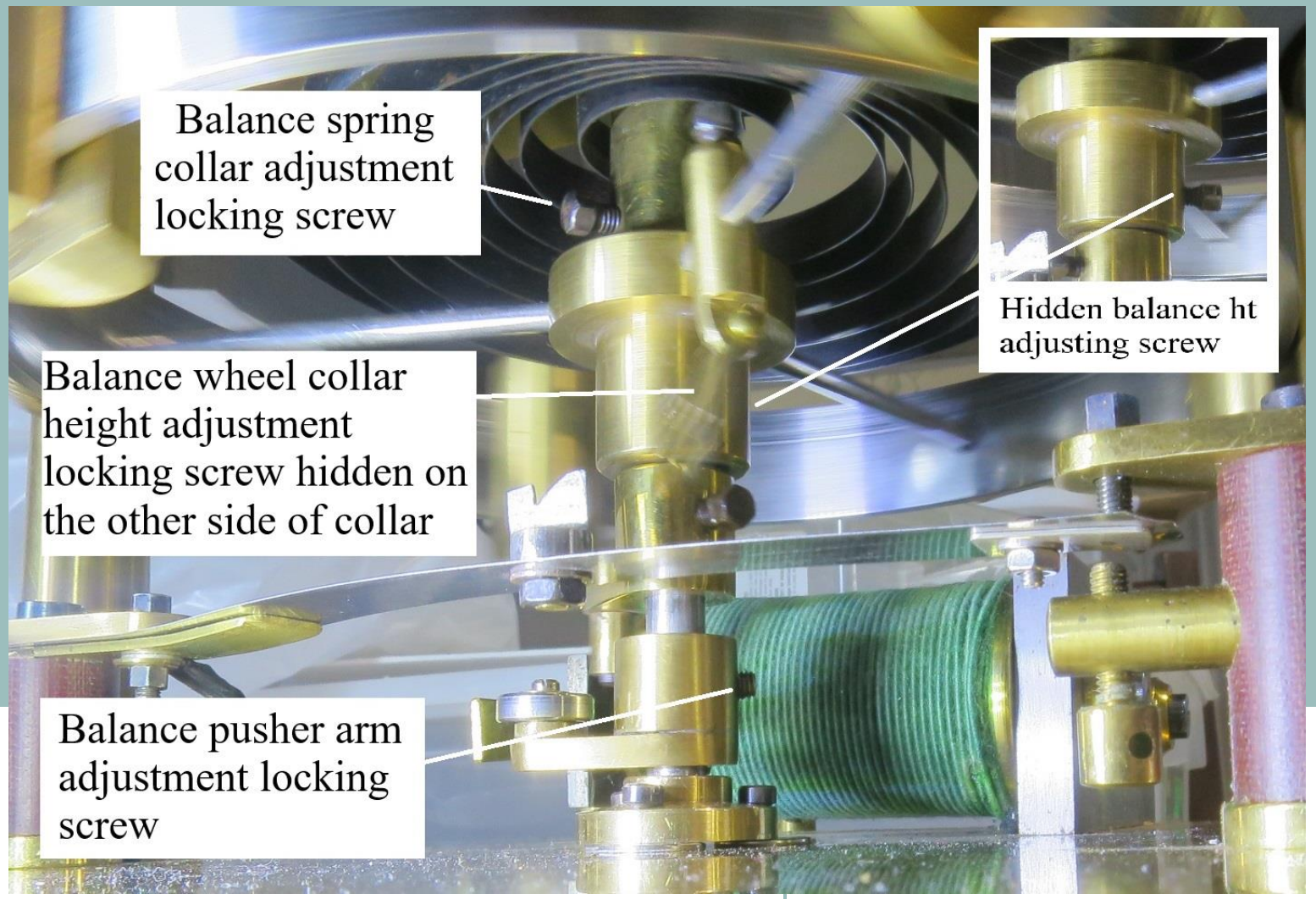


The Hipp Toggle adjustment that works well is –

- The Hipp Toggle activates the solenoid when the total angle of rotation of the balance drops below 160 degrees.
- After an impulse the balance angle of rotation should be around 240 degrees with a fresh battery.
- If the bearing and movement friction losses are low then it should take around 7 to 8 rotations between Hipp toggle actuations – so at each rotation the balance loses about 10 degrees.
- As the battery voltage drops, or the bearing/movement friction increases then the number of rotations between impulses decreases but should always be at or above 3 rotations.

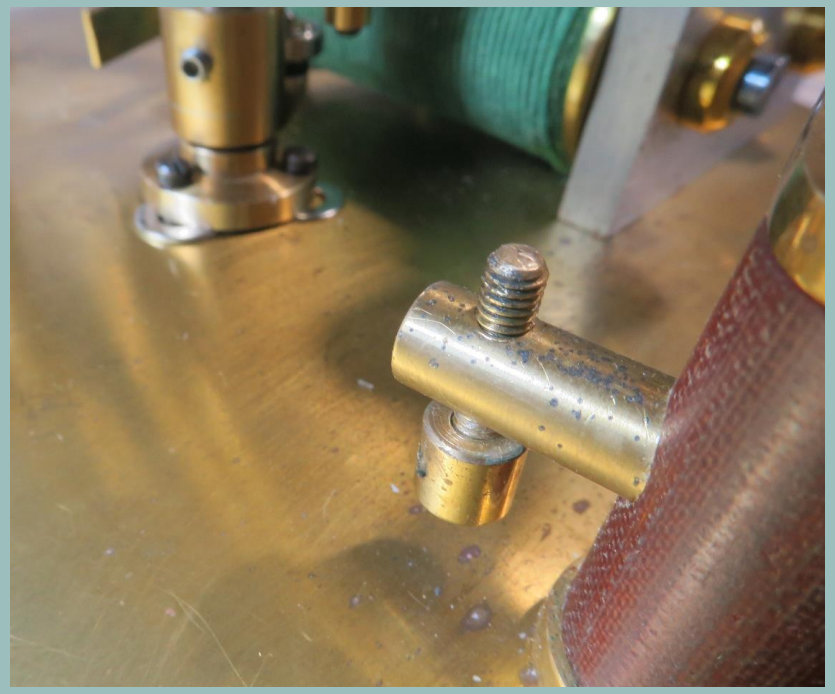
The third Hipp Toggle adjustment

- This is the balance pusher arm position when the solenoid is activated.
- This arm is mounted on a collar and is adjusted by manually engaging the Hipp toggle blade in the groove on the return stroke
- When the contact first closes the pusher arm position is adjusted to start pushing the balance at this point



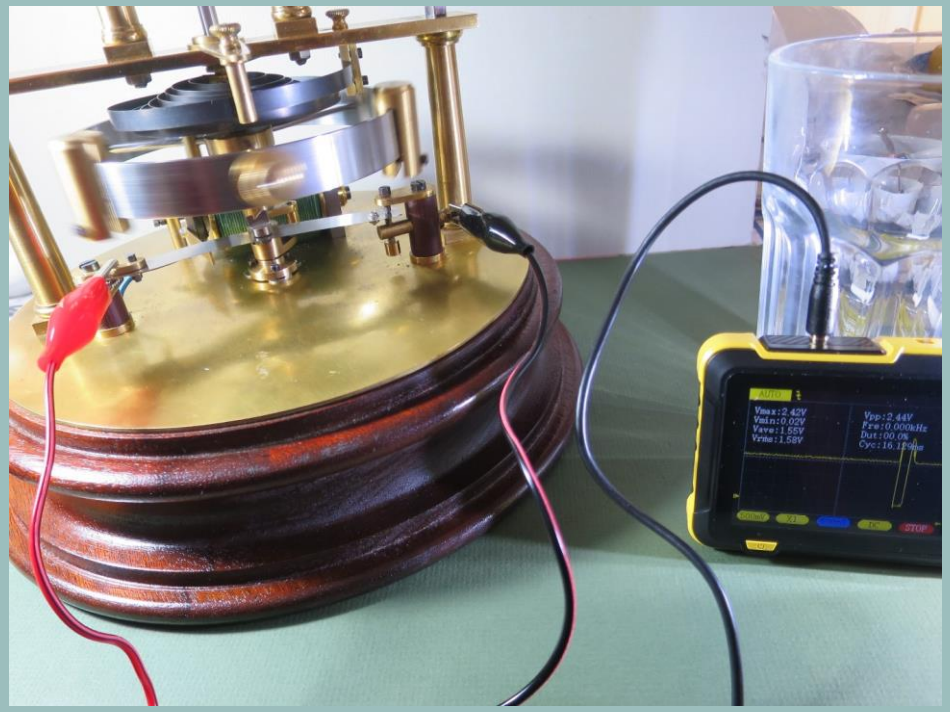
7 Electric contacts

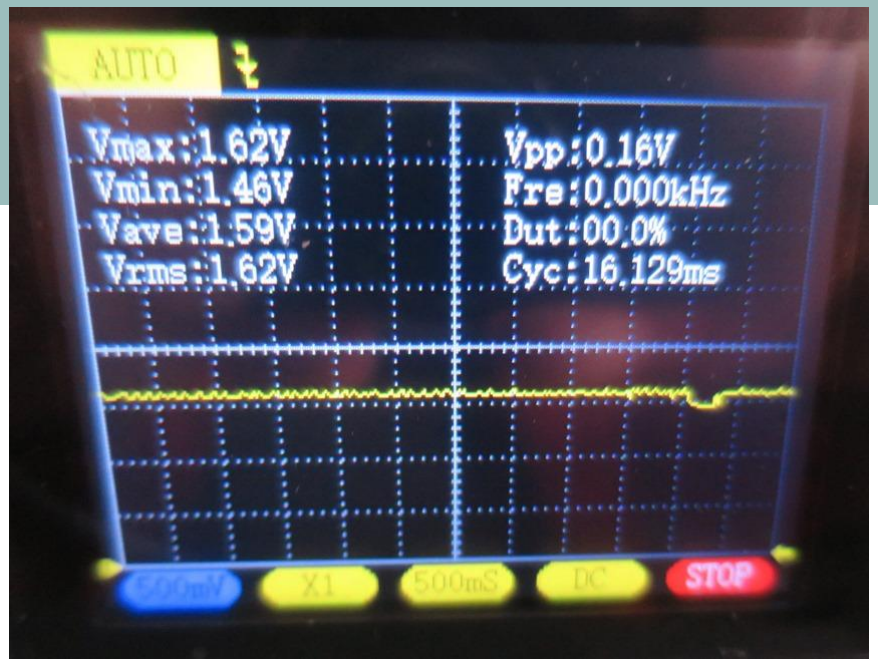
- The lower contact consists of a coating of silver brazed on to the end of an adjusting screw
- The upper contact consists of a silver plates screwed to the underside of the flexible stainless steel blade.

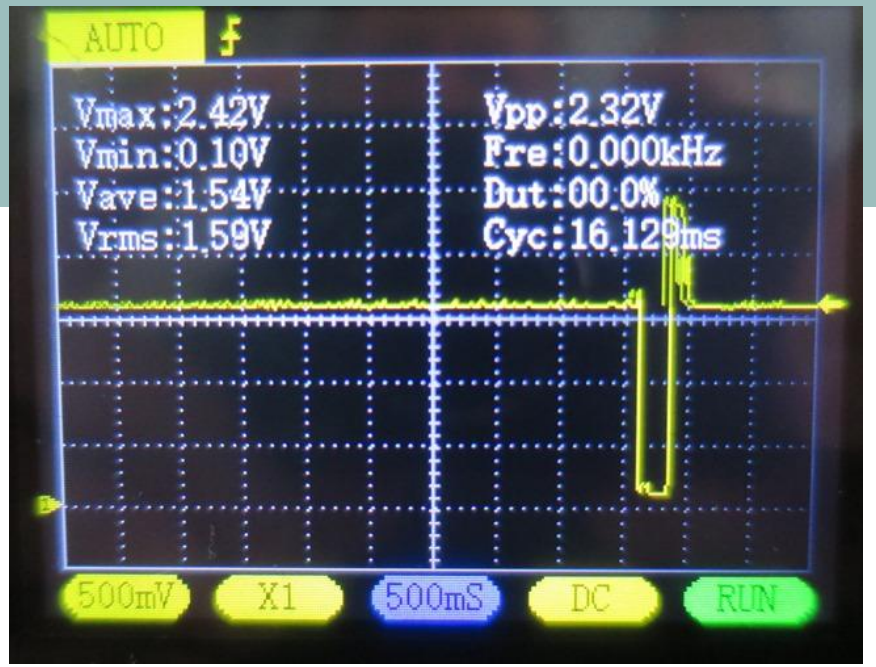


8 Electric contact checks with small Oscilloscope

- A small Oscilloscope was used with the voltage sensors placed across the contacts.
- Battery voltage was 1.60 V. The contact voltage drop was 120 to 160mv and the battery voltage dropped by about 150mv when the Hipp toggle operated.
- The contacts were closed for around 250 milliseconds.

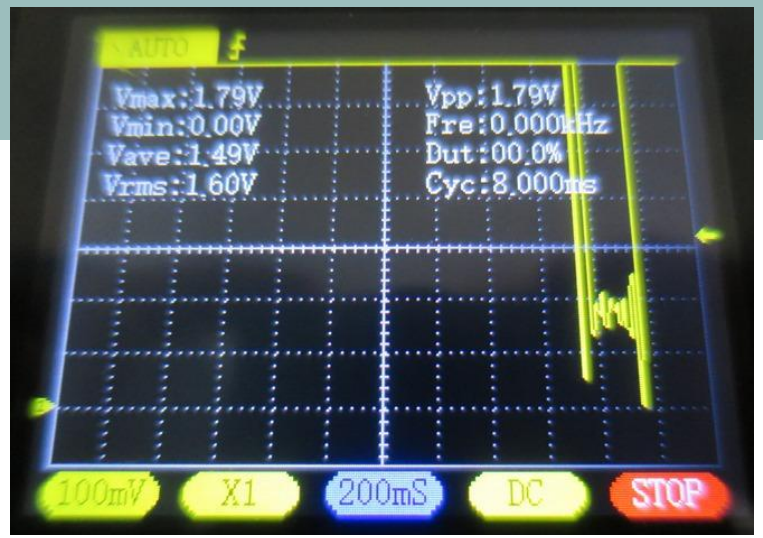


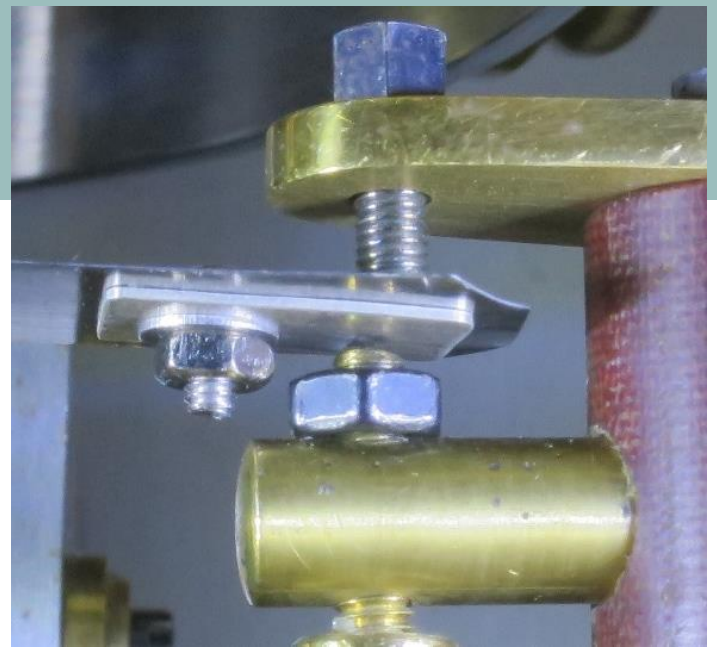




9 Fixing contact bounce

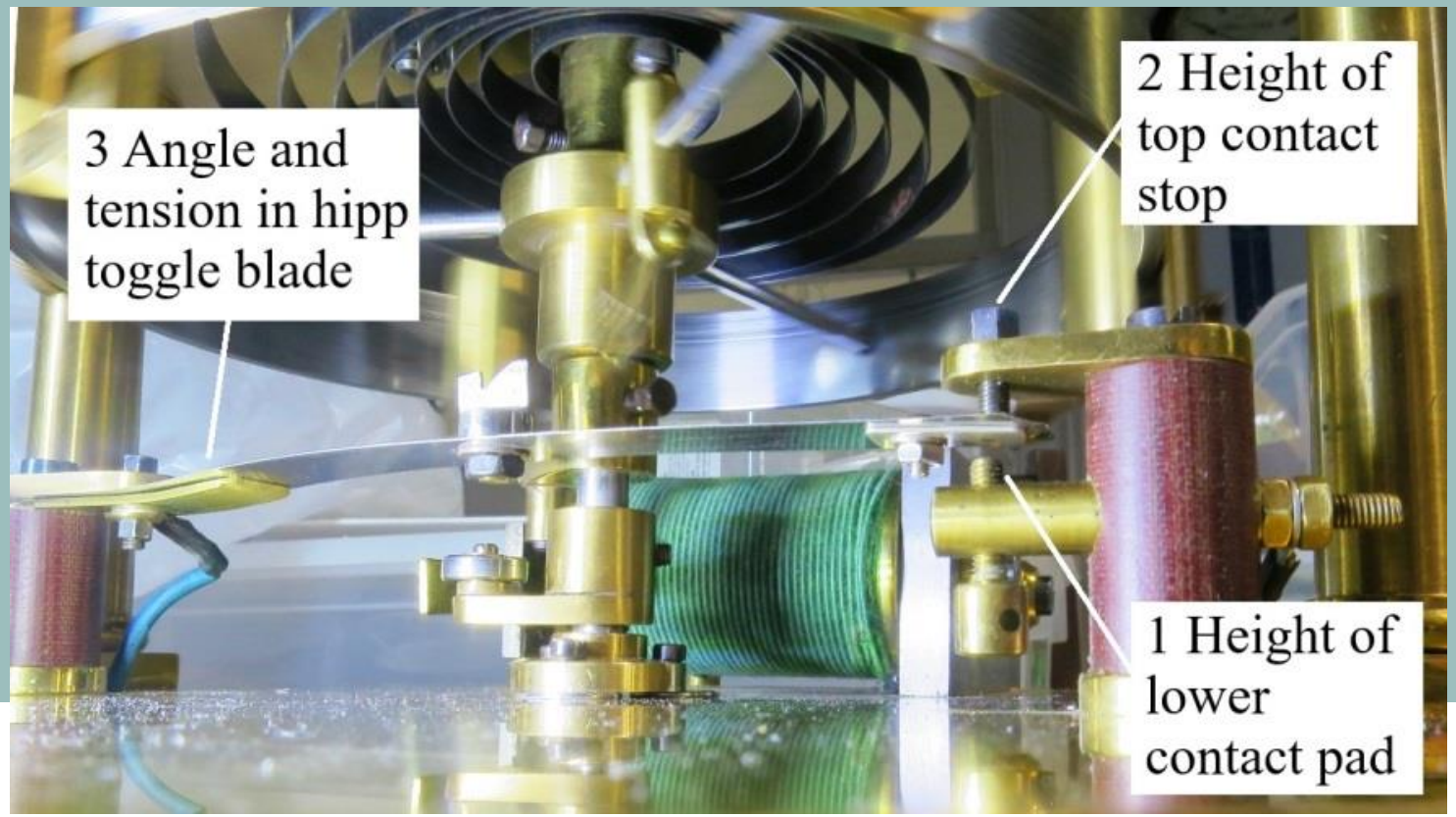
- A good way to look at the contact bounce problem is to video the contacts and then slow them down by about a factor of about 5 to 10
- The bounce problem was that the gap between the top stop of the blade and the bottom contact pin was too large because of a loose bottom contacting screw working it way undone. Contact drops were 150 to 170mv
- This was adjusted to narrow the gap and a black locking nut was fitted to prevent the bottom contact screw working loose again.
- Contact voltage drop was reduced to 20 to 40mv immediately and after 5 days was 60 to 70mv





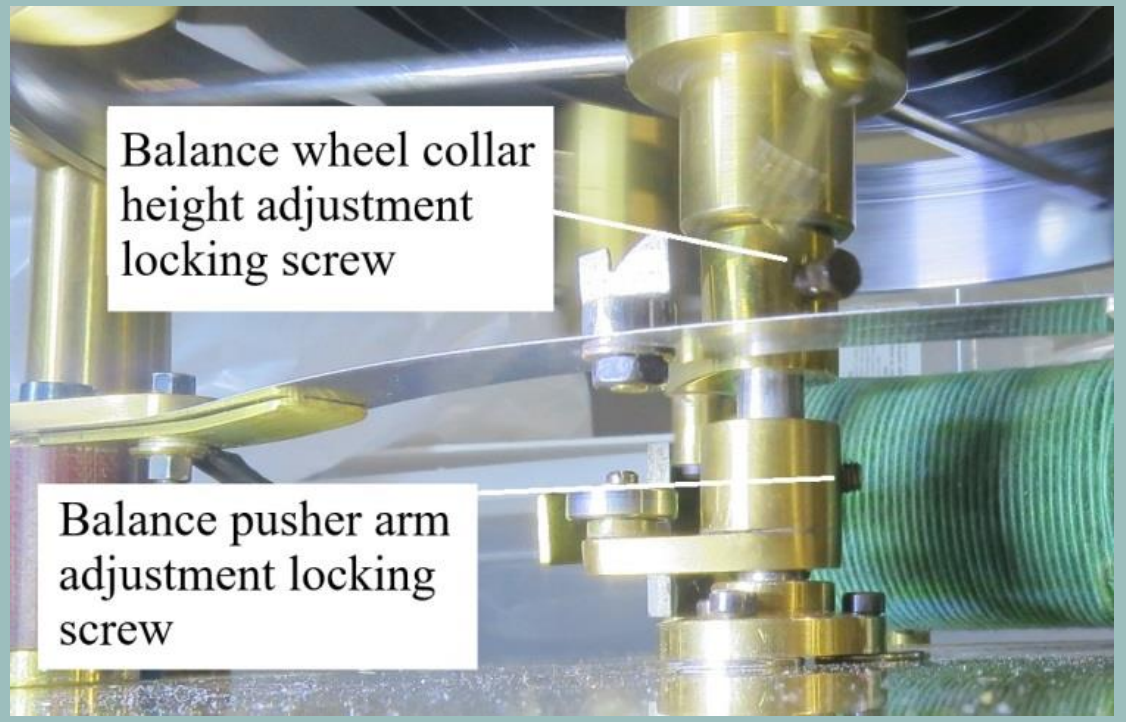
9 Fixing contact bounce – Fine Tuning Toggle Bade Contacts

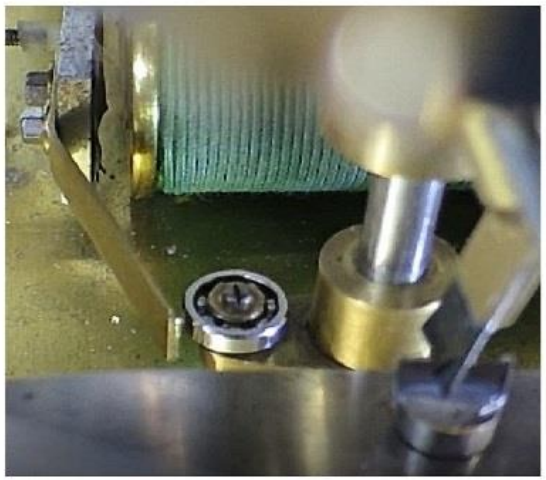
- The three adjustments are shown in the photo.
- Adjustments 1 and 2 are discussed in previous slide
- The third adjustment is made (if necessary) to the angle of the Hipp toggle blade. This is done by grasping the blade and small brass finger beneath the left hand pillar with some pointed nose pliers and bending the blade/brass finger either up or down.
- This changes the pressure the contact screw makes with the contact on the blade. and has a small effect on the height of the anvil and so the amount of time the switch is on.

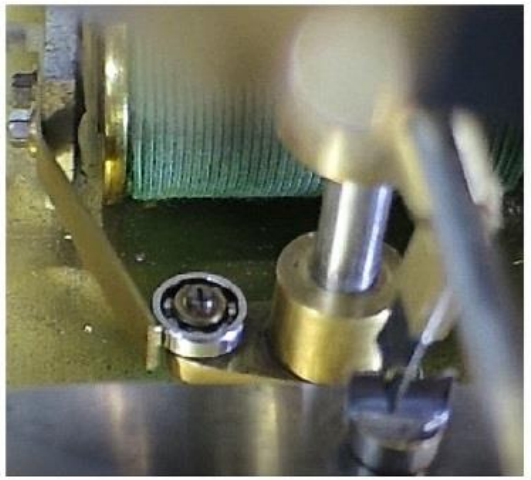


10 Solenoid stop and Pusher adjustment

- A soft stop is made by fitting a short length of soft rubber tube to the end of the Stop adjusting screw.
- The adjusting screw is used to close the clearance between the brass solenoid pusher arm and the bearing mounted on the Balance Staff to about 1mm.
- Final tuning of the location of the bearing position is best done by videoing the action and slowing it down by 5 to 10 times and then make any adjustments so the bearing has just entered the end of the brass pusher.

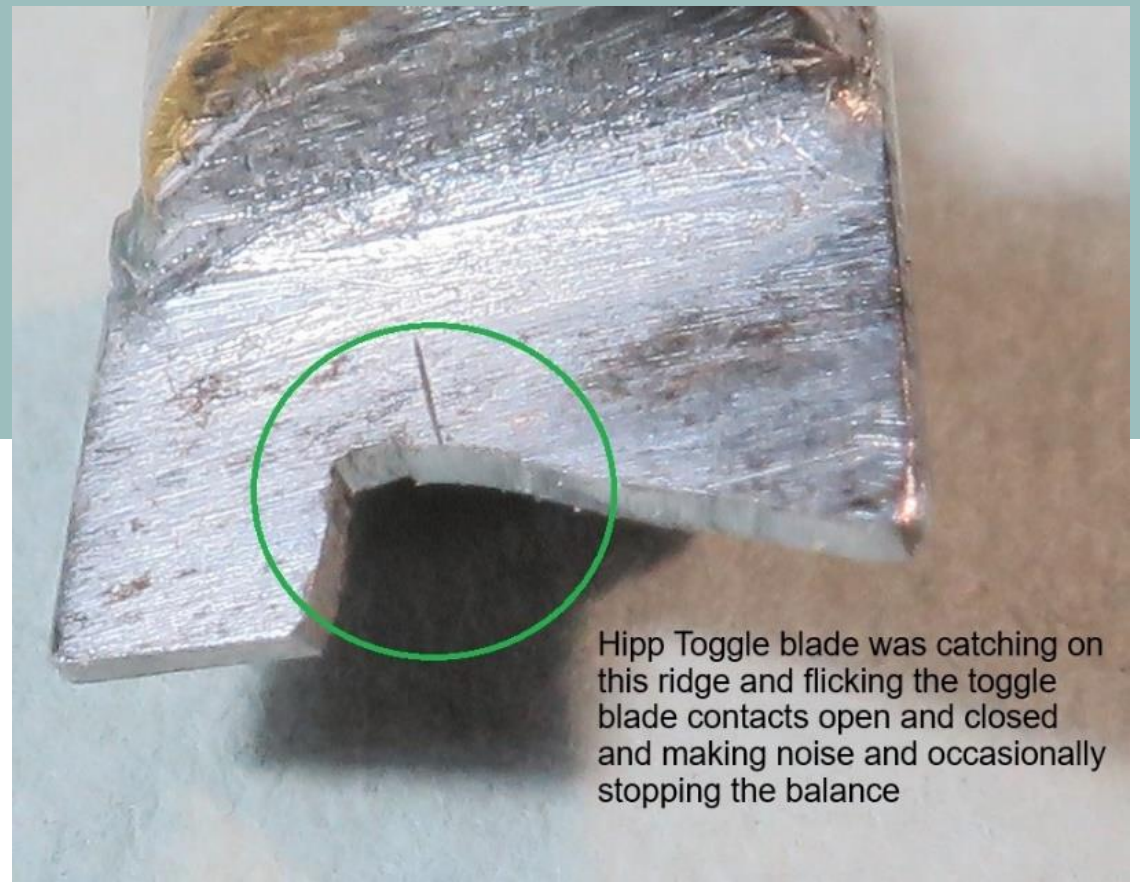






11 Hipp Toggle Anvil polishing

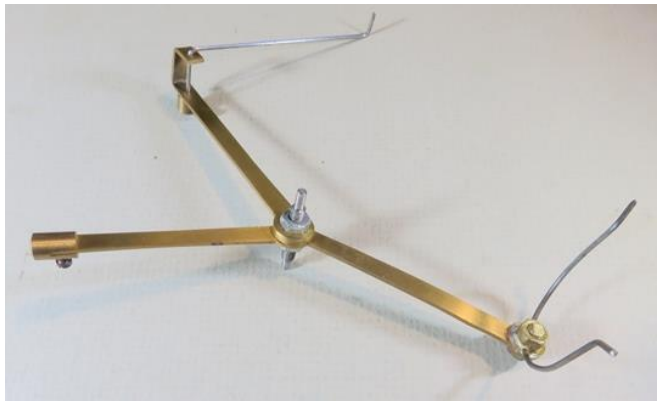
- An issue that can cause problems is if the anvil of the Hipp toggle is not smooth the toggle blade can catch in the groove and cause the contacts to operate badly.
- The Hipp anvil was removed from the stainless steel blade and the notch ground and polished smooth
- After this the toggle blade engaged and released smoothy with the anvil and contact flutter was virtually eliminated.

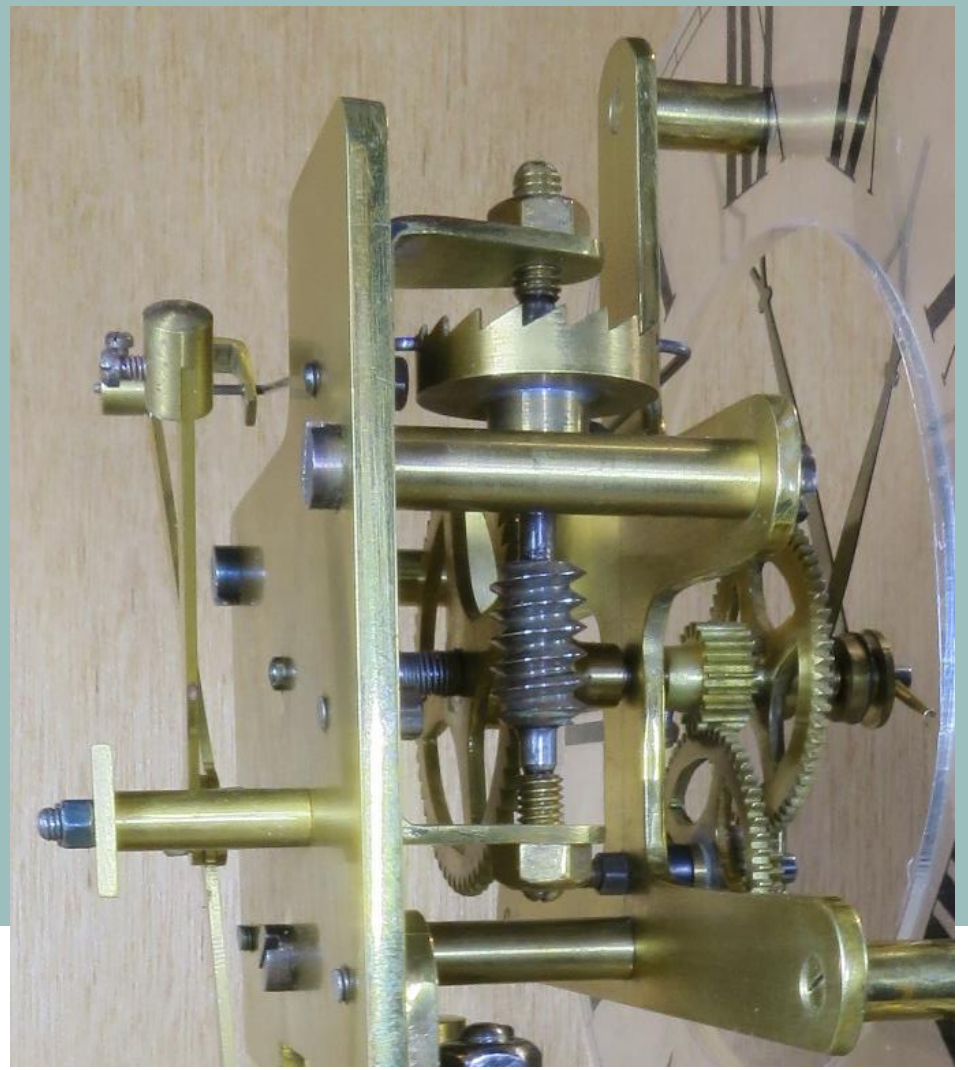


12 The Movement

The design of the clock is a modification from the original Murday and uses a crown wheel rather than a 5 segment index wheel.

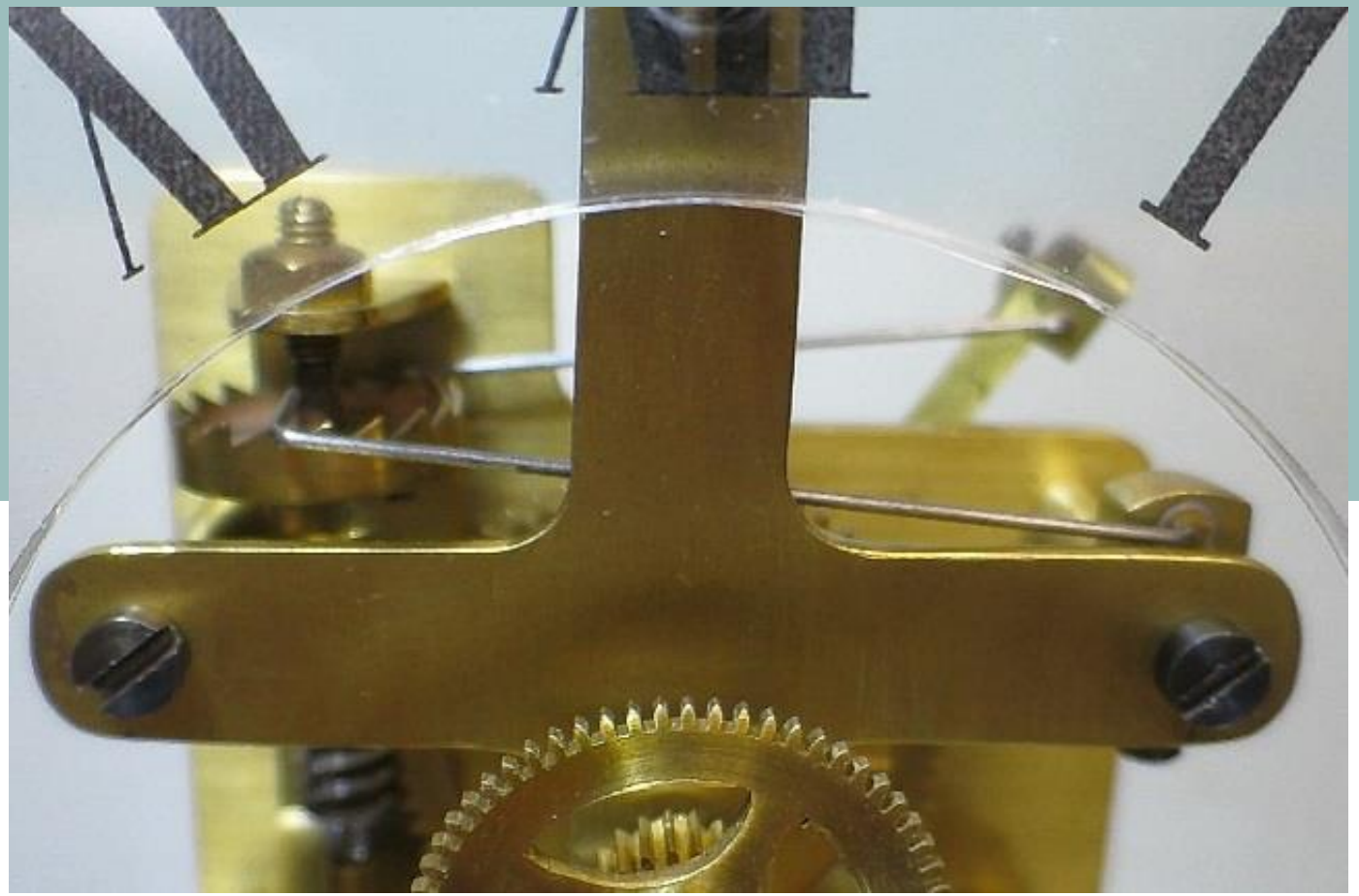
The crown wheel shaft has a worm gear which drives the minute hand shaft





12 The Movement (continued)

The rocking verge wire is moved by a brass post mounted on a collar which is in turn mounted on the balance staff. The collar height and angular position is adjusted to engage the stiff wire circular lugs mounted on the end of the rocking verge.



VIDEOS

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THE END

Of Part I

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