My Wooden Regulator

Gerardo Stein reflects that, as a maker of wooden clocks, he and Harrison were in the same boat[1]

Introduction

I BUILD wooden clocks. Before referring to my efforts in this field, I need to tell the story that justifies such a daring deed.

Some 68 years ago, my grandfather opened the back of his pocket watch and said, showing its pulsing balance wheel: 'This is its little heart, what makes it work'. The emotion I felt at that time was unforgettable. Life would later on teach me that such feeling has a name: 'falling in love'. From that instant, I longed to be able to build clocks. I started when I was 14, the moment I came to know that they were made of wood in ancient times: 'If they worked back then, maybe I could also build one'.

Being, by profession, a psychoanalyst, I should be thinking of the Oedipus complex. However, I am also an amateur clockmaker and, as such, I have no doubt about the first time I fell in love.

Both professions agree that my passion for my grandfather's carpentry shop has played a decisive role in my predilection for working in wood. Self-analysis has not succeeded in providing a convincing answer for the origin of such a vocation.

As the whole family knew where my affections lay, every alarm clock that was out of order ended up in my hands and I was always ready to take it to pieces. I cannot recall if I was able to fix a single one. Nevertheless, these alarm clocks were at the same time my victims and my dearest teachers.

My first attempts to cut a gear wheel were entrusted to the magic of a small manual fretsaw that I had bought back then (when I was 14). The first clock I built that really worked was at the time of the birth of my first daughter (46 years ago), and one of the main tools I used in its production was that old little fretsaw.

Today, I possess almost every tool I ever dreamt of. As time passed, my ambitions grew and I tried to improve and perfect, to the maximum possible, the clocks I have been building including gear wheels and other components – all of them made of wood. In that way, through trial and error, I arrived at the version I am about to describe in the second part of my text.

1. Rupert T Gould, from Dava Sobel and William J H Andrewes: *The Illustrated Longitude,* FOURTH ESTATE, London, 1999, p.202.
2. Sobel, Dava: *Longitude*, WALKER PUBLISHING COMPANY, New York 1995

A few years ago, Alberto Selvaggi, a clockmaker who, just by pure chance, came across my work, jokingly commented that I could have very well been the reincarnation of a British clockmaker whose name, at that moment, slipped my mind. When in August 2002 I visited the Observatory in Greenwich, I finally understood that, that particular name (which Selvaggi later confirmed) was John Harrison, whose clocks I never got tired of visiting and observing every single morning of my stay in London, as soon as the rooms where they are kept were opened to the public.

I cannot find other words to describe my feelings when I saw for the first time the wooden gear wheels of the H1, but they were the very same ones I experienced 68 years ago when my grandfather opened up the back of his watch. During my stay in London I looked for all possible information about Harrison. I greatly appreciate the video and publication by Jonathan Betts, as well as *Longitude* by Dava Sobel[2]. The curious coincidence of Harrison's carpenter background and mine impelled me to meet Jonathan Betts and, thanks to his generosity, I got to know many details of Harrison's life. More than that, thanks to Betts' suggestion that some clockmakers might be interested in knowing about my work, I set myself the task of producing this article.

Quebracho Regulator

The clock I am about to describe, **1**, is made of quebracho, but I have also used wheels made of ebony, holy wood, jacaranda, incense tree and whatever hard wood I happened to discover in my constant search. This search has turned out to be part of the charm of the job.

The most outstanding characteristic of this clock that I call 'Quebracho Regulator', is the type of wood its wheels are made of. It comes from the northeast of Argentina and has been obtained from 100 year-old railway sleepers, **2**. This is another coincidence; the British built the first railways in Argentina. Due to its history this material did not need seasoning. The other types of wood I have used were not so old but have worked very well.

1. The finished clock. Note the driving weight, in a wooden frame, left, and the jockey weight, centre.

2. The author cutting the required sections from a hundred-year-old Quebracho railway sleeper.

When I learnt how Harrison had built each gear wheel of his regulator, using wooden triangles of similar structure as regards the direction of its fibres, I came to fully understand the paucity of his means and how brilliant his ideas and working methods were. I cannot avoid comparing my luck to his: it was impossible for him to count on the variety and quality of tools and resources available nowadays.

I frequently recall a sequence that appears in the Harrison video several times: it is the image of a young man, giving form to a wooden bar using a precarious pedalled lathe by the light of a candle. I think of Harrison struggling against the lack of resources and the envy of others to achieve his ambition 'to solve the biggest scientific problem of his time',[3] by means of a marine clock, an instrument to protect lives and explore seas.

His powerful reasons made me explore those that had motivated me in building clocks. My restlessness arose from the irresistible beauty of gears in harmonic movement and the untiring dance of its escapement, the 'little heart' my grandfather showed me. To this aesthetic marvel, I must add the pleasure it means to work with wood and to feel one can endow it with functions that would be better performed by a suitable piece of metal.

My irremediable inclination towards clocks is not only nurtured by my affection for my grandfather the carpenter, and his work, but it also lies in its warmth and perfume. Warmth and perfume which neither bronze nor steel would ever be able to transmit to the mechanism of a clock.

In addition to my admiration for Harrison's ability to solve the problems of friction and unsatisfactory lubricants, I was surprised to have solved the problem by means of bearings, not knowing that what I was using had been invented previously by Harrison. In my case, using bearings of minimum dimensions (3x1x1mm).

3. Sobel, Dava: *Longitude*, WALKER PUBLISHING COMPANY, New York 1995, Subtitle.

Other resources added to those already mentioned have allowed me to use, instead of the oakhe used, quebracho wood, a compact kind of wood as hard as ebony. The latter, as well as any other fine-grained wood with similar properties would be suitable for anyone undertaking a similar adventure.

At this point, I feel I must admit that my clocks have been based on the alarm clocks mentioned previously, those same ones that I had observed with gloating enjoyment as a child. Before begining to build this regulator, as a form of rehearsal, I built another one using acrylic instead of wood. It works as well as the one that is the subject to this article.

Selection and Working of Material

It is important to carefully select wood free of any cracks, and to discard any pieces that are likely to crack.

The disk turned for the great wheel is at least 25mm thick. Those for the remainder of the train get progressively thinner. Each wheel blank is turned 2mm oversize. The grain runs across the discs. I mounted them together on a common spindle to form a tight cylinder and reduced the diameter very slightly each week to achieve the required dimension. The finishing touches were made every one or two days.

These finishing touches must be performed with carefully sharpened tools at 1200rpm revolutions, no more, using the slowest possible feed. This produces a tolerance of 0.01 to 0.04mm – more than enough precision in my experience.

Such procedures have allowed me to obtain satisfactory results working with 0.6, 0.75, 0.8, 0.9 and 1.00 decimal modules.

To avoid deformation, wheels with fewer teeth (pinions) were made using cylinders whose axis is along the grain.

The problem of strength has been solved by providing pinions of generous proportions, **3**. A 25-tooth gear wheel receiving the action of a 120-teeth drive gear with a thickness of 25mm was built, for example, using 35mm thickness.

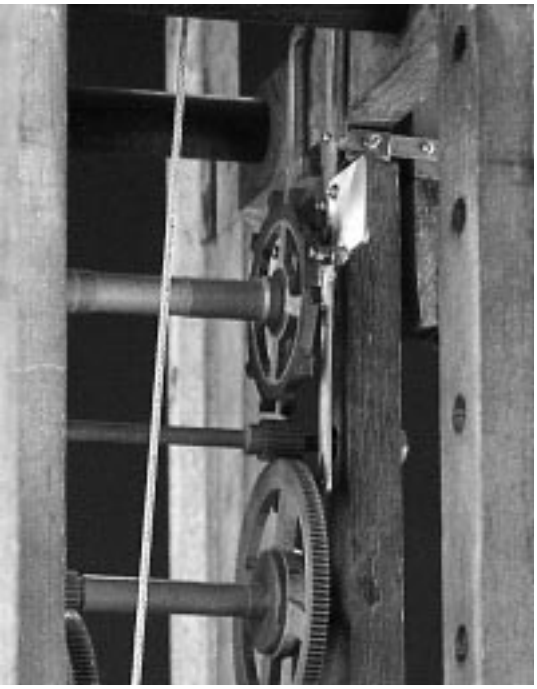
Apart from the drive gear and the wheel that drives the hands and the gravity arms, which were made of silver-steel, all gear wheels were made of the same type of wood. Where the pivots were 1mm, I inserted a steel pin into the wooden spindle.

The issue of friction in the pivot holes was solved by means of the use of small bearings. In the case of the arbor prior to the escape wheel arbor minimum-sized bearings (3x1x1mm) were again used.

The arbors of the gravity arms, **4**, have been given the same kind of bearings. 3.5 x 2 x 1.5 bearings attached to these arms act as pallets alternately locking and unlocking the escape wheel teeth.

Gerardo Stein

3. Some of the train wheels. The great wheels (solid) and broad pinions of the train. Note the 10-tooth escape wheel.



4. Escapewheel and gravity arm. Note the ball race acting as a pallet and the substantial pendulum rod and its suspension.

Friction has, in this way, been eliminated from the teeth of the escape wheel and the gravity arms.

The pendulum rod, **4**, is also made of quebracho. It is a cylindrical rod and is suspended by two steel strips 0.15mm thick, 5mm wide and some 15mm long between clamping points.

The pendulum bob is a solid lead cylinder weighing approximately 2.7kg and is regulated by a bronze threaded rod.

The strange escapement system consists of the combination of a 10-teeth crown, which is linked to the pendulum interposed by both arms functioning through gravity. If asked why and how I got to use this system, I would have to admit that I loved 'developing it'. The fact is that I came to know that some bell tower clocks work that way. I tried, then, to put the system into practice, joining the theoretical principle together with the design of my old victims: the alarm clocks. To my immense delight, only after a few frustrating experiments and inevitable adjustments, the system worked in a way far better than expected. Everything has been made by trial and error without resorting to theoretical calculations.

The idea of having the drive weight slide down guide bars at the sides of the box – just as the counterweight of a lift works- looked very interesting to me. There is no technical explanation for this choice in this case either. It is just that I felt attracted to the idea of building it that way.

A technical detail, already known to most readers: the wooden pivots must have a degree of side and end shake. This comment seems to be taking as long as the time it took me to solve some irregularities in the functioning of the clock by means of this simple manœuver.

The reason why I have omitted many, maybe too many, structural details is that this article is meant to convey my experiences and to encourage others to have a go at building of their own clocks.

Last, but not least, I must say that imperfections in some parts of the clock, obvious in the illustrations, are due to the crafted nature of the object I am introducing, thus my resignation to a more professional and finer finish.

I must confess my determination to do things on my own, when I could have asked for help from a professional clockmaker. I had to solve problems by means of a great deal of experimentation and thought. The only explanation I can find to this scarcely commendable attitude is that discovering things without any help from others has always been part of the pleasure I, personally, find in working.

Final Comments

The rebuilding of this timekeeper (Harrison 1) began in 1931, and on February 1, 1933, it was running once again.[4]

That day, when Gould's efforts had the heart of H-1 beating again, I was almost four months old. Every now and then I am thrilled and amused at the crazy fantasy of having breathed in something that must have been in the air in those times. Something that linked me in a strange alliance, from my humble place, to two people I feel great admiration for. Coincidence –then- offers an illusion that psychoanalysis was not able to explain.

I hope this article will be useful for all those who are trying to experiment in the building of clocks made of hard wood. I am sure their effort will be rewarded through the pleasure of working a noble material, able to respond with unusual generosity to the operation of the tools.

I must also assert that in the art of clock making (as well as in my psychoanalytical work), empirical work has always taken the lead in my discoveries, associated successes and failures piling up to build my piece of work: the experience of working day by day establishing a dialogue among my ideas, my technical restlessness and my constant fascination for clocks.[5]

❒

4. From the comment on the photograph of Rupert T Gould with the H-2, Dava Sobel and William J H Andrewes: *The Illustrated Longitude,* FOURTH ESTATE, London, 1999, p.202.
5. The author is Full Member of the International Psycho-Analytical Association, lecturing member of the Argentine Psychoanalytical Association. Professor at Angel Garma Institute for the formation of psychoanalysts, Member of APA. Author of a variety of articles and publications: "Shared Psychoanalysis" (1992) and others in different reviews about the specialty.