THE TURRET CLOCK KEEPER’S HANDBOOK

(New Revised Edition)

A Practical Guide
for those who
Look after a Turret Clock

Written and Illustrated

by

Chris McKay
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Turret clocks are so very diverse in their design and construction that it is highly unlikely that the illustrations, which are given in this booklet as a guide, will be exactly like the clock for which the keeper is responsible. However, it is hoped that they will convey the spirit of the text and help as much as possible. All pictures are based on real clocks and an indication of the period of the feature has been given where possible.
INTRODUCTION

The objective of this book is to give practical advice to those who look after a turret clock. The book was first published in 1998 by the Turret Clock Group of the Antiquarian Horological Society. Being passionately concerned with turret clocks in England, my aim in writing the book was to promote the preservation and conservation of these clocks through providing information on their proper care.

Over 4,500 copies have been printed, sold or given away. Some years later I put the book up on my web site as a free download. I have no idea how many people chose to download a copy but it must be several thousand.

In 2013 I decided to update the book since things had changed in two fields. The first is health and safety and the second new technical developments. New information has been integrated where possible into the original contents or added at the end. Some of this new information does not lend itself to the graphic treatment used in the original book so please excuse expanses of text.

I did not want to be distracted with printing, storage and distribution so I made the book available as print-on-demand through the internet. Over the years I have had many communications with people in North and South America, Europe, Africa, India, Australia and New Zealand. My chosen means of production meant that anyone in the world can have easy access to this book.

There are many mentions about church clocks in the book; the reason is simple, there are so many church clocks in England. Comments on church clocks can generally be equally applied to any other turret clock.

I have used Imperial measurements since those were the ones in use when the clocks were made.

Disclaimer: All the information and guidance in the book has been given in good faith. I accept no responsibility whatsoever for what you do and the consequences you might create. The situation of each turret clock is unique so please check with all people involved with the clock before taking any actions and do involve a professional turret clock restorer. However, I do hope that what I have presented here is useful and will help turret clocks to be enjoyed by future generations.

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ACKNOWLEDGEMENTS

Many people read through the various drafts of this booklet and offered helpful alterations, additions and corrections. To all those who assisted me I offer my thanks, without them The Turret Clock Keeper’s Handbook would have been a very incomplete book. I would like to thank especially John Ablott, Jonathan Betts, Derek Frampton, David Knight, Chris Pickford, Mike Trickett, Keith Scobie-Youngs, Geoff Sykes and Peter Watkinson, who all made valuable suggestions.

THE AUTHOR

Chris McKay’s interest in turret clocks started when he was 11. His first restoration job began when he was 18 and took 10 years. Since that start he has seen many hundreds of turret clocks and taken thousands of photographs. An early member of the AHS Turret Clock Group, Chris was much affected by the enthusiasm of the late David Nettell. He is a Chartered Engineer who has a broad experience in the electronics industry from field service through to sales and marketing. After a career move, he went into teaching technology and computing in a secondary schools and finished his career in a leading prep school.
Proceeding further up the staircase, we open another door and we are now in the belfry itself. Looking in we see the bells, dull green as seen in the sunlight streaming in through the louvres—the open slats which allow the sound to escape whilst keeping the rain out. Belfries can be very dangerous places, so we do not go inside, but just pause to look in. Suddenly a bell starts to sound, the clock is striking the hour. A few pigeons perched outside the tower are startled and take off, their wings making a frantic clapping noise. The note of the bell is very loud and deep, and since we are so close, it seems to be quite harsh. As the last stroke has sounded the bell goes on humming and humming, softer and softer until after a minute it has died away completely. Our visit is complete, we have discovered a turret clock.
Some clocks have a third weight and train of gears enabling the clock to sound every quarter of an hour; this is often called the chiming train, but a more precise name is the quarter striking train. As this has even more work to do, its driving weight is the largest of the three clock weights. Popular chimes are those called the Westminster quarters used in Big Ben or ting-tangs can be sounded on two bells. The quarter train is almost identical to a striking train; here the main difference is the number of bell hammers it operates.

Another device sometimes connected to a turret clock was a tune barrel. ‘Carillon’ is a term often used to describe these devices, but strictly speaking a carillon is a set of 23 or more bells on which tunes can be played: so we will use the correct term of tune barrel. The tune barrel played tunes on the tower bells, hymn tunes were popular, as were national tunes and God Save the Queen—or King, as the case was at that time. Tune barrels are separate from the clock, look rather like a clock mechanism, but have a large drum with pins in which operate the bell hammers. The whole mechanism is rather like a huge musical box and is usually set off by the clock at certain times of the day. Sometimes the tunes change automatically, either for the different times of the day or for the different days of the week. In the 20th century carillons are sometimes found that are driven by compressed air.
Quarter. This is within the five minutes before quarter striking and ten minutes before the hour.

Wind until the weights are fully up; often a mark is painted on the line and used as an indicator; paint or white correction fluid is useful for this purpose and can be quickly repainted when it wears off. Always control the winding handle, allowing it to go backwards gently when winding is finished, thus lowering the click onto the ratchet to avoid any shocks and possible breakage. Do not begin winding too quickly, but start at a steady pace which can be maintained. It is vital that a weight is not wound too high. If it is then there is the danger of straining the line anchorage, forcing the line to come off a pulley, or at the worst, breaking the line and having the weight come crashing down. A weight of a quarter of a ton descending 30 feet will do considerable damage to anything in its way.

A maintaining power is a device which keeps the clock ticking whilst being wound, usually this is a lever which has to be pushed over to uncover the winding square. This type is known as bolt and shutter maintaining power. It is important to use it if fitted since it not only makes sure that the clock does not lose time during winding, but it also prevents damage to the teeth of the escape wheel.

There is a type of maintaining power, called Harrison’s, which uses energy stored in a spring to keep the clock running. If you turn the winding handle backwards a little you can feel the spring tension up. Another type uses a system of epicyclic gears which are usually hidden inside the barrel; with these clocks the winding handle sometimes turns one way and the barrel turns in the opposite direction.

Large quarter or striking trains sometimes have a winding jack, this contains a set of reduction gears which make the clock easier to wind. Often the jack has to be put onto a winding square, and the winding handle then goes onto the jack. The frame of the winding jack butts against a stop, usually a wooden part of the supporting frame, to prevent it from turning. A variation of this is where the reduction gear is built into the clock; usually a pinion has to be engaged before winding and then disengaged after winding.
Winding Groups

The city of York has a winding club where a group of like-minded people wind the clocks. A charge is made for each clock but essentially the services are provided by volunteers. Money raised through winding fees is re-cycled to pay for maintenance, repairs and restorations. Since a group is involved a person only has a winding rota for say one week in a month or six weeks.

Automatic Winders

Some turret clocks are fitted with automatic winders which do away with the task of manual winding. They operate by an electric motor which winds up a small weight at regular intervals. In the event of a power cut, there is usually enough drop on the weight to keep the clock running for several hours. Some types use low voltage motors powered by a battery, these have a greater reserve and can wind the clock for several days without mains power.

Clocks with automatic winders still need regular care and attention. A visit, monthly at least, is necessary to check time keeping and set to time if necessary.

Setting to Time

Most turret clocks have an internal setting dial which shows the time as indicated on the outside dials. They normally have just one hand to show the minutes, or sometimes a additional hand to show hours. Quite often the numerals on the setting dial run anti-clockwise.

There are several different systems for setting the hands; commonly used is a small key or spanner which fits onto a square on the setting dial, and when turned this moves the outside hands. Always use the spanner if there is one, because if you try to use the hand you are likely to bend or break it. A friction clutch allows the hands to turn, this is quite suitable for small dials, but where several dials, or large dials are used a different mechanism is employed.

Those clocks which drive large dials usually employ a nut which has to be first unlocked to set the hands. Once this has been done, the drive from the clock is completely disconnected from the hands which can then be set easily to time. Once the dials indicate the correct time, the nut is of course locked up again. This system has the advantage that the drive is very positive and there can be no chance of the hands slipping.
An alternative to the nut is a dog-clutch where depressing a catch releases the hands to allow them to be set to time.

Some 8th century clocks are set to time by sliding the pallets out of engagement with the escape wheel and letting the clock run forward. This must be done with great care since the escape wheel can easily be damaged. First stop the pendulum, but don’t just make a grab at it as there is a lot of energy in the swinging bob; rather give it a number of small pushes to oppose its swing. Next push the catch which keeps the pallets in engagement to one side, hold the escape wheel arbor, and slide the pallets out of engagement. Allow the clock to run slowly forward by letting the escape wheel arbor run through your fingers. When you have reached the correct time (on no account let go, or let the wheel turn so fast you cannot control it), grip the arbor firmly to stop the wheel turning and slide the pallets back into engagement. Make sure the catch that retains the pallets is back into place. Finally, restart the pendulum by gently giving it a series of small pushes.

When setting a clock to time always turn the hands forwards and if you have to advance the hands past the hour let the clock strike fully. Should the clock have quarter striking, allow the chiming to finish after you set the hands past each quarter.

**SETTING TO SUMMER TIME AND WINTER TIME**

To set the clock to Summer Time advance the hands by one hour letting the clock strike at the hour and quarters.

To set the clock to Winter Time it is best to stop the clock for one hour by stopping the pendulum. Alternatively you can advance the clock by 11 hours letting the clock strike at every hour and quarter.
Some clocks, usually late 19th century clocks which have compensation pendulums, use small weights for fine regulation. These work by effectively raising the centre of gravity of the pendulum. Regulation weights are often in the form of large washers and slip on to one or two vertical rods close to the top of the pendulum. Sometimes people put a number of odd items on the top of a pendulum bob to help bring it to time.

To make the clock gain add regulation weights.

To make the clock lose remove regulation weights.

Expect a change in time keeping of a second or so a day for removing or adding one washer-type weight.

**Correcting the striking or quarter striking**

The striking may possibly get out of step with the time on the dial or the quarter striking may be out of sequence; this could be due to letting the clock run down and stop, inadvertently tripping the striking, or not allowing the clock to strike fully when advancing the hands.

The clock may be corrected by setting off the striking or chiming. Most clocks have a count wheel to control the striking, this means the clock strikes 1, then 2, then 3 and so on. A count wheel has slots in its edge (or it may have pins that protrude), often they are marked 1, 2, 3 etc., and the spacing between the slots gets progressively longer. When striking has finished the correct number of blows a lever then drops into these slots which in turn stops the striking by locking the fly.

Check the time on the outside dial, then lift the locking lever and let it drop. The clock will then strike. Repeat this process until the striking is back in step with the hands.

Note: The striking cannot be released if the clock has ‘warned’. Warning is the clock’s action just before it strikes. About ten minutes before the hour the going train partially releases the striking train, this is accompanied by a loud click. Exactly on the hour the striking train is released and the hour is struck. A quarter striking train warns about five minutes before each quarter.

Correcting quarter striking is much the same as correcting hour striking except that the locking
Wood as a material for pendulum rods is less affected by temperature, for the temperature range suggested, the error is more like 5 seconds a day. However, wood will absorb moisture if it has not been well varnished and this will also cause an error. A compensation pendulum is made of tubes of iron and zinc and reduce temperature errors to near zero.

Wind has the effect of moving the hands, sometimes adding to the driving force of the clock and sometimes reducing it. This varying force is transmitted to the escapement and this results in changes to timekeeping that are similar in magnitude to errors caused by temperature. The gravity escapement effectively eliminates the problems caused by varying forces due to wind.

A change in air pressure also causes a change in timekeeping, but this is a fraction of a second; quite small in comparison to other errors.

The following chart gives a sort of guide as to what performance a clock might give. It is assumed that the clock is in good condition and that weather conditions are steady with a constant temperature and no wind.

<table>
<thead>
<tr>
<th>Clock</th>
<th>Escapement</th>
<th>Pendulum</th>
<th>Expected accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>17th century</td>
<td>Recoil</td>
<td>Iron rod</td>
<td>2 minutes a week</td>
</tr>
<tr>
<td>18th century</td>
<td>Deadbeat</td>
<td>Iron rod</td>
<td>1 minute a week</td>
</tr>
<tr>
<td>19th century</td>
<td>Deadbeat</td>
<td>Wood rod</td>
<td>30 seconds a week</td>
</tr>
<tr>
<td>19th century</td>
<td>Gravity</td>
<td>Compensation</td>
<td>5 seconds a week</td>
</tr>
</tbody>
</table>

**Your Successor**

Please try to cultivate a group of people who are able to look after your turret clock. In this manner the clock will be kept running despite one person being away, unwell or on holiday.
TURRET CLOCK TERMINOLOGY

This section is primarily intended as an aid to identifying the various parts of a turret clock not covered in the preceding text and to assist with filling in the Turret Clock Database Recording Form. It also gives a little history, particularly general dates as to when certain features on turret clocks were introduced. The dates are a guide only; anomalous styles do occur e.g. when a 19th century maker copies a 17th century clock.

DESCRIBING A TURRET CLOCK

To describe a turret clock first detail the number of trains, then the frame type, followed by the escapement. The clock popularly called ‘Big Ben’ is thus a three train flat bed with gravity escapement.

FRAMES

Naming the frame and the escapement of a turret clock is a good way of classifying a movement. Commonly met frame types are detailed here, but other more unusual and less common types are encountered from time to time.

End to End Birdcage

The end to end birdcage frame is the earliest type. Here the trains are placed in line or end to end. Almost always the material is wrought iron, but occasionally wood is used. Its open frame gives rise to the term birdcage. Wedges or riveting hold the frame together; bars which carry the bearings are removable and held in by wedges. We know that clocks were in use in the 13th century and almost certainly this frame construction was used. It lasted up until the 1660s when the pendulum was introduced and the frame design changed putting the trains side by side. Most clocks of this type have been converted from foliot to pendulum.

Side by Side Birdcage

Birdcage is the name given to the frame made of a cage of wrought-iron. Often the frame is held together by riveting or by screwed nuts. Individual bars that support the trains of gears can be removed and normally these are secured with nuts. The trains are placed side by side. This type came into use around 1670 and was used until cast iron superseded wrought iron at the end of the 18th century.
**Electrical Turret Clocks**

**Waiting Train**
This was really the first commercially viable electrical turret clock; it was patented in 1907. A heavy pendulum works as a motor and drives the dials advancing them by half a minute in about 25 seconds. The movement then stops advancing the hands and waits for a synchronising signal that is supplied every half minute from an electrical master clock. The signal releases the clock to go through another half minute cycle. The waiting train system is able to drive very large dials, some as large as 25 ft diameter.

**Impulse Movement**
Master clocks were introduced in around 1900; they produce an electrical pulse to drive slave dials every half minute. Impulse movements are used to drive small turret clock dials, the mechanism being situated behind the dial.

**Synchronous Motor**
Once the National Grid was established, voltage and frequency of the supply was standardised. A synchronous motor is driven by the 50Hz mains and its timekeeping is entirely set by the frequency of the supply which by law is set to close limits. The first synchronous motor driven turret clocks were installed in the early 1930s. Early synchronous clocks had to be started manually, they were not self-starting as later clocks were. Electronic backup systems are available to overcome power failure problems.

**Radio Controlled**
Today many modern installations use electronic systems. Dials are driven by a motor controlled by very accurate time signals carried by radio transmissions from MSF Althorn. Changes between summer and winter time are automatic.
**Double Three-legged Gravity**

Invented by Edmund Beckett Denison and employed in Big Ben in 1860, this escapement is used on high-quality clocks where accurate timekeeping is required. It is usually used in conjunction with a compensation pendulum. Here two arms are alternately lifted and released by the escapement. The escapement is very ‘active’, the escape wheel turning through one-sixth of a turn for every tick.

There are many variations of this escapement, but all have arms that impulse the pendulum.

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**Verge & Foliot**

Many early clocks were fitted with a verge & foliot. The foliot was a weighted bar which first turned one way then the other driven by the verge escapement. Almost all clocks were converted from foliot to pendulum from the 1670s onwards. To discover an original existing foliot would be an important find, but a few do exist.

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**Verge & Short Pendulum**

For a short period from around 1660 to 1690 some turret clocks were fitted with a short pendulum (about 2 ft long) and a verge escapement. These soon gave way to the long pendulum with a recoil escapement.
**Pendulums**

The pendulum controls the timekeeping of the clock; it is the length that sets the time of each swing, not the weight. Generally the beat, the time taken to swing from one side to the other, is 1, 1¼, 1½ or 2 seconds. However some clocks have pendulums that have unusual beats. Common pendulum beats and lengths are listed below. The real length of a pendulum is slightly longer than the theoretical length.

<table>
<thead>
<tr>
<th>Seconds per beat</th>
<th>Theoretical pendulum length</th>
<th>Beats per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39”</td>
<td>60</td>
</tr>
<tr>
<td>1¼</td>
<td>61”</td>
<td>48</td>
</tr>
<tr>
<td>1½</td>
<td>88”</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>156”</td>
<td>30</td>
</tr>
</tbody>
</table>

Early clocks had pendulums with iron rods. Wooden rods were used later to reduce the effect of temperature changes on timekeeping. In the 19th century compensation pendulums were used to near eliminate errors due to temperature variation. These pendulums employed two metals with different expansion rates and were usually constructed using concentric tubes. Often holes can be seen in the outside of the tube, the idea was to allow the air to access the compensation.

**Weights, Lines & Pulleys**

Turret clocks are driven by weights, though many have now been converted to automatic winding. Early clocks had weights made of stone and sometimes weights of lead can be found. Most commonly weights are made of cast iron. Before the 19th century these were cast as a single weight but by the mid 19th century a much more practical system had evolved. Here a central iron rod held small weights or ‘cheeses’ that could be slotted onto the rod where they fitted together. Cheeses were generally about 50lbs in weight so any weight could be easily made up.

Natural fibre rope was used for clock lines until around 1850 when steel patent line became available. This was invariably used on all clocks after this date and many older clocks that used rope had steel lines fitted as replacements.

Early pulleys for clocks with rope lines were made of wood with wrought iron briddles. Wood suffered from the attack of worm and today most clocks have cast iron pulleys.
Dials

Early clocks did not usually have dials; they only struck the hour on a bell. Dials when they did appear had only one hand, the hour hand. It was about 1700 when the minute hand appeared on turret clock dials. The driving force was probably the arrival of the recoil escapement with its improved accuracy plus society was becoming more sophisticated in its organisation.

Early one-handed dials were generally made of wood, were flat diamond-shaped and had a deep moulding round the edge. Lead flashing round the top prevented water from getting behind the dial. There were no minute marks but half hour or quarter hour makers were common. The hour hand usually extended just into the circle of chapters and had a decorative counterbalance. Often a sunburst or similar design was employed in the middle.

By the early 18th century copper sheet was readily available and the round convex dial became the norm for the next 150 years. Dials were invariably painted and the hands, minute marks and the Roman chapters done with gold leaf. A raised moulding round the edge gave strength in addition to the convexity of the dial. Hands invariably had a rib down them for strength.

By the mid 19th century cast iron dials became popular; these were skeletonised and often glazed with white opal glass and illuminated from inside by gas light. Sometimes a gas switch was driven by the clock to turn the gas on in the evening and off in the morning. Later electricity took over from gas.

Dials of stone, slate, lead or just painted onto a tower wall are also encountered. Sometimes the design of the hands can identify the clock maker from their distinctive style. It was not until the 20th century that ‘modernistic’ dials appear and all sorts were employed.

In medieval times astronomical dials were provided in cathedrals and important churches. There are examples at Wells and Exeter. The latest of these astronomical dials was at Hampton Court Palace in the reign of Henry VIII.
**Automatic Winders**

Automatic winders are used to do away with the necessity of manual winding. In each type an electric motor re-winds a small weight at regular intervals. In the event of a power cut there is normally sufficient reserve to run the clock for several hours. Almost all systems employ a sprocket wheel connected to an arbor or barrel and roller chain to transmit power from the automatic winder to the clock. The weight used can be much less than the normal driving weight for the clock, but of course it has to be wound up more frequently. Early automatic winders were mains powered, but now some are battery powered, the battery being recharged from the mains. This method provides a reserve of several days whilst the mains-powered version, depending on its type and installation, may only provide a reserve of several hours. Battery-powered winders usually employ a small lead-acid battery that will need replacing after several years service.

The Church Buildings Council of the Church of England requires that automatic winders be connected to the great wheel or barrel arbor. This is a good practice. Where automatic winders are connected to second wheels then the second wheel is driving the barrel. Clock gearing is inefficient in this mode and severe wear can be caused in some circumstances.

All automatic winders should be fitted with a safety override switch. In the event of a fault where the winder fails to stop correctly, the override switch comes into action and turns the winder off completely to await maintenance. The override switch should not be reset until the cause of the fault has been identified and corrected.

The four basic types of automatic winder are:—

*Huygens Endless Chain*

A weight hangs on endless roller chain. One side of the chain provides driving power to the clock, the other is rewound by an electric motor when the weight has descended to a certain level. These were the first type used and the chain drive to the clock was connected to the second wheel arbor.

*Monkey up the Rope*

An endless loop of chain passes over a sprocket on one of the clock wheels. The motor hangs from one side of the chain and provides the going weight. The motor winds itself up the chain when it has descended to a certain level.
Night Silencing

In urban areas a clock striking through the night is unacceptable to some people. A night silencing unit can be installed to stop the bells ringing. This unit usually comprises an electrical linear actuator that is controlled by an electronic time switch. At a pre-set hour the actuator is turned on and this operates a wire that pulls the clock bell hammer clear of the bell. The clock carries on striking in the normal manner, but the bell is not sounded. In the morning the actuator is reversed and the clock bell hammer is lowered enabling striking to be resumed.

Clocks with heavy hammers have employed a similar system, but used a motor with gearbox reduction to obtain a similar result.

A useful solution is to arrange a device that holds up the striking release so that the striking train is left on the warning. The hold up is released 12 hours later and striking continues. A benefit of this system is reduced wear since the striking is only running for half the time. This application is best suited to clocks with countwheel striking.

Occasionally mechanical night-silencing can be found that was designed into the clock from the start. Such clocks were often adjacent to hospitals and date from the late 19th and early 20th centuries.
ELECTRO HAMMERS

Traditionally a bell is struck by the clock operating a hammer on the outside of the bell. A wire goes from the clock striking train to a hammer fixed close to the bell. In operation the clock raises the hammer and then releases it allowing the hammer to fall on the bell’s soundbow thus sounding the bell. New installations of clocks, Angelus striking, tolling for services, tolling for funerals, and carillons invariably employ electro hammers.

An electro hammer comprises a pivoted hammer and an operating electro-magnet. A short pulse of power (usually mains voltage) to the unit causes the hammer to turn and strike the bell. A counterbalance inside the electro hammer returns the hammer to the neutral position.

Electro hammers have the advantage of being fairly small and compact compared with conventional hammers. These hammers can be easier to install; since they only require an electrical wire to be run to each hammer, there is no need for steel wires and bell cranks.

Occasionally, electro hammers have a use in traditional installations. One example is when a ring of bells has been augmented say from 8 bells to 10 bells and the new frame does not allow sufficient room to re-use the old clock hammers. In such a case, fitting electro hammers might be a solution to be considered. Switches may be added to the clock and these would be operated by the mechanical hour striking or quarter striking cams. The switches would then activate the electro hammers. However, electro hammers should only be considered when the possibility of using mechanical hammers has been properly investigated.

Whilst a heavy clock hammer will bring out the full range of notes of a bell, electro hammers are thought to be less capable of producing a good note.
TURRET CLOCK MAINTENANCE

Turret clocks have to perform in a hostile environment as often towers are cold, damp, dusty and windy. Basic maintenance is essential to keep the clock in good condition and performing well.

BASICS

The purpose of this section is to enable those responsible for the care of a turret clock, to plan the maintenance of that clock. It is not intended as a do-it-yourself guide since many of the operations need to be done by a professional person experienced in turret clock work. Errors in maintenance could lead to damage to the clock, bells, bell wheels, the building structure, injury to the person winding the clock or to persons in the vicinity. The points presented here are to make the turret clock keeper aware of the aspects involved. As each turret clock installation is different, turret clock keepers are strongly advised to take professional advice concerning the maintenance of their clock.

An eight day quarter striking turret clock with 4 dials needs lubrication in over 100 different places. Clocks have been damaged by people who have oiled or greased wheel teeth; dust and grit sticks to the oil to make an efficient grinding paste which rapidly wears pinions.

Protection is better than a cure, so a good wooden case (which can be locked) round the clock will protect it from dirt. Likewise, it is a great advantage to have a protective box over the motion work behind each dial and another around the bevel gears in the leading off work.

The best scheme is that a turret clock should have an annual service from an experienced professional who would perform the following tasks:

SAFETY CHECKS

Make a safety check on…
- Weight lines
- Weight line attachments
- Pulleys
- Flys
- Striking and chiming fly clicks
- All barrel clicks
- Suspension spring
- Bell hammer adjustments
- Bell hammer pull offs
- Dial fixing

Wipe off excess oil and dirt from...
- Clock movement
- Leading-off work
- Motion work
- Bell hammers and cranks
Restoration and Conservation

Conservation is a discipline that has been used in the museum world for a long time. Only recently clock restorations are being carried out with conservation in mind. Conservation has more than enough special jargon of its own. However, it is worth getting to grips with the key terminology since grant-awarding bodies are likely to favour a conservation-minded approach to planned work.

Terminology

Cultural-heritage is a term met at every turn in the Conservation world; a definition is… Cultural heritage, national heritage or just ‘heritage’ is the legacy of physical artefacts (cultural property) and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. Cultural heritage includes tangible culture such as buildings, monuments, landscapes, books, works of art, and artefacts, intangible culture such as folklore, traditions, language, and knowledge, and natural heritage including culturally-significant landscapes, and biodiversity.

Conservation is the deliberate act of keeping cultural heritage from the present for the future. The activity of Conservation can be further elaborated to be any methods that prove effective in keeping that property in as close to its original condition as possible for as long as possible.

Intervention means doing something to the object. An intervention could range from a non-invasive activity, like introducing environmental control round the object to a full cleaning and execution of actions to stabilise, strengthen and prevent deterioration.

Preventive Conservation is an activity to minimise decay, deterioration or loss. Examples are typically security, environmental control, storage, handling, packing and transportation. To this can be added, education. There a great benefit to educate the winder of a turret clock on its history and correct management as well as educating the carers and owners.

Remedial Conservation is a measure aimed at arresting current damaging processes or reinforcing the structure of an object. For a turret clock this might involve painting bare metal or replacing dial fixings. As such these operations alter the current state of the clock.

Restoration is a word loosely used in horology where it is generally applied to any repair, replacement or cleaning operation. The European Confederation of Conservator-Restorers’ Organisations (ECCO) has a precise definition: Restoration consists of direct action carried out on damaged or deteriorated cultural heritage with the aim of facilitating its perception, appreciation and understanding, while respecting as far as possible its aesthetic, historic and physical properties.

Since Conservation so often goes hand in hand with Restoration, the general term Conservation-Restoration encompasses these two sometimes opposing philosophies, that may be broadly stated as keeping the clock in working order with minimum loss of original material. Turret clocks are expected to work 365 days a year, tell the time with reasonable accuracy, strike on a bell or bells and show the time on a dial that is clearly legible. Balancing restoration and conservation demands a
COMMISSIONING TURRET CLOCK WORK

Major work on turret clocks is only needed on an occasional basis, so those commissioning such work may well be unfamiliar with the various issues. The objective in this section is to highlight topics that are important so that both the owner and the restorer understand exactly what is expected.

When a turret clock needs attention it may be as a result of different situations. Commonly encountered are…
- The clock is in poor condition, it may not run or has several faults.
- The clock has a specific fault or is unreliable.
- Getting someone to wind the clock is a problem, an automatic winder is required.
- The clock needs to be moved as part of a tower reorganisation / re-hanging of the bells.
- The dials are in poor condition and need painting and gilding.

DECIDING WHAT IS NEEDED

An ideal starting point would be a Statement of Significance and a Statement of Needs. In reality such statements evolve as a result of suggestions provided in quotations from clockmakers in addition to the obvious requirement. At the very least a list of needs should be provided; this can be broken down as in this example below. In this way a structured and itemised quotation can be produced. Churches would find it useful to involve their diocesan clocks adviser at an early stage to avoid pursuing a course of action that cannot be supported at a later stage.

Essential
- Clock repaired and overhauled
- Striking working

Desirable
- Automatic winders
- Night silencer

Will need doing at some time when funds allow
- Paint and gild dials

REQUESTING A QUOTATION

You will need to meet the clockmaker on site to explain what you think you need. A qualified professional will be aware of issues that you might not have considered. Access will be needed to the clock, weights, bell hammers and gearing behind the dial. Make sure that any bells are safely in the ‘down’ position. It is useful to involve the clock winder or carer and tower keeper or ringing captain when bells are involved.

Some restorers might ask for a fee for preparing a report. This is not unreasonable since it might involve them in a day’s work plus travelling expenses. Some restorers will give a free report. Make sure you know if a charge is payable before requesting a site visit.
not create cramped or difficult working conditions for winding or servicing. The position chosen should be strong enough to support the weight of the clock and its weights. The lead-off work and bell wire need direct routes to the dial and bell with the minimum of changes in direction. If hand-wound, sufficient fall for the weights is required so that the clock lasts a week between windings; electric auto-winding is often fitted when the clock is relocated.

Provision should be made to contain safely the weights if the lines break or the pendulum if its suspension spring fails.

Every effort should be made to retain earlier weight chutes, and if auto-winding is installed, a secure place must be found for old weights, pulleys and winding handle no longer currently in use and all labelled clearly for identification.

**ILLUMINATED DIALS**

Illuminated dials were traditionally made of a skeleton of cast iron and glazed with opal glass. Illumination on the inside was initially by gas and this was soon replaced by electricity in the 20th century. Incandescent bulbs were replaced by fluorescent tubes and today a wide range of luminaires are available from conventional low-energy bulbs to LED lights. LED lights offer small size thus making them easy to install where motionworks and counterbalances make things difficult. Low power and long lifetimes are other benefits. LED can be run off low voltages and this can be a great advantage in damp environments.

In new clock installations hands can be illuminated with LED strip lights

**ADDING QUARTER STRIKING AND TUNE PLAYING**

It is now an easy matter to expand facilities on a turret clock by adding quarter striking to an hour striking movement, or by adding both hour and quarter-striking to a timepiece. Electro hammers and some electronics to provide the sequence of notes can be installed without altering the clock. It might seem attractive to have an electronic master clock to control the striking. Far better and less cost, is to add a switch on the movement that will initiate the striking. In this manner the striking is always in step with the time indicated on the dial and not early or late with respect to the mechanical clock.

Similarly a tune player can be started so that it follows the hour striking.
WHO WILL DO THE WORK REQUIRED?

People who work on turret clocks can range from a local clockmaker who occasionally works on turret clocks, through to individuals who are employed full-time in the trade to smaller companies that are able to carry out any work anywhere in the country to large companies that can undertake international projects. There is a place for all these clockmakers and choosing the most appropriate one is important. Where possible use a qualified professional who is engaged full-time in turret clock work.

FINDING AND CHOOSING A TURRET CLOCK RESTORER

A competent person should carry out any service or repair work. The best qualification is someone who is experienced in turret clock work and who has a catalogue of successful work with satisfied customers that are willing to give references. There is no formal horological qualification available for those who work specifically on turret clocks, but you should expect to see MBHI or FBHI after the name of the person you are dealing with.

THE APPROACH TO THE WORK REQUIRED

The view of those commissioning work might range from one of ‘The lowest cost is the best’ to ‘The clock is unique and must be fixed, it costs what it costs’. In reality most people are proud of their clock, its heritage and its place in the local community. The important thing is to impart your love of the clock to potential restorers, and communicate to them that a quality job is required. Be aware that the lowest price tender can end up as the most expensive unless all aspects of the work have been covered. There have been cases where additional money was asked by the restorer for fixing problems that they did not spot or where complete areas were omitted e.g. the bell hammers and wires.

QUALIFICATIONS

The British Horological Institute (BHI) maintains a list of their members who are qualified to BHI standards and who are obliged to follow the BHI code of practice. The BHI will provide names of restorers in your area; make sure to ask for someone experienced in turret clock work. Repairers can be searched for on the BHI web site.

BHI member grades are as follows…

- MBHI Member BHI. A qualified member.
- FBHI Fellow BHI. A qualified member with extensive proven experience.

The grades CMBHI, LBHI and GradBHI are no longer in operation.

The Professional Accreditation of Conservator-Restorers (PACR) is an assessment scheme owned by the Institute of Conservation (ICON). PACR enables qualified and experienced practitioners in all conservation disciplines to achieve Accredited Conservator-Restorer (ACR) status; essential for inclusion in the Conservation Register. Turret clock restoration is a discipline that is relatively new to formal conservation techniques so the ICON web site lists only a few persons who do turret clock work.
There are individuals or companies in the UK that deal regularly with turret clocks. Each one has a particular approach and there is room for the one-man-operator, through the small company to the large organization. There are six main features of a good restorer:

1. They have a passion for the historical and technical side of turret clocks
2. They have a record of satisfied customers
3. They provide good value.
4. They are technically competent.
5. They have a well-equipped workshop in which they do their work.
6. They operate good business practices and carry the appropriate insurance.

Turret clock restorers might advertise in such publications as Yellow pages, Diocesan newspapers and directories and The Ringing World. A search of the internet will also be useful. One of the best plans is to ask around for the experience of other local churches, schools and town halls that have clocks. A good recommendation is one of the best adverts a restorer can have.
an occasionally-working exhibit generates public interest and is good form of preservation. The downside of this can be that what starts as a proud exhibit cared for by the parishioners can end up as an uncared for dusty piece of machinery and a nuisance to succeeding parishioners. The clock is then at greater long-term risk. A faculty is always needed to remove a clock.

Weights, Chutes and Pulleys

When automatic winders are fitted to church clocks this is sometimes part of other schemes. These might require the removal of internal wooden weight chutes to make more room.

Where possible weight chutes should be retained. Pulleys and weights should be retained and stored somewhere appropriate; e.g. out of the way in the bottom of the weight chute or in the clock case. The redundant winding handle should be stored in the clock case.

Old Electrical Clocks

There are some electrical impulse clocks driven by master clocks that date from 1910 and after. The first synchronous motors were employed in the 1930s. Electrical installations of this age can still operate in a satisfactory manner. However they require specialist knowledge from the restorer, and are getting to an age when synchronous motors are worn out or the safety of electrical equipment might be questioned. The Antiquarian Horological Society has a specialist Electrical Horology Group that has members knowledgeable in diverse aspects of electrical horology.

Church of England Faculties & DAC Advisers

The Church of England has a control system, the Faculty Jurisdiction, that is roughly equivalent to secular planning law, though control extends to a greater level of detail than with a secular building. Any work to a church clock, other than maintenance, basic repairs, or replacement of wire lines, auto-winder motors and switches, requires a faculty. Faculties are granted by the Chancellor of the diocese (a legal officer) who is advised by the Diocesan Advisory Committee (DAC). Most dioceses have a specialist clocks adviser, who advises the Diocesan Advisory Committee. The adviser is available to help parishes, and discuss proposed work with the clock restorer. There is a Forum in which the various clocks advisers are able to communicate with each other and to discuss issues.

No work should commence until a faculty has been granted. Faculty Jurisdiction applies to all contents of a church, even if the ownership of the item lies elsewhere. Sometimes clocks were purchased by public subscription and are the property of a local council; the Faculty Jurisdiction still applies where the local council owns the clock in the church.

Publicity

Where a clock is in good condition, there are opportunities for a clock-related project, and indeed one which could be fulfilled on a low budget. What about producing a booklet on the clock? This could, of course, be combined with a restoration project and could even be a simple display panel at the tower with good quality photos and some text. Bodies giving grants are likely to pay for this as part of the clock restoration. If the clock is strongly associated with a person is there a photo of them, are they alive or still remembered? Old buildings usually have a printed guide of some sort, this could be updated to include details of the clock. Some places have produced leaflets or booklets on the clock itself, or the clock, tower and bells. Such a booklet gives equal scope to the...
historian and researcher, clock winder, photographer, desk top publisher, artist and so on. What might at first sight be an apparently dry subject of interest to a few technical specialists, can be brought to life to catch the imagination of those in the locality as well as passing visitors. Consider the original reason for the clock’s installation, the minutes in record books, old quotations, bills and correspondence from the maker, newspaper articles over the years and so on. Often the clock case has comments scribbled in its odd corners recording such events as a new clock winder, the death of the King, outbreak of war, a dial repainted or repairs to clock. The winder too is living history and is bound to have some information and anecdotes about their charge. Once written, sketched, photographed and put into a word processer or desk-top-publisher, it remains to be printed. With today’s print on demand facility booklets can be produced in small quantities at reasonable price.

FUND RAISING

When engaging in a major project concerning a clock it is wise to form a dedicated Clock Restoration Committee at an early stage. There are many sources of grant funding-- it is a case of finding them. Heritage Lottery is one and the Church Buildings Council can award grants for clock work.

Local charities should be explored and local councillors often have a discretionary sum they can award for deserving projects.

To raise money for a dial restoration one church had a ‘Sponsor a numeral’ fund raising event where people could ‘buy’ a minute mark or a Roman numeral. There is the old variation on raffle tickets where a wind-up clock is fully wound and sealed in a box. Contributors then guess when the clock will stop and the winner is found when the box is opened. Dial floodlighting, where it exists, could be a means of sponsorship. People might want to pay for the illumination on a certain day in memory of an event personal to them. Holding a concert or service on the theme of time is another scheme.
Health & Safety

The profile of health & safety issues has expanded rapidly over past years and this has now had an impact on the world of turret clocks. In the main visiting and winding a turret clock presents much the same risk as crossing a road. However, it is essential that the risks involved are clearly understood and catered for by the clock owner and anyone attending or winding the clock. From time to time one is told “It’s not safe up there, only the clock winder is allowed up the tower”. If it’s not safe for a sensible informed visitor then it is not safe for the clock winder. Such a statement cannot absolve the clock owner from liability.

Health and safety is all about being sensible and not taking unnecessary risks. It is important that the clock carries on being wound and looked after in a proper manner. Where health and safety issues are identified look for solutions rather than locking the tower and putting up a Keep Out notice.

Safety in Visiting a Clock for Winding

Some simple procedures can be employed to ensure that should something go wrong whilst winding or visiting a clock then suitable help can be summoned. Many churches and heritage buildings will demand lone working procedures. Such a procedure would possibly include such systems as:

Two people working together at all times

One person on their own needs to notify a nominated person that they are visiting the clock and on completion of the job they notify the same person they are out of the building. If the person working on the clock has not contacted the nominated person within a specified time, then a search is instigated.

A mobile phone is carried.

Notices such as ‘Worker in Tower’ are displayed.

Locked In Strategy

Anyone working regularly on turret clocks is likely to experience being locked in a tower at some time. Such an incident can arise from the key holder thinking the building was empty and locking up, someone inadvertently locking a door that they thought had been left open, or from a malicious act. Anticipating such a situation is being pre armed.

Avoidance of being locked in is certainly the best policy making sure that people are aware that someone is working on the clock, locking padlocks so they cannot be snapped shut and having ‘Worker in Tower’ notices.

Strategies to cope with the locked-in situation could involve:

Operating a lone working plan like that above
COLLECTING TURRET CLOCKS

COLLECTING PHILOSOPHY
People collect all sorts of things from stamps to steam engines and some people collect turret clocks. Often these are clock collectors who want to have one turret clock as part of a wider collection. Here a small domestic sized clock is preferable that fits into an alcove or hallway. Some collectors are more serious and use a garage or a barn that soon fills up. Turret clock dials can indeed be incorporated into buildings; garages and stables are the most popular.

POINTS TO CONSIDER
A small turret clock with a seconds length pendulum is highly suitable for incorporation into a domestic environment or the gable end of a garage. A clock that is complete with pendulum, dial, hands, motionworks, weights, pulleys, winding handle, bell and bell hammer commands a high price compared to a movement on its own. When buying be sure as to exactly what comes with a movement. Clocks offered for sale are very often just a movement even lacking the pendulum and weights.

Most turret clocks tend to have long pendulums, either ¼ seconds (length 5 feet) ½ seconds (length 9 feet) or 2 seconds (length 14 feet). Clocks with longer pendulums are less desirable and more difficult to install as a going exhibit.

Going period is another issue. The small clock quoted with probably run for a day with a weight drop of 3 feet, but larger clocks with longer pendulums need heavier weights and might need longer drops to accommodate a day’s running. Restricted drop can be overcome by employing a heavier weight on multiple pulleys. However, multiple pulleys are inefficient and very large weights are generally not suitable in a domestic setting. Of course, the addition of an automatic winder will remove these restrictions.

ACQUIRING A CLOCK & PROVENANCE
With turret clocks, there are ethical considerations to be borne in mind. Turret clocks may be bought in auctions both local and on-line, or privately from another collector. It is important to have the confidence to know that the clock has been legally removed from a building. With the demolition of Victorian factories and public buildings there has been a wealth of clocks coming on to the market. Clocks also appear as buildings are modernised and mechanical movements fall prey to cold economics, discarded in favour of an electronic solution.

If offered a clock from a C of E church then be suspicious and do make sure that a faculty has been granted for its removal. If in doubt contact the diocese. Canon (Church) law, like other legislation, is passed by Parliament and as such carries enforceable penalties. Best to check first than to be held responsible for its return. Similarly a clock from a listed or heritage building might also be subject to restrictions as to its disposal.

Knowing the provenance of a clock not only adds to the clock’s history, but also enhances its value. It also makes it easier to pass on when the time comes to sell the clock as the buyer has the
GLOSSARY OF TERMS

AHS  Antiquarian Horological Society.
Arbor  Horological term for axle.
Arm chair  Incorrect term for double framed.
Automatic winder  Electrically powered device to wind clock.
Barrel  Wood or metal cylinder around which the weight line is wound.
Bell crank  Lever to transfer the pull of a wire through 90˚.
Belfry  Chamber where bells are hung.
Bell hammer  Hammer to sound bell.
Bevel gear  Set of gears to transfer turning of a rod through 90˚.
BHI  British Horological Institute.
Birdcage  Type of clock frame. (End to end or side by side.)
Bob  Weight on the end of the pendulum.
Bolt and Shutter  Type of maintaining power.
Bushing  Brass bearing in which pivots run.
Cam  Shaped device to raise a lever.
Carillon  Common description of a tune barrel. Set of 23 or more bells.
Cast iron  Iron cast in a mould.
CBC  The Church Buildings Council.
Centre wheel  Wheel in going train turning once an hour.
Chair frame  Incorrect term for double framed.
Chiming  The sounding of bells each quarter of an hour.
Click  Device to stop a wheel turning backwards.
Compensation pendulum  Pendulum specially constructed so that it keeps correct time at different temperatures.
Count wheel  Wheel to set the number of blows struck when the clock strikes.
Crutch  Device which connects the escapement to the pendulum.
Dead beat  Type of escapement.
Differential (Epicyclic)  Gears used in a maintaining power or automatic winder.
Diocesan clocks adviser  Person familiar with turret clocks who helps local diocese.
Dog clutch  Device to set hands to time.
Double framed  Type of turret clock frame.
Double three-legged gravity  Type of escapement.
Electro hammer  An electrically operated bell hammer.
End to end  Type of train arrangement in a birdcage frame.
Epicyclic  Gears used in a maintaining power or automatic winder.
Escape wheel  Wheel on which the pallets act.
Escapement  Device to release one tooth at a time and to impulse pendulum.
Face  Incorrect term for a dial.
Faculty  Legal document in the C of E giving a parish permission to do specified work on a church building or its fittings.
Flatbed  Type of turret clock frame.
Fly  Fan-shaped device to limit the speed of striking.
Foliot  Timekeeping device consisting of a weighted bar.
TURRET CLOCK SOURCES OF INFORMATION

ANTIQUARIAN HOROLOGICAL SOCIETY (AHS)

The AHS is a learned body dedicated to the widening and dissemination of historical horological knowledge. It publishes a quarterly journal, books and has a library. There is a specialist Turret Clock Group and also an Electrical Horology Group. The Turret Clock Group may be able to give advice on the historical aspect of turret clocks.

Antiquarian Horological Society
New House
Ticehurst
East Sussex
TN5 7AL
01580 200155
email secretary@ahsoc.demon.co.uk
www.ahsoc.demon.co.uk

BRITISH HOROLOGICAL INSTITUTE (BHI)

The BHI is a professional horological body, about a third of its members are professional horologists. The BHI publishes a monthly magazine, has a library, good collection of turret clocks and runs a wide variety of training courses including turret clock restoration.

British Horological Institute
Upton Hall
Upton
Newark
Notts NG23 5TE
01636 813795
email clocks@bhi.co.uk
www.bhi.co.uk

CHURCH BUILDINGS COUNCIL (CBC)

The CBC is a constituent council of the General Synod of the Church of England and one of its duties is to advise Anglican churches on the care of the contents of churches. Specialist committees advise on monuments, stained glass, wall paintings, metal work, organs, bells and clocks. The Clocks Committee can award grants towards historic clock conservation. The CBC was formerly known as the Council for the Care of Churches (CCC) and before that the Council for the Places of Worship (CPW).

Church Buildings Council
Church House
Great Smith Street
London SW1P 3AZ
020 7898 1866
email ccb.enquiries@churchofengland.org
www.churchcare.co.uk
BIBLIOGRAPHY

The following list of books are those which will give a new reader a good insight into turret clocks. Unfortunately many are out of print and may be difficult to obtain. Libraries which have a good collection of books on clocks are:—

LIBRARIES
Antiquarian Horological Society Library
and
The Clockmakers’ Company Library
(Both of the above are housed in the Guildhall Library, Aldermanbury, London EC2P 2EJ.)

The Science Museum Library, Exhibition Road, South Kensington, London. SW7 2DD

British Horological Institute (Members only)

BOOKS ON TURRET CLOCKS

BEESON, C.F.C.
English Church Clocks 1280-1850.
Antiquarian Horological Society 1971
Brant Wright Associates 1977
The best modern book dedicated to turret clocks. An absolute must for the enthusiast even though it stops at 1850.

BEESON, C.F.C.
Perpignan 1356. The making of a clock and bell for the King’s castle.
Antiquarian Horological Society 1971
The story of the making a medieval turret clock for the king in Perpignan in France.

BUNDOCK, Mike
Herne Bay Clock Tower
Pierhead Publications 2000
A history of an early purpose built clock tower.

BUNDOCK, Mike
Margate Clock Tower
Margate Civic Society 2013
A history of Margate’s clock tower and time ball.

BUNDOCK Mike and McKAY, Chris
James W. Benson of Ludgate Hill
Pierhead Publications 2002
Facsimile articles and catalogue of this firm of turret clock makers.
SAFETY

Check that all aspects of access to the clock are safe. Where ladders and platforms are involved, make sure ladders are secured and platforms have hand rails. If there are any problems report these to the person in charge. If working alone make sure someone knows where you are so they can check it you do not return.

WINDING

If the clock has an maintaining power engage this before winding the going train. Wind carefully until the weight can be seen or a mark on the wire line is observed. Let the winding handle turn slowly backwards so that the click is lowered gently onto the ratchet. When winding an hour striking train do not wind this between when the clock has warned (about 5 minutes to the hour) and when the clock strikes. Similarly a quarter striking train should not be wound between 5 minutes to a quarter and the quarter.

SETTING TO TIME

Most clocks have an internal setting dial; often these run anti-clockwise. Use the key provided to turn the hands forward, do not use the hand on the setting dial. The hands can be turned backwards a small amount, but not past the hour or past the quarters in the case of a quarter striking clock. If the clock is an 18th century one where the pallets have to be disengaged to let the train run, then make sure the escape wheel arbor is held and allowed to turn only slowly otherwise damage is likely to be caused to the escape wheel teeth. To set the clock on an hour for summer time advance the hands pausing to allow the clock to complete striking on the quarters and hours. To put the clock back an hour for winter time it is probably best to stop the clock for an hour since striking clocks cannot be set backwards.

REGULATING

If the clock loses slightly raise the pendulum bob by turning the rating nut. If it gains, lower the bob. To do this, first gently stop the pendulum by opposing its motion with your hand. A heavy pendulum must be dealt with gently to prevent damage to the suspension spring. This might be a two-man job, one to hold the pendulum to stop it twisting and the other to adjust the rating nut. To start the pendulum give gentle pushes to the pendulum until the clock starts to tick. One turn of the rating nut is likely to make a differrence of a minute or more a day. Where a clock has regulating weights on the pendulum take weights off to make the clock lose and add weights to make the clock gain. This can be done with the pendulum swinging.

CORRECTING STRIKING

If the hour or quarter striking has got out of step, lift the locking lever to allow the striking to run. Repeat until the correct quarter / hour has been sounded.

DO’S & DON’TS

Do not oil a clock unless you know exactly what to do. Do not touch bells or bell ropes unless you are a ringer. Do carry on caring for the clock, the local community does appreciate it even though they probably never tell you.

ANNUAL MAINTENANCE

Have an annual maintenance contract for the clock. Its an excellent way of preserving the clock for the next generation.

From: The Turret Clock Keeper’s Handbook by Chris McKay.
Rear Cover

Italian proverb

Warning sign to ringers to pull hammers off before ringing bell 1861