

Restoring the Great Clock of Westminster

By Chris McKay, BSc CEng MIEE MBHI

The morning of Saturday 11th August 2007 was a busy one at the Palace of Westminster (Houses of Parliament) with a large collection of media to witness the commencement of an extensive programme of maintenance on the Great Clock popularly called 'Big Ben' **Photos 1 & 2**.

With the 150th anniversary of the clock just over a year away, the objective was to make sure that the clock would be in top condition for its big birthday. Mike McCann, Keeper of the Great Clock said: "We are embarking on a large and important restoration project, I have every confidence that my team will do a splendid job."

Why was such extensive maintenance work needed? Wear had been noticed in the striking train where the strike barrel was seen to be rubbing on the great wheel during winding **Photo 3**. On the going train the lantern pinion trundles on the 'scape were getting deeply pitted, so that was another indicator that work was needed, **Photos 4, 5, & 6**. In 1913 a motor-assisted winding mechanism had been installed below the movement; this too was showing wear, in one place needing attention. No significant work had been carried out on the striking or going trains for many years.

Of course, since the Great Clock is such an important icon



1. The Great Clock Movement: Striking train on the left, going in the centre and quarter striking on the right. The vertical flies are out of view above the movement.



2. Top view of the movement. At the back the quarter barrel can just be seen. In the centre is the going barrel with its train and escapement. Note the two wheels on the going barrel, the great wheel on the left, the right one is a winding wheel on the barrel itself. In the foreground the cams of the hour striking barrel can be seen along with one wheel of the striking train.

of the British Nation, it is not possible to take it out of service at the convenience of the repairer in the manner one can do for a church or town hall clock. The last time really major work took place was in 1976 when the quarter train was completely rebuilt following a major disaster caused by the failure of the quarter fly.

Ian Westworth, Paul Roberson and Huw Smith are the three Palace clockmakers, **Photo 7**. Apart from making three visits a week up the tower to the Great Clock for maintenance and winding, they are responsible for winding, servicing and repair of over 1,000 clocks in the Palace. In addition, between them they have to provide a 365 days a year, round-the-clock out of hours call-out service in the case of the Great Clock having a problem. A massive task of restoration stood in front of them, and they still had to carry on winding and caring for all the other Palace clocks as well.

Saturday 11th was not the start of the restoration process; a considerable planning exercise had been underway to ensure the work went off smoothly. This was headed up by Mike McCann along with considerable input from his team of horologists. As well as the title of 'Keeper of the Great Clock'. Mike runs virtually every aspect of maintenance around the Palace. In addition to Palace staff, several contractors were engaged for special tasks, so the whole exercise had to (dare I use the pun), run just like clockwork. Planning showed that around six to eight weeks would be needed to complete all the tasks required including some contingency for unforeseen events. Needless to say the 'unforeseen' event obligingly appeared.



3. Rear view of the hour striking barrel. The bolt heads that secure the cam wheel onto the barrel cap were found to be rubbing on the great wheel. As a temporary measure, the bolt heads were reduced slightly.



4. Escape wheel pinion, note the wear on the trundles.

Since it was decided to keep the hands telling the time, an early task was to specify a synchronous drive unit that would neatly fit next to the bevel gear cluster, **Photo 8**. It had to be very powerful but still be easily engaged and disengaged as needed. In good weather it is quite easy to turn the hands on one dial by the pressure of a few fingers on the counterbalance, but get a good gale at the 180 feet above street level and the requirement for driving force dramatically increases. A special synchronous unit was commissioned, built, tested at full load, and installed in the tower the week before the major work started. Fuller details of this special unit will appear in a later article.

The next exercise was the design and building of two robust wooden cradles, **Photo 9**, that would be used to support the striking and going barrels when they had been removed from the clock. These were also to be used for transporting the barrels and for holding them during dismantling and re-assembly.

Since the combined weight of the striking barrel, great wheel, arbor and winding wheel is around $\frac{3}{4}$ ton, careful thought had to be paid to how it would be lifted out of the frame. A custom-built scaffold with lifting chain blocks, **Photo 10**, running on a girder was the solution. However, this could not be installed until the clock was stopped and delicate items like the escapement removed. Again a contractor was employed for this specialist work. Along with the scaffolding, duckboards were to be laid on the deck to protect the floor and anything that had to be rested there.

Normally the dials need cleaning every three years and this is done by a team of abseilers complete with good old-fashioned buckets and sponges, **Photo 11**. Inevitably repairs would be needed to the odd pane of glass and where putty had fallen prey to the vicious action of freezing and thawing; this would be replaced with silicone rubber.

Finally an experienced engineering company was lined up to do the mechanical repairs. With a three-foot diameter great wheel and a four foot long barrel, a seriously large lathe would



5. The escapement. The Westminster clock is somewhat unusual since it has a three-bladed fly on the 'scape wheel.

be needed along with other heavy machine tools. A wide experience of working on heavy parts was an essential requirement.

There was a lot of mundane work that had to be done in preparation. For a start a mass of tools and equipment was moved up the tower. Next the safety fence and protective rails that safeguard the clock movement from the unwary visitor had to be removed and stowed away. A few days before the official start, as much as could be removed was taken off the clock, including winding wheels, and some of the old work for barring off the winding during striking that is no longer used.

Whilst the media gathered on the roof of the Commons to witness the abseilers descend on a dial, the clock team inside the clock room was ready. As soon as 8am struck, the Cumbria Clock Company's synchronous drive unit was engaged and the bolts that connected the clutch unit to the clock released; the dials were now free of the Great Clock and for the first time ever were driven electrically, **Photo 12**. Lord Grimthorpe must have turned in his grave! However, there was no time for thinking about Edmund's view, the quarter striking had to be tied off, the hour striking hammer line released, and the hour and going trains let to run down until their weights lowered themselves gently onto the pile of protective sandbags at the bottom of the weight shaft. Before the scaffold erection could start, the going train was stripped out, **Photo 13**, along with the striking train wheels. Striking winding wheels had been taken out a few days before, but the huge fly and the rest of the train were now carefully removed. The safety brake was also taken out. **Photo 14**.

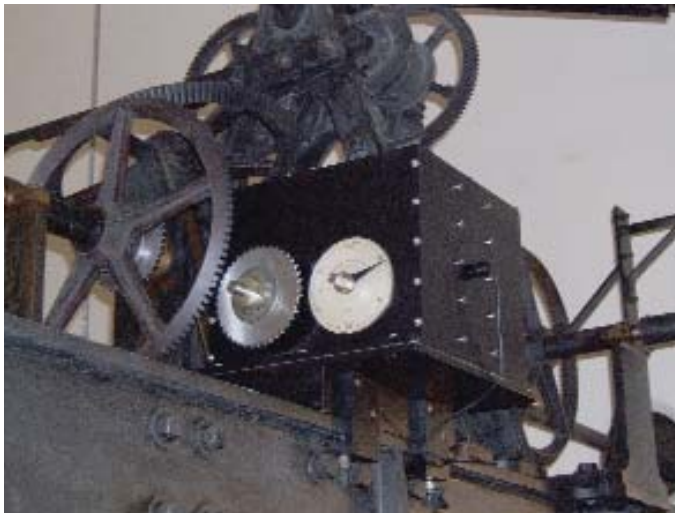
When the two barrels and other parts were removed from the clock, they would have to be lowered to ground level and



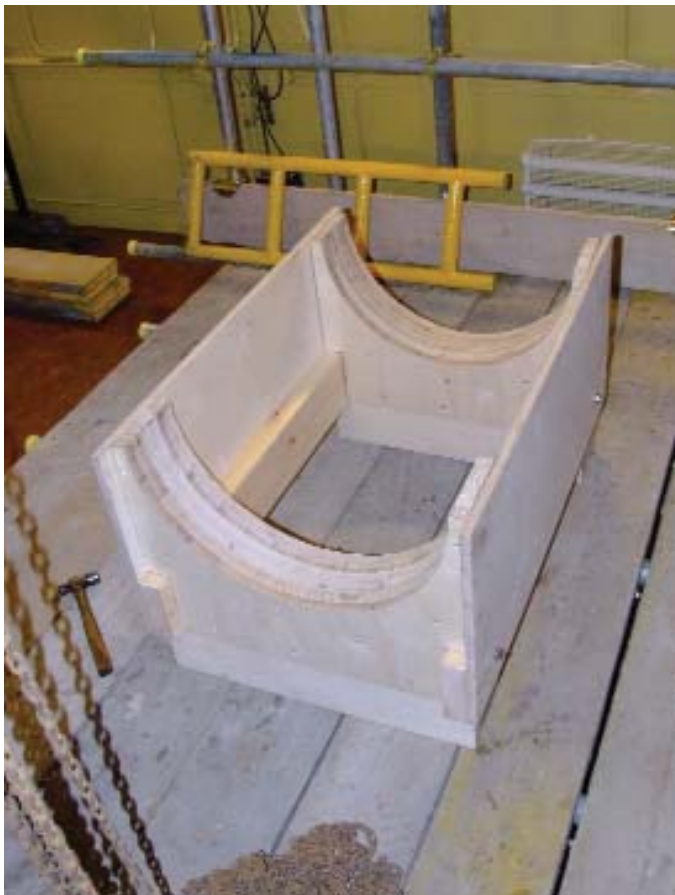
6. The end of going barrel. Note the key that is one of three that retain the great wheel on its arbor. Ratchet-like teeth on the side of the wheel are part of the very effective maintaining power system unique to the Great Clock



7. The Team of Palace horologists, Ian Westworth, Paul Roberson and Huw Smith.



8. Synchronous motor drive unit.



9. Cradle for strike barrel.



10. Putting up the scaffolding to enable the lifting of heavy parts.



11. A brief break to admire the view whilst cleaning the dial.



12. A rarely-seen view. The internal setting dial at the rear of the clock. The nut on the gear wheel is one of the two that clamp up the hand setting mechanism.

removed to various workshops. There were several routes to the ground: the weight shaft directly under the clock, the ventilation shaft that runs from the belfry level to the ground, or the stairwell. Of these the easiest option was the stairwell. A company familiar with lifting and manipulating heavy weights was engaged and they installed an electric hoist at the top of the stair well and organised the lowering of all the parts.

Once the scaffolding was assembled the huge striking barrel was then slowly lifted from its bearings with a couple of chain blocks, **Photo 15**. It was then eased forward in front of the clock and lowered into the waiting cradle. Safely at rest, the winding wheel was removed, **Photo 16**, and the great wheel and its arbor slid out. These three items were then carefully wrapped for the descent down the stair well. Lowering the barrel went smoothly, **Photo 17**, but when the great wheel with its arbor was about half way down the tower it would not pass the hand rails. No doubt some quirk of the building or difference with the handrails had stolen a valuable inch. With the winch taking the weight, the great wheel had to be man-handled out of the well and into the stair area. Once a turn of the stairs had been negotiated, the well was again of sufficient width to accommodate lowering the great wheel.

Much the same procedure was followed with the going barrel, but without the size problem when lowering. When the two barrels arrived safely at ground level, they were loaded onto a truck and taken to the engineering works.



13. The dismantled escapement.



14. Huw removing the safety brake. In the event of over speeding, the brake operates, clamping the great wheel between two brake pads.



15. Paul, Huw and Ian lifting out the hour striking barrel.



16. Safely in its cradle, the great wheel and arbor is removed from the hour the striking barrel.



17. The striking barrel being lowered down the stair well.

Next month we see what work was done to bring the clock back to its original condition.