PATEK PHILIPPE
GENEVE

Press Release

Patek Philippe Geneva
April 2011

Patek Philippe Advanced Research
Patek Philippe presents the new GyromaxSi® balance in gold and Silinvar®.

In the past six years, the Patek Philippe Advanced Research department has repeatedly attracted attention with innovative components that contribute to the higher rate accuracy and reliability of timepieces.

- 2005: Silinvar escape wheel. Requires no lubrication.
- 2006: Concentrically breathing flat Spiromax® balance spring in Silinvar for improved isochronism.
- 2008: Pulsomax® escapement in Silinvar for more efficient power transmission.

Now, in the spring of 2011, the Geneva workshops are presenting a debut that rounds out the spectrum of high-tech rate control elements for mechanical watches: the GyromaxSi® balance in Silinvar® and gold as well as the next evolutionary step of the Pulsomax® escapement. This commitment to cutting-edge technologies is also intended to further optimize traditional watchmaking artistry. A case in point: thanks to the use of innovative Silinvar® components, the power reserve of the limited-edition Patek Philippe perpetual calendar Ref. 5550P was increased from 48 to a maximum of 70 hours, so it can be left on the nightstand for a whole weekend without having to be readjusted on Monday morning.

A limited-edition timepiece has been dedicated to each Patek Philippe Advanced Research innovation so far, and this also applies to the GyromaxSi® balance: integrated in the Patek Philippe Advanced Research Ref. 5550P, the new components will be tested and prepared for implementations in the Patek Philippe collection. Additionally, all self-winding caliber 324 movements as well as the CH 28-520 chronograph calibers have been fitted with a Spiromax® balance spring since nearly a year ago. Gradually, other Patek Philippe calibers such as the 215 and the 240 will be endowed with the new hairsprings as well. The new Pulsomax® escapement has already been integrated into the highly complex caliber R CH 27 PS QI of the Ref. 5208 which had its grand Baselworld debut this year.

Before expounding on the whys and wherefores of Patek Philippe's innovative GyromaxSi® balance, it is important to outline the decisive technical and design-related features of the new balance. The GyromaxSi® balance is a highly innovative construction with two diagonally opposed circular sectors crafted from Silinvar® and 24K gold. The chassis is etched out of silicon wafers with the DRIE process and converted into a Silinvar® component by way of oxidation. The centrifugal masses are gold inlays integrated into the chassis with a technique patented by Patek Philippe. Additionally, the GyromaxSi® balance features four small slotted poising weights that can be precision-adjusted according to the Gyromax® principle (variable moment of inertia). The Gyromax adjustment concept was developed by Patek Philippe in the 1940s and received patent protection in 1951. Now, at the age of 60, it is being superseded by a worthy successor: the GyromaxSi® balance.

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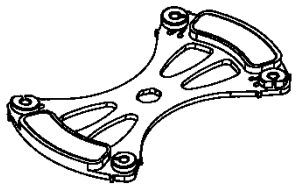


Concentration of mass at the periphery

The fundamentally changed shape of the balance delivers perceptible gains in performance. A balance must exhibit several precisely defined properties. Among other aspects, it must be as lightweight as possible yet have as much inertia as possible.

In conventional balance designs, this apparent contradiction is resolved with a full-circle rim held by a number of arms (spokes). This shifts the balance wheel's mass out to the periphery and reduces its weight. But even then, friction losses must also be minimized. Friction is encountered in the bearing jewels that contact the arbor pivots, and aerodynamic drag must be overcome as well. The air resistance of the balance wheel alone accounts for estimated friction losses of about 60%.
Patek Philippe invested heavily in research to reduce this energy dissipation and boost the performance of its movements. One impressive result: with Pulsomax®, Spiromax®, and the new GyromaxSi® balance, the power reserve of the 240 Q Si movement was increased from 48 to max. 70 hours.

Lightweight Silinvar chassis

To concentrate as much mass as possible at the periphery of the balance wheel, the mass at the arbor must be reduced to the greatest extent. Patek Philippe's GyromaxSi® fulfills this requirement with a Silinvar® structure that carries centrifugal masses at its outer ends. The low density of Silinvar® reduces the mass at the arbor by nearly two thirds. On the other hand, the concentration of a heavy load at the periphery calls for very tight manufacturing tolerances. The peripheral masses must be balanced with extreme precision because otherwise, the balance wheel would wobble and severely impair the rate accuracy of the watch. Thanks to latest-generation DRIE technologies, tolerances are so tight that a low-mass structure for the center of the wheel can be implemented with very precisely positioned inertial masses without causing any imbalance.

These facts suggest some of the numerous benefits of the silicon-based material known as Silinvar®. Silinvar is:

- Lightweight (3.6 times less density than conventional balance materials)
- Homogeneous (uniform mass distribution)
- Antimagnetic
- Corrosion-resistant
- Hard
- Shock-resistant

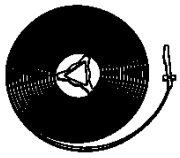
Reduction of drag

Patek Philippe's new GyromaxSi® balance wheel contributes significantly to performance gains in the movement. The Silinvar® chassis structure considerably reduces the mass at the center of the balance wheel. The use of 24K gold for the balance wheel rim (2.5 times more density than traditional balance materials) allows a perceptible reduction of volume. Patek Philippe's design with two diametrically opposed masses results in tangibly decreased air resistance and opens up a totally new field for research. Dynamic measurements have confirmed that the energy bonus in comparison with an ordinary rim-type wheel is more than 20%.

Heavy periphery with variably adjustable inertia

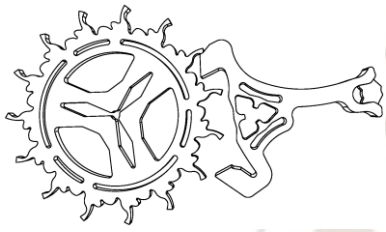
To enable owner-individualized precision adjustments, the familiar Gyromax poising weights were placed directly adjacent to the large inertial masses in an aerodynamically optimized configuration that reduces the braking effect of the air as well. These poising weights make it possible to precision-adjust the watch according to the principle of variable inertia, which is to say without altering the active length of the balance spring and without upsetting the isochronism of the watch.

The Spiromax® balance spring improves isochronisms



Thanks to the superior material properties of Silinvar® and the manufacture's patented geometry with the Patek Philippe terminal curve as well as the integrated collet and stud attachment, the Spiromax® balance spring makes a decisive contribution to the isochronism of the movement. It breathes with absolute symmetry, is totally antimagnetic, corrosion-resistant, shock-resistant, and insusceptible to temperature fluctuations. Another advantage of the Spiromax® balance spring: it is three times flatter than a Breguet spring with a Philips terminal curve of identical isochronism. This makes it possible to craft ultra-thin movements. Never before have all these properties been so ideally combined as in Patek Philippe's Spiromax® balance spring.

The Pulsomax® escapement boosts efficiency and long-term reliability



The new Pulsomax® escapement, which differs from the type launched in 2008, contributes extensively to increased efficiency in the movement. Largely redesigned, especially as regards the pallets, the escapement transmits power to the balance wheel much more efficiently.

The pallet ends feature a locking notch that nudges the lever into the ideal position of departure just before the next impulse occurs.

Several innovative approaches simplify the precise assembly of the escape wheel and lever. The escape wheel has elastic spokes that automatically snap it into the correct functional position when it is pressed onto its hub. The inner felloe between the toothing and the elastic spokes prevents deformation of the teeth after assembly, assuring perfect concentricity of the wheel and its arbor.

The escapement must be robust and function reliably, especially when the watch is subject to blows. Thanks to several innovations, the Pulsomax® escapement fully lives up to expectations in this respect as well. The ample distance between the escape wheel teeth reduces the risk of unintentional contacts between a tooth and a pallet when a jolt occurs. This also applies to the rounded geometry of the lever fork horns that prevent excessive collisions with the impulse pin of the roller when the watch is exposed to shocks. The guard pin – in the form of a bridge between the horns of the lever fork – holds the lever in the locked position if the watch receives a blow.

The Pulsomax® escapement requires no lubrication, which simplifies the maintenance of the movement and improves its long-term reliability. It is crafted from Silinvar® and leverages the following material properties: Manufacturing precision, low density, antimagnetic characteristics, corrosion resistance.

The major advantage of the Pulsomax® escapement is derived from its unique geometry with large, individually shaped pallets. It transmits 15 to 20% more energy to the balance. The Pulsomax® is a genuinely innovative manufacture escapement that originated in Patek Philippe's workshops; it does not merely constitute the emulation of a conventional escapement from a new silicon-based material.

The genesis of Oscillomax®

The components of a watch responsible for its rate accuracy were further perfected with Spiromax®, Pulsomax®, and GyromaxSi®. These elements usher in a new era in which watchmaking artistry achieves even greater precision without neglecting the traditions of craftsmanship. Patek Philippe is proud of its leadership position in a field that makes its timepieces even more accurate and more dependable.
Because Spiromax®, Pulsomax®, and GyromaxSi® interact, but in reality are independent components, Patek Philippe refers to them as an ensemble named Oscillomax®. Thus, a watch with Oscillomax® incorporates a Spiromax® balance spring, a Pulsomax® escapement, and a GyromaxSi® balance.

Silinvar®: the technology of the future?

It is legitimate to ask whether the silicon technology in Patek Philippe's latest developments will be a long-lasting involvement and whether it is compatible with watchmaking traditions. But it is also justifiable to recall that the craft of watchmaking has constantly evolved since the first clocks were made of wood. By definition, the tradition of watchmaking is in itself a process of ongoing evolution. Historic examples include the synthetic rubies that replaced the original metal bearings, the self-compensating balance springs in place of compensation balances, the temperature-compensating Invar alloy instead of steel, the automatic winding mechanisms that superseded manually wound movements, and many more.

The technology of deep reactive ion etching (DRIE) was invented about 30 years and today is widely used for the production of micromechanical parts. Since the beginning of the new millennium, the surface quality of silicon parts has reached a level that now allows the use of this material in watchmaking as well. Accordingly, Patek Philippe gained timely access to these technologies and secured the necessary material science know-how needed to allow future generations to benefit from the progress in this domain.

These new technologies are embedded in a Swiss know-how pool jointly tapped by the Swiss Center for Electronics and Microtechnology (CSEM), the Institute of Microengineering (IMT), and the Swiss Federal Institute of Technology in Lausanne (EPFL) under long-term partnership agreements with Patek Philippe.

Annex:
Silicon technology, Spiromax® balance spring and Pulsomax® escapement in a nutshell

The key physical properties of silicon.
Monocrystalline silicon has physical characteristics that make it ideal for micromechanical applications and certainly also in horology.

Main properties:
- Antimagnetic
- Very hard (silicon: 1100 Vickers; steel: 700 Vickers; ruby: 2000 Vickers; diamond: 3000 Vickers)
- Lightweight (density of silicon = 2.33 g/cm^3; steel = 8 g/cm^3; gold = 19 g/cm^3)
- Highly corrosion-resistant
- Absolutely smooth surface that requires no lubrication
- Can be machined into exact clones with DRIE
- Can be refined into Silinvar® with oxidation
- Despite its hardness, silicon is flexible in microstructures, similarly to extremely thin and flexible glass fibers.

With latest-generation DRIE technology, silicon can be three-dimensionally machined to thousandths of a millimeter. The individual components are identical, i.e. always have the same shape and mass. Moreover, they have totally smooth surfaces. The process is used to produce identical, high-precision component that enhance the performance of a movement.

The Spiromax® balance spring by Patek Philippe at a glance

- Made from monocrystalline silicon with the DRIE process
- Concentric expansion and contraction thanks to a patented geometry (Patek Philippe terminal curve) that improves isochronism despite being flat
- Three times flatter than a Breguet spring with a Philips terminal curve
- Antimagnetic
- Temperature compensation based on the material properties of Silinvar®
- Integrated stud attachment (Patek Philippe patent)
- Integrated, self-centering collet (Patek Philippe patent)
- No disruptive effects due to attachment points, contrary to conventional balance springs
- More homogeneous material structure than Invar alloys
- Less intrinsic friction and greater elasticity than Invar alloys
- Reduced sensitivity to centrifugal and gravitational forces because its mass is three times smaller than conventional balance springs
- No influence on rate due to repetitive smaller jolts in everyday use
- Complies with NIHS random shock standards
- Identical springs (identical active lengths)

The Pulsomax® escapement by Patek Philippe at a glance

- Made from monocrystalline silicon with the DRIE process
- Antimagnetic
- Material (Silinvar®)

- Superior material properties unlubricated (long-term reliability)
- Exclusive patented geometry with innovative functionalities
- Redesigned faces for improved power transmission (enhanced efficiency)
- Parts of identical shape and quality
- Patented geometries for improved shock resistance
- Patented elastic arm system
- Patented inner felloe for simplified assembly

The GyromaxSi® balance by Patek Philippe at a glance

- Chassis made from monocrystalline silicon with the DRIE process
- Effective mass consisting of 24K gold inlays
- Optimized mass distribution
- Lightweight Silinvar® chassis
- Antimagnetic
- Shock-resistant
- Parts of consistent shape and quality (DRIE process for chassis)
- Variable moment of inertia (precision adjustment without changing the active length of the balance spring)

Patents

A total of 17 patent applications were filed by Patek Philippe for the components of the Oscillomax® system.