Report on the Repairs to the Thwaites and Reed Turret Clock at St Mary Magdalene Rodborough Gloucestershire

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1. Introduction

The turret clock at St Mary Magdalene Rodborough is a superb hourly striking two train flat bed mechanism, with 6 legged gravity escapement, manufactured and installed by Thwaites and Reed of London in around 1888.

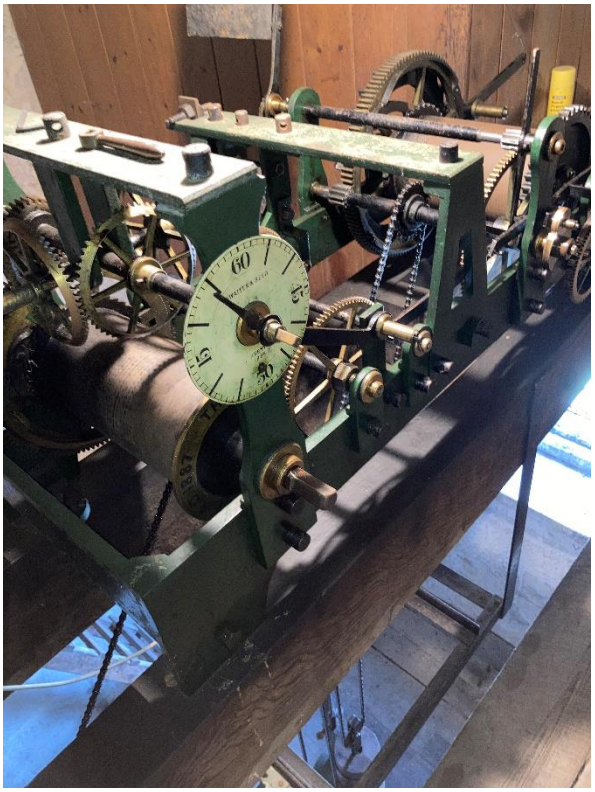

Figure 1

The two trains of time on the left-hand side and count wheel striking on the right, are in fair mechanical condition but have been neglected and are getting clogged up with dust and congealed oil.

The gravity escapement bearings are worn and require attention.

The motion and lead off work, the 12 to 1 gearing behind each dial that drives the hour hand from the minute hand, are in good order. There is a little bit of debris around them, but they are otherwise serviceable. The North face hour hand has worked loose and is pointing to 6 o'clock.

The hourly striking fly ratchet is worn out and requires replacing.

The clock has been converted to Smith of Derby automatic winding and these units are working fine, their bearings are running well, but their weight pulley/sprocket bearings are very stiff to turn, and an overhaul will return them to good order.

Following consultation with the Diocesan Clock Advisory Committee, the necessary faculty approval was granted and in July 2020 work commenced to return the clock to working order.

The following report details the work carried out.

2. Maintenance of the Clock Mechanism

2.1 General Cleaning

The clock frame was brushed off and the years of debris and dust vacuumed away. The clock chamber was also given a spring clean ready to start work on the clock.

The general condition of the clock frame, **Figure 2**, is in good order. Some rust is present on the steel frame and the nuts, and light rust has formed on the pendulum suspension spring, **Figure 3**.

The frame work was given a wipe over with clean rags charged with pure turpentine as the work progressed.

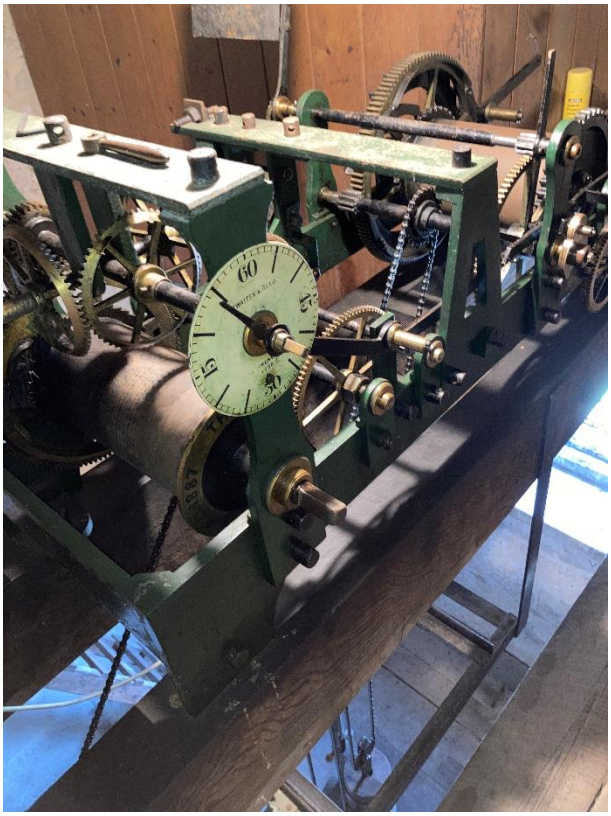

Figure 2

Figure 3

2.2 Bushing the Bearings

The 6 legged gravity escape wheel bearings were found to be worn. At some point in the past a weight has been added to the gravity impulse arm to make the clock go, in other words to overcome the loss in gravity as the arm impulses the pendulum due to increases in pivot wear.

The bronze bearings were cleaned with Liberon Ultrafine 0000 grade wire wool, bottle brushed and then washed with white spirit to remove traces of the old oil, dirt and grease. The front escape wheel bearing with its bracket was centred in the lathe and the old hole enlarged to 6mm in diameter, **Figure 4**.


Figure 4

A new sleeve was then turned from SEA 660 phosphor bronze stock.


Figure 5

The bearing was then forced on to the sleeve and secured with Loctite 640 high strength retaining compound. When the glue was dry the sleeve was parted from the parent stock and faced up.


Figure 6

A second sleeve was then turned in the lathe from SEA 660 phosphor bronze stock and fitted to the rear escape wheel bearing which had been enlarged to 6 mm diameter to receive the sleeve. With the frames lined up and the front escape wheel bracket repositioned in the escapement frame, the two bearings were centred and opened out to just below their finished pivot diameter, **Figure 7**.


Figure 7

The bearings were then in-line reamed to their finished diameter to suit the escape wheel pivots, **Figure 8**, and polished with ultra-fine polishing paper.

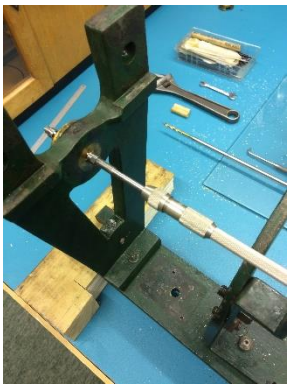
Figure 8

The components were then washed in pure turpentine to remove any polishing residue, dried and reassembled in the escapement frame. The finished bearing repairs were then tested in the main clock for alignment.


Figure 9

2.3 Gravity Escapement

The gravity escapement arms run in ‘V’ shaped pivot holes and these holes had been “punched-up” to remove wear and close up the hole, **Figure 10**. This method of repair is not ideal, as instead of making the pivot hole round, it can create a burred edge and this scores the pivot face and increases wear, **Figure 11**.


Figure 10


Figure 11

A new ‘V’ pivot assembly was manufactured from BS1407 Silver Steel, **Figure 12**. Hardened at 800°C, tempered at 220°C for 1 hour and then polished with successively finer grades of paste through 400, 600, 1200 and finished with diamantine paste, **Figure 13**.

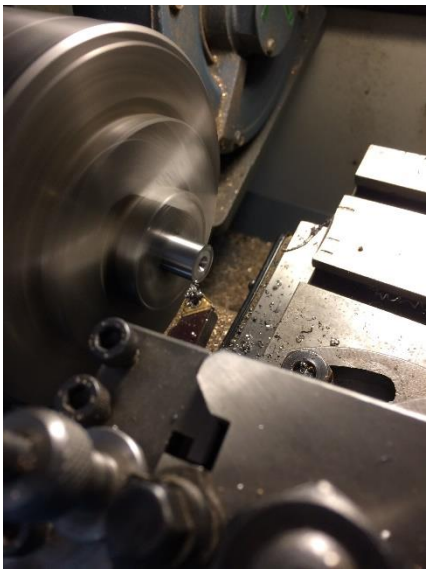
Figure 12


Figure 13

The gravity arm conical pivots were turned down very slightly to remove the scoring using a tungsten carbide tipped turning tool to avoid the need to soften them first, **Figure 14**. The conical pivots were polished with successively finer grades of paste through 400, 600, 1200 and finished with diamantine paste.


Figure 14

The components were then washed in pure turpentine to remove and polishing residue, dried and reassembled in the clock frame, **Figure 15**.


Figure 15

2.4 Wheel Work

The wheels and pinions although dirty and suffering from some dried or congealed oil deposits between their teeth and pinion leaves, were in good mechanical condition.

Larger wheels were cleaned in-situ using a wooden stick and cloths charged with pure turpentine to remove the dirt and debris from between the teeth and pinions, **Figure 16**. The wheels were then washed in pure turpentine, dried and the teeth polished with a brass bristled brush, **Figure 17**.


Figure 16


Figure 17

Small wheels that could be handled out of the clock were returned to the workshop and gently washed in a solution of natural fairy soap flakes, sugar soap and warm deionised water to remove the dirt, **Figure 18**.

Following rinsing and drying, the gaps between each wheel tooth were mechanically polished using a medium grade horsehair bristle rotary brush charged with French chalk, **Figure 19**.


Figure 18

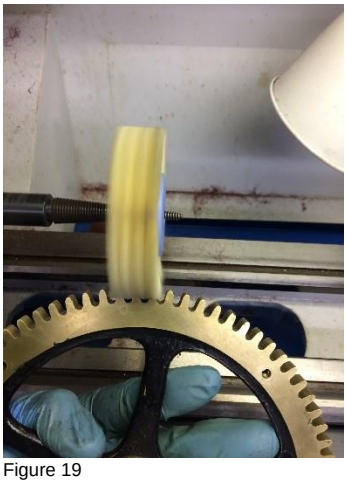
Figure 19

2.5 Striking Train Fly Ratchet

The fly is a two-bladed fan that is used to control the speed of the wheel train when striking the hours. The fly ratchet is a small wheel with pointed teeth that prevents the fly from turning backwards while in operation. These teeth on the ratchet were worn out, **Figures 20** and **21**.

Figure 20

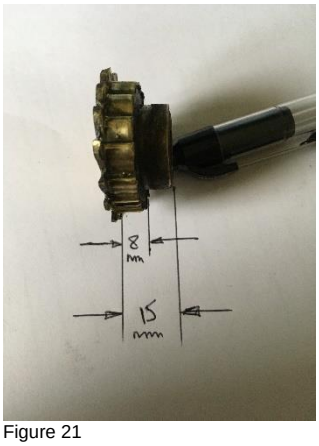

Figure 21

A new ratchet was machined in CZ115 brass to match the original, **Figures 22** and **23**, and then hand finished, squared and fitted to the fly, **Figure 24**.


Figure 22


Figure 23


Figure 24

2.6 Pendulum

The pendulum was in good order, the wooden rod straight and neither cracked nor distorted. The bob being fixed to the rod by traditional means of a rating nut.

The suspension spring was found to be in sound mechanical condition and was cleaned with Liberon Ultrafine 0000 grade wire wood and mineral sprit. A thin layer of petroleum jelly was applied to prevent rust from forming in the future.

Figure 25

2.7 Motion Work

The motion work, **Figure 26**, the 12:1 ratio gearing to turn the hour hand from the minute hand, takes its drive from the clock to turn the hands on the dial, **Figure 27**.


Figure 26


Figure 27

The motion work was found to be in good mechanical order. Build-up of dust and debris was present, and the wheels were cleaned in-situ using cloth charged with pure turpentine to remove this minor debris from between the teeth and pinon leaves.

A rope access team removed the hands from the dials so that the motion work could be cleaned. The hour hand on the North dial was loose on its collet. The collect was cleaned and soldered back in to position. This work being carried out by the rope access team, **Figure 28**.


Figure 28

3. Automatic Winding System

The automatic winding units driving each of the two trains of the clock were found to be working fine but the weight pulley/sprocket bearings were very stiff to turn. The motors were running nicely and remained cold. The gravity switches turning the motors on and off without issues.

Figure 29

With the mercury switches being in good order with no sign of cracks or deterioration, the switching units were given a light clean to remove debris, **Figure 30**.

Figure 30

The over wind safety cut-out rods, although covered in light surface rust, would still operate in the event of the weight being wound to far. The rods were extracted while the clock was apart and treated to a clean and polish with Liberon Ultrafine 0000 grade wire wool, **Figure 31**.


Figure 31

The two weight carrying sprockets were very stiff to turn and were removed from their housings, cleaned and reassembled.


Figure 32

The remaining carrying/guide sprockets and chains were also cleaned and reassembled.


Figure 33

4. Lubrication Details

During reassembly of the clock and the following lubrication has been used:

Motion Work:	Comma Premium Quality Lithium - molybdenum disulphide grease
Lead-off Work:	Castrol XL 30 Oil
Train Wheel Pivots:	Moebius D5 Swiss made oil
Gravity Escapement:	Moebius 8030 Swiss made oil
Barrel Pivots:	Lucas SAE 75W-90 Synthetic Gear oil
Barrel Clicks and Ratchets:	Lucas SAE 75W-90 Synthetic Gear oil
Fly Clicks:	Castrol Spheerol EPL-2 Multi-Purpose Lithium grease
Weight Sprocket Bearings:	Morris SAE 50 Classic Motor oil
Automatic Winding Switching:	Moebius 8030 Swiss made oil
Automatic Winding Over Wind Rods:	Morris SAE 50 Classic Motor oil

5. Acknowledgements

Crackstone Clocks Limited comply with the Code of Practice for Turret Clock Work produced by the Clock Advisors Forum of the DAC Clock Advisors in collaboration with Turret Clock Companies and the Church of England Church Buildings Council.

The author owes a debt of gratitude to many people who have contributed their time and advice during the repairs of this clock. In particular I would like to thank:

Mr John Atkinson, Churchwarden

Mr Chris McKay FBHI, DAC Clocks Advisor, Salisbury

Mr Andy Salter, Park Lane Abseiling Ltd, Coleford, Gloucestershire

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16th May 2022