

# Spring-Driven Wooden Clock

Gerardo Stein discusses the use of 'vegetable ivory' and exotic hardwoods to make sculpture clocks in South America



1. Sculptural table clock with ebony frame and dial with wheels, arbors and pinions in Indian rosewood. Many of the arbors run in ball races. These are also used for the pallets in the unusual 'swing escapement' in which the pallet arms are fixed to an articulated trapezoid frame (see also, 5). At 45cm in height the clock has 'a presence' in a room. Note the unusual winding key, inset, engages the screw head on the ratchet wheel.

I HAVE RECENTLY MADE another wooden clock which I call my 'Sculpture Clock'. In this article I will describe the origin of the design, the pioneering use of 'ivory nut palm' to provide self-lubricated bushes, a new type of gravity escapement (the 'swing escapement'), the types of wood I have used and where they come from and the use of freezing to improve its properties. I shall also explain the use of some metal parts and make some general comments on this type of clock.

## The Design

In order to develop and improve the aesthetics of the clock I made a year or so ago, my wooden regulator, WR<sup>1</sup>. I asked Mariana Berkenwald, an industrial designer, to advise me on style and the selection of woods for the new clock I wished to make. The results of her work have inspired me to introduce the term: 'Sculpture Clock'<sup>2</sup>.

Following her advice, I decided to use two types of wood: Ebony, for the general frame and the wooden part of the pendulum and Indian Rosewood for the gears, arbors, spring barrel, the gravity arms and the hands. In contrast with WR, which was weight driven, the new clock, 1, would be powered by a classic 1010 steel spring.

## Ivory Nut Palm

A distinctive aspect about which I would like to share experiences is the use of a material previously unknown to me, 'Ivory Palm Nut', 2, which I have used to make the bush for the escape wheel arbor. The association with ivory is justified by its physical properties. It may also be called 'Vegetal Teflon'. It seems as hard as ivory (it may be even harder) and very wear-resistant, and offers evenness and smoothness. I feel tempted to call it 'vegetal ruby'. Moreover, as far as I know, there is no adhesive capable of attaching its surface (not even quick drying adhesive is effective).

1. Stein, Gerardo, 'My Wooden Regulator'. *HJ* 146 p.96-8 (March, 2004)
2. Martin Burgess coined the term 'sculptural horology' in the 1960s. - Ed.

Juan Cavallero



2. Ivory Palm nuts, sliced vertically. The darker one, left, is over 18 years old and has been cut from the carving, 3.



3. Ivory Palm nut carved as a souvenir.

The ivory nut is the fruit of a palm tree from the equatorial zone of South America. The largest specimens can be found in Ecuador. The smallest ones may be found in Colombia and the north of Brazil. Another interesting characteristic is that they fall naturally and may be collected from beneath the trees. They are simply allowed to dry in storage.

Before the development of plastics, ivory nut was used to make fine buttons, greatly appreciated by dressmakers of the time. Nowadays, its popularity is booming as it is being promoted as an alternative to the cruel use of elephant ivory.

I found out about this marvel by chance on a visit to the Amazonian region of Brazil. I was mesmerised by the material some locals used to manufacture necklaces. Just by asking around I came across its popular name *pedra yarina* (flour stone). I was also informed I could possibly purchase it in its natural state at the City Market in Manaus, where I managed to buy a kilo of 'tagua nuts' (*Phytelphas aequatorialis*).

The very first time I saw one of these nuts, it reminded me of a souvenir I had bought in Ecuador over 18 years ago, 3. It shows the face of an Ecuadorian, and is carved from a 5 cm tagua nut. When I compared it to the Brazilian '*pedras yarinás*' I could see it had not lost its properties, on the contrary its hardness had intensified without losing either its fine texture or its form. There was still another change it had experienced its original ivory had darkened, not only on its surface but also in its inside as I was able to see when I eventually decided to sacrifice the craftwork just to investigate it, 2. This material, as well as the younger specimens I have recently purchased, showed it was suitable for turning, 4.

The use and performance of this material has, so far, been completely satisfactory. Through the Internet, I have found several companies that export these nuts and have been able to purchase a lot

of 5 cm nuts. Do not hesitate to contact me in case you need further information about obtaining some.

### Swing Escapement

The escapement system used in this clock is similar to the one in my WR<sup>1</sup>. However, in this case both arms work together, united by a third horizontal arm, 5.

This structure was thought of because of the need to protect its delicate mechanism and to prevent a careless movement of the clock from causing the escapement to run on, particularly if it is freed from the retentive action of the gravity arms. This did not constitute a concern in the case of the WR. Its weight and size made it unlikely to be disturbed.

The needs and the concerns mentioned above allowed me to find out that the escapement of the clock could operate without the pendulum. On the contrary, transmitting it to one of the extremes of the pendulum swing was enough, as it is at this point where two actions are added; the pushing drive from both gravity arms and the tensioning action of the inclined plane of the escape wheel's corresponding gap; both actions are joined by the rod assisting both gravity arms.

As this escapement system does not only look like an old wooden swing but has also got its same structure, I came to the conclusion it would be a great idea to name it: 'swing escapement', 5.

### Precious Woods

Apart from the great satisfaction that working with precious woods brings, it is necessary to report some frustrating aspects that go with such work. One is the impossibility of avoiding waste, even with the carefully selected pieces, due to their quality and aging. Experience has taught



4. An example of the way in which the palm nut can be turned. Note the sharp edges produced.



5. Rear view of the clock showing the arms of the swing escapement and the crutch, which bears on the turned ebony pendulum rod via a ball race.

me to be prepared for unsatisfactory material, even with pieces that seem sound. It can be very annoying. This is the first warning I would like to share with those who want to take up this kind of task.

Following this, I will list down names and origin of the woods I work with<sup>3</sup>. All of them share the same quality: they are much heavier than water and do not float. This characteristic gives them a hardness that together with the beauty of their grain makes them ideal for this task. They are difficult to find in wooden objects, due to their cost and the difficulty of working with them using the usual professional tools. Nevertheless, they are perfect for clockmaking and used in specialist

3. For information on exotic wood see: [www.hardwoods.com.ar/eng/fichas/itin.htm](http://www.hardwoods.com.ar/eng/fichas/itin.htm)

workshops for several musical instruments.

The list is not that long. The foreign woods are: Nabon and Macasar Ebony from Africa, and Rosewood from India. From Argentina, the local ones are: Quebracho (*Schinopsis spp.*), Itín (*Prosopis kuntzei*), Guaiacum (*Caesalpinia paraguayensis*), and Holy wood (*Bulnesia sarmientoi*). As regards the original Argentine woods, especially Quebracho and in lesser degree Itín, I may offer further details about where to purchase them and how to transport them to the places you need them to be delivered. It has been quite complicated to get the other three types, even in small amounts, as they do not have any industrial use. I managed to get some wooden boards in Salta, capital city of one of the northern provinces in Argentina, where this type of wood comes from.

The problem is that in order to purchase the wood, you must make your way to some workshops near Orán, 270 km north of Salta. In summer, when I made my trip, it turned out to be almost unreachable, due to the high humidity and temperatures over 50°C. These climatic characteristics, together with the need to personally reach the places where these specimens grow, make mosquitoes and gall midges into a certain risk. Due to this, I had to put off my following trip to Orán till next winter. If I am able to make it and, of course, if I have encouraging results, I will be very glad to share the information about where to get these precious woods.

On the other hand I suggest purchasing Ebony and Rosewood from local importers of wood from Africa and India. Obviously, I would be thrilled to know of any other hard precious wood I am not yet aware of.

### Freezing Wood to Avoid Deformation

It is now time I turned to specific technical details. As I warned in my previous article<sup>1</sup>, when the wheel blanks are machined they are turned over-size. The idea is to allow for a characteristic of these cylinders: a couple of days after being turned they change shape due to the release of internal tensions in the wood. The diameter along the grain becomes wider than the diameter across it. With discs 80 to 90 mm across the difference may approach 0.20 mm (0.25%).

In my previous article, I referred to the technique I found in order to minimize the problem: to reduce the blanks to the final diameter when they are assembled prior to cutting the teeth. This technique offered perfectly acceptable results within the tolerance required for satisfactory meshing of the train.

In the case of the clock I am describing here, I tried another technique, which was

even more satisfactory. In the worse case the variation in diameter after turning was just 0.03 mm. The new technique consisted of freezing the discs for two or three days (at around -15°C)

I have not as yet found scientific sources to explain why freezing should be so efficacious but I am sufficiently sure of its success to want to share it. 'Wood shrinking by freezing' may be a suitable term and have analogies with heat treatment of steel. Although it may not be reasonable to compare fibres in wood, with molecular re-alignment in; there is, in fact, a certain reordering of the distribution of water and the typically wood resins. I would appreciate any information on the subject as all these comments are, so far, just suppositions and I lack better data on the topic.

### Metal Parts and General Comments

It was impossible or, certainly not very convenient, to use just wood for all of the components of the clock. The need for the highest durability and precision mitigates against such an ambition. As a result, although the arbors are made of the same Indian rosewood as the wheels and pinions, their pivots, which are fitted into ball races or run in ivory nut bushes, are made of silver steel. In addition, the barrel arbor is made of the same metal as it must be strong enough to withstand the power of the mainspring.

The barrel is formed from a brass cylinder with wooden discs at each end. The suspension for the pendulum, 5, is from 0.4 mm stainless-steel sheet supported by a couple of 2.5 mm brass sheets joined by tiny Allen screws. The pendulum is regulated by two mechanisms. One is a coarse threaded brass rod one hidden inside the ebony rods, embedded one within the other. The clock is regulated by turning the lower ebony cylinder. The second regulatory mechanism, finer and more classical than the former one, is achieved by means of a lower threaded end that supports both twin steel cylinders filled with lead (its total weight is 945 g)

Neither any part nor any material of the mechanism of this clock needs any lubrication. Everything built in wood, including the gears has been treated with a high quality sealing material that may be purchased in any specialised shop. The clock needs to be wound daily but it will run up to 40 hours, offering some flexibility in the winding schedule.

I would like to conclude by expressing my wish to keep contact with all those sharing the experience of manufacturing clocks in order to exchange experiences, discoveries and knowledge (my e-mail address is: gerast@fibertel.com.ar). □

# Watches



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