DE BETHUNE

L'ART HORLOGER AU XXI[e] SIÈCLE

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CHRONOMETRY IN THE 21ST CENTURY

Chronometry according to De Bethune: two decades of innovation, the Sensorial Chronometry Project and in-house hairspring production.

Under the leadership of co-founder and master watchmaker Denis Flageollet, De Bethune has been constantly improving the accuracy, regularity and reliability of its timepieces since 2002. Through a series of technical breakthroughs – including its hairspring with flat terminal curve, new-generation balance wheels, anti-shock solutions and escapement optimisation – the Manufacture has laid the foundations for contemporary chronometry. The Sensorial Chronometry Project and the recent opening of its hairspring production workshop mark a new step towards the integration and customisation of watch adjustment.

De Bethune pursues a clear ambition: to sustainably improve mechanical watches' accuracy and reliability in the face of brief, disordered wrist movements. This approach combines craftsmanship, materials research and technical innovation to offer timepieces whose chronometry (precision timekeeping) remains stable in real-world conditions.

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Stage 1: Securing the reliability of the watch's beating heart: the balance wheel and hairspring

Designing the 21st century oscillating organ was the starting point for technical innovation at De Bethune. Research initially focused on the balance-wheel and hairspring pairing, adopted right from the very first calibre produced for the brand's iconic DB15 Perpetual Calendar model (2004).

1. HAIRSPRING WITH FLAT TERMINAL CURVE

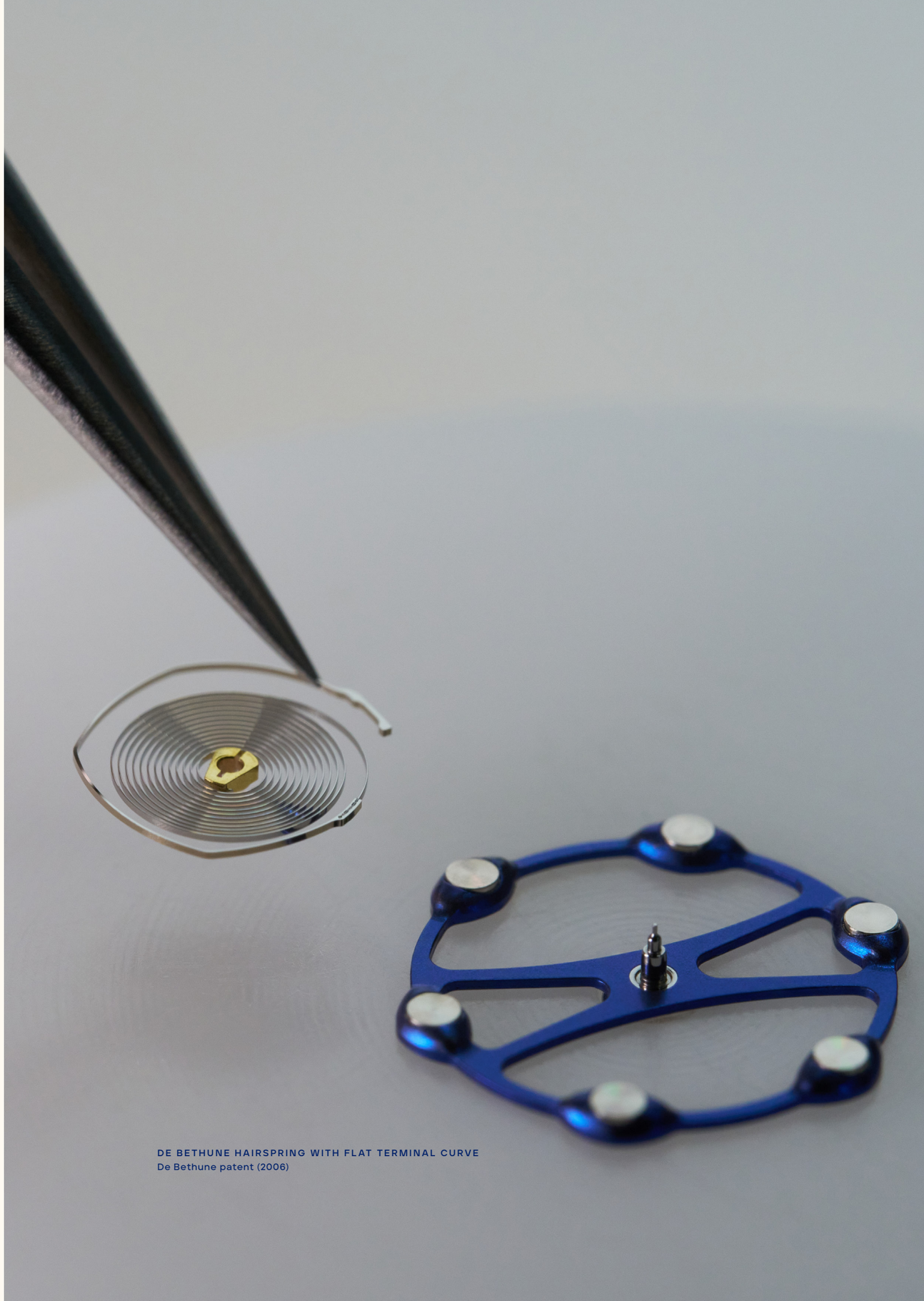
De Bethune developed a hairspring featuring an outer curve designed to enable concentric development, improving the isochronism of the balance wheel and hairspring during wrist movements and in different positions. It has also been designed to better absorb shocks and significantly reduce the deformations observed on conventional hairsprings in the event of impacts. The result: increased oscillator stability, greater resilience against shocks and frequency preservation in real-world conditions. Its geometry also optimises space within the calibre and facilitates adjustment.

2. OPTIMISED BALANCE WHEEL: STABILITY AND CHRONOMETRIC PRECISION

Thanks to advances in materials and finishes, De Bethune designed its own balance wheel: a lightweight titanium core surrounded by peripheral weights in white gold concentrates the mass at the periphery to increase the moment of inertia while limiting the overall mass. Combined with an optimised ergonomic profile and meticulous finishes, this distribution reduces friction and sensitivity to external disturbances, stabilises the amplitude and enables reliable operation at high frequencies of 28,800 vibrations per hour (4 Hz) and 36,000 vibrations per hour (5 Hz), even in the event of repeated impacts – thereby guaranteeing stable chronometry for a wristwatch.

"The balance wheel's high inertia combined with its lower overall mass contribute to the stability of the regulating organ and serve to achieve a high degree of quality that is essential for optimal chronometry."

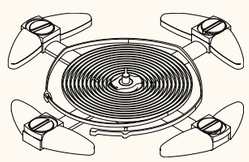
— Denis Flageollet



DE BETHUNE HAIRSPRING WITH FLAT TERMINAL CURVE
De Bethune patent (2006)

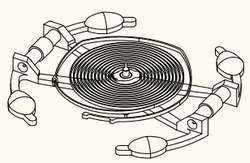
THE DE BETHUNE BALANCE WHEEL AND ITS EVOLVED VERSIONS

De Bethune patent 2004



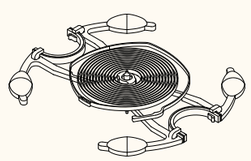
2004

Titanium / platinum balance wheel



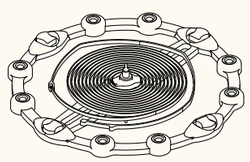
2005

Titanium / platinum balance with X-arms and weights inserted in the arms



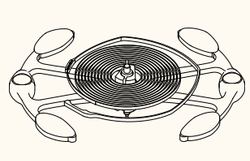
2006

Thermocompensated silicon balance wheel



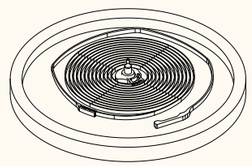
2007

Titanium / platinum annular balance wheel



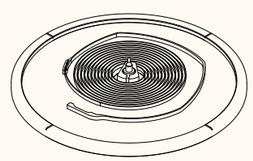
2008

Titanium / platinum balance wheel with gold plots



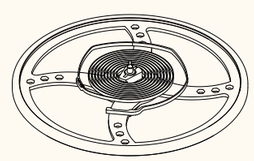
2008

Silicon / platinum annular balance wheel



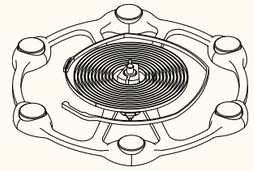
2009

Silicon / palladium annular balance wheel



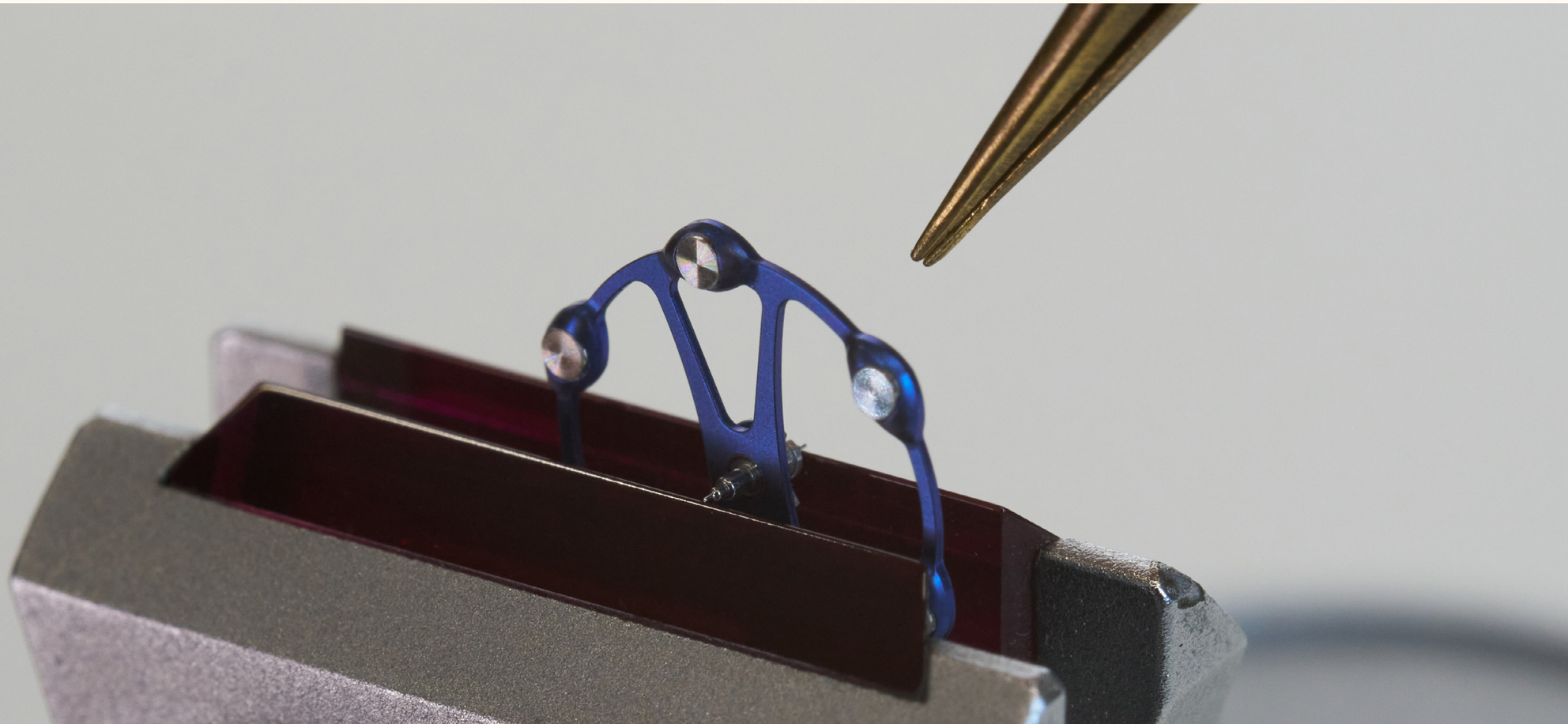
2010

Silicon / white gold annular balance wheel



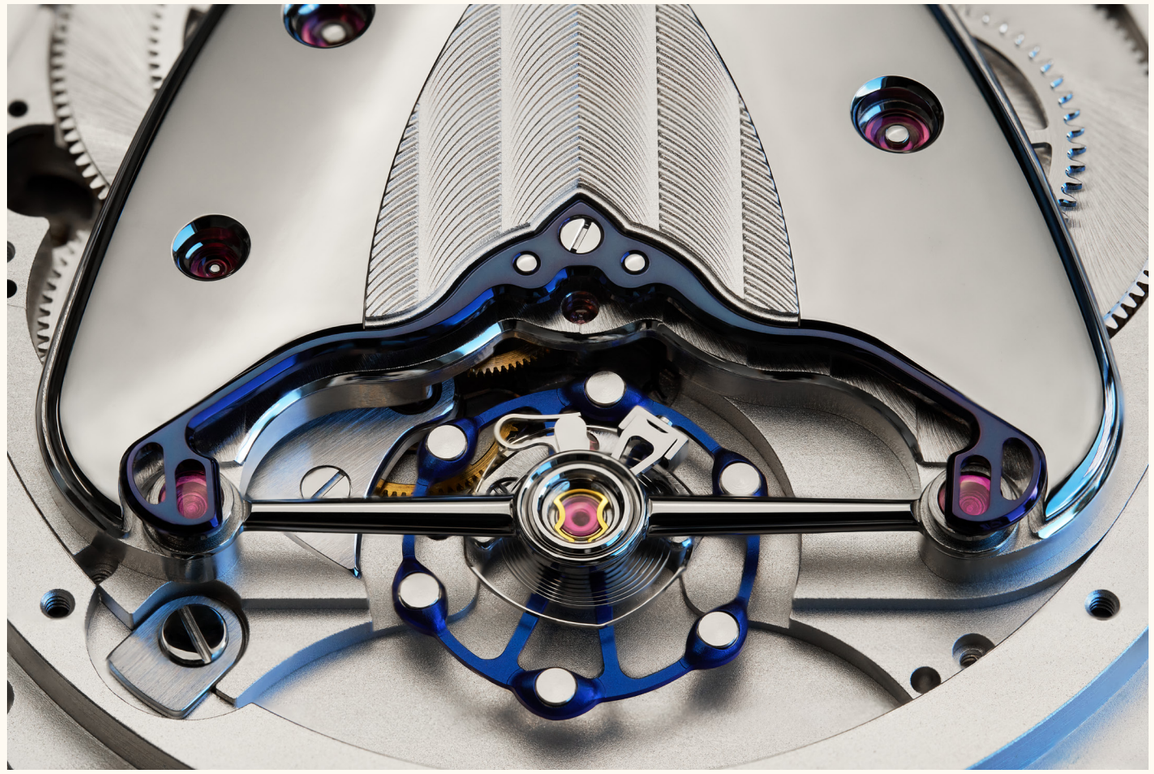
2016

Titanium balance wheel with white gold inserts



Stage 2: Shock resistance: the triple *pare-chute* system

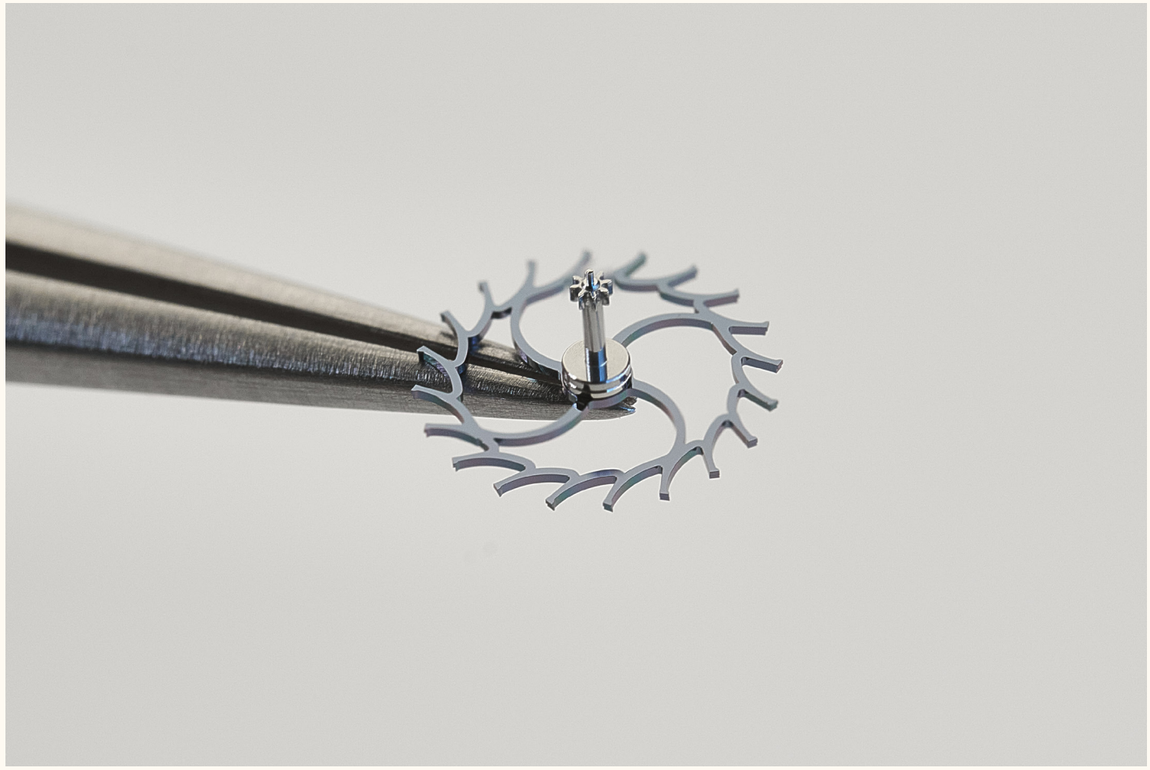
De Bethune is the first contemporary watch Manufacture to develop a three-point shock-absorbing system designed to reduce external influences and protect the heart of the watch. A titanium bridge is fitted at its ends with two shock absorbers (jewels teamed with leaf springs) and a central counterpart. This structure ensures both axial and radial support for the balance wheel, guarantees its position and thus preserves amplitude stability and chronometric precision.



TRIPLE *PARE-CHUTE* SHOCK-ABSORBING SYSTEM
De Bethune innovation (2005)

Stage 3: rethinking the lever escapement through the lens of silicon and efficiency

In perfecting its approach to chronometry, De Bethune redesigned the Swiss lever escapement. The escape wheel stands out for its innovative geometry and silicon construction, effectively halving the risk of wear on the lever pallets. This exceptional material – that is both lightweight and elastic – optimises friction and improves the efficiency of all calibres produced since 2009. By combining a specific pallet design with a silicon escape wheel featuring optimised teeth, De Bethune minimises inertia and creates profiles that facilitate the smooth sliding of surfaces in contact, thereby reducing the force of impacts. This approach results in maximum energy savings and substantial improvement in the escapement's efficiency.



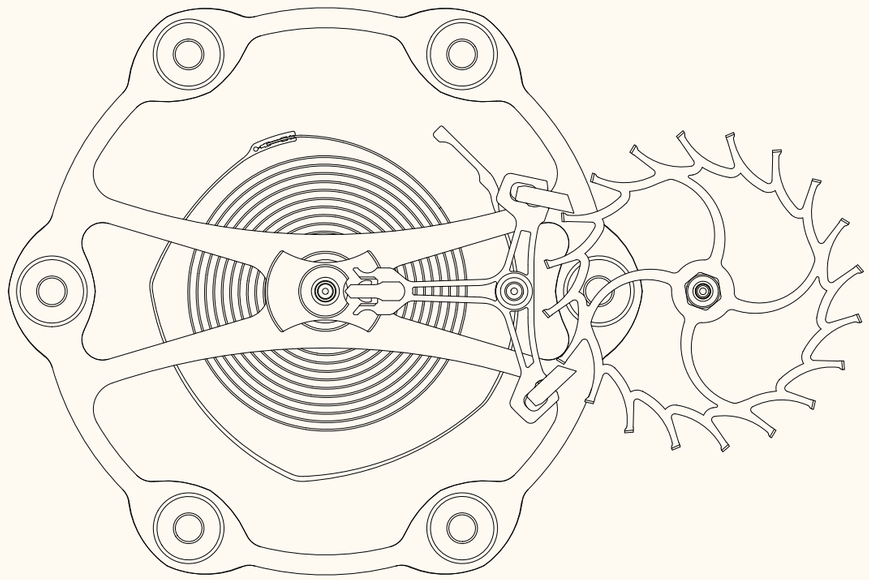
THE DE BETHUNE SILICON WHEEL
De Bethune innovation (2005)

THE ROBOTIC ARM AND ITS ATMOSPHERIC SIMULATION CHAMBER IN THE DE BETHUNE CHRONOMETRY WORKSHOP
De Bethune innovation (2022)

Stage 4: Customised adjustment: the Sensorial Chronometry Project

In 2022, De Bethune launched the “Sensorial Chronometry Project”, a watchmaking first offering truly customised chronometric adjustment. Intended for owners of a DB28GS Grand Bleu, the project involves the customer wearing a test watch equipped with sensors (movements, positions, shocks, ambient temperature, humidity, atmospheric pressure, etc.) for two weeks, generating significant data flows that are analysed by the Chronometry Workshop in L’Auberson.

Installed in an atmospheric simulation chamber, a robotic arm faithfully reproduces the wearer’s environment and movements in order to adjust the watch to the constraints of real-life use: each custom-made timepiece is accompanied by a personalised report.
This exclusive, gradually rolled-out service aims to go beyond the standard static tests performed by the entire watch industry (including those for the most prestigious certifications) and instead offer precision tailored to the owner’s lifestyle and daily activities.

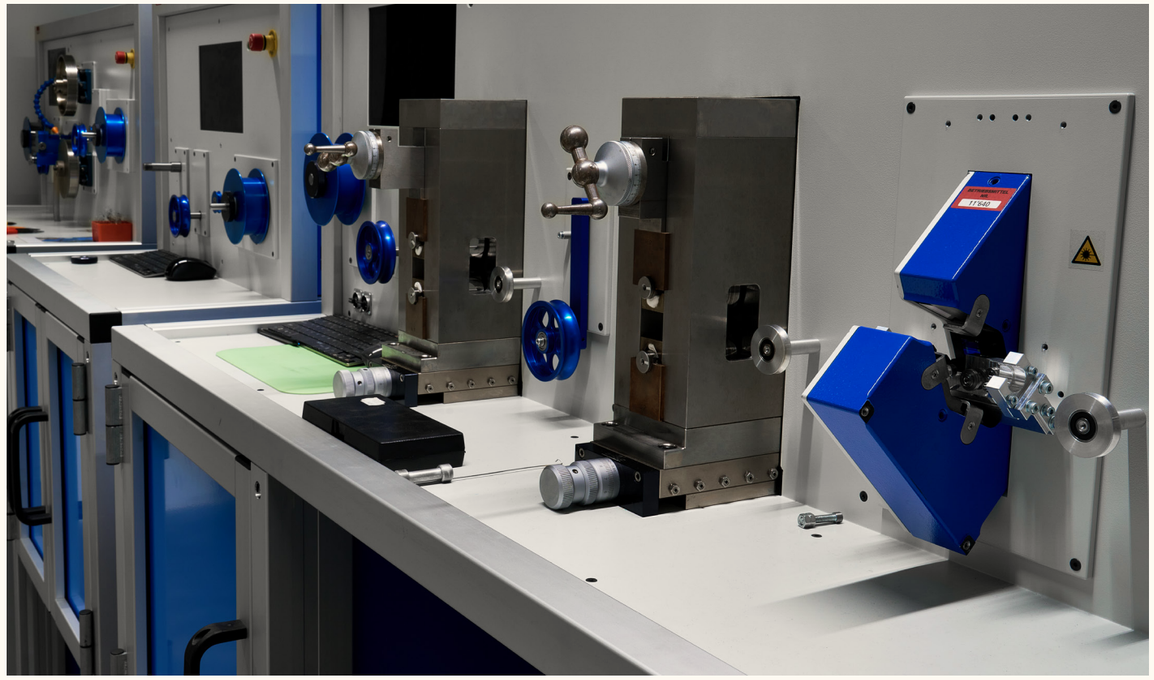


THE DE BETHUNE ESCAPEMENT AND ITS SILICON WHEEL
De Bethune innovation (2005)

Stage 5: Hairspring workshop

This year, De Bethune is taking a new step forward by integrating the entire hairspring production in-house: from wire drawing and rolling to precision operations – cutting, heat treatment and colleting – through to its assembly with the Manufacture balance wheel and final adjustment of the watch.

Above and beyond autonomy, the stakes are also technical: externally produced hairsprings meet standards based on averages that do not enable fine adjustment of the dimensions to suit a particular balance wheel or its specific positioning in a calibre. By mastering each stage, De Bethune can now adjust variables down to micron levels – thickness, height, coiling start and collet radius – and adapt the geometry of the hairspring to its balance wheel as well as the specific positioning of each manufactured calibre.



HAIRSPRING PRODUCTION WORKSHOP - DE BETHUNE

“Mastering this technology in our workshops enables us to fine-tune every detail of the hairspring. A few microns here or there serve to push the limits of chronometric precision even further. We can finally size each hairspring to perfectly match our balance wheels and all our calibres.”

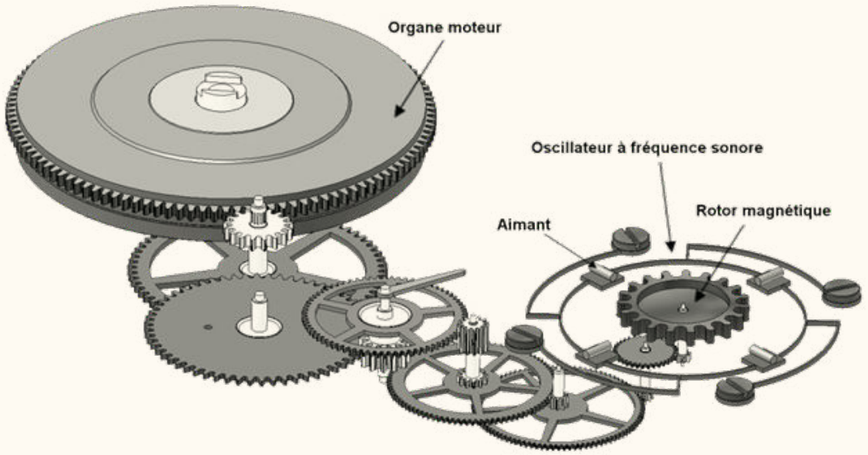
— Denis Flageollet

Research and prospects

In 2012, as part of the *Résonique* project, De Bethune explored the spring functions of silicon to achieve high frequencies and avoid friction in the balance-wheel pivots. These avenues nonetheless remain challenging: the systems proposed to date do not offer free oscillations – as they are servo-controlled, hence not isochronous – and remain sensitive to temperature variations.

In light of this work and the lessons learned from the *Résonique* project aimed at high frequency that did not meet all its objectives, the De Bethune development team is now convinced that mechanical watchmaking will gain in precision by furthering research into the balance-and-hairspring inherited from Huygens 450 years ago.

With more than 20 years of research and innovation under its belt – including eight patents and 31 calibres to its credit – De Bethune is constantly reinventing itself, driven by pure passion to rethink, improve and innovate. The resolutely future-oriented Manufacture prioritises technical expertise to ensure creative freedom, pursuing an ideal of precision dear to Denis Flageollet.



RÉSONIQUE HIGH-FREQUENCY PROJECT
De Bethune research (2012)

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