# Report on the Repairs to the Gillett and Bland Turret Clock at St Mary's Church Woodchester Gloucestershire

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# 1. Introduction

The turret clock at St Mary's Woodchester is a superb quarter chiming three train flat bed mechanism, with 15 legged gravity escapement, manufactured and installed by Gillett and Bland of Croydon in 1876.

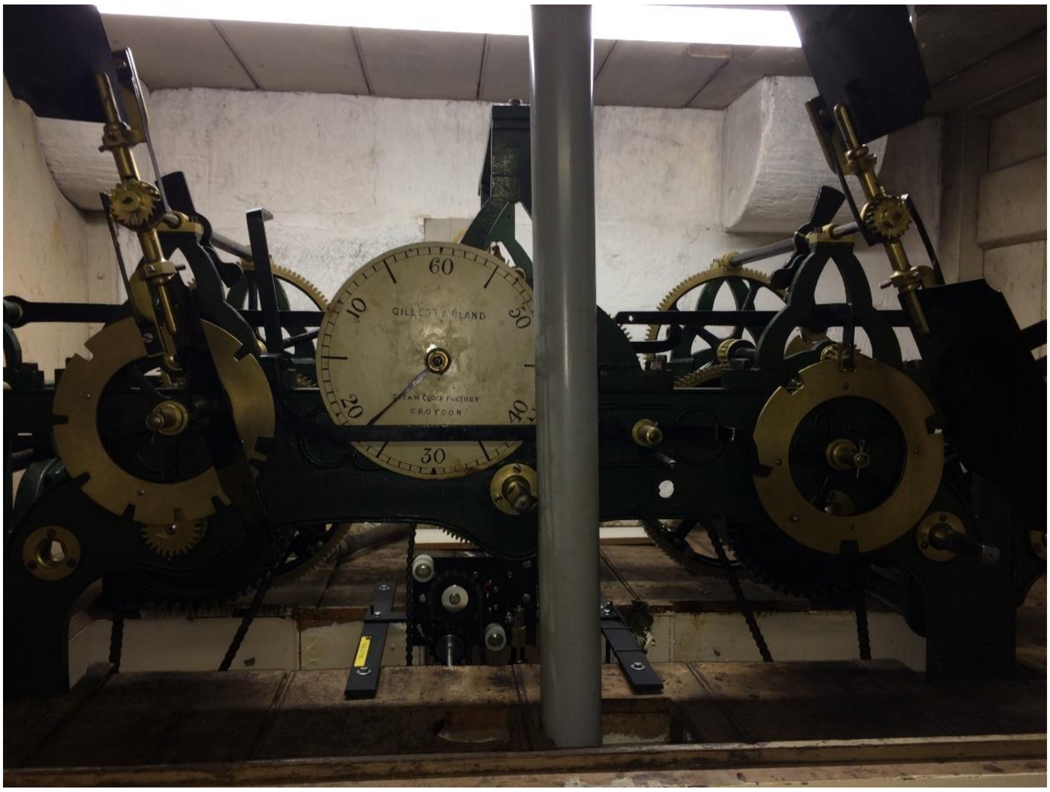

Figure 1 – The clock following maintenance

During a ringing session in early 2019, a link in the quarter chiming automatic winding drive chain snapped, **Figure 2**, and the 17 kg driving weight fell to the floor, **Figure 3**, narrowly missing one of the ringers on its way to the floor and on health and safety grounds, the clock was stopped.

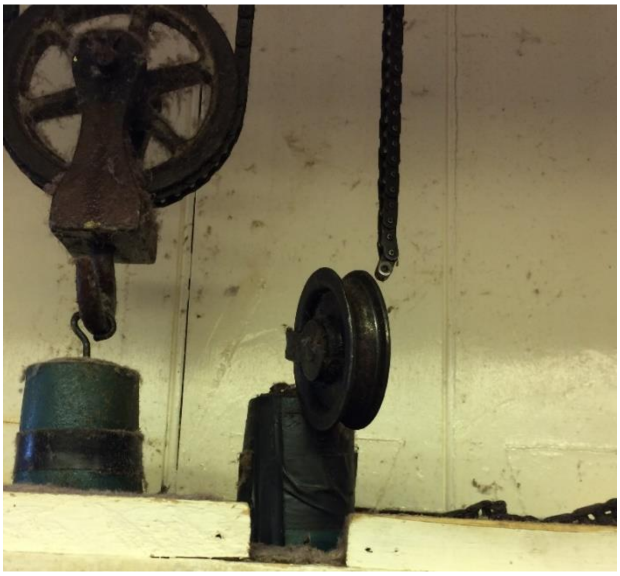
Figure 2


Figure 3

A decision was made to overhaul the clock, the bell cranks and replace the automatic winding system in order to move the striking and chiming weights to the corners of the ringing chamber. This move would put the weights safely out of the way of the ringers and allow the weights to be enclosed in panelled safety cages.

The going weight that drives the time side of the clock could remain positioned centrally under the clock adjacent to the pendulum housing. A new automatic winder would be provided, and as this would only require the new driving weight to rise and fall over a distance of 8 inches, and as there was sufficient head room to keep the clock running in the event of a power cut and provide a suitable box to safely enclose the drive weight, a ringer standing beneath the pendulum housing would also be protected from the driving weight.

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

Additional approval was sought and granted for the fitting of night-silencing.

The following report details the work carried out.

# 2. Maintenance of the Clock Mechanism

## 2.1 Overview

The three trains of going (time), hourly striking and Westminster chimes are in good mechanical condition but have become clogged up with dust and congealed oil, and some of the bearings are running dry of oil.


Figure 4


Figure 5

The clock cabinet is somewhat dirty with dead insects and debris scattered about it, **Figure 6**. With dust and old spider webs generally taking over, **Figure 7**. The whole clock cabinet and surrounding area was given a clean before the clock repair work commenced, and the years of dust and dead insects were vacuumed away.


Figure 6

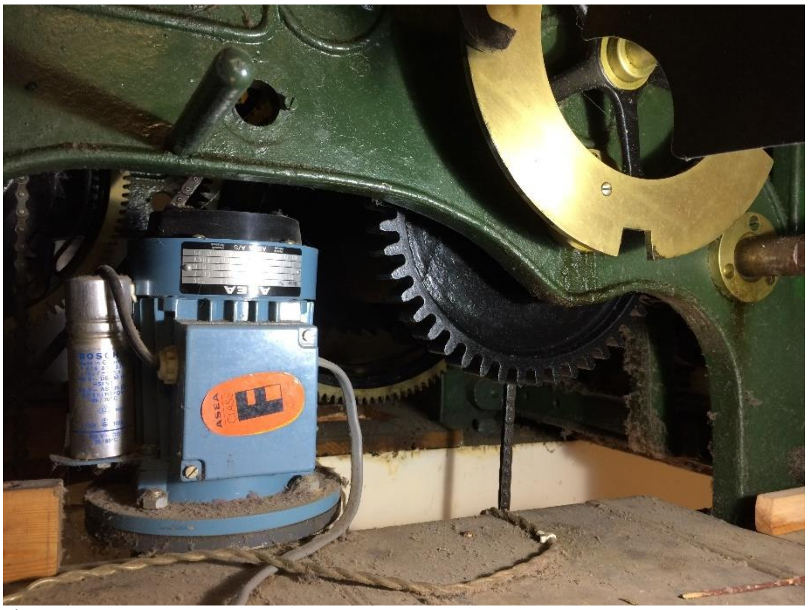

Figure 7

## 2.2 Framework and Train Bridges

The flat bed framework, cocks and train bridges were thoroughly wiped down with cotton rags to remove the bulk of dirt, thickened oils and grease. The bronze bearings were cleaned with Liberon Ultrafine 0000 grade wire wool, bottle brushed and then everything was washed with pure turpentine to remove all remaining traces of the old oil and grease.

The framework threaded holes, threads of nuts and bolts were cleaned, and given a coating of light grease to protect them. Light grease was applied to the surface of the framework where each of the cocks and bridges are secured to ease removal during future maintenance work.

**Figure 8** illustrates a group of the cleaned train bridges.

Figure 8

## 2.3 Wheel Work

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


Figure 9


Figure 10

Small brass parts were gently washed in a solution of natural fairy soap flakes, sugar soap and warm water to remove the dust and congealed oil. Lantern pinions were cleaned using various tools, such as pipe cleaners, peg wood and kitchen towels to dislodge and remove dirt and oil between the trundles, **Figure 12**.


Figure 11


Figure 12

Where required and prior to washing, pivots were polished in the lathe using 3M 9 Micron / 1,200 grit polishing paper laps. **Figure 13** illustrates a polished fly wheel pivot held in a custom made steel lathe mandrel.


Figure 13

Where minor surface rust was present, these parts were individually soaked in a solution of 50ml of Alcohol Ethoxylate 2-Aminoethanol per 1 litre of deionised water, the rust then being gently removed with Liberon Ultrafine 0000 grade wire wool or ultra fine aluminium oxide sanding pads. The arbors were dried by hand, rinsed in pure turpentine and then fully dried using a hot air bench dryer.


Figure 14

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 15**.

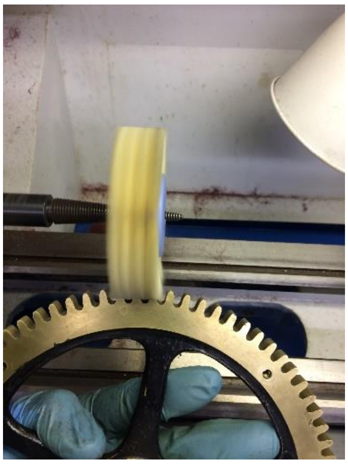
Figure 15

Larger wheels, such as the barrel great 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. The wheels were then dried, and the teeth polished with a brass bristled brush.


Figure 16

Figure 17

Exposed steel work received a coating of micro-crystalline wax[1] applied with a horsehair bristle brush, heated with a hot air gun and allowed to dry, before being buffed with a clean cotton cloth. In keeping with the previous finish, the brass work has not been lacquered.

**Figures 18** and **19** illustrate groups of the finished wheels.

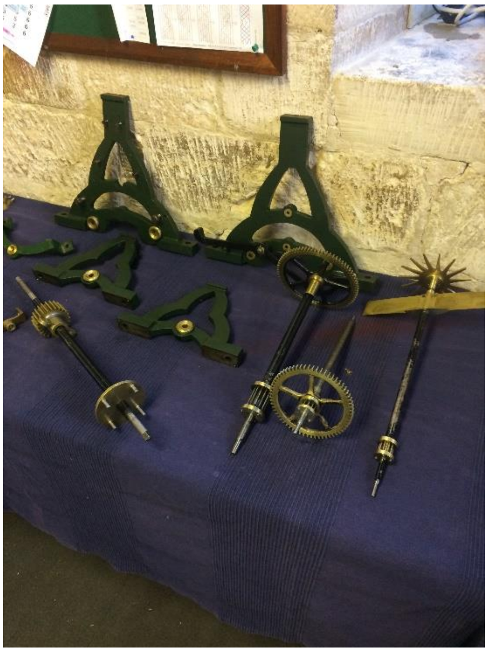
Figure 18

Figure 19

[1] A conservation approved product that is free from acids (pH neutral) for protecting unpainted steel.

## 2.4 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 had light surface rust present and was found to be in sound mechanical condition.

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

The pendulum rod was waxed using Lochinvar Olde English Furniture Cream[2].

The bob was brushed to remove dust and dirty and then given a coat of Curator Slate Blackening Compound[3].

Figure 20

[2] Lochinvar Olde English Furniture Cream is a modern cream based on the original Stevenson's old English recipe dating back to 1856.

[3] Curator Slate Blackening Compound is ideal conservation product for protecting unpainted iron. It is a durable water-based emulsion polish that can be removed with pure turpentine without damaging the original surface finish.

## 2.5 Motion Work

The motion work, **Figure 21**, the 12:1 ratio gearing to turn the hour hand from the minute hand, takes its drive from the rear of clock to turn the hands on the dial, **Figure 22**.

Figure 21

Figure 22

The motion work was found to be in good mechanical order. Build 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.

# 3. Cranks

Servicing of the cranks was carried out with them remaining in-situ in the deadening chamber. The bearing was cleaned on each crank with cotton cloths charged with pure turpentine to remove the dirt. The whole area was then vacuumed, and debris removed. New 3mm stainless steel rods were cut to length and eyes carefully formed at each end and connected to the cranks by their original 'S' hooks.

Figure 23

The chime hammers were checked and their adjustment nuts and securing mounts checked for tightness. The No.3 bell hammer was bent, and this was straightened out. The 'S' hooks were all in good condition and were reused.

All necessary adjustments were made to the new rods with hammers carefully checked for the correct pull-off, at rest and striking positions. New adjustable tensioners with integral lock nuts have been fitted between the wires and clock hammer lifting levers to facilitate any future adjustments.

Figure 24

# 4. Automatic Winding System

The old automatic winding system was driving each of the three trains of the clock from their 3rd wheels and not their main barrels. **Figure 26** illustrates the drive sprocket and chain mounted on to the 3rd wheel of the quarter chiming train.

Figure 25

The current guidance requires that the drive to the clock must be to the great wheel or barrel assembly (referred to as main barrel automatic winding). In other words, as the clock would have been originally driven if the weights were still being wound by hand. This is because gearing in clocks is designed for a large wheel to drive a smaller pinion. Driving a large wheel from a smaller pinion can result in abnormal wear on pinion leaves and wheel teeth, or if a jam occurs, the possibility of broken leaves and teeth.

New automatic winding units have been fitted to all three trains. The quarter chime and hourly striking units are of the epicyclic differential gear type, **Figure 27**, where the weights, **Figure 28**, are positioned away from the clock in the corners of the ringing chamber, and through sprockets mounted on each of the main barrel assemblies, **Figure 29**, power from the weight to drive the clock is provided through a transmission chain.

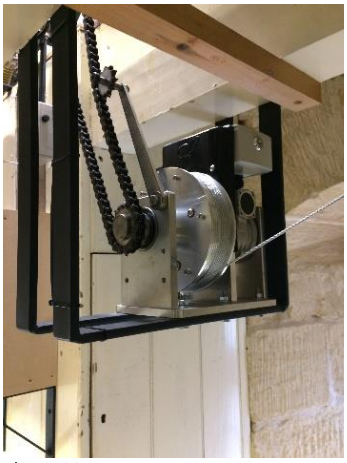

Figure 26

Figure 27

Figure 28

The epicyclic differential gear units have been bolted on to specially fabricated substantial brackets, **Figure 27**, that have been secured to the wooden support structure upon which the clock is mounted, through the bolt holes occupied by the previous automatic winding system.

The weight lines run in to the corners of the ringing chamber via a series of pulleys with the hourly striking weights to the left of the clock cabinet and the quarter chime weights on the right, as illustrated in **Figure 30**. Substantial safety cages have been fabricated to enclose the weights as they rise and fall during normal operation.


Figure 29 – Panels removed to show fabricated safety cage

The going train (time side) has been fitted with a smaller automatic winding unit, **Figure 31**, that rewinds the weight that powers the clock through a Huygens Endless Chain Transmission arrangement, **Figure 32**.


Figure 30


Figure 31

In line with the health and safety requirement to protect the ringers from failures, this going train automatic winder is also securely bolted to a substantial bracket and the drive weights are enclosed in a panelled box, **Figure 33**.


Figure 32

# 5. Night Silence System

Night silencing has been fitted. A digital time switch controls two linear actuators, one positioned for use on the hourly striking side and the other, as illustrated in **Figures 34** and **35**, to pull the quarter chiming hammers away from their bells at night and return the hammers to normal operation during the day. Care being taken to fit the actuators in to old unused rope holes.


Figure 33

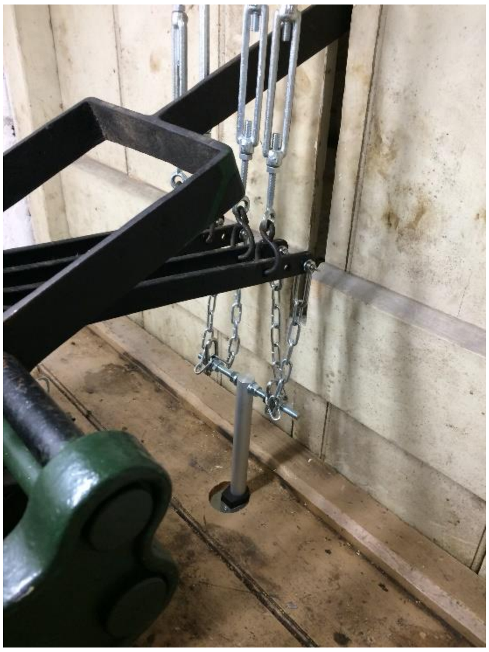
Figure 34

The existing manual hammer pull-offs are still in use for change ringing.

# 6. Technical Details

## 6.1 Going Train Wheel Count

| Going Train | | |
|---|---|---|
| | Pinion Leaves | Wheel Teeth |
| Barrel | - | 100 |
| Centre Wheel | - | 24 |
| 3rd Wheel | 11 | 75 |
| 4th Wheel | 10 | 64 |
| Escape Wheel | 10 | 15 |

## 6.2 Pendulum

Effective length: 51.36 inches (1.3 metres)
Period: 2.3 seconds
Beats per hour: 3142
Beats per minute: 52.3
Seconds per beat: 1.15

## 6.3 Driving Weights

Going (time): 25 Kg
Strike: 50 Kg
Chime: 70 Kg

## 6.4 Lubrication

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
Hammers and Cranks: Comma Premium Quality Lithium - molybdenum disulphide grease
Weight Pully Ball Bearings: Morris SAE 50 Classic Motor oil

# 7. 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 dept of gratitude to many people who have contributed their time and advise during the restoration of this clock. In particular I would like to thank:

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And sincere thank you goes to the parishioners and residents of Woodchester for their kindness and support.

Simon J Gilchrist MBHI
Clockmaker

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