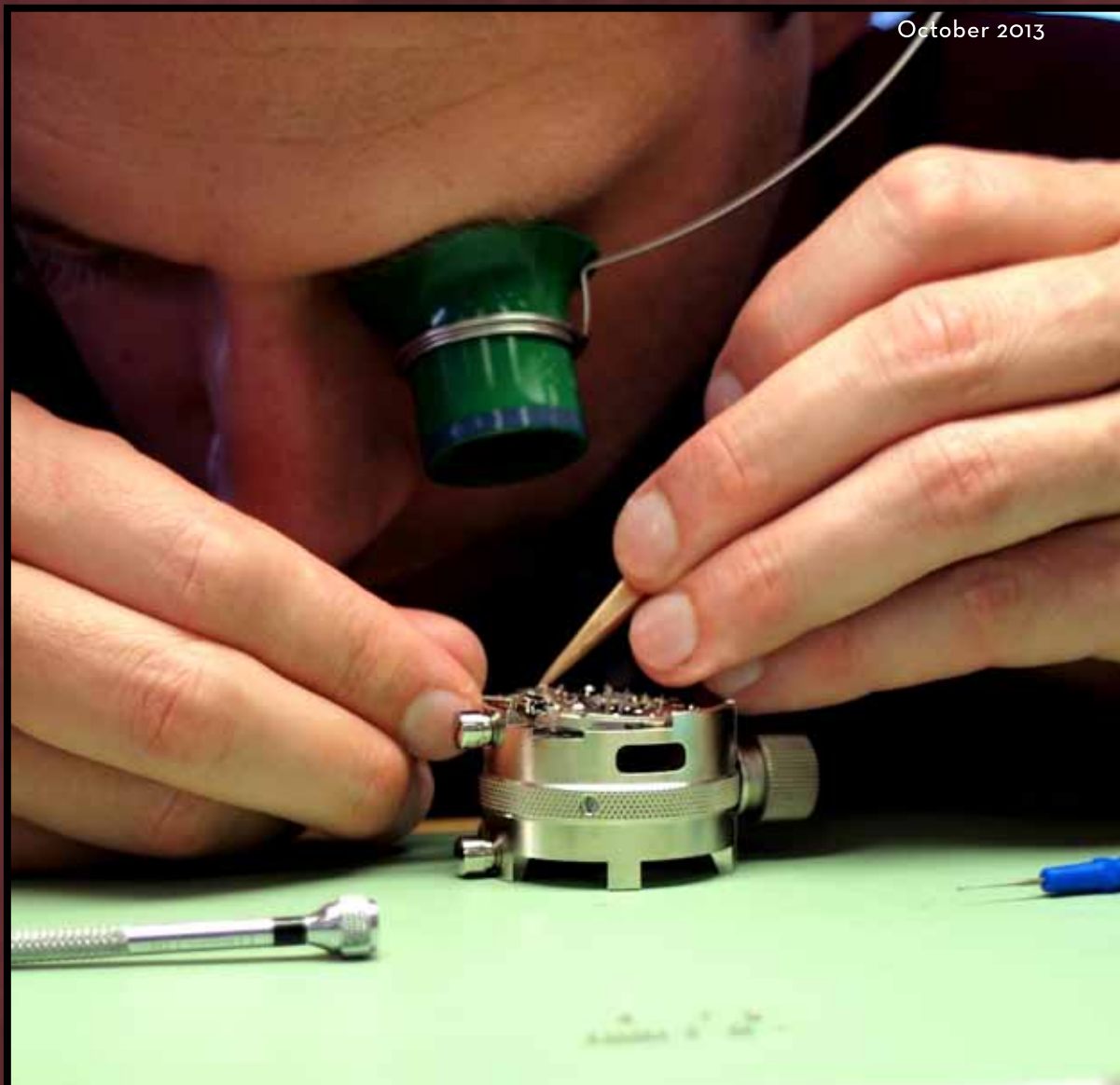


HOROLOGICAL TIMES™

ADVANCING THE ART, SCIENCE & BUSINESS OF HOROLOGY

October 2013



AMERICAN WATCHMAKERS-
CLOCKMAKERS INSTITUTE

Herman Mayer: Modern Mechanical Chronograph 7750
Edmond Capt: A Man of Record
reprinted from *WatchTime* magazine
Student paper: Magnetic Indexing of the
Minute Counting Wheel
Robert Little: Refurbishing and reinstallation of
The Village of Glouster Clock, Part 2

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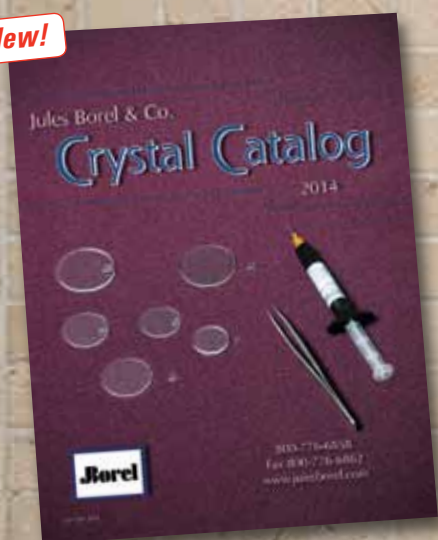
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COVER IMAGE:

Joe Defilippo examines a student's work on the 7750 during the August 2013 Modern Mechanical Chronograph class.

Photo by Herman Mayer



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a message from the president

MANUEL YAZIJIAN, CMW21



Manuel Yazijian
myazijian@gmail.com

Dear AWCI Members, Election results having come in, I would like to welcome the following directors: First-time runner Drew Zimmerman, past President Joseph Cerullo, and current Vice President Wesley Grau, who was also Affiliate Chapter Chairman for the past two years and currently serves as our Chief Examiner. Welcome, gentlemen. I am

confident you will work in unity within the Board of Directors in an unselfish manner to better the profession of watchmakers and clockmakers.

To the members who ran but did not win (David Douglas, John Safranek, Terry Curkan, Justin Shiver, and Michael Michaels), please try again next year. We value your input and your participation in our organization.

As a reminder to all members, the first step to running for the board is to join a committee and participate in projects so we can get to know you better, and also that you may give back a little to the profession.

Part of our ongoing improvement within AWCI is the continued success of our courses, taught at headquarters in Harrison, Ohio. The team of instructors from Lititz Watch Technicum, of Lititz, Pennsylvania, Herman Mayer and Joseph DeFilippo, are doing an outstanding job

in providing world class education to our members and garnering many accolades from students.

The following comments are from one of the participants of the course, Rob Gamber.

"The 7750 course I took on August 26-30 was a pleasant surprise. I was ready for a nose to the grindstone all week with no down time. Herman and Joe did an outstanding job with the teaching of this course. The first day was a little stressful since we were in a new location with a bunch of people we did not know, but Joe and Herman made us feel right at home in no time. Our day started at 8 a.m. and ended at 6:30 to 7 p.m. every day but Thursday, when some of us were there from 6:30 a.m. to 6:30 pm. We were running out of time in the week to cover all the aspects of the 7750, so Joe and Herman recommended that we start early to cover the pallet stone adjustments. I'm glad they did. I learned more than I was expecting to."

I invite other industry members to take advantage of our state-of-the-art facility to teach courses. We welcome you to teach brand/caliber-specific courses, or to teach the various courses currently being offered, or to offer new topics that would benefit the horology community.

Looking forward to seeing you all in class.

As always, keep your skills honed, your standards very high, your attitude professional, your tools and equipment in great condition, and your workshops clean and organized; it is a reflection of who we are and what we do.

education & certification



We are pleased to announce some exciting new changes coming soon to our education programs at AWCI. Several of our scheduled courses will be taught by visiting instructors from the Lititz Watch Technician.

Attention Clockmakers! Your questions have been answered. Coming soon! Courses for watchmakers and clockmakers will be bridged ranging from basic tool and spare parts making to vintage chronograph! Specific courses require special know-how. Utilizing brand-specific tools will be made available to participants.

Here's an example of an upcoming bridged course:

Basic Tool and Spare Parts Making Courses 1-3.

Participants: 10 students maximum

Length of course: 4 days each

Course 1 would be a basic course, and Course 2 would be an intermediate course. Each built around developing and mastering essential micro-mechanic proficiencies. Each course is based on reconstructing a clock movement to a functional level. Course 3 teaches traditional micro-mechanics for watchmakers and/or clockmakers. It would be an advanced capstone course which requires the theoretical and practical knowledge of the proficiencies taught in Courses 1 and 2.

Content:

- Beveling
- Blueprints
- Broaching
- Burnishing
- Centricity
- Clamping
- Connection Techniques
- Cutting Geometry
- Deburring
- Drilling
- Filing
- Grinding
- Hazardous Materials
- Hole Alignment/Center Distance
- Lathes
- Lubrication
- Materials
- Measurement
- Metalworking
- Punches
- Reaming
- Safety
- Sawing
- Surface Finishing
- Thermal Treatment
- Tools
- Tracing
- Turning

I urge you to attend AWCI courses in our state-of-the-art facility. The experience and knowledge gained will be well worth the time spent away from your workshop. This is a prime opportunity to receive hands-on instruction from some of the best educators in the industry!

More information on class schedules can be found on our website as well as your email inboxes.

AWCI ACADEMY OF WATCHMAKING 2013 COURSES

OCTOBER

Service & Adjusting the Lever Escapement

October 15-18 | 5 CEUs

The purpose of this course is:

- To gain a good theoretical understanding in order to evaluate the condition of the lever escapement and thus proceed with the verification and analysis of the escapement functions.
- To teach the student all the fundamentals of the proper functioning of the lever escapement.
- To be able to make all the adjustments with ease and confidence.
- To understand the effects of adjustments on timing.
- Proper lubrication methods and its effect on timing and overall performance.

Prerequisites:

- Minimum 3 years full time experience in watch repair
 - (and/or) Having attended the following AWCI Courses:
 - Basic Watch Repair and/or
 - Automatic Watch Repair
- Ownership of the book *The Theory of Horology* is essential.

- **Must read pages 99-101 of *The Theory of Horology*, prior to attending the course.**

- Knowledge of watch & escapement terminology
- Membership with AWCI
- Ownership of hand tools as per tool list.

Length of course: 40 hours, 4 days

More specifically, the student will learn about:

- Overview of the nomenclature of the lever escapement and its various components
- General repair procedure
- Checking the various components
- Adjustment & correction of the division of the escape wheel, the lever & balance wheel
- Adjustment & correction of the clearance of the fork horns & guard pin
- Adjustment & correction of the various clearances in the escapement
- Adjustment & correction of the pallet jewels
- Logical steps of repairing the lever escapement
- Proper technique of applying shellac
- Oiling the escapement
- Final assembly
- Timing adjustments and analysis

NOVEMBER

Polishing & Refinishing November 11-15 | 5 CEUs

Polishing a watch today requires many skills. Today's consumer has high expectations concerning the quality of the watch repair, including the refinishing of the case and bracelet. Knowledge is the key.

class covers:

- Casing information
- Case and bracelet refinishing
- Metallurgy
- Lathe finishes
- Use of modern variable speed polishers
- Modern polishing techniques ensuring case shape integrity
- Water resistant testing

This course is designed to help you realize:

- A higher quality of service
- reduced come-backs due to moisture issues
- faster turnaround time
- higher customer satisfaction

For additional details about specific courses in comprehensive syllabi form, including complete tool list, visit: <http://www.awci.com/education-certification/education2/list-of-continuing-education-courses/> or contact Cindy Whitehead at 866-FOR-AWCI (367-2924), ext. 303

Prerequisites: Must be able to stand for long periods of time. Operate machinery safely. Use a lathe.

Length of course: 5 days (Monday – Friday)

Topics and Areas of Study

- Identifying the content
- Knowledge of the Hallmarks
- Pre-cleaning procedures
- Polishing procedures
- Use of modern water resistant testers
- Crystal/Bezel removal and principals of a case press
- Taping and protecting the sealing surface
- Texturing finishes
- Speed and direction related issues
- Preparation and maintenance of the polishing wheels and buffs

More specifically:

Knowledge of water resistant principles will be taught. Disassembly and assembly of case components and the use of a crystal press and dies will be explained. Procedures related to water testing, including the “condensation test” will be demonstrated on a wide variety of modern, currently produced testers. Techniques demonstrated during this program will cross over to many other brands.

The Polishing Supply Kit includes the following:

- | | |
|--------------------------------|--------------------------------------|
| 1. Felt wheel | 6. Felt bezel fixture |
| 2. Buffs | 7. Safety glasses and safety mask |
| 3. Satin wheels | 8. Abrasives, emery stick, sandpaper |
| 4. Set of compounds | 9. Specialty items |
| 5. Brass fixture for case back | 10. And more |

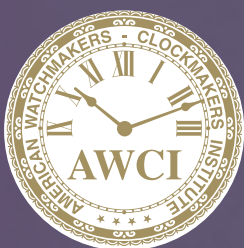
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AWCI strives to not only encourage the advancement of horology but provide educational and technical services to our members.

For over 50 years, we've dedicated ourselves to preserving and promoting the highest standards of workmanship in the horological crafts.

Our goal is always to maintain a standard of excellence applied to the quality of instruction for both the restoration and repair practices that are taught worldwide. As our valued members, make sure you take advantage of all the benefits AWCI membership offers:

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AWCI conducts training through Continuing Education courses in Harrison, OH and Off-Site Bench Courses.
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- **Technical Assistance**
Members may request technical bulletins and schematics at no charge or parts lists for watches and clocks via our research assistance network.



We continuously work to offer the most valuable services and assistance possible because we appreciate all our members.

Visit AWCI.com to renew your membership. Or, call toll free:

1-866-367-2924 Ext. 301.



TOM'S TIPS

Tom Schomaker
article #7

FREEDOM IS THE NEW BUZZWORD

Endshake vs. Freedom

Freedom is the new buzzword that is frequently used in trainings. It is similar to endshake, although the details are what really make the distinction. As watchmakers, we understand that endshake is defined as the amount of vertical movement of a part within a set of parameters or tolerances. The definition of freedom is a little bit more elusive. Simply defined, it is the freedom or movement of a part without a specific tolerance.

An example is as follows: If you were to check the vertical endplay of the barrel, between the main plate and the barrel bridge without the ratchet wheel and screw, you would be assessing the amount of barrel endshake. There is a tolerance assigned to this, generally speaking .02mm to .03mm.

Now, let's add the ratchet wheel and screw. In order to now check the vertical endplay we will place a piece of Rodico on top of the ratchet wheel and screw. Press it down firmly before attempting to lift it up to feel the slight amount of movement that is necessary. However, this is not endshake; this is "ratchet wheel freedom." The second you add the ratchet wheel and screw and perform this test, you are adding another variable that can affect the actual endshake of the barrel.

On a Rolex 3035 for example, it is possible that you can have the proper barrel endshake (tolerance of .01mm to .03mm, without the ratchet wheel). However, after applying the ratchet wheel and screw, you check the "ratchet wheel freedom" only to find that it is either very tight or nonexistent. How can that be?

The answer is a bit more complicated. It is possible in this model to move the upper barrel bushing with the Horia tool in a direction towards the ratchet wheel to add endshake to the barrel,

achieving your barrel endshake tolerance of .01mm to .03mm. By doing so, you have displaced the bushing upward and, upon checking the endshake of the barrel, everything appears to be correct and within tolerances. Now add the ratchet wheel and screw. When you check the freedom (using Rodico) there doesn't appear to be any freedom or vertical movement. So where is the problem? It seems that the bushing is protruding enough to rub on the bottom of the ratchet wheel, thus removing the vertical play or freedom of the ratchet wheel.

Do you think that you should have moved the bottom bushing downward? No! That would not be correct. You see on this model, the lower bushing has a step built into it that must be fully seated. You cannot move the bottom bushing towards the dial as it would become unseated and unstable, because it is very thin in this area.

To Correct This Problem

We need to proceed in a logical manner. Remove the ratchet wheel and screw along with the barrel bridge. Now, lower the upper barrel bushing down to make it level with the top of the barrel bridge by using the Horia tool. This will give us a good starting point. Carefully reassemble the barrel bridge onto the main plate with the barrel in place. Do not tighten the screws too harshly. Check to see if any endshake exists. Probably not (in this example), but you may be able to gauge how tight the barrel is. We know that we cannot move the upper barrel bushing or the bottom barrel bushing in the main plate, as it needs to be fully seated. So we begin the correction by removing the barrel bridge and barrel.

The correction procedure will be made by applying pressure to the lower barrel bushing surface (in the main plate) with either a large piece of pegwood or something similar. The pegwood must be flat (non-pointed) and have a wider width than the bushing itself. It may not enter into the bushing

TOM'S TIPS



hole itself. Place the main plate into a movement holder. Using the pegwood, apply a small amount of downward pressure on the lower part of the main plate, centered over the lower bushing. This will cause the main plate to flex and bend slightly. After making this slight correction (remember, we are only dealing with hundredths of a millimeter here), recheck the amount of endshake of the barrel between the plates with the barrel bridge and screws fully secured. You must achieve the correct amount of barrel endshake through this process. Once achieved, add the ratchet wheel and screw, and recheck for “ratchet wheel freedom.” You should now have it, as the upper bushing is in a relatively neutral position where it can no longer rub the underside of the ratchet wheel.

Because the barrel arbor bushing area in the main plate is often so thin, it can easily be distorted and slightly bent. When we are performing the above correction, we are in essence not bending the main plate, but simply manipulating it back to its original position. When in that position, as from the factory,

we would have the appropriate endshake (within the permissible tolerances). We have thus restored it to its proper initial shape. Bending on parts, if done arbitrarily, is never a good idea. When we make a precise, calculated adjustment, it is a totally different story.

Why Is “Ratchet Wheel Freedom” So Important?

This is one factor that accounts for a high number of comebacks in automatic watches. This causes poor efficiency of the automatic system due to the fact that there is binding (friction, rubbing, etc.) that keeps the automatic system from being wound fully and providing the correct amount of power reserve. So, the wearer isn’t able to achieve the benefits of: a full wind, stable higher amplitudes (more accurate timekeeping), and a watch that provides the correct amount of power reserve. This check comes in very handy on any automatic watch that is returned or is in for estimating.

At a training that I recently attended, I was told that the automatic system is responsible for more comebacks than timing issues.

Checking for ratchet wheel freedom applies to other brands as well. But if you are able to move the bottom jewel or bushing, the job can be a little less complicated. **Remember**, if you move the barrel jewels (or bushings) to achieve proper barrel endshake, you may cause a ratchet wheel freedom error that, if not checked and corrected, would cause yourself a potential comeback.

To download a copy, go to www.awci.com home page and click on *Tom's Tips*



Tom Schomaker, CMW21, former watchmaking instructor for the American Watchmakers-Clockmakers Institute (AWCI), has received brand-specific training in the U.S. and Switzerland, and has performed after-sales service for a Swiss manufacturer.

American Watchmakers-Clockmakers Institute 866-367-2924 © AWCI 2013.

The ETA caliber 7750 is one of the most prevalent mechanical chronograph movements in service today. It is found in a wide product range that is commonly serviced both at the retail store level and by independent watchmakers. Its rock-solid and streamlined design makes it very service friendly and it therefore enjoys a strong popularity amongst watchmaking professionals.

Several major brands offer specific training for their retail service accounts; however there is also a strong demand for continued education seminars on this movement—like the Modern Chronograph seminar recently given last month by Joe Defilippo at the AWCI headquarters in Harrison, Ohio.

What Is the Profile of Participants in These Courses?

First of all, numbers are critical. Watchmaking education is intense and requires a low student-to-teacher ratio. Up to 10:1 is ideal, with 12:1 being the limit, especially when dealing with a varied group. This is often the case in continued education seminars where participants typically come with a wide variety of personal and professional backgrounds.

And indeed, our group of 10 students was quite diverse. Some of them learned the profession at watchmaking schools, some in an apprenticeship. Several students had around 40 years' experience, some less than 10. The cumulative experience of the group added up to 267 years, with an average of slightly below 27 years of experience.



As varied as the group was, they had one thing in common: all were watchmaking professionals who recognize the value of continued education in getting ready to tackle the opportunities that come with an increased demand in servicing complicated watches.



A chronograph with an hour counter, automatic winding and day/date indication is a complex mechanism, and the complete *comprehension* of it is essential for efficient troubleshooting. Without *fully understanding* the mechanism that is before us on our bench, the quality and efficiency of our work becomes compromised when guesswork replaces logical action.

Since all of the participants were experienced watchmakers, there was no need to begin with a disassembly/reassembly exercise. Instead, we started with a caliber 7750 movement completely disassembled with all the parts mixed up. The primary goal was to work ourselves through the movement, in a practical way, as well as conceptually, by following the various power transmission chains. Therefore, the barrel was chosen as the starting point of our journey through the 7750 since it stores the power provided via the automatic system and supplies it through various trains to the oscillator, the hands (including chronograph hands) and day/date indicators.

Barrel Service and Diagnostics

For a course that was titled “Modern Mechanical Chronograph” the start was mundane: Barrel Service and Diagnostics. What appeared to be an extremely simple topic gained complexity as we discussed components such as the sliding bridle (is it sliding along the barrel wall?), wear patterns and their symptoms (including mainspring damage and wear), the purpose of the mainspring S-curve (what is its purpose and how does it fulfill it?), various kinds of barrel lid designs and the correct way to open them, whether the endshake of the barrel between the bridge and the main plate has an influence on the performance on the going train (it doesn't—because the arbor is not even rotating when the watch is running).

We spent a few hours working through the concepts relating to power storage and, just as we moved away from it, there was another brain teaser waiting: what holds the mainspring power in a 7750 movement (as with most other self-winding movements) when the timepiece is in operation on the wearer's wrist? The first answer to this question that comes to mind is "the ratchet wheel click," which is incorrect. In fact, the ratchet wheel click is not needed at all for running the watch, as long as the movement is complete. It provides a purpose only during the service process once the automatic winding components are removed. Only then does the ratchet wheel click actually hold the mainspring power. We ended the "Barrel Service and Diagnostic" segment with new knowledge of an expertly diagnosed and serviced barrel. The first step on our journey through the 7750 was complete.



Analyzing the Going Train and the Winding Train

Next we needed to analyze the going train, consisting of the great wheel, third wheel, seconds wheel, and escape wheel. The main topic of interest in this gear train is the driver cannon pinion, which sits dial-side on the great wheel and supplies power to the motion works through the minute wheel. Although not complex, it is a critical area when servicing the movement and does not tolerate a random approach. Proper performance of the driver cannon pinion depends on the correct removal, cleaning, lubrication of the friction mechanism, and finally, the installation.

The winding train was next. Even a functional group as simple as this is worth consideration. In our daily routines often we get so comfortable with our workpieces that we lose our analytical perspective. The simple task of describing the power flow from the crown to the barrel arbor during manual winding is a good example for this, as there is a tendency to overlook the sliding pinion in this chain.

A close look at the bearing surfaces of the winding stem and the possible damage that can be caused by careless clamping of the stem during crown installation

was another eye opener, given the fact that a critical review of your own procedures can be highly beneficial.

At this point, which was the end of the first day, we completed the base movements and were ready to tackle the next functional group: the chronograph mechanism.

The Chronograph Mechanism

Like most chronographs with a traditional clutch design, it gets its power from the seconds wheel through a rocking pinion that functions as a clutch by engaging and disengaging with the chronograph runner. This rocking pinion deserves attention in various respects. Regarding lubrication: frequently, the lower pivot is overlooked; due to the fact that it is installed *after* the jewels on the dial side get lubricated. Regarding wear analysis: the upper pivot of the rocking pinion is running in a steel/steel bearing situation, and therefore could be prone to wear, especially when the



lubrication is compromised. Lastly, there is the depth adjustment of the rocking pinion in its engagement with the chronograph runner, which is performed via an eccentric that acts as a stop for the clutch.

From the chronograph runner the power flow continues to the intermediate minute counting wheel to the minute counting wheel via an adjustable finger (officially called the chronograph wheel jumper). Here too, the depth between this finger and the intermediate minute counting wheel is essential (too deep, and the minute counter jumps twice per revolution of chrono runner; too shallow, and the minute counter does not jump at all). Also, the angular positioning in relation to the heart cam of the chronograph runner ensures the correct positioning of the finger for starting the chronograph after a reset. The fact that a minute counter rotates only a few degrees once a minute is responsible for a lubrication idiosyncrasy: the intermediate minute counting wheel as well as the minute counting wheel must not be lubricated.

The fact that the wheels of the chronograph mechanism operate outside of the main power flow (barrel to escape wheel) requires a friction spring to compensate for the play in the teeth. Although the one in the 7750 is a mostly maintenance-free area, we explored thoroughly the consequences of friction springs that do not provide sufficient tension (irregular movement of the chrono hand), as well as friction springs that are too tight (excessive drop in amplitude as well as reduced power reserve with chronograph running). Apart from the various kinds of friction springs with their adjustment and diagnosis, we reviewed other designs which compensate for play of teeth in general—such as the double wheel with tension spring that can be found in traditional indirect sweep seconds designs, including flexible teeth whose spring action assures a play-free power transfer.

The Cam

We have now established the power flow from the movement through the chrono hand and the minute



counting hand. Next in line is the shifting mechanism that allows the user to turn the chronograph mechanism on, off, and to set it to zero.

These functions rely on the action of a clutch (which turns the power flow from the movement on and off), a brake (or lock, which holds the chronograph runner in place when the clutch is disengaged), a hammer (which interacts with one heart cam on the minute counter and one heart cam on the chronograph runner in order to set them to zero by exerting radial pressure on them). The actions and interactions of all these components are controlled by a cam which turns as the user operates the chrono pushers. There is a switch as well, which can be described as a cam follower attached to a shaft that transfers the position of the cam to the dial side, to control the action of the hour counting mechanism, which is located separately.

The cam is sitting on top of the crown wheel core, which means that it not only positions the crown wheel, but has a significant responsibility in the smooth function of the chronograph as well. This is worth mentioning since very few watchmakers, if asked to list some factors that can influence the proper action of the chronograph mechanism, would mention the crown wheel core. Yet this component can easily fail in its function as a bearing for the cam. Not by itself, of course, it needs a small amount of help from a watchmaker—and the ones that don't believe in comprehending underlying principles are typically more than willing to provide this help in an involuntary kind of way.

And here is how it's done: The crown wheel core has two screw holes to attach it to the bridge, and it has two short positioning pins which appear to be made by means of extrusion. The screw holes are symmetrically arranged, while the positioning pins are located on one side of the core. This arrangement is necessitated by the fact that the milled-out section for the sliding pinion is located under the crown wheel core. If a watchmaker is not observant and does not believe in comprehending underlying principles (fastening and positioning elements in this case), s/he could install the

crown wheel core 180° offset, which is curiously possible because the milled-out section for the sliding pinion as well as for the barrel would allow the core to be seated, the positioning pins standing free, with only the screws holding it in place. This can hardly be called a successful repair since crown wheel and cam are positioned now with a largertolerancethan provided by design, and considering the large radial force that acts on the cam by the jumper and the main operating lever, it is only a matter of time before the connection fails, causing the entire movement to become dysfunctional.

A cam controls a multitude of actions simultaneously, similar to a driver of a vehicle with manual transmission: when the clutch starts transferring the torque to the chrono runner, the brake must open at the same time. When the power flow stops, the brake must engage immediately to prevent the chrono runner from moving freely and displaying a false reading. When the hammer forces the heart cams to the zero position, the brake must be open as well. Comprehension of the individual actions of these shifting cycles allows efficiently diagnosing any malfunctions and taking correct remedial actions, while a lack of comprehension leads to the random replacement of parts with uncertain outcome.

The Jumper Spring

Another adjustable parameter is the jumper spring position. As this movement has a pivoting reset hammer (self-adjusting), it requires a precise coordination when



it comes to the positioning of the minute counting wheel. When the hammer is down, the minute counter is positioned by the hammer acting on the heart cam. When the hammer is lifted away from the heart cam, the positioning of the minute counting wheel is taken over by the minute counter jumper. At that moment, if the jumper and hammer action are not precisely coordinated, the minute counting hand will make a jump. This adjustment must be made under high magnification in order to visually verify that the jumper beak is positioned between two teeth of the minute counting wheel, and resting against both teeth at the same time.

However, not only is the jumper position essential, the jumper tension is just as important. A jumper that is too tight has a strong influence on the performance of the watch, something that many watchmakers are hardly aware of. What shows up as a short and—depending on the integration time—more or less noticeable drop of amplitude during the jump of the minute counter translates in real life to reduced power reserve, a parameter that watch owners are quite aware of.

Once the chronograph components and functions were fully understood, we moved on to the relatively

straightforward automatic winding mechanism, which can constitute a challenge for watchmakers because of its arrangement on two levels. This requires a very focused approach when it comes to oil application in order not to leave a pivot dry. However, here too, knowledge of the power flow and torque conditions support a fast diagnosis, for example when an automatic driving wheel is slipping on its arbor under high load, causing a reduced power reserve.

The Dial Side

The last area that underwent our thorough analysis was the dial side. Apart from the motion works it carries two functional groups: the hour counting mechanism and the day/date indicator.

The design of the hour counting mechanism is fascinating in its simplicity. The start/stop command from the cam (on the movement side) is transferred to the dial side through the switch, which opens or engages the hour counter lock. The reset command comes directly from the reset pusher, through the hour hammer operating lever to the hour hammer via a beak on each component. When the hammer moves towards the



heart cam, it lifts up the brake at the same time to allow for free rotation of the wheel during the reset action. As soon as the reset action is completed the hammer leaves the heart cam again and the brake holds it in place.

There are two versions of hour hammer operating levers and hour hammers in use. The only difference between them is a slightly offset beak. If either the hour hammer operating lever or the hammer is replaced with an incompatible version, the beaks will not line up, making the reset impossible. This area too, serves as an example of how understanding the mechanism will help avoid these kinds of problems, and increase work speed and quality.

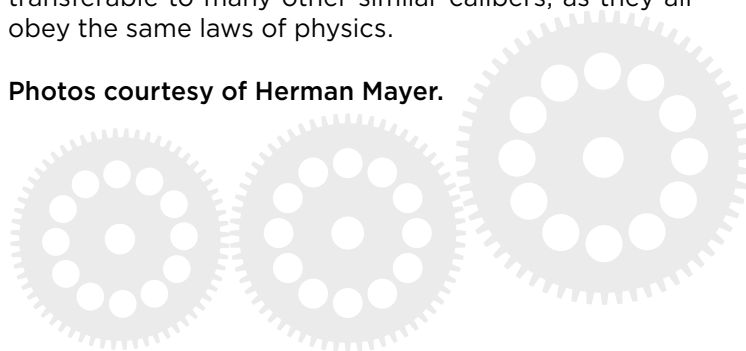
Comprehensive Analysis

We analyzed a few more areas in detail, and halfway through our one-week course we completed our com-

prehensive analysis of caliber 7750. We then applied this newly learned material in the form of a complete servicing, which included dialing and casing. We also practiced repeated multiple adjustment exercises in order to develop solid process routines to more effectively service this timepiece with confidence.

However most importantly, we were able to establish an analytical approach to watch service with an elevated level of comprehension instead of blind and unreflective adherence to step-by-step procedures. The information shared in this course is by and large transferable to many other similar calibers, as they all obey the same laws of physics.

Photos courtesy of Herman Mayer.



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A Man of Record



One of the world's most important caliber-designers: Edmond Capt directs both the Frédéric Piguet and Lemania manufactures.

A Man of **RECORD**

LUCIEN F. TRUB

Edmond Capt, a native of Switzerland's Vallée de Joux, is the creator of the Valjoux 7750, the world's most popular chronograph movement, as well as 32 other calibers. Since 1999, Capt has served as the general director of both Frédéric Piguet and Nouvelle Lemania.

This article originally appeared in the August 2003 issue of WatchTime and is reprinted with permission.

At first glance, there's really nothing particularly surprising about the fact that 56-year-old Edmond Capt is currently the director of both Frédéric Piguet and Nouvelle Lemania, two important manufacturers of mechanical watch movements. (And both owned by the Swatch Group.) Nor is it at all remarkable that Capt has distinguished himself as an ingenious designer of mechanical and electronic calibers. After all, the Capt clan, which emigrated from France and settled in Switzerland's Vallée de Joux in the mid 16th century, ranks among the

most famous watchmaking dynasties, along with such families as the Meylans, Piguets, and Rochats. And like all good dynasties, the Capt's too have passed down their talents from one generation to the next.

But prior to Edmond, you'd have to trace the Capt's family tree in Le Brassus all the way back to the late 19th century before you'd find another watchmaker in its branches. Although the gene that predisposes a person to become a watchmaker seems to be present in all of the valley's families, it's still a bit of a genetic crapshoot as to who develops it and who allows it to lie dormant. Obviously, Edmond Capt was blessed with a dominant watchmaking gene.

However, Capt wasn't exactly predestined to enroll at the school for watchmakers in Le Sentier. He loved to draw and paint, but his parents couldn't afford to send him to his



Capt's uncommonly slender automatic movement 1150 has become an important base caliber for Frédéric Piguet and Blancpain.

A Man of Record

LUCIEN F. TRUEB



The smallest movement of its kind: The Caliber FP 23 with a flying tourbillon, a hand-type calendar, a power-reserve display and an eight-day power reserve.

first choice, the renowned school for graphic artists in Paris. Capt therefore remained in the Vallée de Joux and enrolled at the famed school for watchmakers in Le Sentier, where his extraordinary achievements soon attracted the attention of his teachers. During his final year at the school, Capt became a *calibriste*, i.e. a watchmaker who builds the prototypes of calibers. A *calibriste* must be capable of transforming a two-dimensional blueprint into a complete watch movement made of brass and steel. After graduation from the school in Le Sentier, the 20-year-old Capt enrolled at the school of engineering in Geneva, from which he graduated with the title “watchmaker engineer” in 1969. Capt quickly found a good job at Rolex in Geneva, but stayed only one year.

Most *combiens* (i.e. natives of Vallée de Joux) emigrate only temporarily from their home, and sooner or later are likely to return to their wonderfully peaceful and unspoiled high-lying valley. This was certainly the case with Edmond Capt. When Valjoux’s *ébauche* subsidiary in Les Bioux offered him a job in 1970, he didn’t hesitate. (The company name ‘Valjoux’ is, of course, a creative contraction of Vallée de Joux.) Freshly arrived at his new workplace, Capt was entrusted with the task of developing an innovative automatic chronograph movement. The device was to measure 13.25 lignes in diameter, would have to include an integrated self-winding mechanism and a

large central rotor, and would bear the designation Caliber No. 7750. The project began early in 1971, when automatic chronographs were first experiencing strong demands. But the developmental challenges proved to be much more difficult than either Capt or anyone else in Valjoux’s management had expected. Computer power saved the day, and the Caliber 7750 is one of the first movements whose module was simulated on a computer. There were several critical steps in its assembly process that Valjoux preferred to perform on its own premises to ensure perfect quality.

The newly developed caliber first went on sale in 1973 and sold quite well for the next two years. Annual production increased to 100,000 units. But demand for the 7750 plummeted to nearly zero after 1975. Valjoux’s management was convinced that the era of the mechanical chronograph had come to its end and that this type of timepiece would probably never again be manufactured. The design engineers were told to scrap everything connected with the Caliber 7750. But the specialists in Les Bioux decided to ignore this order and with canny foresight neatly packed away the tools and machinery. Their “insubordination” paid off in 1983, when demand for mechanical chronographs suddenly revived. The management was glad to discover that production of the Caliber 7750 could rapidly be resumed, largely thanks to the “illegally” preserved tools and machinery that



Capt is particularly proud of the Caliber 1270, which is powered by two quartz movements.

had been tucked away in Les Bioux eight years earlier.

Capt spent eight years at Valjoux, where he witnessed firsthand the quartz crisis that began in 1972. The situation didn't become grave until 1978, when the share of the market commanded by mechanical watches shrank rapidly and it became virtually impossible to sell mechanical stopwatches and chronographs. At Valjoux, all talk of developing new mechanical calibers soon ebbed to silence. In 1978, Capt was asked to take over the leadership of quartz movement manufacturing at Peseux, the ébauche factory. At almost the same moment, however, Frédéric Piguet's owner and chief designer Jacques Piguet offered him the job of technical director. Naturally, Capt was glad to switch to Piguet... not solely because employment with this firm would allow him to stay in the Vallée de Joux.

When Capt joined Frédéric Piguet, sales of the ultra-slim mechanical movements FP 21 (9 lignes) and FP 71 (12.5 lignes) had declined by two-thirds. Annual sales of 15,000 units had shrunk to just 5,000 units per year. After comprehensive discussions with Ebel's Pierre-Alain Blum, Jacques Piguet decided to begin manufacturing quartz movements of the very highest quality. Capt was obliged to organize this manufacturing from square one,

Capt's first position was at Rolex in Geneva, but he only stayed there for one year.

and he proved himself very successful at this task. Thanks to collaboration with Ebel, followed by further collaborations with Cartier and Audemars Piguet, Frédéric Piguet soon stopped speaking of a "crisis" altogether. Between 1979 and 1981, Capt designed three quartz movements: a 6.75-ligne caliber (the FP 620) for Ebel-Cartier; an 8.25-ligne caliber for Audemars Piguet (the FP 820); and a second 8.25-ligne

caliber with a sweep seconds-hand and a calendar display (the FP 8310). In addition to these devices, Capt also developed an 8.25-ligne mechanical caliber (the FP 18) for Audemars Piguet. Capt is particularly proud of the twin-motor chronograph Caliber FP 1270 (12 lignes in diameter and 4.75 millimeters in height) that he developed in 1985. Equipped with a mechanical split-seconds function twelve years later, this caliber contains two separate movements, one of

which is used as a shock-resistant base caliber, the other (running at a pace of 16 Hertz) used for the chronograph function. This frequency enables the chronograph's seconds-hand to progress through 16 increments each second, a motion that the human eye perceives as entirely smooth and continuous, not unlike the 24-frames-per-second progress of movie film through a projector.

A Man of Record

LUCIEN F. TRUB

Jean-Claude Biver purchased the Blancpain brand from SSIH-Omega and went into business on his own in 1982. It was on the basis of this brand that he and Jacques Piguet founded a new enterprise. In accord with Blancpain's "no quartz calibers" philosophy, Biver reactivated an existing 12-ligne Piguet caliber with moon-phase display (the FP 65) and commissioned the construction of a 9-ligne automatic caliber for ladies' watches (the FP 63). But because Blancpain needed reliable mechanical calibers that combined a broad spectrum of complications with slenderness on a par with Frédéric Piguet's quartz movements, the majority of items had to be developed anew.

It wasn't difficult to use quartz movements as the motors inside very elegant ladies' watches that, despite their petite dimensions, could also boast remarkably accurate timekeeping. But it was a first-rate challenge to develop comparably reliable mechanical calibers that could be housed inside these same diminutive cases. The hand-wound Caliber FP 810 (8.25 lignes, two hands) was developed first, followed by the automatic Caliber FP 951 (9 lignes, three hands and date display) in 1985. This latter movement, which was occasionally encased inside

men's watches as well, remained without competitors for nearly a decade. The FP 23, an 11.5-ligne hand-wound caliber with tourbillon, is the smallest caliber of its kind. Tourbillon and minute repetition were completely new complications for Capt, who was fascinated by both of them. As far as chronographs were concerned, he could apply the know-how that he had already acquired during his many years of work in this field.

These were hectic times at Frédéric Piguet. At least one new caliber was launched each year, as well as various modules such as annual calendars, perpetual calendars, and power-reserve displays. The current assortment includes: hand-wound or automatic calibers measuring 6.75, 8.25, 9, 11.5, and 12 lignes; the 11.5-ligne FP 1180 chronograph caliber; and its successors with flyback function, split seconds, calendar, and big date. One

of the latest Piguet products for Blancpain is the Caliber FP 2383: this 12-ligne-chronograph caliber with tourbillon is also available in a split seconds and flyback version. Blancpain's Quattro model combines a chronograph, a tourbillon, a split seconds and a perpetual calendar with an automatic movement. These recent calibers for

Capt's first great task was to design the Valjoux 7750. It came on the market in 1973.



Recently developed for Blancpain: the Caliber FP 2383 combines a chronograph's functionality with the aesthetic power of a tourbillon complication.



Edmond Capt's house near Le Brassus is the former home of famed watchmaker Louis-Elysée Piguet.

Louis-Elysée Piguet personally carved his initials into the yellowish sandstone of the doorpost. Edmond Capt restored the mechanical bell-pull for his own use.



Frédéric Piguet helped Capt set a number of world records, some of which have yet to be broken. For example, the Caliber FP 615 still holds the distinction of being the world's smallest and slimmest automatic movement. It measures 6.75-lignes in diameter and just 3.70 millimeters in height, and its hand-wound version (FP 610) is a mere 2.10 millimeters slim! The 10.5-ligne FP 33 minute repeater is 3.30 mm tall in its hand-wound version and 4.85 mm tall in its automatic version (the latter goes by the name FP 35). These two calibers boast the absolutely smallest volumes of any mechanical movements in existence.

After the SMH Group (today's Swatch Group) took over Frédéric Piguet and Blancpain in 1992, Capt switched to Nouvelle Lemania, where he served for two years as technical director. Capt was particularly stimulated by the tasks of developing two items: the Lemania 7875, an 8.5-ligne automatic movement for ladies' watches; and the 10.5-ligne Caliber 1050. The latter, which holds the record as the world's smallest chronograph movement, is exclusively reserved for Breguet. The Caliber 7875 has been encased since 2002 inside Breguet's egg-shaped Reine de Naples wristwatch; an additional mechanism at the more pointed end of the ovoid supports the moon-phase and power-reserve displays. When Jacques Piguet retired, he invited Capt to return to Frédéric Piguet. But in December 1999, shortly before Lemania was taken over by the Swatch Group, Capt was entrusted with the directorship of Lemania.

As Capt sees it, the job of simultaneously directing both

enterprises isn't as difficult as you might think. After all, Frédéric Piguet and Nouvelle Lemania (along with the brand-new Breguet *manufacture*) aren't fundamentally different. Of course, Piguet and Lemania each developed their earlier calibers independently of one another, but both firms adhere to the Vallée de Joux's legendarily high horological standards. Furthermore, the traffic of watchmakers and other specialists switching from Piguet to Lemania or vice versa has always ensured that ideas have been exchanged, as it were, horizontally. Both companies

give the highest priority to classical watchmaking aesthetics. The two firms are also quite similar in their annual output of between 70 and 80 thousand watch movements, and each employs approximately 400 people.

Capt's childhood home in Le Brassus was unfortunately sold before he had acquired the financial wherewithal to secure it for himself and his family. But a few years later and not far from his parental home, Capt was able to purchase the farmhouse in which Louis-Elysée Piguet had lived until 1890, personally converting it into a comfortable residence while painstakingly preserving the building's original style and flair. The farmstead is somewhat large for him, but it's just big enough when his six lively grandchildren come to visit. Capt seldom finds time for painting these days, although he does make time to cook. To stay in shape, he rides his mountain bike along the cool winding paths of the Vallée de Joux or in Brittany, where the Crozon Peninsula and Camaret-sur-Mer have become his home away from home during vacations.

Capt's extraordinarily slim calibers hold a number of world records.

The Creation of the Valjoux 7750

When Edmond Capt first arrived at Valjoux in 1970, he was handed the tried-and-tested hand-wound Valjoux 7733 chronograph movement and asked to equip it with a fully integrated self-winding mechanism and a day-date calendar with rapid adjustment. The new caliber was to measure 13.25 lignes in diameter and would bear the reference number 7750. Capt regarded the assignment as an interesting challenge, perhaps not realizing how difficult it would ultimately prove to be. Nevertheless, Capt began work with youthful confidence and élan. When the dust settled, all that remained was a basic concept of a simple, robust watch movement ideally suited for large-series production. Instead of the classical column-wheel mechanism, Capt's brainchild contained a cam that operated on three distinct planes. The components for a mechanism of this sort are stamped with a press, thus guaranteeing their nearly perfect reproducibility—an essential precondition for a favorably priced and top-quality caliber.

During its first year, the project was a one-man show for Capt. In his spare time, he taught a course in caliber design at the watchmaker's school in Le Sentier, where his best student was Gérald Gander. In 1970, Capt persuaded Gander to collaborate with him on the development of the Caliber 7750. Their team was further expanded to include Donald Rochat, and also a draftsman and a watchmaker. All five teammates were very young and got along with one another famously; and they all loved to play (harmless) pranks. They frequently got together for dinner after work, often to celebrate a birthday or some other holiday.

Capt soon realized that classical graphic methods wouldn't be sufficient for a complex construction that had to be completed under such severe time pressure. Conventional methods left too much leeway for errors. Computers, unfortunately, were still prohibitively expensive at that time, and the company could afford to own just one, which it kept in the office of the technical director in Neuchâtel. Capt regularly brought his sketches there, where they were digitized, so that the functions of the springs and "heart-piece hammer," as well as the effectiveness of the push-pieces and the pressure on the bearings, could be simulated. This highly innovative working method saved a lot of time and enabled Capt to dispense with the necessity of building a complete prototype, thus freeing him to devote more time to other tasks such as the manufacture of critical sub-units and modules. Capt invested a great deal of work in the development of an innovative linkage between the chronograph mechanism and the base movement. In classical chronograph mechanisms, the coupling-yoke is a large and very critical component with a high moment of inertia. Strong blows can cause it to lift, which results in the loss of seconds

and erroneous counting during a stop-time sequence. To solve this problem, Capt developed an entirely new system for the 7750, one operated via a very lightweight and highly shock-resistant rocking lever. When a counting sequence begins, this pinion meshes with the fourth wheel; when the "stop" push-piece is depressed, it is lifted away from the fourth wheel. The hours counter was integrated into the base caliber. This marked a distinct change compared to older chronographs, in which the hour counter somewhat inelegantly receives its power from the barrel. Further distinguishing attributes of the 7750 are the way its counters are powered via a slip clutch with a built-in brake that supports brief-delay stop and release.

The characteristic arrangement of subdials on the 7750 derives from the need to avoid a potential conflict between the winding-stem and the axis of a counter at the "3." The 7750 has its minutes counter at the "12," its hours counter at the "6," a small seconds subdial at the "9," and a date display (and a weekday display, if present) at "3." If this conflict hadn't been resolved, a mechanically weak point in the plate would have been inevitable. Although the arrangement of the subdials is asymmetrical with respect to the dial's vertical axis it was readily accepted and ultimately became something of a status symbol.

The base movement was completed in 1972. The moment when the 7750 first began to tick was a very exciting experience for Capt. Thanks to computer simulations, he was confident that the chronograph mechanism would function properly. At the same time as Capt was designing his new caliber, plans were also made for its serial production. The caliber was designed to ensure that all of its components could be readily manufactured and easily assembled. The decision-makers were willing to trade off these benefits against a somewhat hefty size: with a height of 7.9 millimeters, the 7750 is hardly a slim caliber. On the other hand, the 7750's comparative thickness also makes it remarkably robust and relatively easy to service.

The 7750 hasn't been subjected to any fundamental reworking since 1973. Right from the start, the movement was so good that only a few small changes have been made to it. The biggest improvement has been in terms of materials: all but one of the parts formerly made of plastic have since been replaced by metal components. The original 7750 has also evolved into a whole family of calibers. In all of its versions, its external appearance now looks far more refined than it did back in the 1970s, when utilitarian concerns took top priority and simple sandblasting was all the surface finishing that its plates and bridges received. Nowadays customers insist on aesthetics, so its bridges (which are plated either with rhodium or gold) and its oscillating weight are decorated with Geneva Waves, its springs and screws are polished to a high gloss and its wheels are plated with gold. The Caliber 7750, which is surely the world's best-known automatic chronograph movement, has enjoyed an enviably good reputation for the past 30 years. Though its current annual production far exceeds 200,000 units, that's still not enough calibers to fully meet the demand.



The Valjoux 7750 debuted in 1973. Over 200,000 are made per year, making it the most popular mechanical chronograph movement in the world.

Magnetic Indexing of the Minute Counting Wheel

Tyler Ludwigson graduated in August 2013 from the Lititz Watch Technicum and accepted a watchmaker position with a jeweler in Southern California. He wrote this brief research paper, which is part of our graduation requirements, in his second year of the 3500-hour program.

The chronograph is a widely popular feature in terms of horological complications. It is the feature that measures elapsed time, by means of a push piece, with specific hands that are different than those telling the normal time. Among these other hands, one is the minute recorder that is attached to the minute counting wheel, and is the focus of this paper. This paper will discuss the procedure used to make and fit a custom minute counting wheel for the ETA 7750 that replaces the stock wheel and minute counter jumper.

ETA 7750

A stock 7750 is a caliber of movement made by ETA that is designed to be a chronograph automatic, as well as indicate the day of the month and the date. The minute counting wheel is a component that is part of the chronograph section of the movement. In an assembled and cased watch, it will have a small sub hand placed on one end of its pivot that comes through the dial. When the chronograph feature is enabled, the minute counting wheel will record the elapsed time in increments of one minute, up to 30 minutes. In order to keep the minute counting wheel stationary between jumps, a spring with a “V” shape at its end, which fits in between two of the minute counting wheel teeth, is used to hold the wheel in place (Figure 1). When functioning properly the wheel will stay stationary between jumps, and then the minute counting driving wheel will push the minute counting wheel forward. This will overcome the tension of the spring, moving it one tooth forward where the spring will then fall on the declining surface of the next tooth, snapping the wheel into place at a rapid speed, and holding it in that position until the next minute has passed. This process will happen without adjusting the placement

of the spring. However, when the chronograph feature is off and reset, the hammer spring will hold the position of the minute counting wheel, and if the minute counting wheel spring is not properly adjusted, the minute counting hand will make an initial “flicker” when the chronograph is turned on, which is an undesirable outcome. To adjust the minute counter spring, an

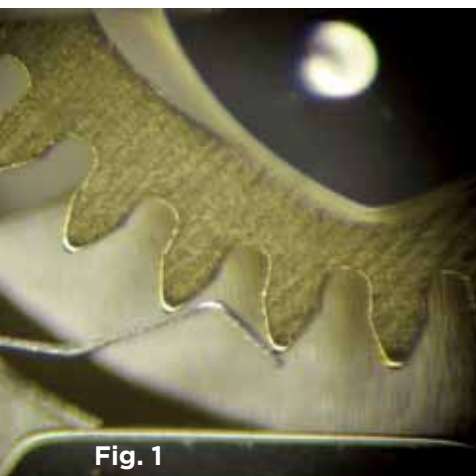


Fig. 1

eccentric screw must be manipulated to position the “V” end of the spring to precisely fall within the space between two teeth when the hammer spring is engaged. Although it is very small, one problem with this system of indexing between the wheel and spring is friction. Over time, one or both parts could become worn. This type of wear is referred to as adhesive wear and is common in watchmaking, but should be avoided if possible. This is where the aspect of magnetic indexing comes in, because if the spring is removed and replaced with a magnet there is no contact between components and therefore no wear.

Positioning the Minute Counting Wheel

I used this idea to try to come up with a better way of positioning the minute counting wheel using a magnet. To start off I needed to make a new minute counting wheel, because in the original that comes with the 7750 the wheel is made of a non-ferrous material, most likely brass. Brass cannot be magnetized, so a new wheel had to be made. I first removed the wheel and heart cam from the pivot, which was held in place by a rivet. I took the dimensions of the wheel and using a lathe and indexing plate, cut a new wheel made of steel (Figure 2). After parting off a wheel, it had to be made to the correct thickness, which was done by making a jig that the wheel could fit into and allow the excess thickness to be faced off (Figure 3). This also allowed me to drill a hole with a very accurate center in relation to the teeth. After the wheel had been cut to the correct thickness, I needed to ream out the hole to the correct diameter to fit back over the hub that it

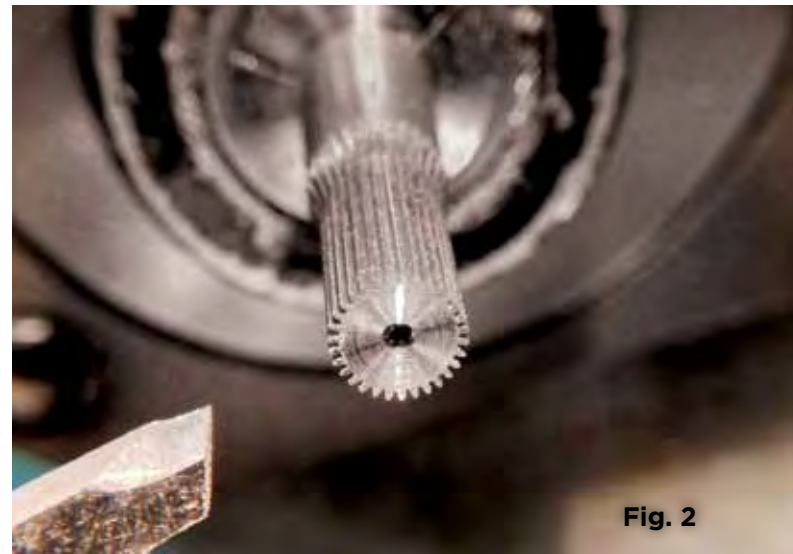


Fig. 2



Fig. 3

originally rested on in order to be riveted back on its post. Once the wheel was riveted back on, the heart cam fit on with a friction fit (Figure 4).

Magnetic Indexing

One of the aspects of making magnetic indexing a possibility was to see if there was an increase in power reserve with the new system, which could be due to the



Fig. 5

fact that there was less friction from the magnets than there was with the traditional spring system. To test if my new wheel would work I needed base numbers to use, and to see how long the power reserve was in a stock 7750 movement. I set up over three trials, using a full winding of the movement and a full unwind, and recorded the elapsed time. After those results had been established, I installed the new wheel into the same 7750 to test its basic function. Now with the installed minute counting wheel, I needed to use magnets to index it properly. To do this I purchased very small (1.60mm x 1.60mm) cylindrical neodymium magnets, and created a housing for them using stators from a quartz movement (Figure 5). I stacked the modified stators on top of each other and used adhesive to bond them. From there I needed to affix the housing to the main plate of the watch, which was also done with adhesive. (Adhesive is not typically used in watchmaking, but with this being a prototype, testing if magnetic indexing could actually work was more important than abiding by typical watchmaking practices.) I could now place one of the magnets inside the housing without it influencing any surrounding components that were made of steel. I used a small steel screwdriver blade, which was held in place with magnetism, and orientated it close enough to the tips of the teeth of the steel minute counting wheel so that it would hold it in place between jumps, and where it was close enough to cause it to snap into place when it did jump (Figure 6). All this was done in as controlled environment as possible, meaning all tests were done in



Fig. 4

Magnetic Indexing of the Minute Counting Wheel

the dial up position, all with the same serviced movement, and done over three times with each indexing method. The results of the tests are below.

These results show, on average, a 20-minute increase in power reserve with the new magnetic indexing system over the stock spring indexing system. With such a small increase in power reserve and the time and resources used

to make this system, the results do not justify my further exploring magnetic indexing in regards to the application of the minute counting wheel in the 7750. However, that does not mean there are not useful applications for magnetic indexing in other areas of the watch, or in other calibers. Only further study and interest will reveal new areas of the watch that could be improved upon with this system.

	Original wheel with spring ran for:	New wheel with magnet ran for:
Test 1	2 Days 5 Hours 25 Minutes	2 Days 5 Hours 48 Minutes
Test 2	2 Days 5 Hours 11 Minutes	2 Days 5 Hours 40 Minutes
Test 3	2 Days 5 Hours 27 Minutes	2 Days 5 Hours 36 Minutes
Average	2 Days 5 Hours 21 Minutes	2 Days 5 Hours 41 Minutes

Fig. 6



The Village of Gloucester Clock Project, Part 2

ROBERT LITTLE, CC, CW

In Part 1 of The Village of Gloucester Clock Project, Bob Little explained how he removed the 107-year-old clock from its post in the Gloucester Depot and took it back to his shop to refurbish it. Here he completes his explanation of his refurbishing process and tells how the clock was reinstalled on its pole in the village and unveiled during a dedication ceremony.

In the clock restoration process, the new dials have been fabricated and the movements have been slightly modified and mounted to the aluminum U-channel clock mount that I had fabricated. The movement has been aligned with both dials. The next step will be to complete the movement control installation and wiring.

I next fabricated the control panel. The entire unit is mounted within the clock behind the door, and is fastened with 1/4"- 20 flathead bolts. I used one of the unused movement box backs, fabricated a 1/8" aluminum mounting plate for the two preassembled movement control switches and pilot lights, and then attached the plate to the box back. See Figure 2.1. The seams were sealed with the RTV sealant. I made a second easily removable lower control panel and attached it to the lower part of the panel with two pan-head sheet metal screws. This smaller panel holds the main power switch, the light's power switch, and the wiring connector strip. I made this with easy removal in mind, so it can be lifted up and out of the way, and the 5/8" x 2" base-mounting bolts are easily accessible.



Fig. 2.1

With the motor mount and control panel done, I made a wiring harness. See Figure 2.2. I used flexible 16-gauge copper wiring throughout, and I soldered, capped with wire nuts, and then taped all connections. I installed UL-rated insulated push connectors on the motor wiring and sealed them with "liquid tape." See Figure 2.3. Everything was now wired,

including the wiring for the photocell to control the bezel lights, and the lighting wiring itself. I installed the photocell in the lower part of the case near the control panel and drilled a 3/4" hole in the case for the photocell body, which was slightly greater than 5/8". I fitted two O-rings on the cell body for a snug fit, coated it with RTV sealant, and pressed the body in place. See Figure 2.4. I installed the optic end of the photocell slightly below flush and screened the original weep holes in the clock body near the photocell to prevent bug entry.

Next, I fabricated the bezels using dimensions from the old ones. From what the local residents stated, the clock has always had wooden bezels. The latest ones were shaped redwood boards nailed together. They failed because the small finish nails rusted away, and the wood deteriorated and just fell apart. I seriously considered fabricating them from aluminum, but I went with the wood as per their request. I decided to use 3/4" rot-resistant exterior plywood and cut the front and back of each bezel out of a solid piece so there would be no exposed seams to fail. The interior piece was made out of four 90° sections joined with biscuits and premium exterior wood glue. See Figure 2.5. All circular pieces were individually precision cut with a 3-hp, variable-speed router and circle-cutting jig. See Figure 2.6.

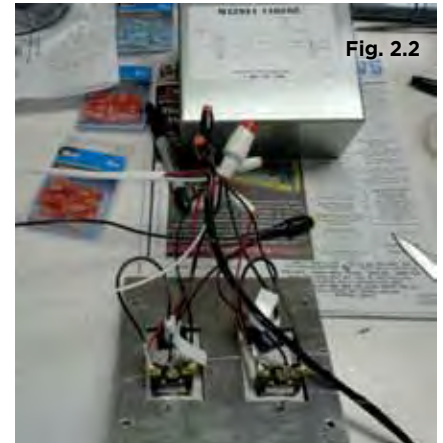


Fig. 2.2



Fig. 2.3



Fig. 2.4



Fig. 2.5



Fig. 2.6

I gave all sections of the plywood layers a heavy application of exterior wood glue, and I clamped and further fastened them with permanent epoxy paint-coated deck screws countersunk 1/4". I cut the face piece with a 1/4" recess and 1/2" lip for bedding the 3/16" polycarbonate lenses, or "glass," in silicon RTV sealant. Behind the polycarbonate, I routed a 1/2" recess outward in the side for the insertion of the 1/2" LED light. The LED lighting has one light per inch and draws 7.2 watts per side, and is rated for a 100,000-hour service life.

I transferred the 12-stud, bolt-mounting holes from the case, and I marked on the back of the bezel, and drilled 1/8" oversize on a 1/2" drill press. It is interesting to note the original construction has the 12 bezel studs rotated counterclockwise a few minutes on one side and clockwise on the other. Also, on one side the holes were drilled, apparently by template, and were about

1/2" off-center. All of the dial dimensions and case casting on one side are 1/4" larger than the other side, so the dials and bezels don't interchange.

I left these misalignments alone,

allowing them to remain original to the clock. Both new bezels were saturated with Minwax High Performance Wood Hardener, and imperfections were filled with Minwax High Performance Wood Filler, two-part exterior-rated. See Figure 2.7. After curing, the bezels were finish sanded, sprayed with two coats of primer, air dried two days, and sprayed with three coats of satin black exterior wood and metal-rated enamel. Figure 2.8 shows primed bezels temporarily hung on primed clock case. The finish coats were applied full wet and allowed to tack dry in between coats. An excellent smooth satin finish resulted. After curing a week, the polycarbonate was set in the routed recess with RTV silicon sealant. After curing two days, the LED lighting was installed with stainless steel fasteners. The bezels have screened weep holes on the bottom if any moisture should develop.



Fig. 2.7



Fig. 2.8



The original hands were specified to be reused. I mounted the American Time & Signal machined hubs on the hands and balanced them. After balancing, each pair weighed in at 8.3 ounces. See Figures 2.9 and 2.10. The factory-specified maximum weight for each pair of balanced hands is 19.9 ounces. The aluminum hands passed the weight test by being less than half of the specified maximum.

The early pictures of the clock in Athens revealed that it had what appeared to be a cast iron finial. It was never seen on the clock in Gloucester. On the front and back of the finial were the names of the business owners, Millikan and Hickle. The clock committee wanted the missing finial recreated and lettered with the village name. Athens Historical Society officials provided me with a surprisingly clear, enhanced section of a photo showing the clock and finial. The picture was taken during a 1908 campaign parade for William Howard Taft on Court Street, and it just happened to catch the clock in the corner of the photo. See Figures 2.11 and 2.12, both courtesy of the Athens



Historical Society and Museum. To my advantage, the dial in the picture I printed measured 1". Knowing that the dial is actually 36" across, I established a scale and calculated dimensions from the picture. After dusting off my mechanical drawing instruments from high school, I developed a full-scale drawing of the missing finial. I next transferred this to 1/4" rigid, white art foam board. After trial fitting (see Figure 2.13)



Fig. 2.13

and slight trimming for fit, I had a workable pattern for the finial. One thing I don't have is a gas forge, but my neighbor does! He offered his help and forge, so I got about 12' of 3/4" hot-rolled iron and two 14" x 36" sheets of 1/8" hot-rolled plates and cut them to size and length from the pattern. I traced the pattern with chalk on his driveway near his forge, and after about three hours of heating, hammering, heating, and hammering of all of the pieces, I had the parts for the finial assembly. See Figure 2.14. The next day, I set all of the pieces on the floor and tack welded them together with a MIG welder. See Figure 2.15. Note my boot for size perspective. After trial fitting, tweaking, and more trial fitting, it was ready for final welding. I welded all of the



Fig. 2.14



Fig. 2.15

3/4" formed rods together, checked the fit, and then fabricated the internal mounting and fastening brackets. They are made to slip over the eye bolts on the top of the clock that are used for lifting and removing the clock. With careful alignment, the front and back plates were positioned and welded in place. See Figure 2.16.



Fig. 2.16

I next cut 1" strips of the 1/8" plate and welded them between the 1/8" face plates, forming a water-tight top plate on the assembly and giving the finial the appearance of being 1-1/4"-thick solid stock. I drilled 3/8" bolt holes in the front and back finial plates, and a 3/8" bolt passes through the hole on one side, then the eye bolt on the clock, and then the plate on the other side, and keeps the finial in place. Due to the theft in our area of cast iron grates, sewer manhole lids, and other ferrous items that are not "bolted down," I used 3/8" stainless steel carriage bolts for attaching the finial. I machined away the square shoulder with a parting bit, and then while in the lathe, drilled a 1/4" pilot hole in the head end of the carriage bolt. See Figure 2.17. When I installed the finial and then inserted the bolts, I used red Loctite to



Fig. 2.17

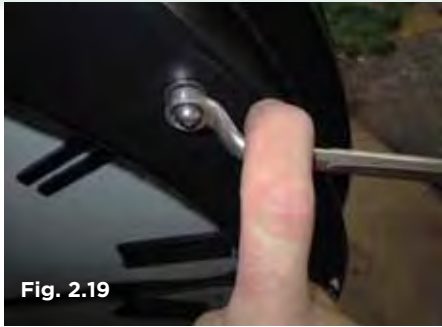


Fig. 2.19



Fig. 2.20



Fig. 2.21



Fig. 2.22



Fig. 2.23



Fig. 2.18

permanently attach the cap nuts. If the finial needs to be removed in the future, all that has to be done is hold the cap nut with a wrench and drill off the head of the carriage bolt. This would probably be quicker than trying to remove a frozen nut from a regular bolt. The bolts can simply be replaced with new ones when reinstalling the finial. It took less than five minutes per bolt to make. Actually, the finial is very strong and can be used to hoist the clock for removal. The only reason I could think of that would warrant finial removal would be if it needed to be re-lettered in the future. The finial and clock body were both sprayed with the primer and satin black enamel so that the bezels, hands, numerals, finial, and clock body would match. See Figure 2.18. I took the finial to a very talented couple in Athens who volunteered to paint the village name on the finial. They cut the templates for the name and transferred them to the finial plates, and hand-painted them with two coats of imitation gold sign-lettering enamel.

Everything was then assembled for the final time. I made in-place gaskets for the bezels to seal the clock from rain. I coated the body casting with a mold-release agent where the bezel groove fit in the lip on the casting. I then applied black RTV silicon sealant to the bezel groove and pressed them together. I snugged the bezel bolts but did not give them a final tightening. After the RTV sealant cured, I pulled them apart and cleaned the mold release agent from the casting. Then, all fasteners were tightened down for the final time. Figure 2.19 shows how little torque is needed to tighten the cap nuts, less than 20 inch-lbs. I first connected the bezel lighting wiring and taped the connections. Excess wiring was all pushed back into the dial. Figure 2.20 shows connections before taping. I then tightened the stud cap bolts down in a crisscross fashion until the bezel touched the dial, which is the point when the gasket is tightened properly.

The clock pole has individual embellishment-like castings at the very top, just underneath the clock and are held on with 1/4" flat head bolts. Three of the sets were missing. I made fiberglass reinforced plastic reproductions by first removing and sandblasting one set consisting of three separate pieces. See Figure 2.21. I then primed them and made a silicon rubber mold of the individual pieces. See Figures 2.22 and 2.23. I then made three new complete sets by using a two-part plastic that is poured into the mold. See Figures 2.24a-d. The original pair is on the left. Since some of the pieces are long and thin, I cut strips of fiberglass mat for reinforcement that would fit into the mold. The plastic mix immediately soaked



Fig. 2.24a
Original Primed



Fig. 2.24b
New Unpainted



Fig. 2.24c
New Primed & Painted



Fig. 2.24d
New Primed & Painted



Fig. 2.25

into the fiberglass and left no strands showing. The parts were removed from the mold after 15 minutes, and then another set was poured. After the parts were primed and painted, the only way I could tell the original from the new is the originals are cast iron and weigh about twice as much!

The last step involved testing the clock for leaks. I figured the best way to simulate rain was to directly spray 45 psig water in a narrow stream onto all sealed joints. See Figures 2.25 and 2.26. The clock did not leak a drop anywhere! I wiped it clean for the final time, and it was ready to run for observation. See Figure 2.27. The movements keep perfect time and are totally quiet. The lighted dials have a nice glow that makes them easy to see and read at night.

After two weeks of running, the clock was loaded up and taken back to Gloucester, where it was reinstalled on the support pole. See Figures 2.28 and 2.29. Removal as well as installation was tricky due to power lines on the street. The lift operator did an outstanding job of safely maneuvering the clock into position, and could make accurate 1" or 2" adjustments as needed, using a remote control see (Figure 2.30, where I am unbolting the wooden shipping base, and the lift operator is behind me with the remote controls). The time was set, and the clock was tarped so that no one could see it until its unveiling at the dedication ceremony a week later. The dedication ceremony was held on May 25, 2013, from eleven till noon. A crowd of over 250 residents, officials, and guests witnessed the unveiling of the clock. See Figure 2.31.



Fig. 2.26



Fig. 2.28



Fig. 2.29



Fig. 2.27



Fig. 2.30



Fig. 2.31

The clock has gone through several renovations. And while historians know a considerable amount about the clock, there is still a good bit they don't know, such as where it was actually made, and why it ended up being relocated to Glouster at the old Rail Station, right after WWII. In the time period that the clock was made, 1905, cast iron was used for just about anything they could think of, just like plastic is used today. Foundries were common in Southeast Ohio where coal was plentiful. It could very well have been cast right in Athens. I hated to see the clock leave my workshop for its destination in the village. It represents a bygone era when the industrial revolution had not yet peaked. I felt nostalgic just looking at it. The clock is now, as it always has been, very much treasured and appreciated by the village. The project was a pleasure to work on.

I gave the village officials a 12-page operation and maintenance manual, a two-year warranty on all materials and labor, and I will inspect the clock in six months, and again 30 days before the end of the two-year warranty period. This is for my benefit as well as theirs, so I can see how my work is doing and how the clock is holding up.

Photo Credits: Figures 2.28 and 2.29 are courtesy of Lauren Volpe.

Figure 2.30 is courtesy of the Athens County Historical Society, taken by Donald Newell. Figures 2.11 and 2.12 are courtesy of Athens County Historical Society and Museum. The rest of the photos are courtesy of the author.



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Breaking Even

I recently heard from a watchmaker who explained that he was working on a watch that needed an extra \$20 or so in material to finish a repair. His concern was that the extra \$20 was going to make that repair go from a profit to a loss. He was literally going to cross his break-even point by spending \$20 more than he originally estimated. After complaining a bit, he purchased the material, completed the job, and went on to the next repair. This watchmaker is far from a novice. He has been working in his own shop for a substantial number of years so inexperience is not a factor. Yet something is amiss here. This watchmaker's lament is certainly one that we have all heard as long as we have been repairing watches. When I first began my watchmaking career, I was amazed at the ingenuity I saw on the part of watchmakers who had previously repaired the watches that were coming across my bench. The most ingenious repair I saw was on a broken blue steel mainspring in an American watch. Someone had punched a hole adjacent to the break on each of the two pieces of mainspring and stitched the spring together with a piece of fine wire. Why would anyone do that when a new alloy spring was selling for \$0.75 and was readily available? It puzzled me to find missing screws, crowns soft soldered to stems, shock resistant jewels held in place with cellophane tape, etc. Then I came to learn why.

After WWII the watchmaking profession was literally flooded with thousands of veterans who trained under the GI Bill. Unfortunately, for members of this "Greatest of Generations" the marketplace could not sustain all of them. Therefore, the competition for work became fierce and they gained market share by sacrificing wages. One watchmaker clearly explained the plight of those watchmakers in an article published in an NAWCC *Bulletin* about 20 years ago. In the late 1940s, after graduating from watchmaking school, he went to work in a trade shop located in one of the large cities in the northeast. There were about 15 watchmakers in that shop. Each morning the manager invited bids from each watchmaker (they were all on piecework) for the jobs he had available for that day. The watchmakers had to bid on every repair job so that each repair went to the lowest bidder. These watchmakers supplied their own tools and materials. Because they were competitively bidding for the work, they often inadvertently bid too low. If the repair went smoothly with no problems, they would break even which meant they would be paid for their time and the cost of material, but with no room for prof-

it or error. If the repair needed some unexpected extra material, the expense came directly from their wages. If they lost a screw, broke a jewel spring, snapped a pivot, etc., they paid for it from their salary. That system kept the cost of a repair low and always at the expected cost to the consumer, but it was not at all good for the quality of a repair. Lost screws were not replaced or, if they were replaced, it might have been with a screw that was forced into place. The broken jewel spring was no problem. The watchmaker remedied that with a dab of crystal cement or cellophane tape to replace the spring. There was no sense putting in a new mainspring when only the end was broken. They just punched a new hole or heated the spring's end to make a new tongue end.

The aforementioned observations in no way demean that generation of watchmakers. Their working conditions forced them to make many substandard repairs just to earn a week's pay. Pitifully low wages forced them to make these repairs, just to break even. Those days are now history. The watchmaker of today commands a salary undreamed of by older generations and most of those sweatshop trade shops disappeared years ago.

Yet watchmakers today, particularly those who are self-employed, still face the challenge of pricing their work not just to break even, but also to yield a profit. In essence, when they price a repair they are bidding on the job. The difference between today and 1948 is they have no competitors other than their worst enemy. That enemy is the fear of not getting the job. Hence, the low, break-even bid to get the job may cause that repair to become a loss, if there was any error in the estimate or any accidental damage done during the course of the repair. The result is the same as it was in 1948. The self-employed watchmaker reduces his salary by the amount spent on the extra material. It does not have to be this way, but it still happens all too often. In a well-run factory service center, the watchmakers repair the watches and the business managers manage the business. In the sole proprietor business model, the watchmaker repairs watches, manages the business, and does everything else that needs to be done. The successful sole proprietor must do everything well in order to succeed. That person is the qualified watchmaker, bookkeeper, sales clerk, spare part specialist, and is computer literate. That successful sole proprietor understands that the goal of a small business is to earn a consistent profit and not just break even. The break-even point is where profit begins or ends, depending upon one's point

of view. Every estimate for work must consider the break even point as the cost basis and then have the profit margin added to it and a little extra added for the unanticipated problems. Breaking even is never the goal in business, because the general rule is “to break even is to lose.”

For Want of a Nail

(anonymous)

For want of a nail the shoe was lost.
For want of a shoe the horse was lost.
For want of a horse the rider was lost.
For want of a rider the message was lost.
For want of a message the battle was lost.
For want of a battle the kingdom was lost.
And all for the want of a horseshoe nail.

The message of the old saying about the nail refers to the cascade of damage that may result from overlooking a small need. Watches all have small, seemingly insignificant needs that, left unattended or ignored, can go on to cause a series of problems. These needs are often relatively invisible to a watch owner. That is, until the problem cascades. Spring bars wear out. Expensive watches break, when dropped, just as readily as a low cost watch. Check out the accompanying photo of a pair of worn spring bars from a luxury watch brand. Expensive watches also

rust extensively when they fill with water. The owner of the watch cannot see the damaged case gasket or the leaky crown, but he will see the water accumulate in the watchcase as the movement becomes rusty. Watchmakers need to be mindful of these small

details every time they perform a repair, even a minor one. The factory service centers always check over these details even if the watch is only in their shop for a battery replacement (often called partial service). Factory service centers do not want those minor repairs turning into a major customer relationship headache. They make sure the spring bars are in good shape. They replace the gaskets and crowns as needed. They test each watch for water resistance after opening the watchcase. If the watch’s overall condition is questionable, they advise a full service and decline to do the partial service. The people in the service centers know that the proverbial overlooked “Nail” may well cause a “Battle” with a consumer that can only be lost. Take care of those nails on every repair and you will not lose the battle.



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Fusee Mainspring Ratchet Tool

DALE LADUE, CMW21

The English fusee pocket watch, when viewed with its top plate removed, is a rather simple mechanism as shown in Figure 1, especially compared to today's modern wristwatches with their calendar and auto-wind mechanisms. The "complication" to the fusee pocket watch is the fusee engine, chain, and mainspring barrel. This combination was developed to present equal power to the gear train throughout the mainspring's power curve. The cone spiral-turned steps of the fusee, through varying leverage, equalize power from wound full to unwound. When the mainspring is unwound, the chain is wrapped around the barrel several times, and hooked into the spiral at its largest diameter. The chain transfers full tension of the mainspring to the smallest circumference (top) of the cone when fully wound. At this point, the theoretical lever arm length is equal to the radius of the small top-spiral diameter. The spiral diameter increases as the mainspring unwinds, lessening tension. Yet, because the leverage is increasing, the power to the train remains constant. Tension has to remain on the chain when no power is applied to the gear train (run completely down). This pre-tension enables the chain to remain taut and solidly hooked on the barrel. A turn or so of barrel tension will also prevent the absolute least power applied to the gear train, which would certainly cause very poor timekeeping. A stop-works finger, attached to the top of the fusee cone, stops the winding process before the absolute most power can be employed. The function of the fusee is to equalize the center portion of the mainspring's natural power curve.

I have found it paramount to determine the condition of the internal mechanism of the fusee engine before beginning the repair of a fusee watch. Typically, there is a small ratchet and what appears to be a "click" under the dial. The "click" is, in actuality, a stop-and-hold piece that allows the aforementioned pre-tension to be applied and maintained. A square on the end of the barrel arbor protrudes through the plate, as well as through a square hole in the center of the ratchet. This square allows a key to wind the mainspring, to create the required tension, and conversely release the tension prior to disassembly. This square is necessarily short, being that it is located under the dial. This makes it susceptible to damage if a proper fitting key does not have a good purchase, or an ill-fitting key is used on the square stub. In Figure 2, I have shown the situation described above. I could not remove tension due to a damaged square, and had to create a tool that would securely grasp the ratchet. A slot, which spanned slightly less than the root diame-

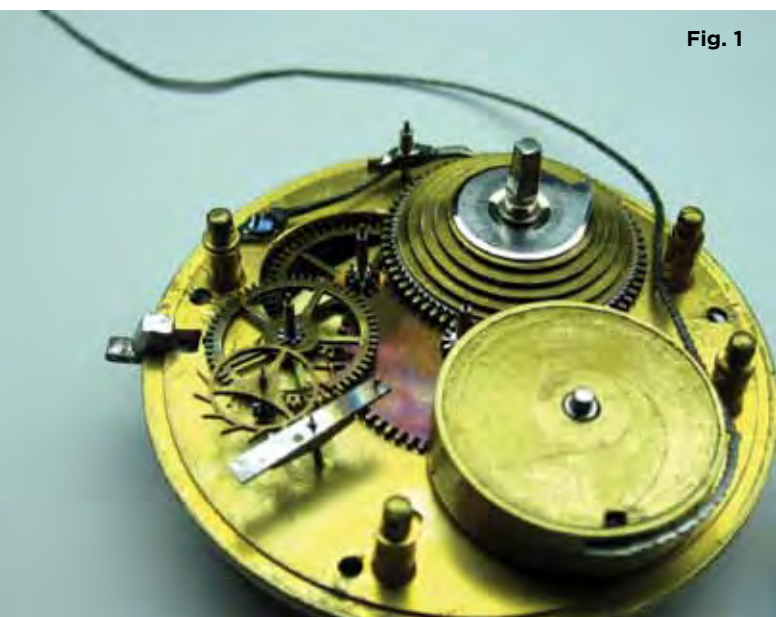


Fig. 1



Fig. 2

ter of the ratchet teeth, was ground in the end of a short section of steel clock mainspring, as shown in Figure 3. The slot that was created needed to be deep enough



Fig. 3

Fusee Mainspring Ratchet Tool



Fig. 4



Fig. 5

to clear the worn square stub. A bevel that matched the approximate 60° angle of the ratchet teeth was ground on the first pillar, and an opposing angle facing the opposite direction on the other, Figure 4. The finished tool is shown in Figure 5. It is not necessary to have the angles exact; however, these mainsprings are quite strong and the posts should grip the ratchet teeth, providing a firm hold as shown in Figures 6 and 7. Releasing the ratchet stop's hold-down screw allows the wheel to be turned back enough to release the stop, permitting the tension to be carefully removed. This tool is basically a "one-up tool," hastily created to resolve a perceived problem. Taking into consideration the scribe tool marks present from the watch's creation, as well as careless handling-tool marks from long ago repairs, I was careful to not add marks from the twenty-first century! In order to prevent marks, if indeed I use this tool again, I beveled the ground edges using a silicone rubber medium-grit disk mounted on a mandrel, and spun in the lathe as shown in Figure 8. **It is important to use safety glasses when grinding, as the grit and rubber does fly off the disk.** Also notice that the lathe is protected from the grit with a covering of plastic film. Figure 9 shows the highlighted relieved sharp edge. A fine-grit disk was used to further soften and polish the tips and edges as shown in

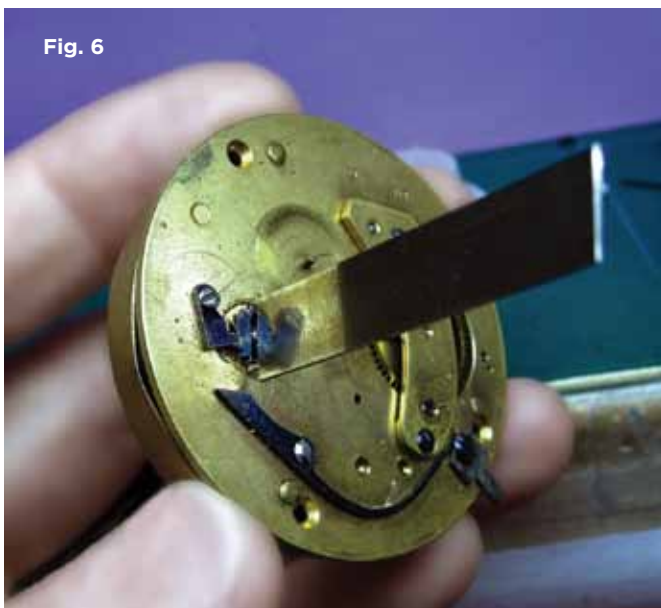


Fig. 6



Fig. 8



Fig. 7



Fig. 9

Fusee Mainspring Ratchet Tool

DALE LADUE, CMW21

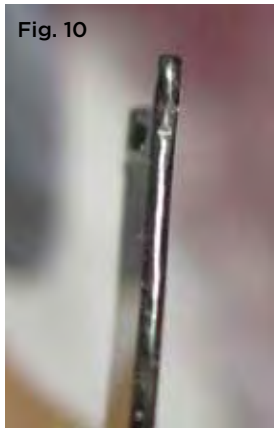


Fig. 10

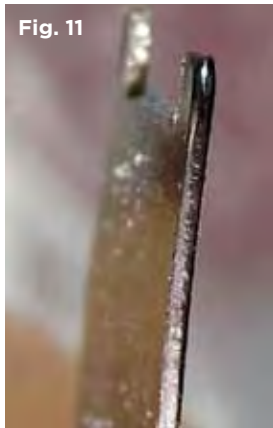


Fig. 11



Fig. 12

Figures 10 and 11. A little more time spent created a safer and presentable little tool, Figure 12.

Once the mainspring tension was removed, the plates were separated and the fusee was removed and disassembled. It was evident by the amount of wear on the fusee clicks and ratchet wheel, Figures 13 and 14, that this watch has seen many years of service. The close view shown in Figure 15 depicts the worn fusee ratchet wheel teeth that are very near failure.



Fig. 13

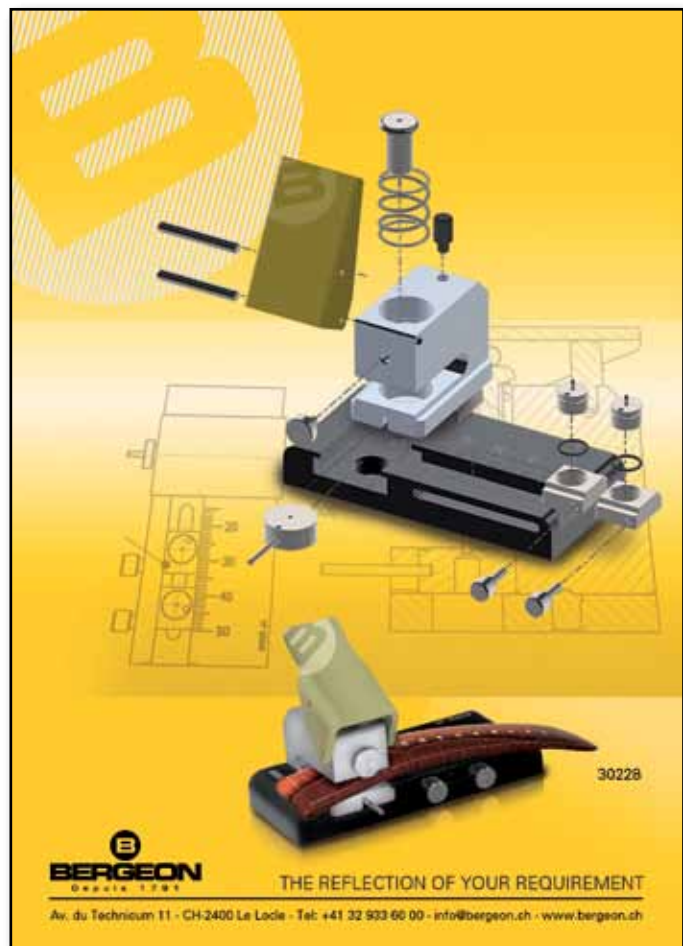
Without quickly crafting this tension-releasing tool, I would not have been able to expeditiously view this needed extensive repair. However, the owner opted to not have the fusee ratchet and clicks made.



Fig. 14



Fig. 15





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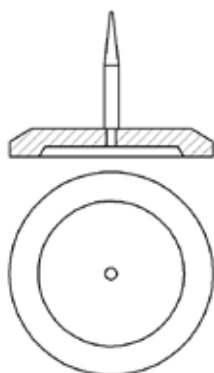
This month I am illustrating a few tools and one jig, which is a simple device for rating a balance wheel and spring. Essentially, it is a support for the balance wheel and spring assembly which allows the wheel to rotate. As they rotate, the wheel and staff lift up and down, as the spring tightens and relaxes, tapping on a metal sheet placed beneath it. Some watchmakers, who deal with balances more frequently than clockmakers, have an ear sharp enough to discern the difference between 18,000, 20,000 or 16,000 taps per hour—18,000 taps per hour is, of course, five taps per second, and no one in their right mind is going to count up to 18,000!

My ear is not sharp enough for that so I make use of one of the electronic timers that is on the market. When I have placed the cock on the spike, Figure 10.01, I put different thicknesses of plate underneath so that the pivot just rests a small distance, say 0.5mm, above the metal. The timer has a lead with a crocodile clip and this is sprung onto the plate. As the wheel rotates the tapping can be heard and its rate is calculated by the timer. My sketch, Figure 10.02, demonstrates just how simple this jig is. ***This is only performed when the cock and wheel assembly is out of the movement. The timer will detect tics, and rate them if it is attached to a fully assembled movement.***



Fig. 10.01

Fig. 10.02



Center Distance Measurement

This is an adjustable version of what, if my memory serves, was an old clockmaker's instrument called a preacher (Jack Fennell of Ireland assures me that 'Preacher' is the old name...). This instrument is used to measure the original centers of worn holes in a clock

plate and mark them again after plugging the hole. Figure 10.03 is a scaled sketch of the device. I have not dimensioned all the parts because that will depend upon what range of center distances it will be dealing with; the dimensions are not, in any case, critical. Figure 10.04 is the actual tool, somewhat tarnished after 10 years of use.

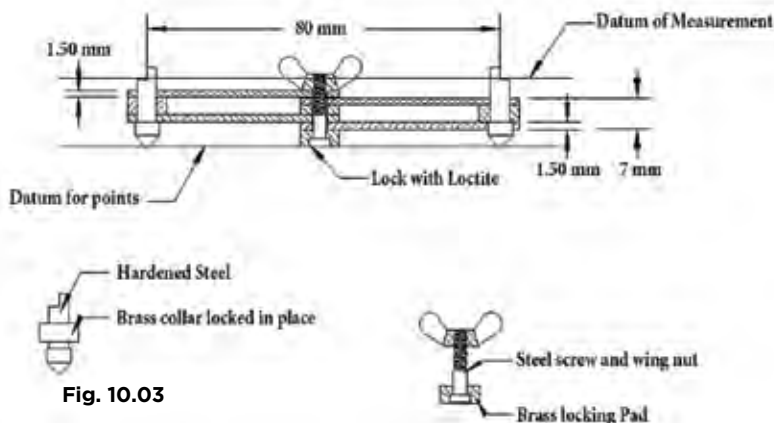


Fig. 10.03



Fig. 10.04

The cones are fairly acute so that they will locate on the unworn part of the pivot holes, which are usually keyhole shaped and having more than 180° of undamaged periphery. (This does not work when the damage is spread over more than this arc.)

Loosen the thumb screw and locate the point in the holes on the inside surface of the plate, and not in an oil cup or a significant chamfer. Hold the points firmly in place and lock the thumb screw again. The true center distance should now be recorded for use when the hole is plugged. Bushes are not used for this because, rather obviously, you cannot scratch a line or make a center punch mark in the bore of a bush.



Clockmaking—The Tools, Part 10

LAURIE PENMAN



Fig. 10.05

One center distance on its own is of no use in locating a new hole, a second measurement from the other meshing gear is needed and this too is recorded. Notice that the upper part of the cone spindle bears a flat that is precisely on the center line. This allows a vernier to take the measure-

ments. When the hole has been plugged, the instrument can be re-adjusted to the requisite distance by setting the vernier, opening the limbs of the tool, and locking it when the jaws of the caliper are flat on the spindles, Figure 10.05. If you own two vernier calipers, they can simply be left locked after taking the center distances; this eliminates one source of error. Use the two settings to mark crossing arcs, Figure 10.06, on the plug, and center punch the intersection. This can be done with the cone if a light brass hammer is used to tap the top of the spindle. This light dot may then be emphasized with a center punch, but do not forget

to support the plate on an anvil of some sort or you will knock the plug out or at least depress it.

Boring Tool

High Speed Steel (HSS) and Tungsten Carbide (TC) tools are both used in clockmaking, but do not neglect high carbon steel in the form of drill rod or silver steel. High carbon steel, when fully hardened and stress relieved by tempering to the barest hint of amber, is actually harder than HSS. It has to be used at lower speeds (about 100ft/min for annealed steel and 200ft/min for free-cutting brass), because it loses its strength as the temperature of the cutting edge approaches 200°C.

The boring tool shown in Figure 10.07 is made from drill rod, and is eccentric so that it can be rotated in the tool post for adjusting the height of the tip. If it was mounted on dead center, as in external turning, any overloading of the cut would cause it to dip and increase the depth of cut in the bore, making matters worse. Placing the cutting edge above center makes sure that the load is relieved if the tool dips. Figure 10.08 shows the tool being used to make a chuck for an assembled wheel and arbor prior to repivoting;



Fig. 10.06

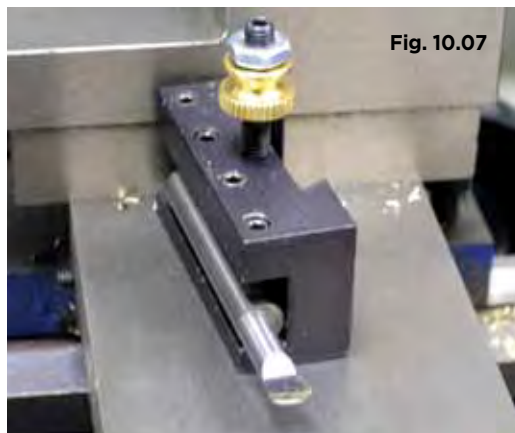


Fig. 10.07



Fig. 10.08

Clockmaking—The Tools, Part 10

Laurie Penman



Fig. 10.09

the smaller bore is to allow the arbor and pinion to be passed through. In Figure 10.09 the large rebate is being tested for a close fit on the wheel and in Figure 10.10 the wheel is locked in position and a center established for drilling. In Figure 10.11 an insert has been turned and is ready for burnishing.

The flat that you can see on this tool was put there so that when used in a fixed tool post, instead of this adjustable height version, the point was dead-on center for facing every time it was used.

The hardening for a tool of this size (10mm) is carried out by heating to bright red without sparking at the edges, keeping or “soaking” at that temperature for about one minute, and then plunging into cold water. Tempering consists of thoroughly brightening the steel, and then heating the stock carefully until a very pale shade of amber can just be seen at the cutting edge before plunging into cold water again. This is about as hard as we can manage with ordinary workshop facilities.



Fig. 10.10



Fig. 10.11

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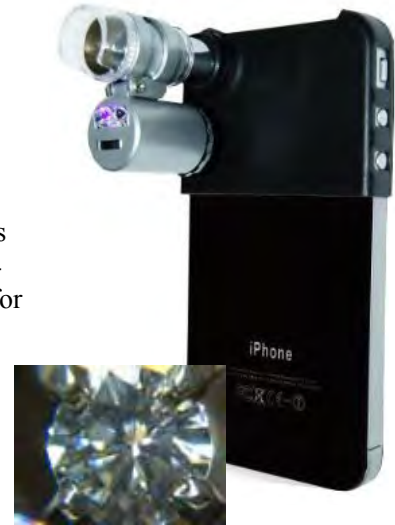
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and Easytether allowed me to get a new activation key at no charge. Easytether Lite is free, but you can't go to secure sites or email sites like Gmail. The full version has a one-time charge of \$9.99. I have not tried it, but I think it can also work with a Bluetooth connection to your computer. Either way uses some of your data allowance. I prefer to use it instead of the free Wi-Fi HotSpots. Free Wi-Fi can easily be hacked by anyone within range for your passwords, etc.

Ophelia

There is another nail in the coffin for PCs. Dell has a PC on a stick called Ophelia. It is slightly larger than a thumb drive and has Wi-Fi and Bluetooth. It

can use almost any HDMI display. It has a Rockchip RK3066 processor, on-board memory and a microSD slot for more. It has been shipped to some beta testers and is rumored to work with all the cloud-based programs these days. This could be all you need to have in your pocket to connect to the Internet world and all it has to offer.



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OMEGA Announces the First Truly Anti-magnetic Watch Movement

OMEGA has announced the creation of a watch that is resistant to magnetic fields greater than 1.5 tesla (15,000 gauss), solving a problem that has challenged watchmakers for centuries.

The movement was introduced at a press conference at the Cité du Temps in Geneva in January by Raynald Aeschlimann, OMEGA Vice President and member of Swatch Group's Extended Group Management Board. Mr Aeschlimann opened the press conference, introducing Jean-Claude Monachon, OMEGA Vice President and Head of Product Development, Michel Willemin, CEO of ASULAB, Thierry Conus, the Director of Research & Development at ETA and Mathieu Oulevey, a Tribology and Materials engineer at ETA.

In his opening remarks at the press conference, Mr Aeschlimann gave credit to Swatch Group's ability to benefit from the contributions of the best engineers and researchers from all of its brand and companies. He added, "All of the heroes are here - not only my colleagues from OMEGA but from ASULAB and ETA. It was only through their shared creativity and enthusiasm that we could introduce this important innovation to you."

The technology developed by the team led to the first prototype of the movement, which has been fitted in an OMEGA Seamaster Aqua Terra. Unlike other efforts to combat the effects of magnetism, the OMEGA movement does not rely on a protective container inside the watchcase but on the use of selected non-ferrous materials in the movement itself. Several patents are pending for the new movement.

Jean-Claude Monachon reminded the attendees at the press conference of OMEGA's history, showing slides of highlights going back to 1894. He went on to point out that magnetism has always been an issue for watchmakers, adding that magnets are now more present in our daily lives than they have ever been before. Watchmakers have to deal regularly with the issue of magnetism, as it is necessary for them to demagnetize mechanical watches whose performance has been compromised by exposure to magnetic fields, a problem that will be solved with the new movement.

He explained that G. N. Hayek, the CEO of Swatch Group, challenged OMEGA to create a totally non-magnetic watch and announced that OMEGA, with engineers, scientists and metallurgists from its sister companies had met the challenge.

Michel Willemin's presentation focused on issues of magnetism in daily life. He gave a brief primer on magnets and magnetism and pointed out that the evolution of the strength of permanent magnets was a key motivation behind the development of the movement.

Thierry Conus explained how magnetism had been dealt with previously, including inner cases designed to limit the effect of magnetism. He pointed out the limitations of the approach including the facts they couldn't handle the challenge of the increased strength of permanent magnets and that, from an aesthetic standpoint, they block the view of the movement. He then showed a short film showing how a conventional mechanical watch exposed to high levels of magnetism stopped immediately, and dramatically lost its accuracy. The

OMEGA prototype was subjected to even higher levels of magnetism (15,000 gauss) and continued to perform. Testing showed that the watch was as accurate after its magnetic exposure as it had been before.



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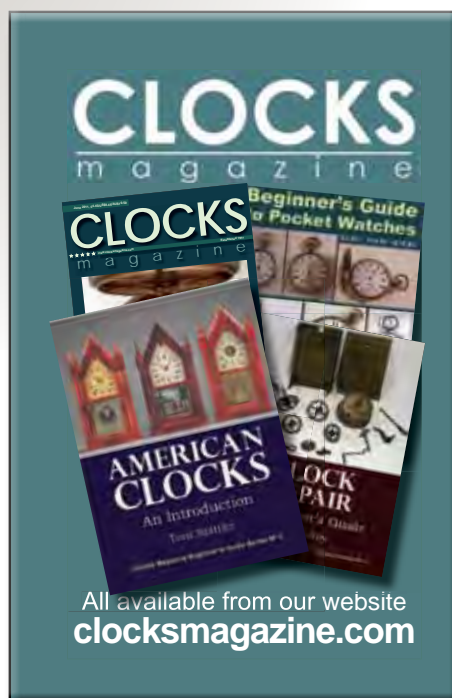
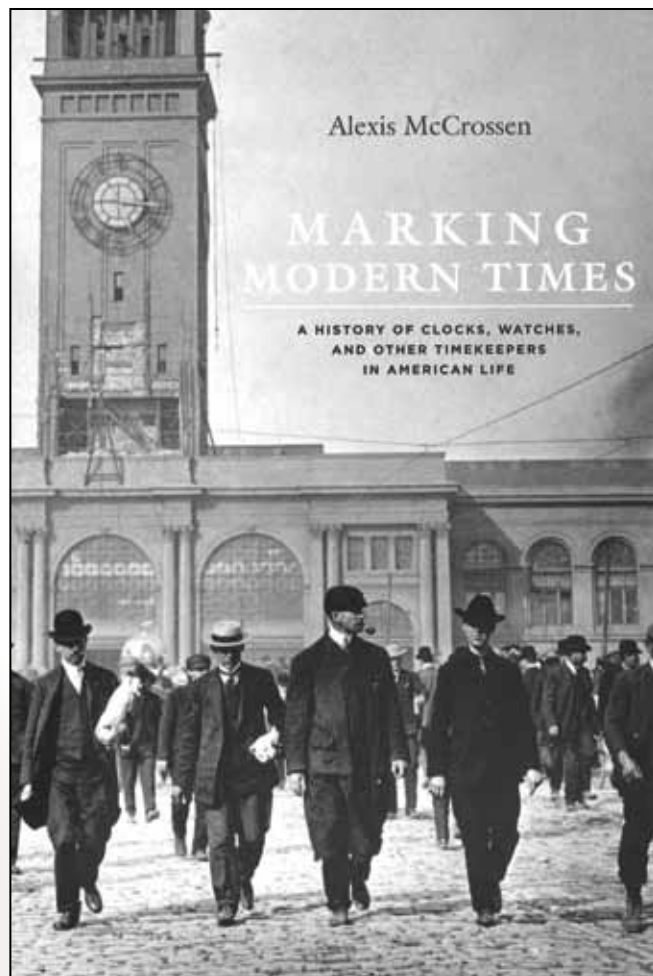
Marking Modern Time

by Alexis McCrossen

Marking *Modern Time* by historian Alexis McCrossen tells the story of public clocks in America. But it is much more than an accounting of street clocks and tower clocks. This is a very readable study of the “complicated history behind the remarkable timepieces that once adorned our streets and public buildings” in the late 19th and early 20th centuries. The author reaches beyond the public clocks and expands our understanding of the development of *modern time discipline*, which is “a cultural system in which clocks provide the reference point for temporally organizing and controlling society. Time discipline is shorthand for how time – ideas about it, ways of measuring it, instruments for meting it out – controls actions thoughts, dreams, (and) desires.”

Through this deeply researched study the author, who is associate professor of history at Southern Methodist University in Dallas, relates how the American preoccupation with time has led people across all social classes to acquire watches and clocks, “decorated their homes with clocks and included them in their poetry, sermons, stories and songs.”

In short, *Marking Modern Time* is an enjoyable and revealing study about the impact of time discipline and timepieces upon the American social, economic, and political fabric.



Capital Area Watchmaker and Clockmaker Guild (CAWCG)

Meetings of the CAWCG are held at Pok-E-Jo's Smokehouse in Austin, TX. The July program was "The Metals Used in Clock and Watch Making" by Glen Morehead. The August program was "Life in the Factories" presented by Don Bugh. The September program was presented by David Douglas. Items are auctioned every month between the end of the meeting and start of the program.

The following is an excerpt from the monthly message of CAWCG president, Rob Putney:

"...During my high school and college days, I had purchased about 10 watches. For the next 10 years, I mostly collected watches. Surely one wasn't enough. Fast forward to around 2000, when David Craft introduced me to the Capital Area Watchmaker & Clockmaker Guild. I enjoyed the meetings, but for me, the fun and interest hit a whole new level when I took my first class.

I attended a class on Vintage American Pocket Watches. I disassembled, cleaned, and re-assembled an 1882 Illinois pocket watch. It was an 18-size, key wound watch with an Illinois Watch Company 15J movement, serial number 422930, made in Springfield, IL. The case was a Keystone nickel, serial number 4319395. It did not run when the class began. George Kiser was the instructor and Duane Bennett was my teacher. They did a great job, and a relative novice took home that working watch he bought from George.

Now, about 13 years later, we can do it one more time. **George Kiser will lead an Antique Pocket Watch Class on September 21, 2013.** This is a very special class, truly an encore performance from a great man whom our Guild and community has been blessed with for many years...."

Rob Putney, President

Future Horological Events:

CAWCG Meeting: October 22, 2013
NAWCC Chapter 15: October 26, 2013
Southern Regional: November 9-10, 2013
Chapter 15 Case Refinish class: Tentative date Nov. 16, 2013
CAWCG Meeting: November 26, 2013

2013 Program Presenters

October: Terry Palmer
November: David Arnold

President: Rob Putney
Phone (512) 289-2627
Email rob.putney@sbcgglobal.net

V-P: Glen Morehead
Phone (512) 964-5642
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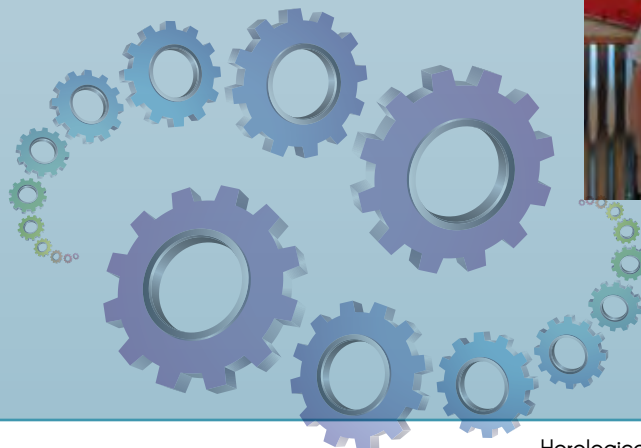
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Email hugh@txcyber.com

Secretary: Jay Holloway
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Members checking out the auction items

The July program was given by Glen Morehead with an in-depth program on the metals used in clock and watch manufacturing and repair.



Minnesota Clockmakers Guild (MCG)

Meetings of the MCG are held at the Hopkins Pavilion in Hopkins, MN. The September program was the viewing and discussion of the DVD of *The World's Oldest Computer*, recently shown on Public Television.

The August presentation was given by Maria Rizkalla, from Fine Arts Conservation, LLC, and was an interesting and informative discussion on the techniques used with Paint Conservation, Stabilization, and Restoration. She began with the work she performed on the Ft. Snelling Tower Clock movement, which included stabilizing the paint around the main movement castings that had been cracked in a grid-like pattern from years of heat and cooling in the tower. After cleaning with a mixture of acetone and ethanol, she applied Aquizol 200 to consolidate and relax the paint, and fill in any chips with blind cleavage capillary action. After this a coat of Acryloid B72, a non-yellowing acrylic polymer, was applied to the finish with a small brush. The decal was removed with solvent, scalpel, and tweezers and was then placed in a Mylar envelope made with double-sided tape. She then described glass repair by taping the pieces together with Scotch tape, tipping the piece over, and filling the joint with Hxtal NYL, a crystal-clear, non-yellowing, two-part epoxy resin adhesive that takes up to seven days to dry. She then showed how to scrape off the Scotch tape and any excess resin with a razor blade. If any voids remain, she would then build a small dam and fill them again. She would finish by buffing and polishing with 3,200 through 12,000 grit micro-mesh. She ended her presentation with a discussion of cleaning agents to try, in order of strength from weakest to strongest:

Solvent Based

Acetone
Keytones
Ethanol
Mineral Spirits
Alcohol

Water Based

Saliva
De-ionized water
1/2 - 1% Ammonium hydroxide
2-1/2 - 5% Timonium Citrate

Also at the August meeting, four Door Prize drawings were made: Two books from Milo Bresley's family, *Clock Identification and Price Guide*, by Roy Ehrhardt, won by Dave Swart; *Clock Identification and Price Guide #2*, by Roy Ehrhardt, won by Paul Engebretson. A book donated by Kern Schwartz, *The Chainmakers*, by Allen White, was won by Garth Antila. A 1/128mm vernier caliper donated by Garth Antila was won by Jeff Pomeroy. For Show and Tell, Ron Widenhoefer shared his latest clock movement with a double flying tourbillion escapement.

FUTURE MCG MEETINGS/Topics:

October 3, 2013 - TBD
October 12, 2013 8:00 am Saturday - OTL Clock and Watch Auction

MCG OFFICERS:

President: Richard Zielike
952-938-0681 richard@edinaclock.com

Treasurer: Garth Antila
715-386-3575 3mgarth@gmail.com

Secretary: Dean Ziegenbein
952-322-4776 dpz72@hotmail.com



Maria Rizkalla shared with us the layers of built-up dirt, and steps in removing to enhance a painting.



Hand engraved dial with Roman numerals and chapter ring filled with shellac. Delicate leaves and flowers engraved on lower front plate.

Ron Widenhoefer showed his latest clock with a flying double tourbillion escapement and two-week run time between winds.



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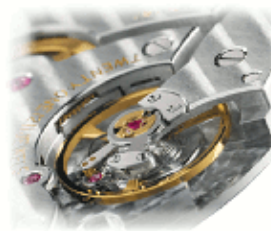
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Independent Accountant's Report



CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT ACCOUNTANT'S REPORT ON APPLYING AGREED-UPON PROCEDURES

Board of Directors
American Watchmakers – Clockmakers Institute
Harrison, Ohio

We have performed the procedures enumerated below, which were agreed to by American Watchmakers – Clockmakers Institute, solely to assist you with respect to the ballot tabulation and related matters of American Watchmakers – Clockmakers Institute for the 2013 election of Board of Directors. American Watchmakers – Clockmakers Institute management is responsible for the company's ballot tabulation process and related matters. This agreed-upon procedures engagement was conducted in accordance with attestation standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of those parties specified in the report. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

Our procedures and findings are as follows:

1. Obtain a listing of both the Domestic and Foreign American Watchmakers – Clockmakers Institute members in which ballots are to be mailed. The listing should include names and addresses of all members.

Result:

We obtained the listing of both the Domestic and Foreign American Watchmakers – Clockmakers Institute members in which ballots were to be mailed from Bueke Printing & Mailing. We noted all member names had a corresponding address except Ronald Pflieger and John Shorts.

2. Verify the number of members in total for both the Domestic and Foreign listing obtained in #1 above is one thousand seven hundred seventy three (1,773).

Results:

We verified the number of members in total for both the Domestic and Foreign listing obtained in #1 above is one thousand seven hundred seventy three (1,773).

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Independent Accountant's Report



CERTIFIED PUBLIC ACCOUNTANTS

3. Verify the starting and ending ballot number, 130001 and 131773, respectively.

Results:

We examined the preprinted ballots and verified the beginning and ending ballot numbers were 130001 and 131773 respectively.

4. For any misprints of the ballots verify that the original ballot was destroyed and record the replacement ballot number for the respective member of which the original ballot was designed for.

Results:

For misprints of ballot we verified that the original ballots was destroyed and recorded the replacement ballot number for each respective member of which the original ballot was designed for.

5. Randomly select twenty (20) addressed envelopes from the population of envelopes and verify that all of the information (name and mailing address) from the listings obtained in #1 above agrees to the addressed envelope.

Results:

We randomly selected twenty (20) addressed envelopes from the population of envelopes and verified that all of the information from the listings obtained in #1 above agreed to the addressed envelope (name and mailing address). No exceptions noted.

6. Randomly select twenty (20) member from the listings obtained in #1 above and verify the information therein (name and mailing address) agrees to the addressed envelopes to be mailed to each of the respective members.

Results:

We randomly selected twenty (20) members from the listings obtained in #1 above and verified that information therein agrees to the addressed envelopes to be mailed to each of the respective members. No exceptions noted.

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7. Witness the mailing of the ballots.

Results:

On June 7, 2013 we witnessed Chuck Bueke take the 1,773 ballots to the post office for mailing.

8. Develop a database and record the results for all of the returned ballots post marked on or prior to July 3, 2013 and with 3 or less candidates selected.

Results:

We developed a database and recorded the votes indicated on the returned ballots post marked on or prior to July 3, 2013 and with 3 or less candidates selected.

There were 458 valid ballots returned. Results are as follows:

John Safranek	123	David Douglas	132
Drew Zimmerman	209	Joseph Cerullo	198
Terry Curkan	96	Wesley Grau	188
Justin Shiver	86	Michael Michaels	73

9. Maintain a listing of invalid returned ballots, those ballots that do not meet the stipulations discussed in #8 above.

Results:

We maintained a listing of invalid returned ballots that did not meet the stipulations discussed in #8 above. The ballots that were invalid were 130232,130379,130867,131034,131390, and 131400.

10. Scan returned ballots, both front and back, in numerical ordered and provide digital files of the scanned ballots to the Board of Directors for American Watchmakers – Clockmakers Institute, the nominating committee, and Paul Wadsworth, Parliamentarian.

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Independent Accountant's Report



CERTIFIED PUBLIC ACCOUNTANTS

Results:

We scanned returned ballots, both front and back, in numerical order and provided digital files of the scanned ballots to the Board of Directors for American Watchmakers – Clockmakers Institute, the nominating committee and Paul Wadsworth.

We were not engaged to, and did not, conduct an audit, the objective of which would be the expression of an opinion on the election results of the American Watchmakers – Clockmakers Institute. Accordingly, we do not express such an opinion. Had we performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of American Watchmakers – Clockmakers Institute and is not intended to be and should not be used by anyone other than those specified parties.

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July 22, 2013

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