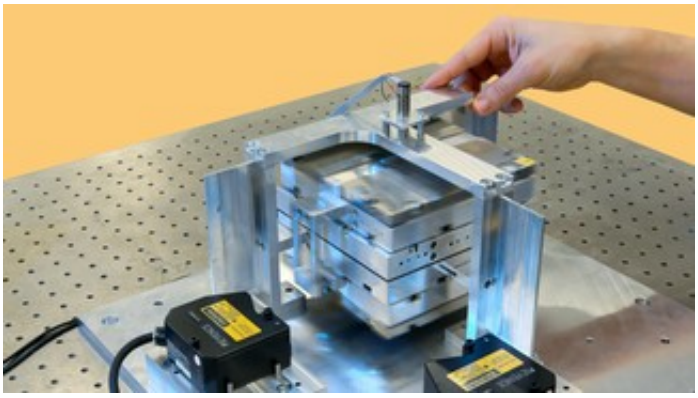
The oscillator that could makeover the mechanical watch

September 18 2014, by Laure-Anne Pessina



Credit: EPFL

For the first time in 200 years the heart of the mechanical watch has been reinvented, thereby improving precision and autonomy while making the watch completely silent. EPFL researchers have developed an oscillator that turns continuously in one direction, eliminating one of the crucial mechanisms of traditional watches.

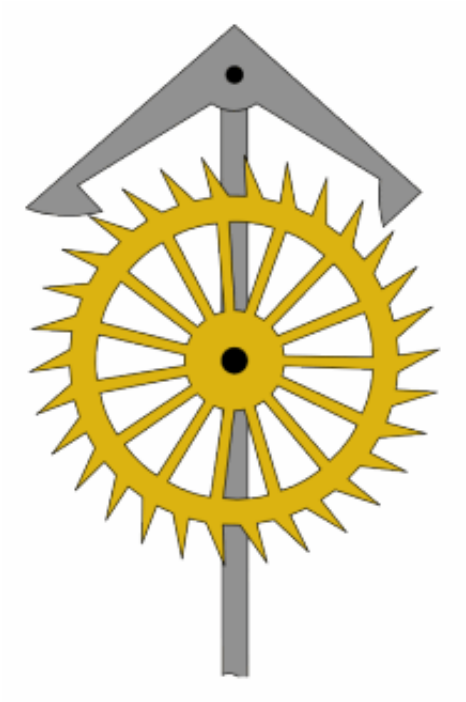
Will the familiar ticking of our watches be a thing of the past? A group of EPFL researchers has imagined a unidirectional continuous oscillator which could become a new timebase for the mechanical watch. This would revolutionise the mechanical concept whose basis has remained unchanged for centuries.

IsoSpring, the name given to the new oscillator, was recently revealed to the public at the Journée d'Etude de la Société Suisse de Chronométrie, the annual conference of the Swiss watch industry. IsoSpring allows one to bypass the most complicated mechanism of traditional watches. The result will be more precise watches with increased autonomy which would also be noiseless.

"Our prototype weighs four kilograms but we're already trying to miniaturise it so as to fit it in a wristwatch; the watch industry has expressed great interest in the project," says Professor Simon Henein, holder of the Patek Philippe Chair and director of Instant-Lab. IsoSpring differs from the pendulum, the spiral-balance wheel and the tuning fork, the three oscillators used in clocks and watches. It represents the first conceptual change in the mechanical watch in 200 years.

60% energy lost in traditional watches

Mechanical watches depend on a system of gears leading to the alternating oscillations of the balance wheel and the motion of the hands. The interface between these gears and the balance wheel is the escapement. It continues to represent the most difficult challenge to engineers. Every time the balance wheel changes direction, the entire gearing mechanism starts and stops yielding the familiar ticking sound. "This stop and go motion wastes enormous energy, for this reason even the best escapements are limited to 40% efficiency," explains Simon Henein.



Compliant mechanisms

Due to its continuous rotation, IsoSpring eliminates the need for an escapement. Gone are the traditional intermittent mechanisms, now substituted by smooth motion based on compliant mechanisms. One of Simon Henein's specialties, compliant mechanisms use the elastic properties of matter to effect the motion of mechanical components, eliminating friction and the need for lubrication.

"Our concept is in a mechanical tradition. We do not appeal to high technology and our methods are accessible to 18th century engineers," points out Simon Henein.

Elasticity for elliptical rotation

But how does IsoSpring work, exactly? Imagine an ancient sling in which you use a leather strap to make a stone turn in a circle. If you replace the strap with an elastic band, the stone will now move in an ellipse and its speed will no longer be constant; on the other hand, its period will now be constant so it can be used to measure time precisely. This principle, discovered by Isaac Newton in the 17th Century, is the conceptual basis of the new oscillator. The rotation is maintained by the traditional barrel spring.

"Our watch is a departure from chopped up ticking time and a return to continuous time as seen in nature by the motion of the stars," concludes Simon Henein.

Provided by Ecole Polytechnique Federale de Lausanne

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