

# HOROLOGICAL™ TIMES

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*American Watchmakers-Clockmakers Institute*

# Paul Gerber's Retro Twin

Behind the Curtain

© March 2004

Curtis D. Thomson

## Introduction

It is hard to imagine the chief revisionist of the World's Most Complicated Wristwatch, a *tour de force* of horological engineering, and the mind that problem-solves for many in the industry and creates for the same, would find his own brand relatively unrecognized and under appreciated by the larger watch culture, but it's true. Paul Gerber, master watchmaker and AHCI member, has his own line of watches, which bear his name but find themselves in the shadows of the maker's individual accomplishments outside of the brand. Don't be mislead, there is a loyal following of the Gerber brand, but it has not benefited from the celebrity garnered from other projects like one would have expected.

The Gerber line consists of The Retrograd and Retro twin, a pendulette (miniature table clock with flying tourbillon), and a third wristwatch (a new tonneau-shaped in-house caliber, with spherical moon phase accurate to 1 day in 128 years and Gerber's new patented escapement. His atelier is in the basement of his home, which is nestled near the woods of a Zurich suburb. Team Gerber consists of his wife, Ruth, who carries out all of the administrative duties; Martin Schiess, watchmaker, who was Mr. Gerber's apprentice and now an employee of 6 years; Roland Hohl, watchmaker, who has been working in the Gerber

atelier for a year, but has 6 years of working experience (4 being with IWC); and finally Mr. Gerber's 2<sup>nd</sup> year apprentice (an apprenticeship being 4 years), Isabelle Kappeler, who follows many before her.

*As an aside: Paul Gerber has committed himself to the advancement of watchmaking through not only technical achievement, but more significantly in the training of future watchmakers. An endeavor which, in my opinion, all Master watchmakers should be engaged in. The traditions in the art and craft of watchmaking are being lost. Watchmaking schools tailor their programs to the massive modern after-sales markets, with skills to suit. Now, more than ever, the*



*Master watchmaker needs to embrace the motivated student or aspiring watchmaker and impart the skills and knowledge of a life's work. For all of his horological achievements, I respect Paul Gerber most of all for his commitment to the future of watchmaking and its watchmakers.*



Paul Gerber



*Mr. Schiess, Mr. Hohl, Miss Kappeler, Mr. Gerber*

The Gerber atelier is friendly, but quiet in conversation, organized, full of activity that ranges from assembly and making parts for the Retro Twin, any other Gerber brand product for that matter, to working on specially commissioned jobs for the industry (he has constructed 30 original calibers) or patiently answering questions on the phone and/or for his staff. Of course, there must be time for Mr. Gerber to construct, which was the only thing put on hold during my visit to document the making and assembling of the Paul Gerber Retro Twin, as it was Paul Gerber who took me through the process from A to Z.

### Basics

The Retro Twin is based on a rhodium plated manual wind Peseux 7001 and is purchased from Soprod, with their finest available finish. This caliber was chosen for its proven reliability, its availability and its sub seconds design which adapts well to his retrograde seconds construction, as well as providing a suitable platform for his patented double rotor automatic system.

In its original form the movement has a diameter of 23.68 mm and a height of 2.5 mm, with 17 jewels. After modification the Peseux takes

on the reference, Paul Gerber caliber 15, which has an increased diameter of 28 mm and an increased height of 5.2 mm, with 27 jewels. The frequency and power reserve are unchanged, remaining 3 Hz and 42 hours respectively. Now that you know the beginning (Peseux 7001) and end (PG caliber 15) of the story, let's discuss the plot.

### Modifications

The Retro Twin is extensively modified from its humble beginnings. I know we have read this before, "heavily modified," "scarcely recognizable" and the like, when in fact there hasn't been any significant change at all, but in this case, you will find those descriptions fitting.

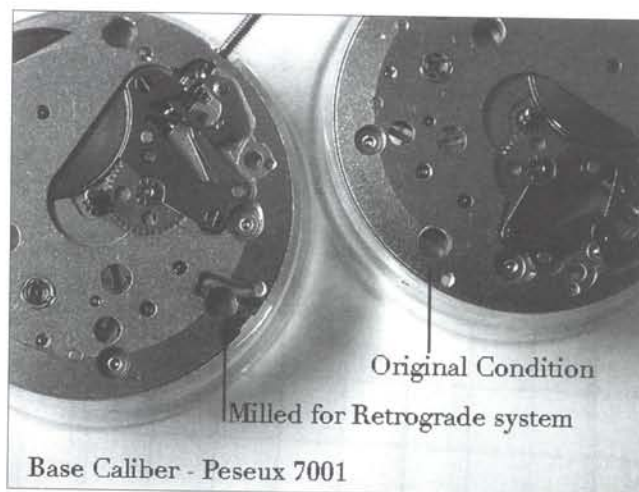
The Peseux starts out with a standard sub seconds design and ends up with retrograde seconds, with all necessary parts (arbor, pinion, rack, cam, ring) and modifications (milling portion of movement plate) made in the Gerber atelier. The Peseux starts

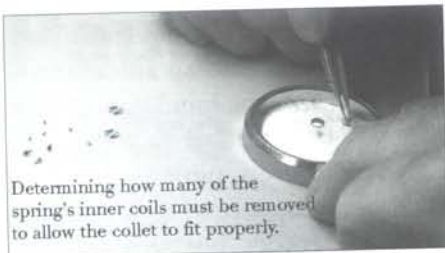
out as a manual wind movement, but is transformed into an automatic—not any automatic mind you, but his own patented double rotor system. All parts (wheels, pinions, cams, levers, bridges, screws (He used to make 18k rotors, but now they are platinum and made outside the atelier.) and modifications (drilling and tapping holes in movement plates and modifying the barrel for automatic use, with appropriate mainspring) are made in the Gerber atelier. And, for good measure, the dials are made in the atelier, as well.

After the components are made and tested, the necessary finishes are applied, which includes perlage for the automatic bridges and retrograde spacer ring. The brass wheels of the automatic system will receive gold plating; automatic bridges and spacer ring will be plated in rhodium—all of which take place in the Gerber atelier.

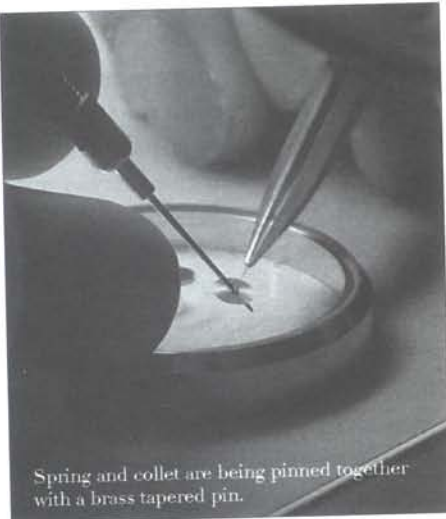
### Making

*It should be noted that, while each watch is assembled in the manner to be described, the parts and modifications are carried out in bunches. That is, parts are made many at a time and not per watch.*





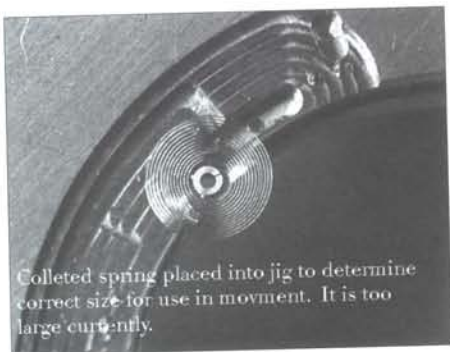
Determining how many of the spring's inner coils must be removed to allow the collet to fit properly.



Spring and collet are being pinned together with a brass tapered pin.



Pinned - Tapered pin needs to be trimmed to the collet



Colleted spring placed into jig to determine correct size for use in movement. It is too large currently.

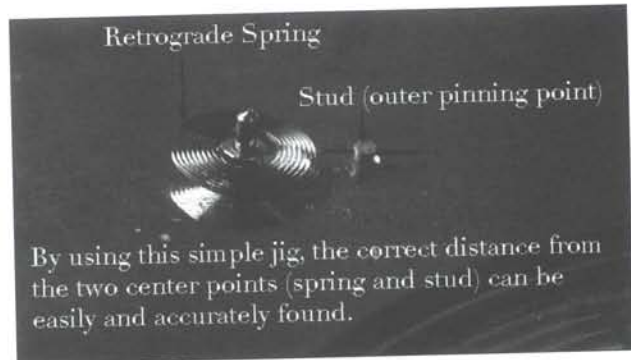


Spring properly fitted into the recess of the jig.

### Retrograde System

The first step is to mill out a section from the dial side bridge to allow for the retrograde seconds. This is followed by the fabrication of a three-sectioned brass ring, which fits around the movement housing the bulk of the retrograde system. The three sections are the primary brass ring, which has a milled out area (top and bottom) that corresponds with the position and needs of the retrograde components. The two remaining brass pieces act as bridges and are drilled and jeweled for the retrograde rack and retrograde pinion and spring to be "sandwiched" in between.

Once the machining is finished on the retrograde brass ring, the individual components may be addressed, which in this case are the retrograde rack and its arbor, the retrograde spring and its arbor and pinion, and the cam. To begin this process the spring, which is a very weak hairspring, must be colleted and pinned. This is done in the traditional manner of "springing," with a round, split brass collet, which accepts the innermost portion of the spring and is held steady by a brass tapered pin. The colleted spring is then placed in a brass jig that has been milled to match the milled section of the retrograde brass ring where the spring will be placed. The jig allows for a very quick trial and error period where the outer coils of the spring are carefully snipped away until the spring fits comfortably in the designated area. Once this has been determined the spring is moved to another area on the jig where there is a small post, which represents the pinion and arbor for the spring, and a small hole, which is precisely placed, for the spring's stud. This jig

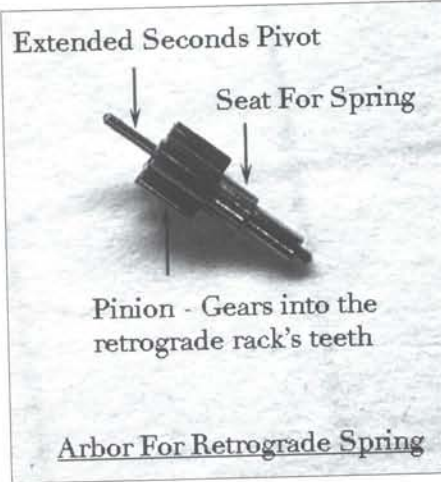


Retrograde Spring

Stud (outer pinning point)

By using this simple jig, the correct distance from the two center points (spring and stud) can be easily and accurately found.

allows for the correct length of spring from the body to the stud to be quickly and accurately gauged. The spring is now colleted, with stud, so must be friction fitted to the arbor and is done so with a staking tool. The spring is made to be true in the



Extended Seconds Pivot

Seat For Spring

Pinion - Gears into the retrograde rack's teeth

Arbor For Retrograde Spring



Completed Retrograde Spring Fitted To Its Arbor



Retrograde Rack

Rack's Tail (rides on cam's circumference)

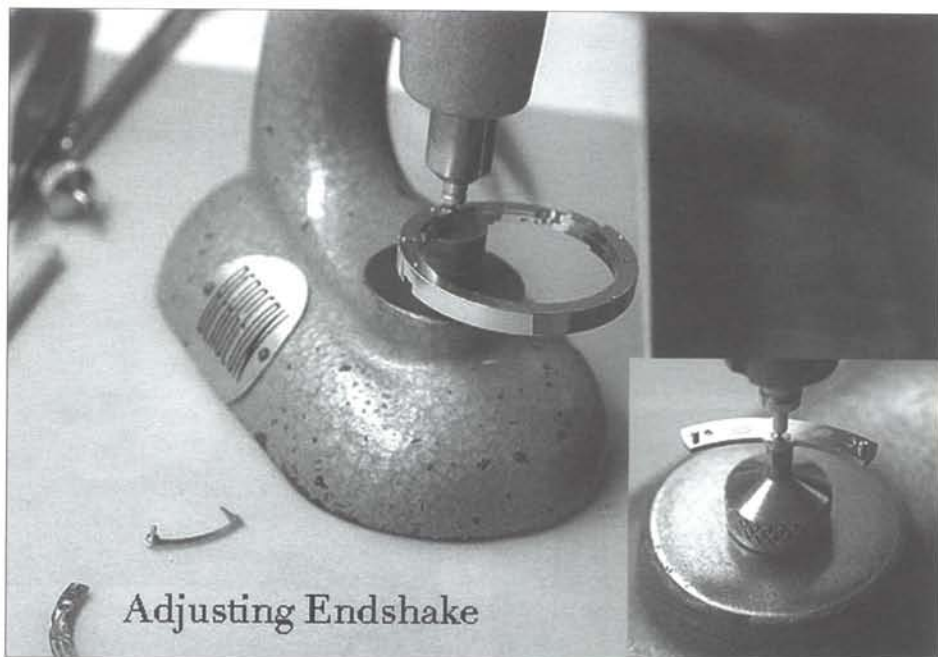
Rack's Teeth (gear into Retrograde Arbor's pinion)

round and in the flat, so the "assembly" is as it should be.

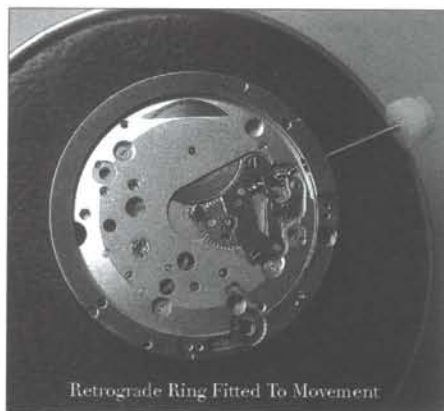
The choice of spring is not an arbitrary one. It must properly fit in the available area given, but not be too strong, as to have an effect on the amplitude by more than 10 degrees. Yet, it must be strong enough to snap back the seconds hand smartly and not bobble or waiver if knocked about. Yes, much testing was required to find the spring to meet these requirements.

With the spring ready and the retrograde rack mounted on its arbor, the two bridges that sandwich these components to the retrograde spacer ring are jeweled and correctly depthed. To do this, each component is individually secured to the spacer ring, correctly adjusted for vertical position in relationship to one another and individual endshake. Once each component appears correct, they are removed from the spacer ring, which is then slipped on the movement and correctly aligned with the milled portion of the movement and held in place by the stem.

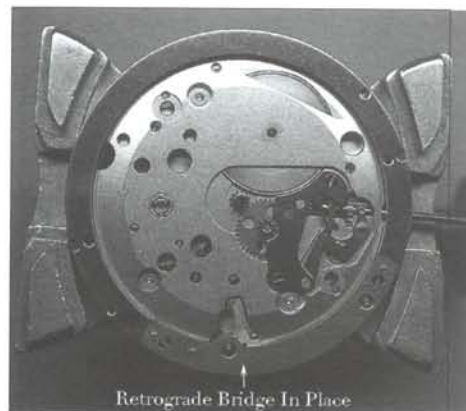
Now is the time to discuss the cam. The cam is shaped in such a way to allow the seconds hand to travel the 120 degrees seconds sector accurately. It is made with precision machines, but still requires fine-tuning. The circumference of the cam is smoothed with a Degussit stone, followed by burnishing and polishing to



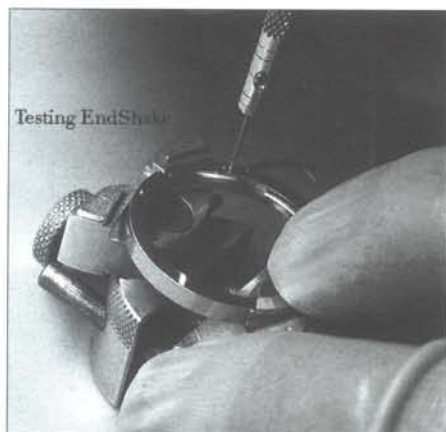
Adjusting Endshake



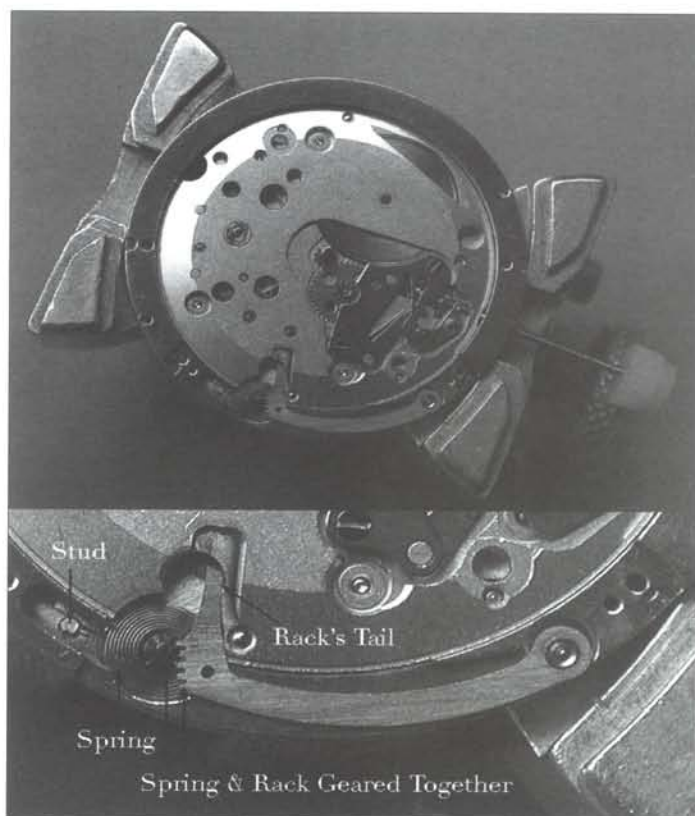
Retrograde Ring Fitted To Movement



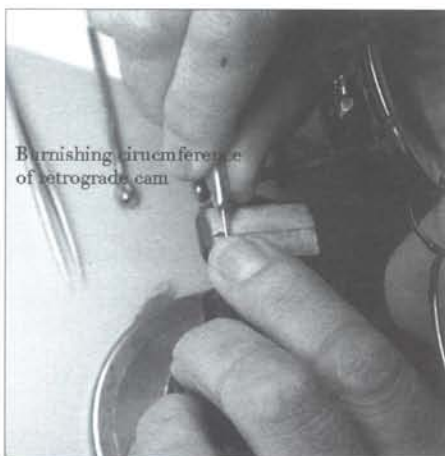
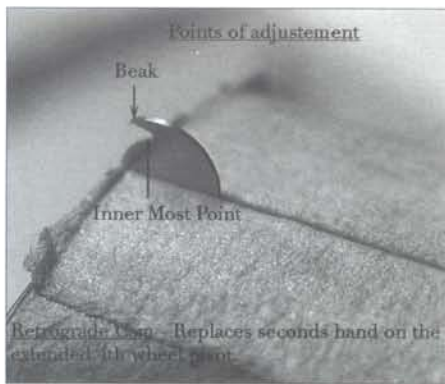
Retrograde Bridge In Place



Testing EndShake



Spring & Rack Geared Together



Burnishing circumference of retrograde cam



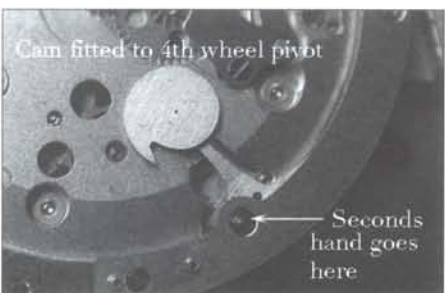
Retrograde Cam partly burnished

Unburnished

Burnished

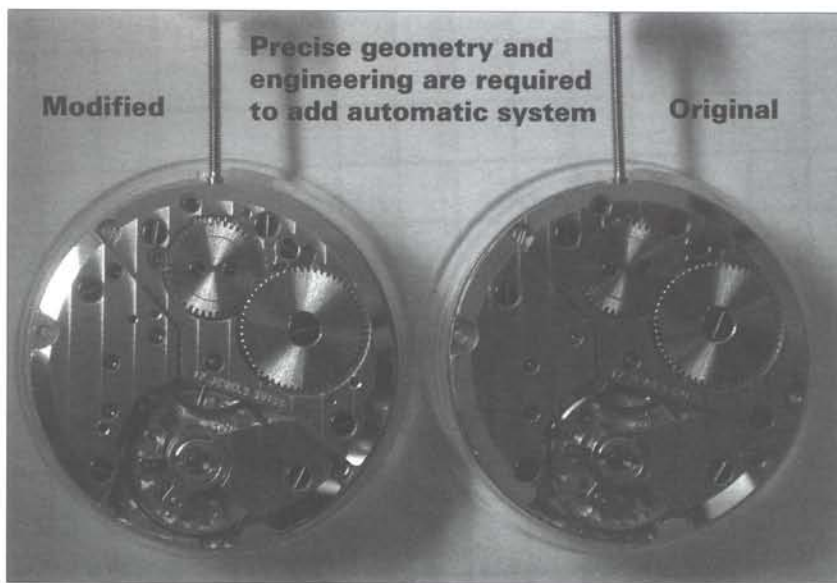


Staking cam to 4th wheel pivot



Cam fitted to 4th wheel pivot

Seconds hand goes here



Modified

Precise geometry and engineering are required to add automatic system

Original

ensure the seconds hand functions smoothly. After this the cam must be adjusted so the action of the seconds hand is correct, i.e., it begins and ends when it should and with the “snap back” desired. This is accomplished by the careful filing away of material from the beak and/or the innermost point of the cam. Using an old damaged dial, the action and travel of the seconds hand is tested and adjusted until correct. This is a very time consuming process of trial and error.

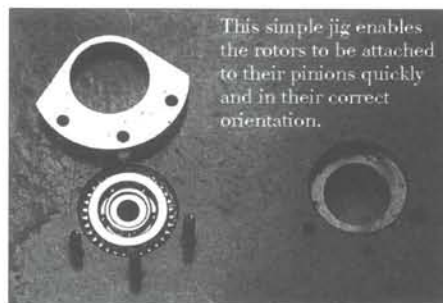
### Automatic System

The self-winding mechanism is a dual rotor, unidirectional system, for which Paul Gerber received a Swiss patent. When asked, “Why a dual rotor? Does it increase the efficiency?” he responded, without pause, “No, it doesn’t, but it is fun... why not?” One can only smile to such whimsical honesty, but the truth is, this a clever...fun system.

The rotors are planted on the same plane, but on separate axes. The distance between the two axes is “less than the sum of the radii of the circles circumscribed by the associated oscillating masses.” -Abstract from Patent CH692539. To prevent the rotors from colliding, a central coupling wheel is used, which makes

their movements synchronous. To ensure perfect alignment of the rotors, in relationship to the coupling wheel, a jig is used to secure the rotors to their ball bearings and wheels.

The system is modular, with its own plate and bridge, which is fitted on top of the movement’s bridge side. Its plate and bridge are machined with his CNC mill from brass. Several cutters and operations are required to make one plate and its small bridge. After machining, the surfaces must be deburred, smoothed, finished, rhodium plated and then



This simple jig enables the rotors to be attached to their pinions quickly and in their correct orientation.



Platinum rotors attached to their rotors & ready for use

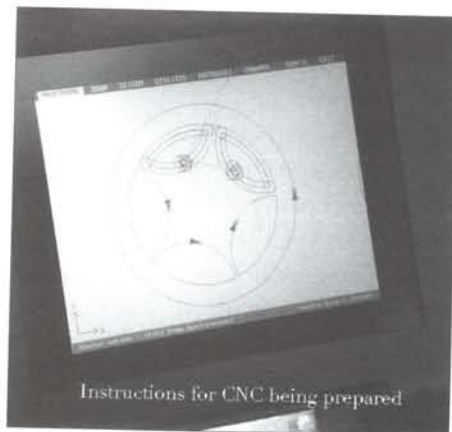
jeweled. Not content to find acceptable, ready-made wheels and pinions, Gerber makes the 7 gears that make up his automatic system (3 brass wheels, with their associated steel arbors and pinions, a steel gliding pinion, with arm and spring, two steel rotor pinions and a brass coupling wheel) in the atelier as well.

Let's discuss the making of the brass-coupling wheel. From sheet brass the CNC mill cuts the wheel blanks, including the crossing out of the wheels, which is a huge time saver, as the individual maker who wishes to cut their own wheels must either do the tedious and labor intensive crossing out by hand (piercing saw and files) or by use of a pantograph, which is much faster than the hand method, but still requires an operator

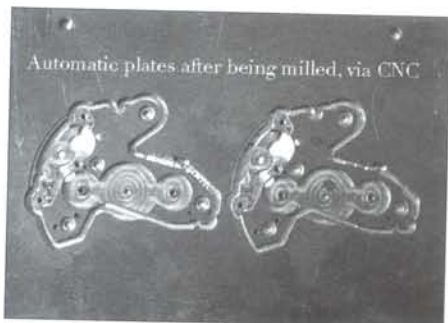
to be present to guide the cutter. The CNC, on the other hand, gives the operator the freedom to continue other tasks while the blanks are being cut... Well, at least during each operation, of which there are three for the coupling wheel and 5 passes each of the cutter per crossing out!

The wheel blanks then have their burrs and related rough areas removed and smoothed for cutting the teeth. Gerber uses his Schaublin 70 lathe, with its milling attachment for this task. As mentioned above, many components are made/machined at once and cutting teeth in wheels is generally no different. Although, due to the stepped design of the coupling wheel they can't be stacked and sufficiently supported, so these are cut one at a time.

The wheel blank is fitted to an arbor so it may be placed in the headstock of the lathe for cutting, but first the outer diameter of the wheel blank must be trued and brought to size. (It is intentionally left a little oversized during the first steps.) Once



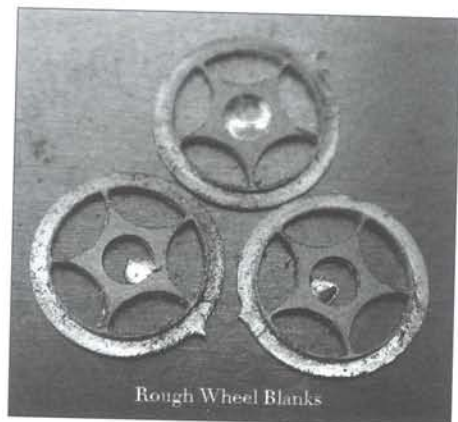
Instructions for CNC being prepared



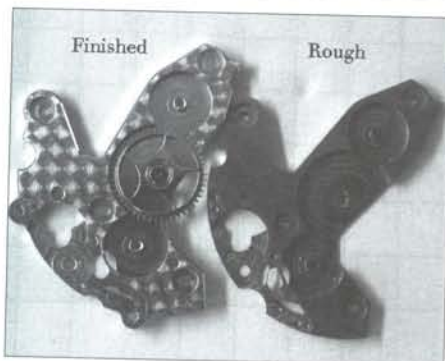
Automatic plates after being milled, via CNC



Milling Coupling Wheel



Rough Wheel Blanks



Finished

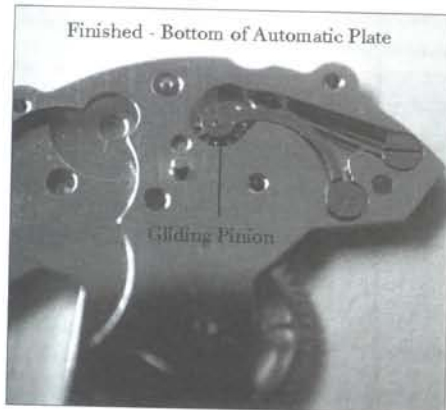
Rough



Milling Coupling Wheel



Truing & Bringing Wheel Blank To Size

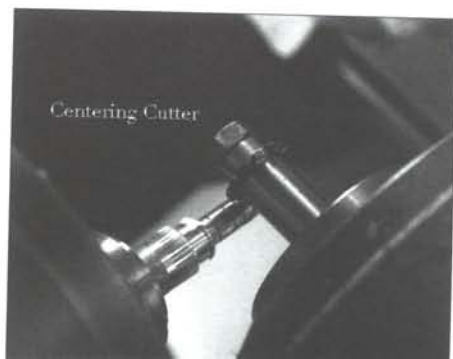


Finished - Bottom of Automatic Plate

Gliding Pinion



Milling Coupling Wheel



Centering Cutter

this has been accomplished the correct cutter is centered in relation to the wheel blank and the correct index plate is chosen for the number of teeth to be cut. Having found the centerline, the cutter is slowly brought to bear on a test piece. From

this point a slow and measured process of small passes between the center position and one indexed position begins—back and forth, with small increases of depth until one tooth is formed of the correct shape. Once this has been achieved the depthing of the milling attachment is locked and the wheel blank may be cut in full depthed passes.

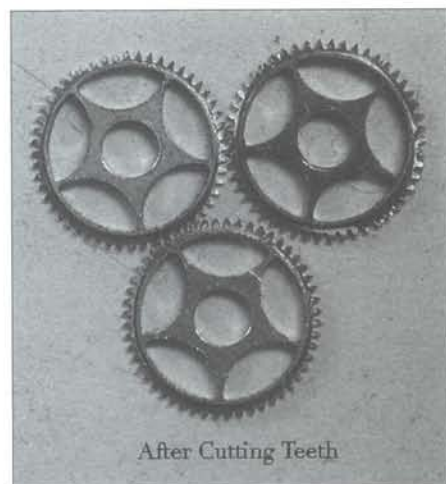
The completely machined wheel must now be finished. This begins with lapping underneath the wheel at the drill press using 1600 grit emery paper, with the wheel fitted to a brass jig, which keeps the wheel in place and flat while slowly rotating on the emery paper. The lower stepped portion of the wheel is lapped by hand, using the same brass jig. A synthetic stone is used on the upper step and then cleaned in an ultrasonic bath. The upper step is then lapped with 8-micron and 3-micron diamond paste on Plexiglas, with



Checking A Cut



Cutting A Wheel



After Cutting Teeth



Removing Burrs



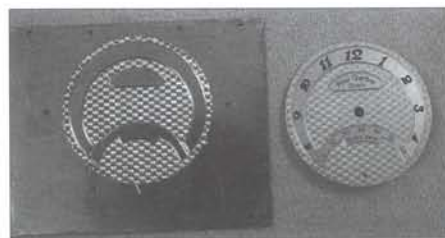
Working With Synthetic Stone



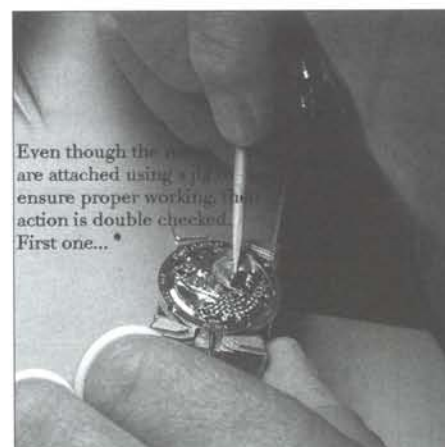
More Finishing



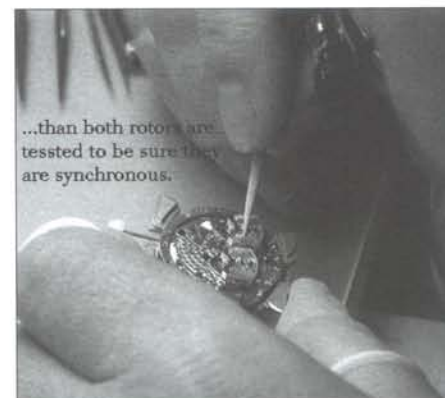
Finish is getting better and near complete



Polishing Platinum Rotor



Even though the wheels are attached using a jig, ensure proper working. This action is double checked. First one...



...than both rotors are tested to be sure they are synchronous.





ultrasonic cleaning in between. This is followed by a few strokes on a jeweler's cloth, being careful not to round the edges, and a final ultrasonic bath before gold plating. After plating, the finished coupling wheel has the ball bearings pressed into its center and is now ready for use.

### Dial & Rotors

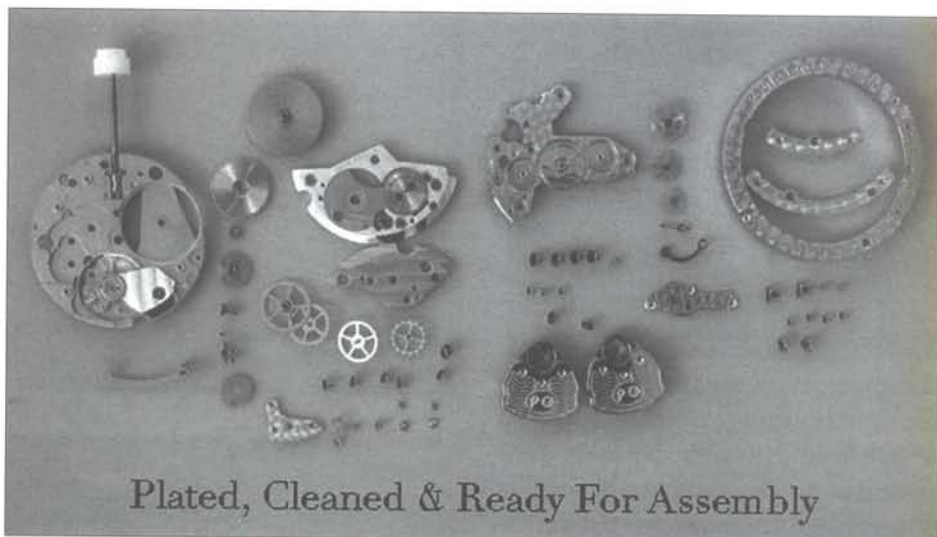
The dials are made in the atelier as well. They are produced from sheet brass and CNC milled, which gives an engine turned effect. The dials are tidied up from machining and then rhodium plated. An outside specialist firm applies the numbers and printing on the dials.

The rotors used to be gold and were made in the Gerber atelier, but long-term field reports indicated they were not sufficiently massive to routinely obtain full wind. All Retro Twins now use platinum rotors, which work superbly, and all older Retro Twins will have their gold rotors switched for platinum rotors at no expense. While the making of the rotors is now handled outside of the atelier, the finishing is done in-house and it takes one hour to polish one platinum rotor using 6- and 3-micron diamond paste.

### Assembly

With all necessary parts made, tested in the movement and finished as required, e.g., perlage and gold or rhodium plating, it is now time for final assembly.

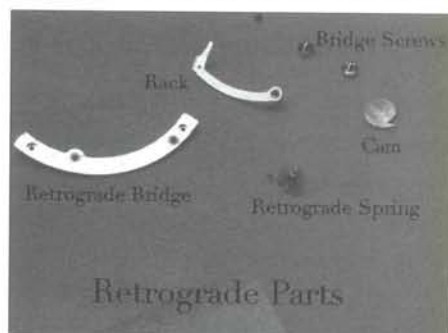
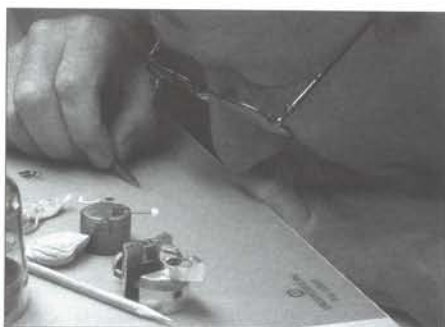
After cleaning the movement, non ultrasonic, as he feels it is too harsh for general cleaning, the base movement is assembled in the traditional fashion, making necessary checks/tests throughout and lubricating as required. Having assembled the base movement he conducts the first timing test, no retrograde system, and is striving for 300 degrees amplitude in vertical positions, with +/- 5 seconds/day. Passing the first timing



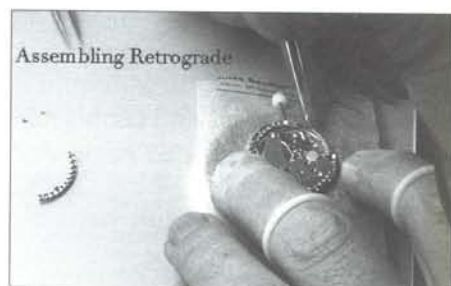
Plated, Cleaned & Ready For Assembly



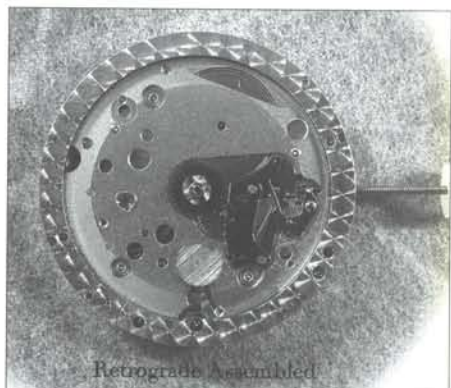
Retrograde Ring Fitted To Movement Waiting For Retrograde Parts



Retrograde Parts



Assembling Retrograde



Retrograde Assembled

test the retrograde system is now ready to be installed.

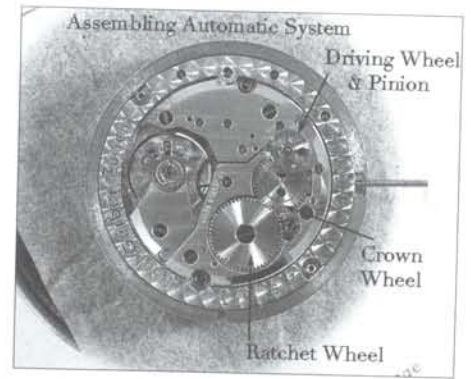
Having slipped the retrograde ring over the movement and aligned it correctly, the retrograde cam is staked onto the seconds pivot of the 4<sup>th</sup> wheel (this is where the seconds hand would normally be placed), which enables the cam to make one complete revolution per minute. The retrograde spring, which is fitted to an arbor and pinion, with its stud anchored to the retrograde ring, is put in place followed by the retrograde rack. The rack's teeth are geared into the pinion of the retrograde spring, with the corresponding retrograde ring bridge screwed into place and proper movement/endshakes are checked again. The rack's tail is adjusted to ride on the circumference of the cam and as the cam rotates, and its shape changes, the rack is moved, which in turn advances the retrograde spring's pinion "to & fro". This arbor has an extended pivot where the seconds hand will be placed.

With the retrograde system sorted, the dial is inspected and then put into place. Any watchmaker will tell you that one of the most tedious bits of assembly are the proper positioning and adjusting of the hands. While not a struggle, by any means, Mr. Gerber takes his time and shows due care in making the hands "just so." In particular, the seconds hand takes some playing with to get it to begin and end precisely at 0 and 60 on the seconds sector.

Using a special holder, that won't damage the dial or hands, the movement is placed dial down into the holder so the automatic system may be attached. The drive wheel/pinion is geared into the crown wheel, with the automatic plate placed over it and screwed to the movement. The rest of the automatic train is assembled, followed by the automatic bridge, and properly lubricated.



Attaching Dial to Movement



Assembling Automatic System

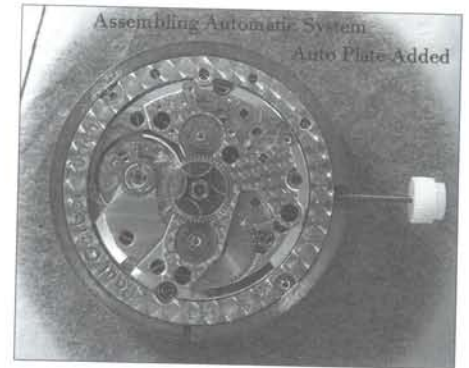
Driving Wheel & Pinion

Crown Wheel

Ratchet Wheel



Broaching Hand For Proper Fit

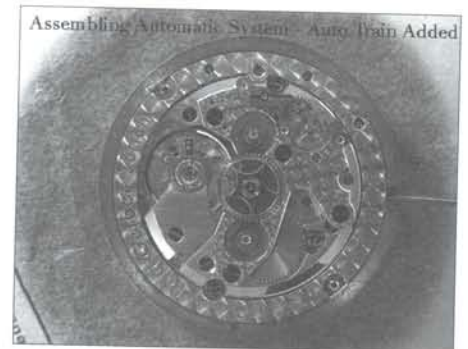


Assembling Automatic System

Auto Plate Added



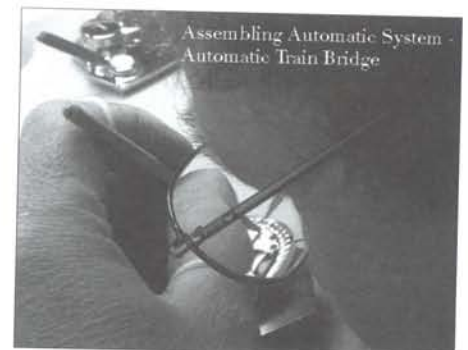
Attaching Seconds Hand (Retrograde)



Assembling Automatic System - Auto Train Added



Checking Alignment & Action of Hands



Assembling Automatic System - Automatic Train Bridge



Movement - Dial & Hands - Awaiting Auto System



Automatic System - Awaiting Rotors

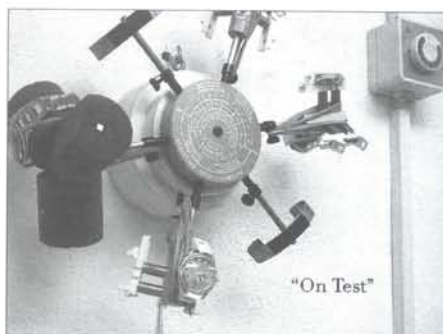


The movement is now ready to be cased. The 18 kt. gold case is blown out, wiped and inspected for quality before inserting the movement. The "working" stem that had been used is replaced with the "real" stem and gold crown. The movement is kept in place via two case screws and the required gasket is added.

The platinum rotors are now screwed into place starting with the rotor that directly gears into the automatic reduction train. The action of the rotor and auto train is then tested. Once satisfied, the other rotor is screwed into place and, even though a jig was used to ensure their proper orientation, their action is tested to be sure they are synchronous. The case back is blown out, wiped, inspected and attached with six screws to the case.

### Control

With the movement completely assembled and cased, the final checks, or control, begin. The watch is checked on the timing machine and, now with the retrograde system installed, the amplitude must not drop below 310 degrees in the horizontal position, nor dip below 280 degrees in the vertical positions, while maintaining +/- 5 seconds/day timekeeping. The watch is then moved to an "instrument for checking the winding rate," which simulates the motions of the wrist and provides information about the efficiency of the automatic winding and its power reserve. The watch spends three weeks



"on test" and is checked and documented each morning. Having passed the control stage, the cased movement has a strap attached and is placed in its wooden display box ready to be shipped to the purchaser.

### Conclusion

While the intent of this article was not to "review" the Retro Twin, one can't help but have an opinion when the process is over. Having witnessed the transformation, from base movement to finished Gerber caliber, two thoughts spring to mind: there is a tremendous amount of design and fabrication involved in making the Retro Twin and, knowing this, the Retro Twin is a great value.

The Retro Twin is not as extravagantly finished as some other watches in this price range, but there is no question that whatever is lost in artistic sensibilities, is more than compensated for with design and first-rate engineering. Two in-house "complications" from the mind and hands of a modern master guarantee a standard and uniqueness that can't be easily found away from the Zurich atelier of Paul Gerber.

\*Thank you to Paul & Ruth Gerber for their kindness and generosity during my stay in Zurich. Paul Gerber's website is [www.gerber-uhren.ch](http://www.gerber-uhren.ch)



\*To Michel Schmutz of Intro\*Swiss, US importer of Paul Gerber Zurich, for his assistance in arranging my visit with Mr. Gerber, and to the watchmakers of Gerber-Uhren who accepted my disturbances with good cheer. Thanks to you all!

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