

Automatic winding: one direction or two?

BIDIRECTIONAL

MIRKO HEYNE

DESIGN ENGINEER OF THE NOMOS TANGOMAT:



» The automatic winding mechanism of the Nomos Tangomat must wind a comparatively strong mainspring. Its strength lets us use a large balance, which contributes to the good rate results. According to an old watchmaker's equation, a large movement equals large components equals a highly accurate rate. Nomos subjected this new watch to thorough testing. The accuracy of the rate is excellent. The deviation is considerably less than one minute per week, a performance on a par with the accuracy of a certified chronometer. This means that Nomos's bidirectionally winding rotor has plenty of work to do. That's why it's so heavy and so large. The radius of the Nomos rotor is larger than the radius of rotors in comparable watches, and this bigger radius translates into more efficient winding. When you wear a watch with a unidirectionally winding rotor, you often feel the rotor when it swings freely in the non-winding direction. It accelerates strongly, but this can also create an unpleasant feeling on the wrist. A bidirectional rotor doesn't have this shortcoming. Furthermore, a unidirectionally winding rotor has fewer rotations that wind the mainspring. Hence, the translation must be reduced and the rotor must be either heavier or larger. We didn't want this effect in the Nomos Tangomat, so a bidirectional rotor was the best solution. «



Powerful mainspring, big rotor, bidirectional winding: the Tangomat from Nomos

Watchmakers have long debated which automatic winding system is better, unidirectional or bidirectional? We asked some experts to weigh in.

BY GISBERT L. BRUNNER

As with many technological advances, self-winding watches evolved by a process of trial and error. The first attempts began before 1770 and are associated with the names Abraham-Louis Perrelet and Hubert Sarton. We can't say for certain who invented the self-winding mechanism. But who was first really doesn't matter. Far more important is the fact that rotors with unlimited turning capability span the history of self-winding watches: from the modest beginnings of self-winding pocket watches to today's serially produced wristwatch calibers, which are far more suited than pocket watches for automatic winding systems.

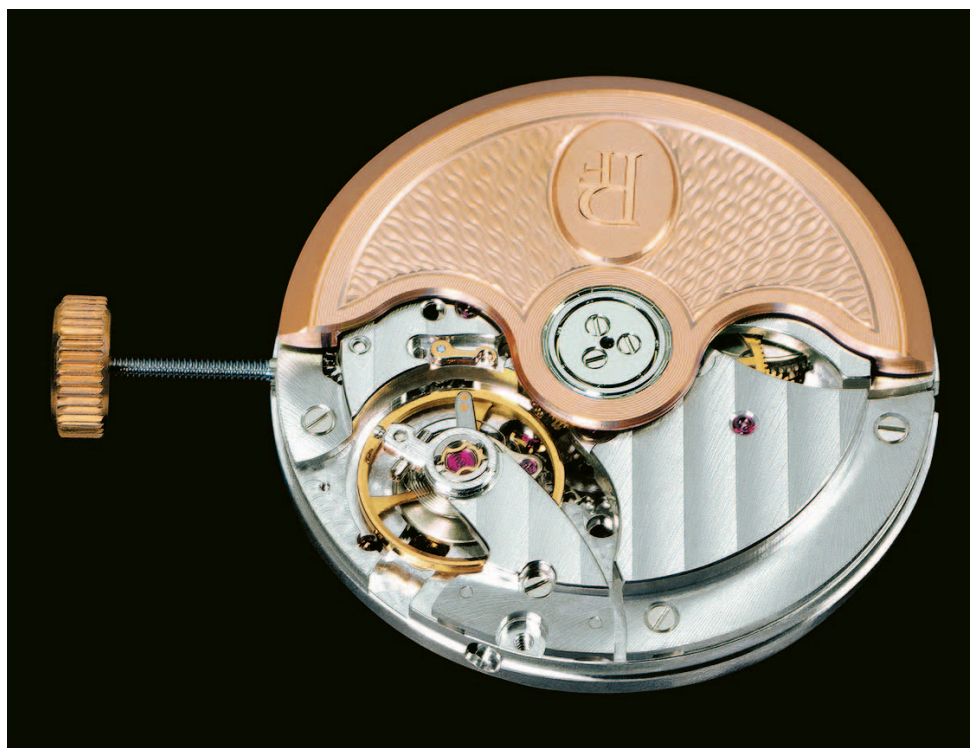
A major turning point came in 1930. That year Rolex founder Hans Wilsdorf and his gifted technical director, Emil Borer, announced "the invention of an automatic winding mechanism that turns to and fro absolutely silently, smoothly and without buffers." The Rolex Perpetual debuted in 1931, with the 7.5-mm-tall Caliber NA 620 ticking inside its case. This caliber's rotor turned in both directions and relatively silently; but the rotor wound the mainspring in only one direction. Two years later this construction was granted nearly "watertight" worldwide patent protection. Rolex's com-

petitors had no other choice but to make do with hammer-type winding mechanisms.

In 1978, Harry Borer, the owner of Rolex Bienne, recalled what happened. "When the 15-year term of patent protection elapsed in 1948 and the invention became legally available to anyone who wanted to use it, practically the entire domestic and foreign watch-making industry began using this ingeniously simple self-winding system." But Borer was only partly correct: he either forgot or ignored Felsa, which was founded in 1918 and was integrated into Ebauches SA in 1928. Located in nearby Lengnau, this ébauche manufacturer had cunningly finessed its way around Rolex's patent. When Caliber 410 (or 415) was launched in 1942, this 11½-ligne, 5.8-mm-tall movement was equipped with a bidirectionally winding rotor. The trick here was a little sliding gear that created the connection to the reduction train and the barrel via one or two gears, depending on the direction in which the rotor happened to turn.

Longines followed suit with a rotor-equipped caliber of its own three years later. With a wary eye on the patent situation, this *manufacture* had likewise devised an innovative and patent-worthy device. The oscillating mass inside Longines's 13-ligne, 6.5-mm-tall Caliber 22 A was effective in both directions of rotation. This bidirectional functionality was accomplished by a so-called "eccentric reverser" and a cleverly designed system of switching and blocking pawls.

Eterna in Grenchen joined the self-winding club three years later in 1948. The engineer Heinrich Stamm, whose colleagues respectfully gave him a German nickname equivalent to "Rube Goldberg," created a rotor that turned around a miniature ball bearing. This solution reduced both friction and the danger of breakage. Furthermore, the Calibers 1198 and 1199 each had a patented reverser train with springless pawls. This efficient system suffered very minimal losses of energy when it reversed directions. Its success prompted other makers of self-winding movements to pursue similar solutions in subsequent years.

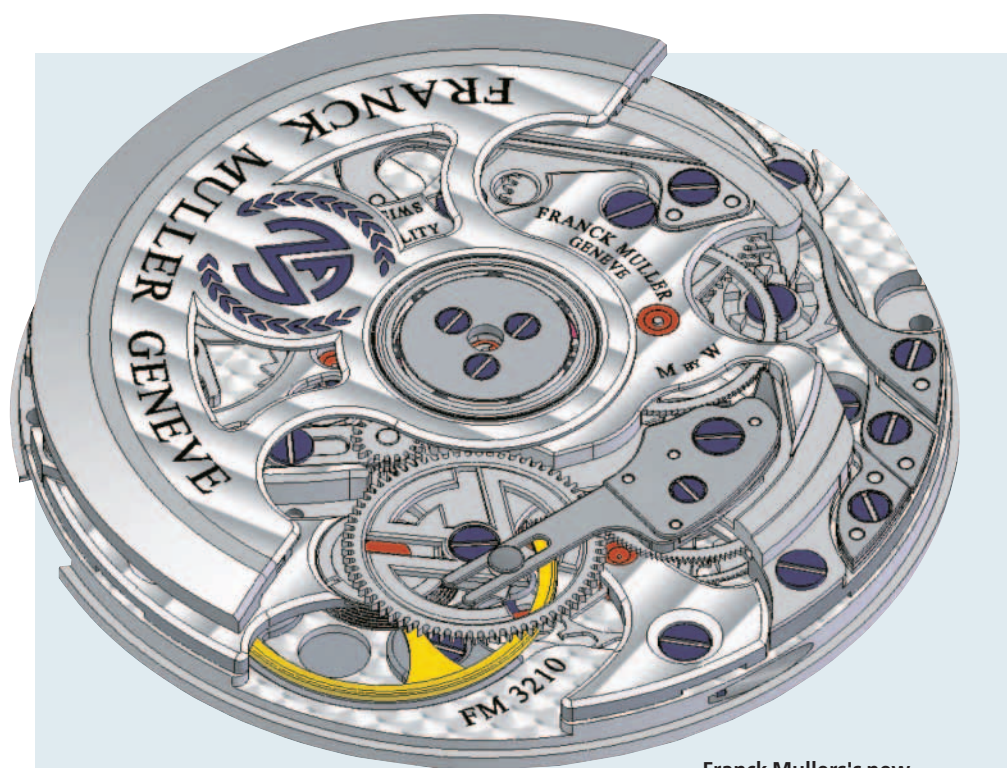


Unidirectional winding: Caliber 331, Parmigiani's basic automatic caliber



UNIDIRECTIONAL MICHEL PARMIGIANI FOUNDER, PARMIGIANI FLEURIER:

» We've opted for unidirectional winding in Caliber 331, as in all our other calibers. The reason has to do with the construction. There are cogent arguments for and against both systems. The winding factor of the oscillating mass is greater in a unidirectional system, and that makes this system more efficient. «



Franck Mullers's new highlight: Caliber FM 3210

BIDIRECTIONAL
PIERRE-MICHEL GOLAY
DIRECTOR OF RESEARCH & DEVELOPMENT AT
FRANCK MULLER WATCHLAND:

» The advantage of a bidirectional 'wheelbarrow' winding system of the sort that we use in our chronograph Caliber FM 3210 lies in the fact that it winds twice as quickly as a unidirectional system. The result is a more precise time display for people who don't move their forearms very much when they wear their watches. Bidirectional winding systems are much more complicated to manufacture, but they're also more efficient. In accord with an old custom, the Caliber FM 3210 is equipped with a winding system that disappears completely between the bridge and the plate. It's our newest caliber and it's our top-of-the-line item. Its concept makes it particularly well suited for smaller watches. «

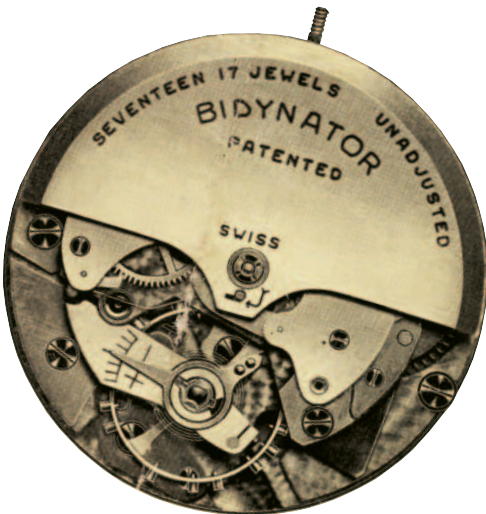


Contemporary journalists praised the Eternamatic as "the scientifically most modern watch, which is most preferred by specialists." Their praise was partly due to the fact that for the first time in the history of self-winding watches, there was an automatic winding module that consisted of just 12 components. By removing just three screws (and only two in newer calibers), the entire module could be lifted out of the underlying movement. This service-friendly procedure required less than a minute to perform. The ébauche-makers at ETA naturally also benefited from this pioneering spirit. Eterna wanted to prevent its competitors from catching up with its technological advantage, so, when ETA's Calibers 1216 and 1256 debuted in 1950, these movements had to make do with click-wheels and oscillating masses that rotated around a conical gliding bearing.

A bidirectional future?

The trend was clear. The future belonged to bidirectional winding because every motion of the rotor, regardless of its direction, could be exploited to deliver energy to the barrel.

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Full of clever tricks: Felsa's Caliber 415 from 1942

UNIDIRECTIONAL
WILLY SCHWEIZER,
CURATOR OF THE
GIRARD-PERREGAUX MUSEUM:



» Many studies — and not only our studies — have shown that the mainspring of a self-winding watch with a unidirectional winding system is always maximally tightened if the watch is worn regularly. The energy supplied by motion of the wearer's arm is entirely sufficient to keep the watch running. The rotor must overcome inertia each time it changes direction, and this saps some of the energy that would otherwise contribute towards winding the mainspring. When the rotation of the mass begins with the free turn in a unidirectional winding system, the mass swings significantly farther and winds the mainspring more efficiently when it returns to its resting position.

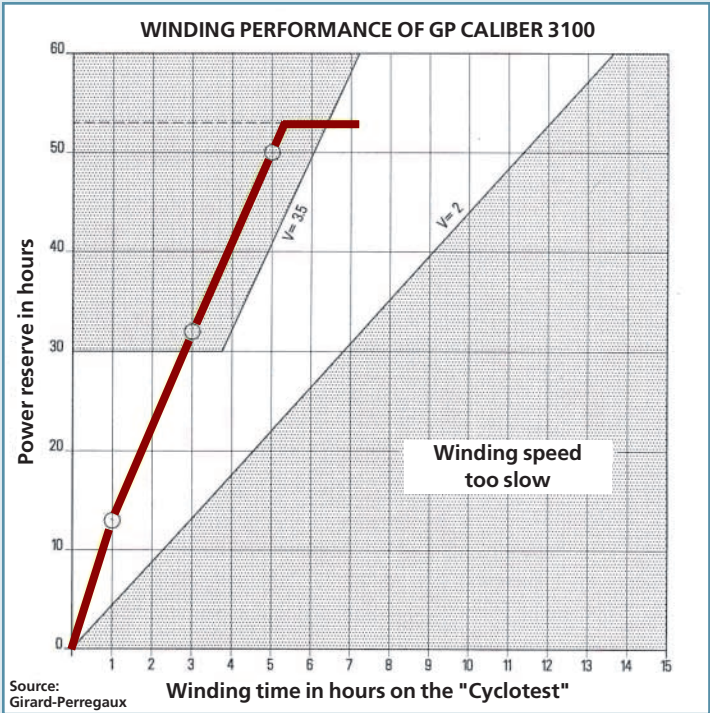
Unidirectional winding systems require fewer components. Here one could say that 'simpler equals more reliable.' The masses in the system are smaller too. Consumers demand progressively greater performance from the few cubic centimeters of mechanisms inside their watches, and a unidirectional system satisfies this demand.

Our choice of a unidirectional system is also based on strategy: bidirectional winding is efficient when the wearer is active, but we believe that people today (unfortunately) spend more time sitting in front of their computers than engaging in strenuous sports.

The accompanying diagram shows the winding performance of Caliber 3100 on the Cyclotest device. The value V is a mathematical formula. $V = 2$ corresponds to the performance of an automatic movement that needs 12 hours of wearing to compensate for a resting interval of 12 hours. $V = 4$ would correspond to a fully wound mainspring in just 6 hours after a resting time of 18 hours. We consider values less than $V = 2$ to be poor, and we consider the angle between $V = 2$ and $V = 3.5$ to be good. The red line shows the winding speed of Caliber 3100. The diagram speaks for itself. «



A high-performance caliber:
GP 3100 from Girard-Perregaux





Jaeger-LeCoultre's split-decision: the Caliber 975 (Autotractor) winds in one direction...



...and the Caliber 899 winds in both directions.



photo: Eveline Perroud

UNIDIRECTIONAL JÉRÔME LAMBERT CEO OF JAEGER-LECOULTRE:

» We tested Caliber 899 in two ways, in the standard version with bidirectional winding and in an altered form with unidirectional winding. Unidirectional winding was significantly slower on the Cyclotest machines. But we also asked different people to wear these watches on their wrists. We gave them wristwatches with slack mainsprings and asked them to wear them from 8 a.m. to 4 p.m. On average, watches with unidirectional winding were twice as strongly wound as watches with bidirectional winding. These results led us to develop the unidirectionally winding Autotractor calibers in our 970 family. We use bidirectional winding systems in all our other automatic calibers. We also rely on bidirectional winding in the caliber that powers our Master Compressor Chrono. This was a technical decision because the functions in a chronograph caliber require a lot of volume. Their special arrangement in the movement made this solution seem more practical and more sensible. «

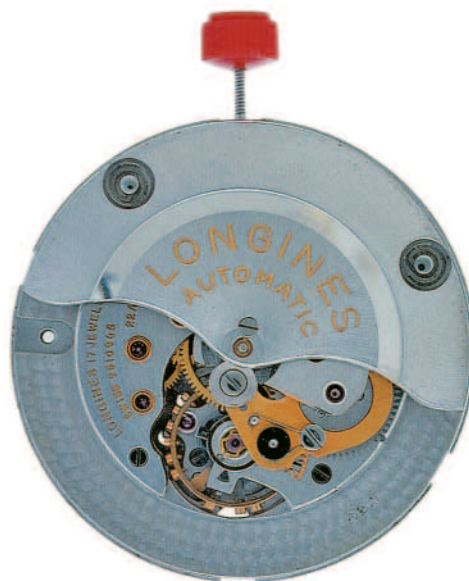
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Engineers vied with one another to devise reversers that would polarize the kinetic energy. Then as now, gears, clicks and eccentric reversers competed to attract potential customers.

Then came the year 1973, and with it a new chronograph caliber that would withstand the chaos of the quartz revolution nearly unscathed: the Valjoux 7750.

Ease of servicing and energetic efficiency were top priorities for Edmond Capt, who designed this classic caliber. Perhaps the most astonishing detail in this movement is its unidirectional winding. Even the most demanding specialists praise this caliber for its commendable winding performance and reliability. These two attributes have elevated this comparatively simple mechanism into the elite circle of mechanical bestsellers.

Under the directorship of Luigi Macaluso, Girard-Perregaux returned to the ranks of manufacturers of self-winding movements in 1994, when it introduced its 3000 family of calibers. The basic Caliber 3000 is 23.9 mm in diameter and a mere 2.98 mm in height. This extraordinarily low-rise architecture makes it



1945: Longines's first automatic caliber, the 22A



Slimmer, thanks to unidirectional winding: the Caliber 315 from Patek Philippe



UNIDIRECTIONAL
MARC-ANTOINE SUDAN
PROJECT DIRECTOR FOR CALIBER 315
AT PATEK PHILIPPE:

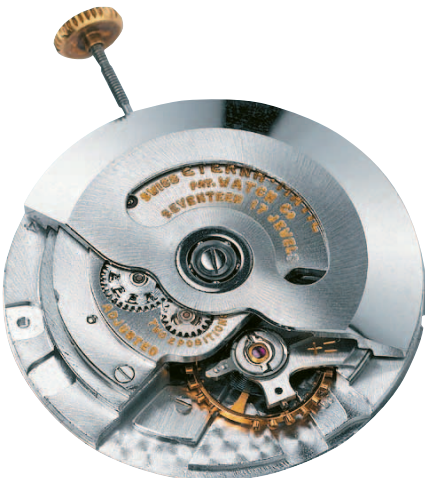
» We decided in favor of unidirectional winding because the concept behind it is simpler and more precise than bidirectional winding. It also lets us make a flatter movement because it requires less space than a bidirectional mechanism. When a watch is worn on a person's wrist, there's no difference in the winding speeds of the two systems. «

one of the slimmest self-winding calibers available anywhere. Its standard equipment includes a jump-type date display with a mechanism to support the rapid resetting of the date. A ball-borne, unidirectional rotor winds the mainspring. A lot of thought and discussion went into Girard-Perregaux's decision to do without a reverser mechanism. The decision wasn't prompted by the need to minimize height. According to Macaluso, "Even with a bidirectionally winding rotor, we could still have kept the overall height under three millimeters."

Jaeger-LeCoultre's Caliber 975, also known as the Autotractor, is one of the newest examples of unidirectional-winding. Launched in 2004, this movement has an oscillating weight with a segment made of 22k gold. After exhaustive tests, Jaeger-LeCoultre opted for unidirectional winding.

Patek Philippe chose a similar path when it developed the self-winding Caliber 324. Unlike the well-known, tried-and-tested Caliber 315 with bidirectional winding, the 21k-gold rotor in the Geneva-based *manufacture's* caliber conveys its energy to the mainspring in only one direction of rotation.

So it seems that there are plenty of persuasive reasons for unidirectional winding — and as many equally persuasive arguments in favor of bidirectional winding. *Vive la différence!* ■



Miniature ball bearing: the Eternamatic from 1948