HOROLOGICAL TIMES™

ADVANCING THE ART, SCIENCE & BUSINESS OF HOROLOGY

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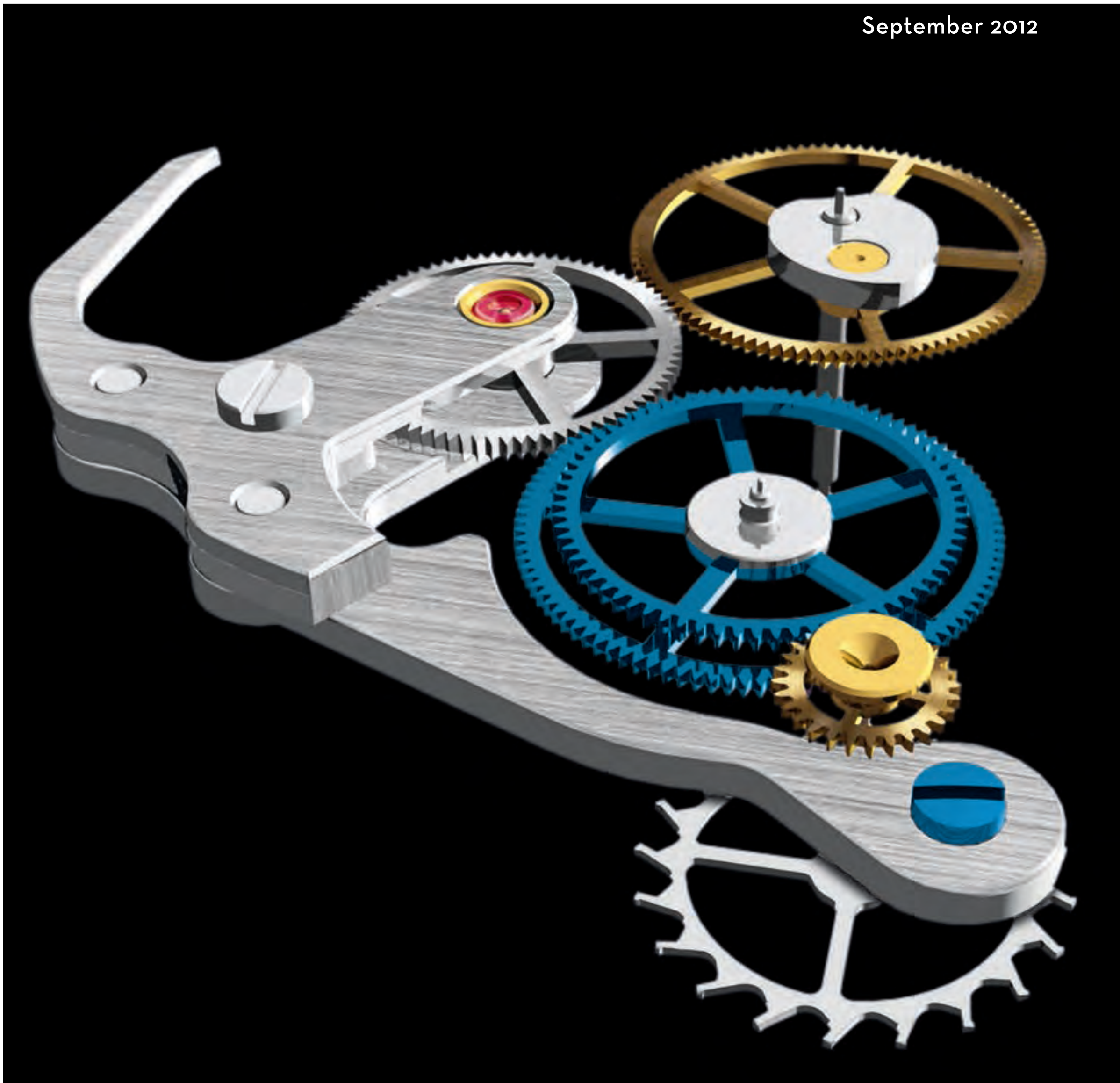

Zenith El Primero, Caliber 4052B Clutch

AMERICAN WATCHMAKERS-CLOCKMAKERS INSTITUTE

This Month's Focus: Technical Spotlight

A Comparison of Cleaning Solutions

From Cleaning a Store to Owning a Store

Vacheron & Constantin during WW I

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Affiliate Chapter News

Feature:

Vacheron & Constantin

and the "war to end all wars"

Matthew Bleecker

BY MATTHEW BLEECKER

Vacheron & Constantin and the "War To End All Wars"

A Brief History

In May, 1918, purchasing agents from the American Expeditionary Force (AEF) drafted an order for 5,000 Vacheron and Constantin pocket watches. These watches were headed to the Corps of Engineers to be used primarily for the supervision of railroad operations in France. Other contracts were tendered since the U.S. arrival with other Swiss brands numbering over 10,000 watches. With the American presence growing from 420,000 troops to near 1.2 million by the end of 1918, the demand for quality timepieces was constant. Contracts held with Zenith, Ulysse Nardin, and subsequently IWC, Moser and Movado, were for time-only watches. Only Vacheron and Constantin were engaged for chronographs. Of the 5,000 chronographs ordered, 3,289 were delivered by the end of the conflict.

American-made watches would also have been used. Actually, 1,000 Hamilton watches were taken, but because of the unreliable state of the trans-Atlantic shipping routes, the AEF decided to get what supplies it could in Europe. I find it interesting that the very best of Swiss manufacturers was hired, and even that the standard watch being used by the Corps was the famous American-made Hamilton. Timing of military actions was crucial, and it only makes sense that the best timepieces should be employed. The Corps of Engineers required their watches to meet the Railroad-grade standards established in 1893, and some other specific features involving winding and legibility. These requirements both Hamilton and Vacheron and Constantin could easily meet, both being world leaders in quality.

Background

This was a student thesis project for Lititz Watch Technicum. It took the course of one year to complete all the aspects of this endeavor. It will be presented in four consecutive issues of *Horological Times* magazine. This first article is a brief history and introduction to the technical side of the service. The theory behind repairing the "Hedgehog" stop works is also included here. Numerous historic letters accompanying this research can be found on:

www.awci.com

Of the 3,289 chronographs, my great-grandfather somehow acquired one of the .900 silver-cased, gold-plated, 20-jewel chronograph watches. Later in the article I will describe my restoration of this watch which began life with the Corps of Engineers During World War I.

Exact historical facts on how my great-grandfather procured the watch are not available, at this point, anything on the military history of this particular watch would be pure conjecture. What is known is that my great-grandfather Maitland, did not serve overseas during the war, and was, in fact, not in the Corps of Engineers until much later. Family accounts did no justice in recalling the arrival of the chronograph into the Bleecker family. Yet, there are a few interesting stories that are, perhaps, more meaningful to its value as an heirloom. Apparently, there were, at one point, two such watches in Maitland's possession and one was sold to pay for the repairs of the other. The watch was used to time races in the homespun "Olympic" games my father participated in as a boy. Most recently, before it came into my possession, it was being regularly used by my

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grandfather because his digital watch had recently met its end. An interesting circle of events probably surround this watch, never to be known in full detail; however, having the opportunity to service the watch has given me insight into the technical details of its past. Though not an exhaustive account, what I discovered is at least more than what was previously known.

The remainder of this paper is primarily a technical account of the process and work I did in order to restore, to the best of my present ability, this magnificent watch to its original state. Some things were irreversible, and others required secondary fixes, and some components needed to be remade, and one designed and made.

The Service

When I began this service, I approached it as a watchmaker in awe. I was about to overhaul a Vacheron and Constantin pocket chronograph that belonged to my great-grandfather, and I could not make any mistakes. There are no parts available, so whatever did not need to be fixed was treated with care and put aside. I compiled a small list of things to do and parts to make as I disassembled the movement. I did not expect to find anything significantly wrong with the watch since it was actually running when I received it. But, the truth was soon revealed! There were a few minor problems, some missing screws and a small amount of surface rust among them. The major problem was with the oscillator, specifically the balance staff and the lower hole jewel. I knew right away this was going to be the first thing I fixed. I wanted to work in an order that made sense. It seemed to me the best approach was to repair the items necessary in order for the watch to run again. So post haste, I began repairing the jewel, then made plans for making a balance staff. Lastly, I would make the missing screws.

I believe the service went basically as planned, although there were several major changes I had to make along the way. There was also a mishap or two that ended up setting me back a few steps. I had originally planned to focus on the historical aspects, but the information was either closely guarded or had been long forgotten. In a time of war, the small details pertaining to watch purchases seemed to have fallen by the wayside or were never documented from the beginning. My final plan consisted of documenting, to the best of my ability, the watch and its parts. My goals were fixing the lower balance hole jewel and making the balance staff, the missing stop-work wheel, and the missing bridge screw.

The Watch

Movement: A beautiful gilt main-plate and three-quarters chronograph bridge are home to magnificently-finished levers and poised gear-train wheels. It has a Swiss lever escapement, bi-metallic balance wheel, column wheel chronograph and barrel stop works.

16 Size, 19 Lignes

Swiss Lever Escapement

Split Bi-Metallic Balance Wheel

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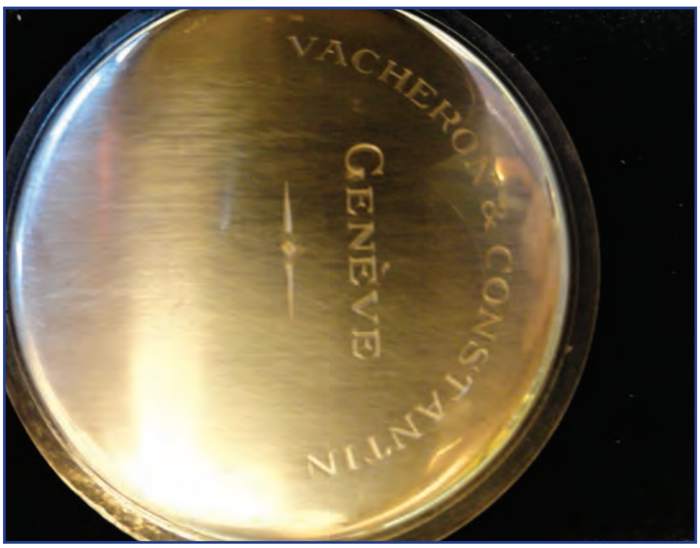
The Case: It is a four-piece .900 silver case. The back is engraved with "Corps of Engineers U.S.A., No. 2366." The inner dust cover is engraved with "Vacheron & Constantin" and "Geneve." Both the back and the dust cover are hinged to the main case, but the bezel and crystal snap on.

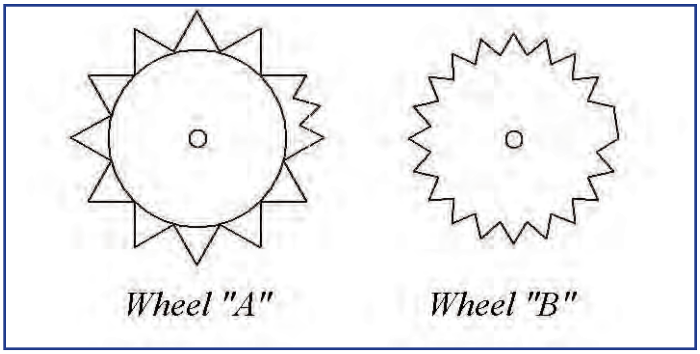
Corps of Engineers Stamp



Brand Engraving on Caseback

The Service Actuated

The Stop Works: As I dove into the project, I eventually made it to the stop works. Not only was a component missing, but none of my instructors had ever seen the design before. This system was atypical and I had no idea what the missing component looked like. The concept is, of course, the same as the average stop works, but is comprised of two star-shaped wheels instead of the Maltese cross design. With the help of Mike Graham, a fellow Lititz student, and some mathematical principles, I was able to ascertain the design of the missing wheel.



This was the first technical endeavor I undertook. As soon as I had the design figured out, I made a model to help me better understand how it worked plus a drawing so I could remake it.

The missing wheel has to be mathematically derived from the existing wheel. I used what Mike figured out, then I came up with a process to unequivocally determine the design of the missing wheel. Wheel "A" has a certain diameter and number of teeth, two of its teeth are divided into three smaller teeth.

My detailed process relies on the dimensions and circular pitch of wheel "A" and the recess into which the missing wheel "B" must fit.

$$\text{Circular Pitch} = \frac{D(\pi)}{\textit{Tooth Count}}$$

Tooth count = 12 teeth

Diameter Wheel "A" = 5.1 mm

$$\frac{D(\pi)}{\textit{Tooth Count}} = \frac{5.1(3.1416)}{12} = 1.335 \text{ mm}$$

Circular pitch = 1.335 mm

Now that I have the circular pitch of wheel "A" I can determine the circular pitch of wheel "B." Since wheel "A" has an even number of teeth—and two are clearly divided into three—wheel "B" must relate not only to the larger tooth profile but also to the smaller.

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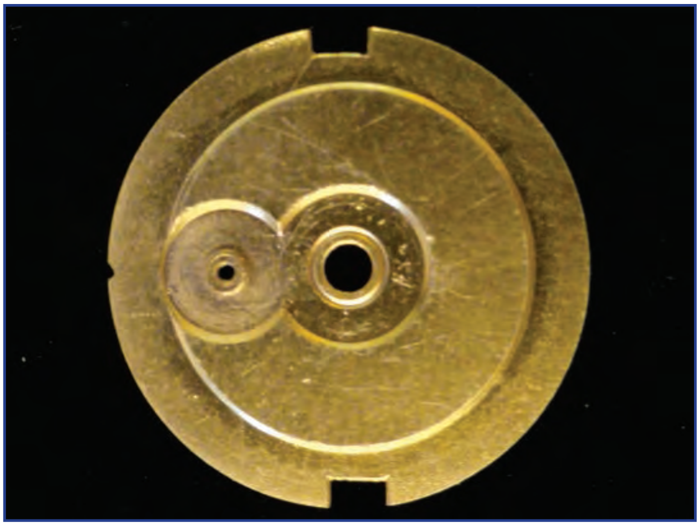

Stop Works on Barrel Lid

Doubling the tooth count of "A" and, therefore, dividing the circular pitch in half is a good place to start. This will divide to the correct circular pitch. It will also define a wheel whose diameter is the same as "A" with twice as many teeth. Since the recess for wheel "B" is a maximum of 4.4 mm, a wheel of equal size will not work. In order to make the diameter smaller, but keep the circular pitch the same, the number of teeth on wheel "B" must be lessened by multiples of two. To find the proper number of teeth and to find a system that concludes in the proper number of turns, I started with the maximum number of teeth and systematically eliminated two at a time, working backwards until the diameter would fit in the recess.

Diameter "A" and "B" = 5.1 mm

Tooth count = 24 teeth

$$\text{Circular pitch (CP)} = \frac{1.335}{6} = .667\text{mm}$$

$$D = CP \times \frac{\textit{Tooth Count}}{\pi}$$

$$D = \frac{.667(24)}{\pi} = 5.1 \text{ mm}$$

Since I know that wheel "B" must be smaller than or equal to 4.4 mm in diameter, using the same formula and less teeth will equal a smaller diameter. The tooth count of wheel "B" can be lessened to 22 teeth, which will make the diameter smaller but keep the circular pitch the same. This process is repeated until the answer is a diameter that will fit in the recess of 4.4 mm. The 22 teeth will equal out to 4.67 mm, which is still too big, so it must be 20 teeth.

$$D = \frac{.667(20)}{\pi} = 4.24 \text{ mm}$$

Diameter = 4.24 mm

Knowing the dimensions and number of teeth of both components, I can now determine if such a system allows a proper number of full rotations of the ratchet wheel. Wheel "A" has a diameter of 5.1 mm, 12 teeth and a circular pitch of 1.335 mm. Wheel "B" has a diameter of 4.24 mm, 20 teeth and a circular pitch of .667 mm. The importance of the circular pitch is to determine the rational relationship between the two wheels.

This part is a little tricky to understand. What I need is the number of turns that wheel "B" allows wheel "A" to make. The important principle that takes effect is that wheels with different tooth counts mesh with different teeth on every rotation until returning back to the zero point. Using 1 turn of wheel "B" as a reference, we determine that "A" turns only a fraction.

When I refer to the "number of turns," imagine that there is a mark on each wheel at the line of centers. The number of turns refers to the number of times both marks return to the line of centers at the same point. The genius of this system is in the different tooth counts on the individual wheels which allow the uncut tooth to travel freely until returning back to the zero point. The number of turns can be empirically determined once the wheels are in place, but should be mathematically calculated as a purposeful function of the system. The number of turns using 20 teeth for wheel "B" is calculated thus:

$$\text{Number of turns} = \frac{Z1}{Z2} = \frac{N2}{N1}$$

Key:

$Z1 = 12 \; Z2 = 20 \; N1 = X \; N2 = 1$

$$\frac{12}{20} = \frac{1}{X} \quad = \quad 12X = 20 \quad = \quad \frac{12x}{12} = \frac{20}{12} \quad = \quad X = 1.2$$

For every one turn of wheel "A" wheel "B" makes 1.2 turns. In order for the starting points of both wheels to make it back to each other wheel "A" must rotate 5 times.

$$1.2 \times 5 = 6 \textit{ Turns of wheel } \text{B}$$

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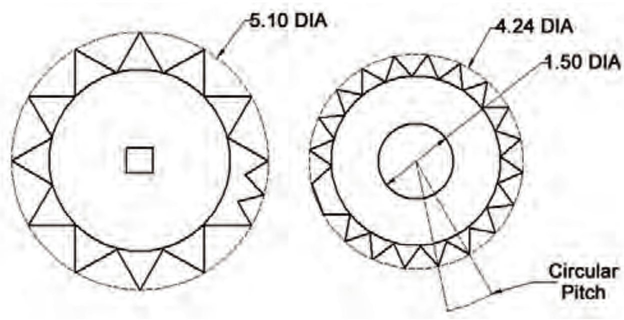
20 Jewels

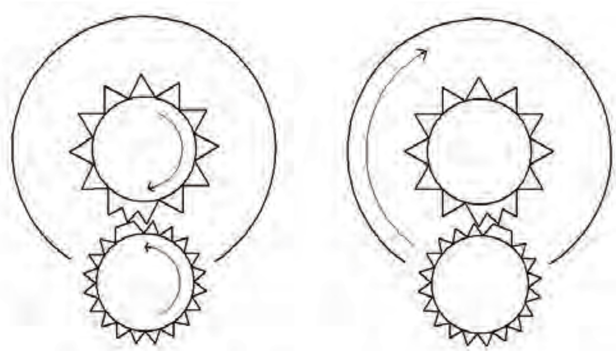


Key Dimensions of the “Hedgehog” Stop Works


Column Wheel Chronograph

Theoretically, 5 turns is the maximum number of turns wheel “A” is allowed to make for every 6 turns of Wheel “B”. The practical application brings this all together. Eliminating the top and bottom of the torque curve of the mainspring is essentially the same as just eliminating the first full turn of the ratchet wheel and the last full turn. I estimate this is the setup in this watch and that a full wind is 7 full turns of the ratchet wheel. Since wheel “A” is directly connected to the barrel arbor and, subsequently, the ratchet wheel, installing wheel “B” after one full rotation of wheel “A” eliminates this initial wind from normal run down.

At this point I need to mention the placement of each wheel which allows this system to work. The existing wheel “A” is located directly on the barrel arbor and is stationary under normal running. Wheel “B” is located on the barrel lid and under normal running orbits around wheel “A”. When the watch is wound, wheel “A” drives wheel “B” until reaching its locking point.


Winding   Normal Running

In next month’s issue, I will explain the repair to the main plate and the process of making the new balance staff. ♦

***See* accompanying series of letters between Vacheron & Constantin and the Corps of Engineers concerning this order of chronographs for troops during World War I.**

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