

A Journey in Watchmaking

David Cottrell

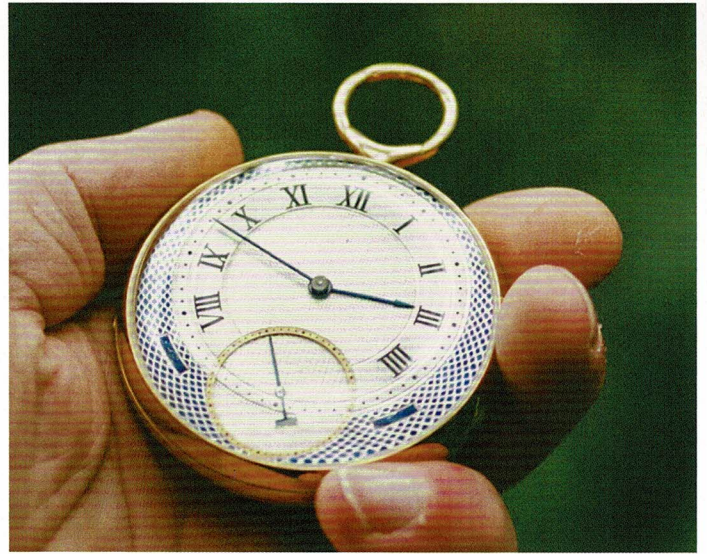
Starting from Scratch Part 2

Continued from last time...

With the movement happily ticking away, the question of how to make the dial needed to be addressed. It had already been decided that the dial should be engine turned (guilloché) and made from silver. In an ideal world both a straight-line and rose engine would have been acquired, however it proved difficult to track down suitable machines. By a timely coincidence a series of related articles appeared in the *HJ* written by John Moorehouse. These covered his work on engine turning¹ together with an outline of his equipment. On making contact with John he kindly invited me to his workshop where he had devised an attachment that enabled rose patterns to be cut on a Plant straight line engine.

Encouraged by what John had achieved the decision was made to design a custom machine based on his general principles that would cut both straight line and rose patterns, **Figure 1 and 3**. After some thought it became clear that the machine could also include the ability to recess sub-dials together with the drilling of index markers or other features without disturbing the dial blank. The combination of these capabilities would give greater flexibility, making it less likely to need to make the dial in several pieces which are then soldered together.

For the creation of the subdials, the machine would be fitted with an electric motor under the main table to rotate the spindle and so act as a simple facing lathe. In addition the work-holding head was designed so that it could be unscrewed from the main spindle, **Figure 2**, of the machine and then located in the centre



of the rotary table of the BCA jig borer. Index markers or any other holes could then be drilled without disturbing the dial.

Not only was it going to take some considerable time to build the 'straight-rose' engine, it also required the acquisition of a decent sized milling machine to make the main structural components. It was my feeling that investing in such a machine would provide further flexibility to make other equipment as the need arose.

By now the reader may have guessed that things were getting a bit more serious with this project, to the extent that a sabbatical was taken from the day job to focus on building the straight-rose engine.

As expected, the design and making of the machine, together with learning how to use it and the inevitable further refinements took many months. In the final result, the machine proved its value in more ways than one, **Figure 4**. Not only was the dial made in one piece, in one setting, but in practice it also proved capable of engraving the numerals on the dial, in addition to patterning the curved back of the case.

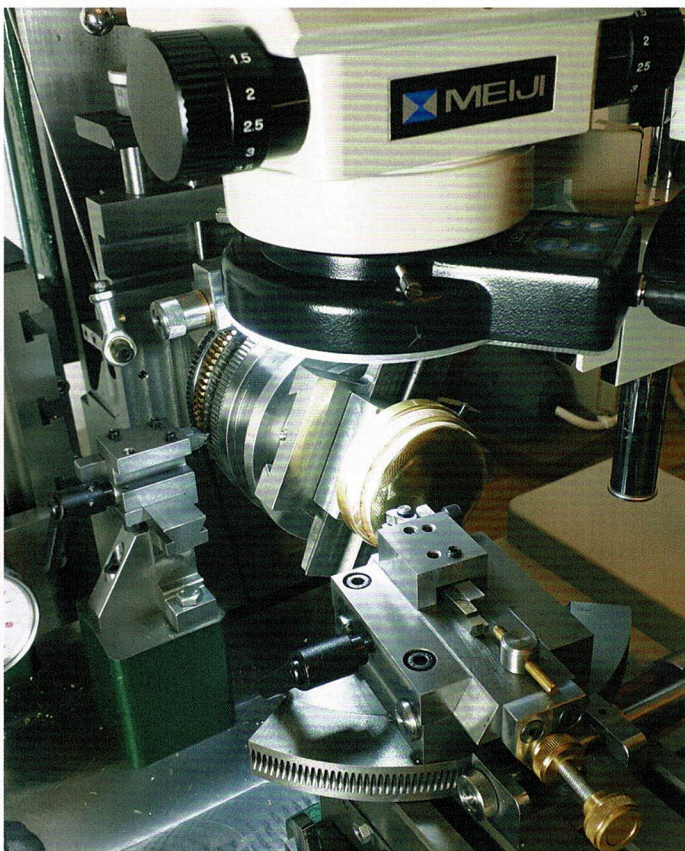


Figure 1. Completed straight-rose engine – patterning the case back.

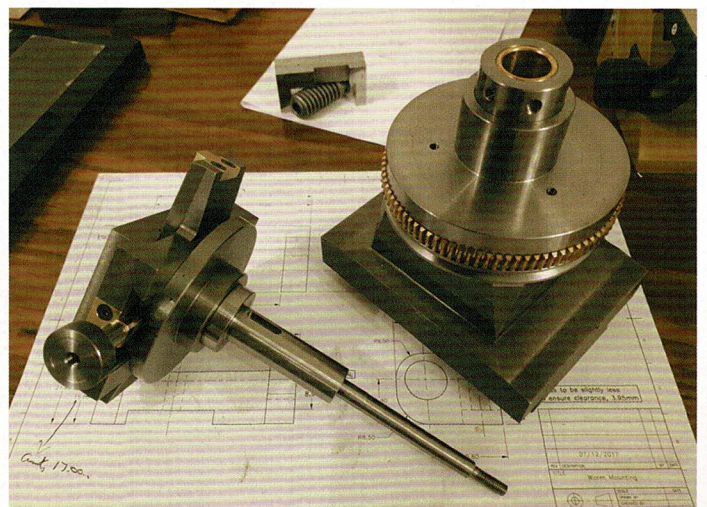


Figure 2. Detachable work holding compound table and sliding head with worm wheel.

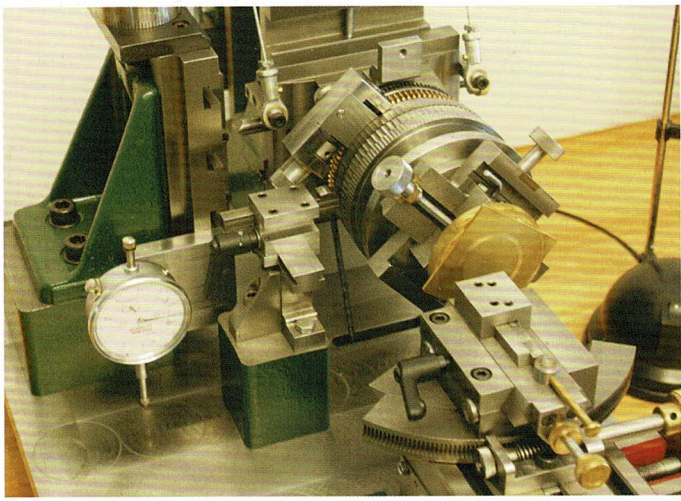


Figure 3. Straight rose engine, trialling a new rose pattern.

With the completion of the watch the obvious question was – what next? Encouraged by the reaction to the first attempt, and armed with a kind but honest appraisal of what needed improving by Roger W Smith, the outline for a second pocket watch started to emerge.

Any project needs a clear objective in order to succeed, and the results should be measurable. For the first pocket watch, the goal was to create a timepiece that functioned and adhered to basic timekeeping requirements. For the second timepiece, I set myself the difficult challenge of creating a timepiece to a level that would (hopefully) be attractive to a collector.

The objective for the second watch clearly meant that greater attention would be required to the finishing of components, and to be honest, there was a temptation to simply re-make the first watch to a higher standard. However, on reflection this did not feel quite right, particularly in light of the objective of making the watch attractive to a collector. As often happens something else came along that hinted at a potential direction.

That direction was provided by an article written by Derek Pratt² detailing his use of a carriage mounted remontoire in which he mentioned that ‘the wear on the escape wheel teeth of a conventional tourbillion watch is often considerable’. This is probably due to the momentum of the carriage that needs to be

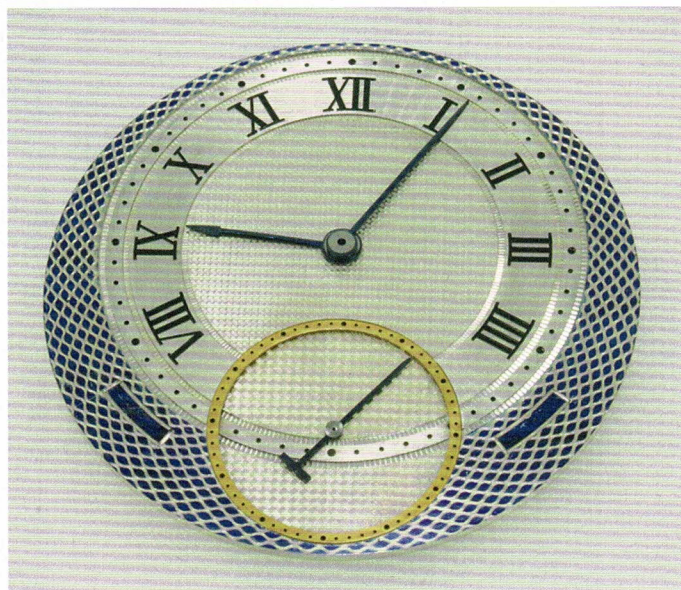


Figure 4. The dial was made in one piece.

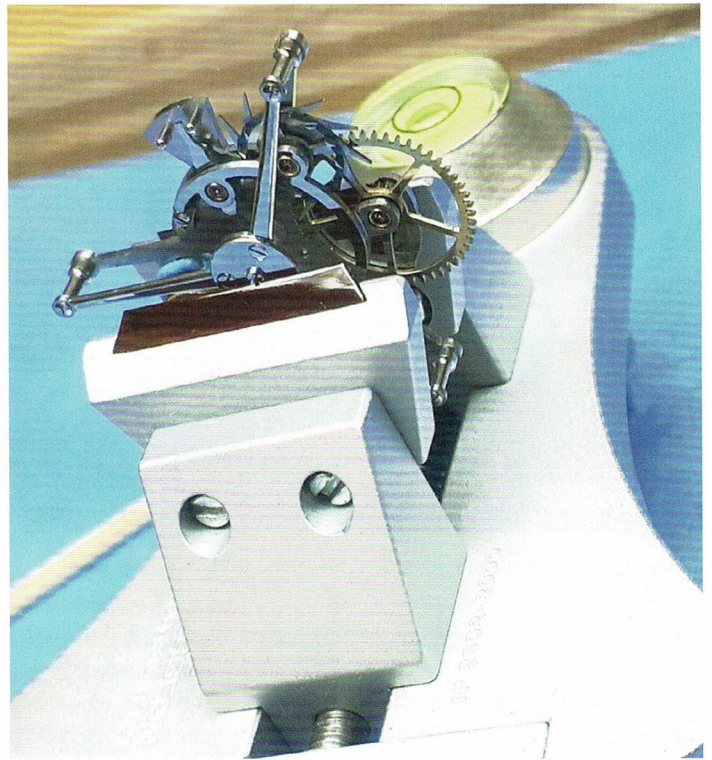


Figure 5. Poising the 4 minute carriage assembly for the ‘slow’ tourbillion.

arrested at each locking, but his introduction of a remontoire effectively isolates the escape wheel from this. His article made me wonder if other approaches were possible. This led me to reflect on the various tourbillons created by Breguet with much longer rotational rates than those seen as the norm today. As a result, the idea of making a watch with a ‘slow’ tourbillion came into being, **Figure 5**.

If you delve into the physics of an object in motion you find that the kinetic energy (work needed to accelerate a body from rest) is the product of its mass and velocity squared³, the key point being the squaring of the velocity. The implication of this is that a change in the velocity, as opposed to mass, has a greater proportional impact on the energy that has to be arrested by the locking teeth. Equally the energy required to accelerate the carriage in the first place is reduced; which should also mean that a lighter main spring can be used. So while you can make the carriage (or any other moving part) lighter that only takes you so far.

In the light of the above, a detailed design with a 4 minute tourbillion was drawn up, with the overall dimensions being similar to the first watch. I knew that the Co-Axial escapement should be retained, though this time with a single piece escape wheel along the lines of that devised by Roger W Smith, together with the advantages of twin barrels, keyless winding and of course an engine turned dial. This left the question of how to drive the seconds hand.

When the carriage rotates once a minute the seconds hand can be conveniently mounted on the extended pivot of the carriage pinion. With any other period of rotation additional gearing is required and traditionally this takes the form of a set of teeth cut in the periphery of the carriage to drive a pinion for the seconds hand.

After going to the trouble of designing the movement with a ‘slow’ tourbillion it seemed a shame to add further mass at the periphery that would (even if only in a small way) add to the momentum and hence load on the locking teeth. Instead the drive to the seconds hand is taken from the carriage pinion, with a layout that is similar to motion work, but with a ratio of 1:4, **Figure 6**. This results in a compact solution that sits under-dial



Figure 6. Part-finished components for the drive to the seconds hand.

and has the added advantage of positioning the hand co-axially with the carriage pivot in the same way as a 1 minute tourbillon.

As part of the focus on the overall quality of the piece the proportions and hand finishing of parts has received much attention. For example screws are one of those items that are easily overlooked but have the potential to transform a movement – for good or bad. This will be, to an extent, subjective and people will naturally have differing views. Where space allows my own preference is for what I would call instrument screws with a slightly curved head and a narrow ‘V’ slot, **Figure 7**.

All screws are turned in the Pultra 1770 for which various accessories have been made including a pivoting radius tool for forming the heads. The fine ‘V’ slots are then cut using slitting saws with a modified profile.

Due to the narrow slots a suitably thin saw would have a tendency to flex with the potential of putting the slot out of true. However the depth of cut is shallow so an over-thick saw can be used as the starting point. Only the periphery is re-ground in a tool-cutter-grinder to the required ‘V’ profile leaving the body suitably rigid.

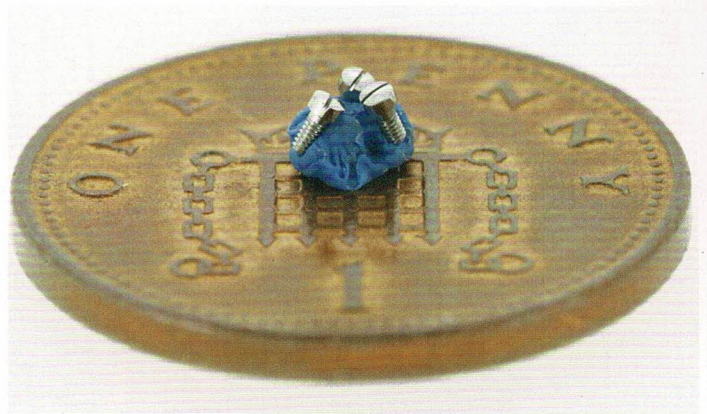


Figure 7. The screws are made on a Pultra 1770 with the fine V slots cut using slitting saws with a modified profile.

To bring things up to date the train wheels and pinions have been made together with the balance, tourbillon carriage and escapement components, **Figures 8 & 9**, main plate, barrel bridge and the majority of the keyless winding components.

At the time of writing the most recent assembly to receive attention is the drive for the seconds hand. I will report further as the project progresses. In the meantime, additional pictures are also posted on Instagram [@djcottrellwatches](#)

References

1. *BHI Horological Journal*, October 2017, Engine Turned Watch & Clock Dials, P454, John Moorehouse MBHI.
2. *Derek Pratt – Watchmaker* 2nd Edition September 2018, Page129, Published by the BHI. ISBN 978-0-9568003-2-0
3. For a body moving in a linear path $KE = \frac{1}{2} m v^2$ whereas for a rotating object the equation is $KE = \frac{1}{2} I W^2$
Where...
m = Mass (Kg)
v = velocity (m/s)
I = Moment of inertia (Kg/M²)
W = Angular Velocity (Radians/s)



Figure 8. Lever for the Co-Axial Escapement.

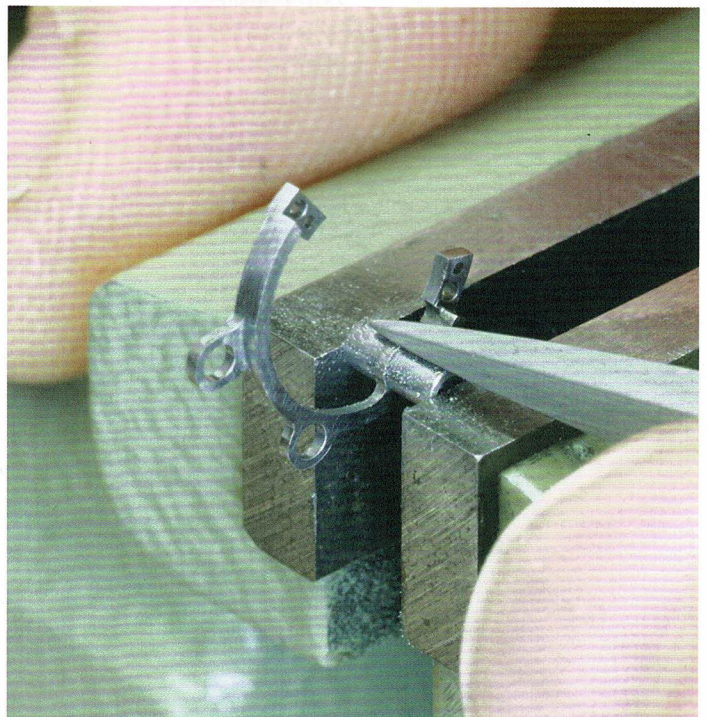


Figure 9. Filing the carriage bridge for escape, 4th wheel and lever.



Dr James Nye FSA.

Dr James Nye FSA is the new Master of the Worshipful Company of Clockmakers.

The Installation Court was held on 25 January 2022, at Painters' Hall, London, followed by a procession to St James Garlickhythe, for Evensong, led by Reverend Hugh Bearn, the Master's Chaplain. A reception and dinner followed.

James, a Guild member, was born in Sussex in 1961, but his family moved soon after to Kampala, Uganda. He returned to the UK in 1969, attending Ardingly College in Sussex from 1972–79, where the Assistant Chaplain, Nick Waters, a part-time community watch repairer, had an extensive workshop in which, most afternoons, he taught a handful of students (including James) the elements of clock repair. The school had an electric clock system, which James looked after for several years, igniting a passion for time distribution systems.

After reading Theology at Balliol, Oxford, James spent a couple of decades in commerce, though clocks filled increasing amounts of his time as he assembled a collection of early electrical horology. From the mid-1990s onward he began researching various electric clock companies, and some of the case studies underpinned a PhD at King's College, London, examining the role of the company promoter in the City in the late Victorian and Edwardian periods.

James is perhaps most widely known as the Chair of the Antiquarian Horological Society, within which he has run the Electrical Horology Group for 25 years, reflecting a lifelong interest in the subject.

In 2011 he founded The Clockworks. Based in SE London, it is the world's only museum, workshop, library and meeting space dedicated solely to electrical horology.

James writes on horological and historical topics, and lectures regularly. He has acted as co-ordinating editor on many horological books, and in 2014 OUP published his history of the Smiths Group (*A Long Time in Making*), while 2022 will see the publication of OUP's *General History of Horology*, for which he acted as an advisory editor, contributing several chapters.

James is a keen cook, and listens to music endlessly, with tastes rooted firmly in the progressive, reflecting his 70s youth. He and Luci live in SE London. They have two daughters who recently graduated, and are also kept on their toes by Merlin, a lively and mischievous Korthals Griffon.

He said: It is a great privilege to be appointed to serve as Master of the Clockmakers' Company for the coming year, in the oldest surviving horological fellowship in the world. Like everyone, I am hoping that as 2022 unfolds we will gradually be able to return to a more normal lifestyle, and as part of that renew horological friendships, and re-establish all manner of in-person events for watch and clockmakers, and everyone generally in horology.

'There remains a huge amount of work to do to advance the cause of our endangered craft, not least in continuing to promote education and to support students in whatever way we can, whether in purely practical ways in their studies, or perhaps in helping to forge network connections that will open up career opportunities. Along with our friends in all the other horological associations, including the Guild, I am sure we can achieve much,' he added.

clockmakers.org



The new Master and members of the Court at the Installation Service. Left to right: Master's Chaplain, The Reverend Hugh Bearn; Past Master (now Deputy Master), Mark Levy; Junior Warden, Robert Wren; Master Dr James Nye FSA; Senior Warden, Jane Pedler; and Renter Warden, Keith Scobie-Youngs.

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