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The Nomos Tangente Neomatik 41 Update

An HJ Tear-Down and Review

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Just how good can it be, priced at only £3,200? The 'Tangente neomatik 41 Update' (reference number 180) is made in-house by the private company Nomos, which is fully independent of the Swiss manufacturing network. Here we tear one down and offer our opinion and technical analysis.

The watch was introduced in 2018, and has won several awards including the prestigious GPHG's Challenge Watch Prize for that year, and a European Product Design Award, in 2019.

I was first drawn to it by the intriguing design of its calendar mechanism, shown to me in early 2018 by Theodor Prenzel, the Nomos Head of Design Engineering. No photos of the (pre-launch) acrylic model were allowed, which only increased my interest. The date mechanism is an unusual arrangement employing differential gearing and a Reuleaux triangle[*], coupled with a stirrup-shaped date-driving trigger.

Nomos watches have a strongly established visual style, which this watch fulfills in every way. There's no mistaking that this is a Nomos. The steel case has a narrow bezel, allowing the dial to feature prominently. At 41 mm, it's fairly large, but I am used to wearing Rolex sports models and a vintage Breitling Navitimer, both at 40 mm, and this watch doesn't feel particularly larger. Perhaps the slimness helps. There's a sapphire crystal front and rear, with anti-reflective coating on the front. At first glance the typography of the dial seems very plain, but upon close inspection all the type designer's secrets are revealed in lots of beautiful details. The snap-on case back is very tightly fitted, and the notch for the case opener is more of a step than a tapered slit. The watch is fitted to a Horween shell cordovan strap, and is supplied in a leather wallet with protective outer box, along with warranty documents and an instruction booklet. According to its website, Nomos now offers a 12-month payment plan with 0% interest.

Horology writers online love to mention Nomos's sleek design and how it might or might not be inspired by that 'B-word' German art school and its philosophy. Notwithstanding its links to the school and its successors, Nomos told me in so many words that it prefers to avoid the B-word, because of how heavily over-used it is; I have therefore eschewed it here. What we can't ignore is that the lean and clean appearance of Nomos watches strongly dictates the technical aspects of the movements within.

Figure 1. Calibre DUW 6101, made in-house by Nomos.

The calibre under discussion is the DUW 6101, **Figure 1**. This is one of a new range of automatic calibres by Nomos, all of which fall under the general name 'neomatik'. This one is only 3.6 mm thick, and yet it features a compact and efficient automatic device, an in-house lever escapement and a novel and idiot-proof calendar function. We'll look at each of these in detail.

Overall, the movement presents a beautifully distinctive appearance, finished in a pale silvery-white plating. The engraved calibre and serial numbers, along with other engraved information are gilt, whilst the winding rotor has a string of gilt text in beautiful *bas-relief*. Of course there is the obligatory patterning of grained stripes, bevelled edges, and spotting in the lower reaches of the work.[†]

* The Reuleaux triangle is a 'shape of constant width'. In other words, if you measure across it at any point, the distance is always the same. The only other such shape is a circle; but a circle can't be used as a cam in the same way. If a Reuleaux polygon is rotated about its geometric centre, while being straddled by a fork with parallel arms, it causes the fork to wobble back and forth. Very useful in horology. It was used to powerful effect by watchmaker Derek Pratt in his tourbillon-mounted remontoire. Nomos here eke even more motion out of it by placing the centre of rotation near one edge. Everyday Reuleaux shapes are found in everybody's pockets in the form of 20- and 50-pence pieces.

† Nomos has a word that it eschews, alluded to above, and I also have one: the P-word, when it comes to describing what Englishmen have for hundreds of years called *spotting*. Victims of heavy Swiss marketing slavishly call it *perlage*, but this is appropriate at best only when describing the pattern on watches made in the west of Switzerland, not to English watches and certainly not to German ones. In this matter I am on the side of Confucius: 'The beginning of wisdom is to call things by their right names.'

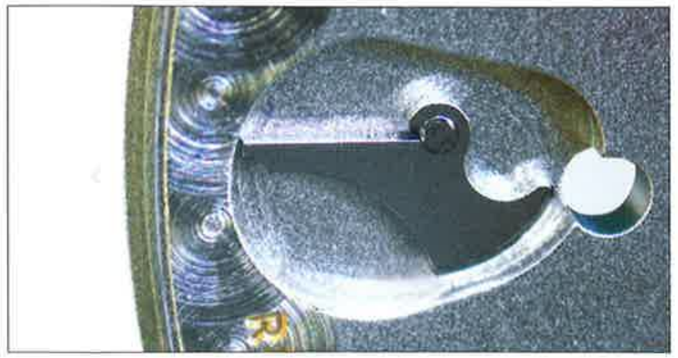


Figure 2. Dial key.

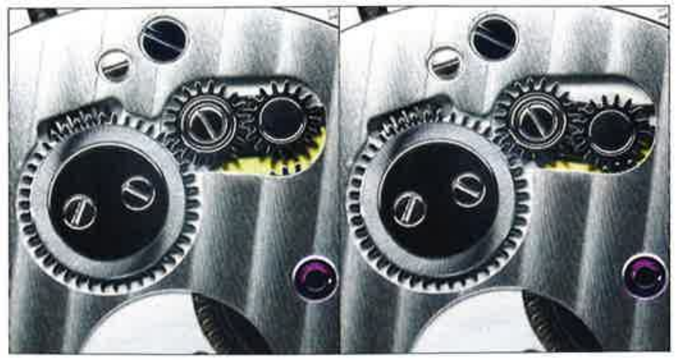


Figure 3. Crown wheel and wig-wag keyless transmission wheels, shown at their two extremes of position.

The balance is mounted under a bridge, said to afford more rigidity than an ordinary balance cock. Of course the escapement is the Nomos 'swing system', the in-house escapement introduced in 2004. All Nomos watches with swing escapements have blued balance springs, with the balance, pallets, and escape wheel, along with their arbors and pinion, made in-house. The escapements are assembled on-site, as described in a previous article (*HJ*, January 2020). I pressed Nomos on the origin of its balance springs, but all I could ascertain was that they are made in Europe, though not in Switzerland.

Regarding the performance of the watch, it exhibited less than half a second per day losing, validating the attestation on the edge of the movement, *Reguliert in 6 Lagen*.

Dial and Hands

The dial is frosted silvery-white, a classically electro-plated brass disc. A slight recess at six for the seconds gives the usual physical and visual separation from the main surface.

Around the edge of the dial are 31 small stadium or pill-shaped slits; these windows are for the red date indicator to peep through. The 31 dates are printed in small type around the dial's edge. Unusually, the red is wide enough to appear through *two* slits at a time, straddling the current date. This works very well, because the slots and date digits are very discreet and don't needlessly draw the eye, but the amount of red makes it easy to read the date at a glance. In theory the visible surface (of the red area) can be larger than would be aesthetically acceptable if there were a traditional date aperture.

This calibre can also sustain a traditional date aperture, placed anywhere around the edge of the dial.

There are two dial feet, held by sturdy keys accessible from the movement edge, **Figure 2**. A milled recess in the rear of the dial near the five gives clearance over the date corrector wheel. Clearly, pressure on this area must be avoided during removal of the hands.

The black-oxidised hands themselves are slender, befitting the style of the watch. Nomos told me that the vertical clearance between them is less than the usual industry standard 0.5 mm.

With the dial removed, we can see the set-hands work and calendar work, although much of the latter is concealed below a steel cover plate. The very light aluminium date ring is smaller than the dial but larger than the movement, so care has to be taken not to damage its edge. I also had to be cautious with the balance, whose rim extends beyond the smaller step in the movement, and a normal (ring-shaped) movement holder here would have damaged it. At the factory of course, heavy custom-made movement holders would be used. I removed the balance and its bridge for safety.

The crown has the usual three positions, for winding, date correction, and set-hands. To study the action of the calendar device, I removed its steel cover. There are no springs below it, but it does hold loose parts captive and care must be taken that these are not lost.

The Keyless Work

This gives me even more reason to admire this watch. Compact, efficient, simple. To the observer, the three-quarter plate is almost devoid of mechanism; the wheel which is normally called the ratchet wheel is concealed below the plate in the manner of some high-grade vintage watches. It is squared to the barrel arbor. The wheel has no click work; this will be discussed later. To one side of this wheel is a wig-wag arm that carries a pair of transmission wheels into engagement with the barrel arbor wheel ('ratchet wheel') whenever the watch is manually wound, but which falls away freely when not in use, **Figure 3**.

To the other side is geared a train of wheels that links it to the winding rotor. Right in the middle of this train is what Nomos calls the 'double-click wheel'. This assembly serves multiple functions:

- As click work to the barrel
- As a reversing device for the self-winding
- It effectively locks the winding rotor once the barrel is wound sufficiently.

The double-click wheel is simple in principle, but requires some ingenuity in hand assembly at the factory. First, about half the parts are assembled; then the assembly is flipped upside down. To stop it all falling apart, it's held by vacuum while the other half is assembled, and then the two sub-assemblies are pressed together. Nomos has published a short film on YouTube showing how this is done. For further details, see 'Automatic Winding Train and Double-Click Wheel', page 63.

Nomos mentions that the winding rotor locks when the watch is fully wound. This is a result of it being unable to overcome the mainspring's raised torque rather than through any positive locking device. The only practical advantage I can see from this is reduced wear to the winding system. The mainspring is a typical reverse-curved automatic spring with a slipping bridle, and indeed the watch may be manually-wound indefinitely without the spring locking.

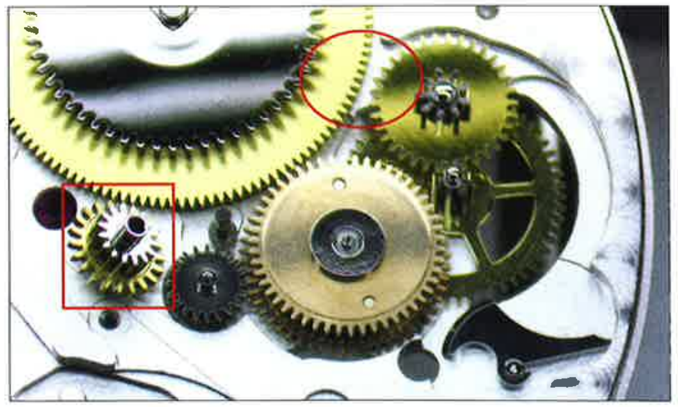


Figure 4. The 'rising pinion', indicated in the square can be lifted straight up off its post once the winding rotor is removed. This releases the mainspring in the manner of a ratchet click. Also shown is the self-winding train of wheels. The idler between the 'ratchet wheel' and the last wheel in the winding train is fastened to the underside of the three-quarter plate and is shown here diagrammatically as an ellipse.

I mentioned that the double-click wheel acts as click-work for the barrel. This part is buried right in the heart of the movement, and its functions cannot be directly accessed even by the watchmaker.

How can the watchmaker therefore release the mainspring power before disassembly? The first wheel after the winding rotor is loose; it can be lifted freely up, **Figure 4**.

In use, the wheel is captive below the edge of the winding rotor. That it can be lifted straight up is not obvious even upon careful examination; however, this wheel (actually a stacked wheel and pinion of close ratio) is capable of locking up the next part of the winding train by its engaging with two other wheels in a triangular configuration, described on page 63.

After allowing the watch to fully run down, and then releasing any slight residual energy by removal of the escapement, this wheel can be lifted straight up. It rides freely on a polished steel pin set into the pillar plate. It could also be lifted while there is wind on the spring, but I feel that such a release would be too aggressive.

The Train and Plates

With the three-quarter plate removed, we can admire the going and winding trains. The going train appears to have involute tooth forms or derivatives thereof. There are high-count pinions, up to 16 leaves in the case of the third wheel. The gold-plated wheels are beautifully low-centre of gravity, making re-assembly an absolute dream, **Figure 5**. The three-quarter plate supports no fewer than nine pivots, and in my examination with multiple re-assemblies, it dropped squarely into place every single time without needing any fiddling.

The wheel tooth profiles of the going train are a proprietary design, arrived at by Nomos collaborating with the Technical University of Dresden (as discussed in *HJ*, January 2020). Contrast these with the more classical ogival form of the winding train teeth, **Figures 6A and B**.

Both trains are jewelled throughout, including the barrel arbor in the plates (except the first auto-wheel stack on a steel pin as described earlier). The winding rotor is mounted on a ball bearing with nine steel balls. It is separated from the three-quarter plate by a brass shim, to fine-tune the vertical separation of the rotor from the movement, **Figure 7**. Shims are unusual in watchmaking, but not unheard of. For example, Rolex furnishes

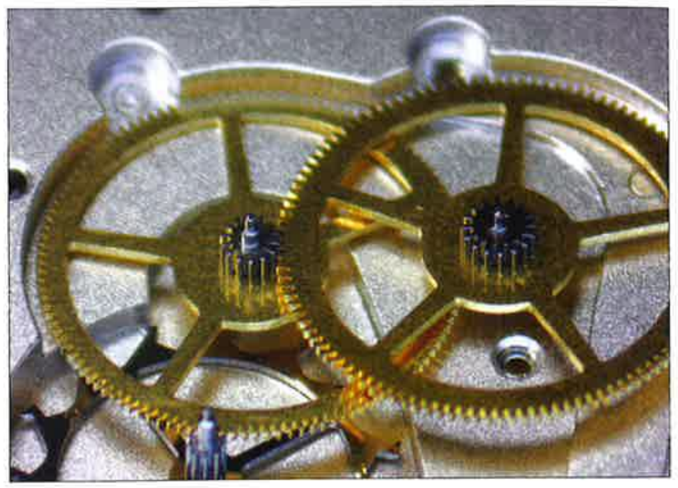
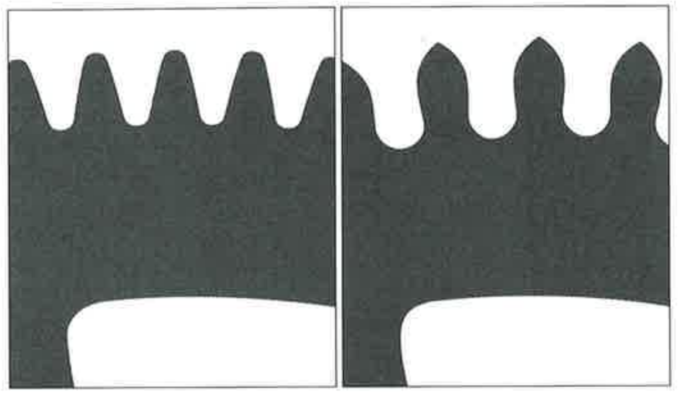


Figure 5. The low-centre of gravity wheels aid easy re-assembly.



Figures 6A and B. Wheel tooth profiles. Left: going train. Right: Winding train.

a packet of shims of different thicknesses for fine-tuning the action of the calendar in its Day-Date calibre 1555.

The Date Mechanism

Moving now to the dial side of the movement, we see evidence of much technical development. The action of the date mechanism is described in detail on page 64 *et seq.*, but in summary it works as follows: the hour wheel drives a train of idlers that branches near its end to two independent wheels, mounted one above the other. By their different tooth counts, the lower one moves faster than the upper, in the ratio 2:2.5. The lower goes round five times a day, and the upper one four times. The lower wheel drives the Reuleaux triangle (which Nomos call the 'program disk') while the upper wheel carries a stirrup-shaped trigger that advances the date. The trigger goes round four times a day, but on three of those it simply passes the tooth of the date ring, never catching it. On the fourth rotation, the Reuleaux triangle coincides with the stirrup in just the right way to nudge it far enough forward to catch the date ring tooth, and draw it forward.

Why this system? Certainly not to do with space-saving, because there is plenty of space on this large calibre, and in any case the chosen outcome was to go thicker, the one direction here where space is actually at a premium. Nomos said that it prefers not to use a large 24-hour wheel for the date function because of the long duration of the engagement. A smaller wheel will get into and out of engagement with the date ring much more quickly, **Figure 8**. In this case it's about

Figure 7. A brass shim separates fine-tunes the clearance of the winding rotor over the movement.

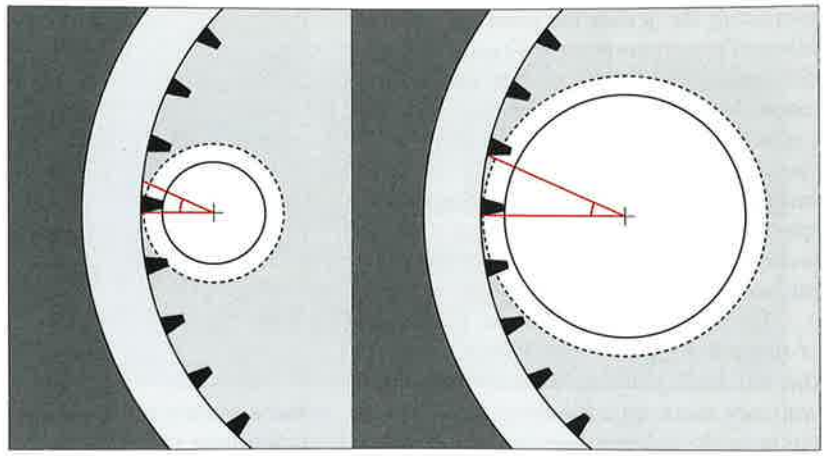


Figure 8. The date drive beak, turning 4 times a day, and being at a small radius in this calibre (left), approaches and retreats from engagement with the date ring much more rapidly than a classical large 24-hour drive wheel (right).

30 minutes from start to finish, although by my observation it only takes about 18 minutes from the moment that a tiny motion of the red can be observed until the date jumps. The benefit of this short date-change time frame is that it cuts down on the time when the date can't be corrected.

Moving on to the user-operated date correction, here too are a number of special features. The date can be set forward or backward. Furthermore, if the wearer attempts to set the date at any time when the system is engaged, a frictional slip arrangement in the date-correction star simply sheds the torque and no damage ensues (see detail in associated box). This is in force 45 minutes either side of midnight. In many other watches, especially at this price range, setting the date 'at the wrong time' will result in immediate catastrophic damage to the calendar work. I really like the Nomos solution; it is a thoughtful, user-oriented design. I have always found it obnoxious when expensive watches require pages of bossy instructions for what should be a straightforward function. Just design the thing properly in the first place.

The pivot of the date ring jumper is eccentric, allowing the watchmaker to finely adjust the ring's resting position, **Figure 9**. This is an improvement on the system used in their previous date calibres.

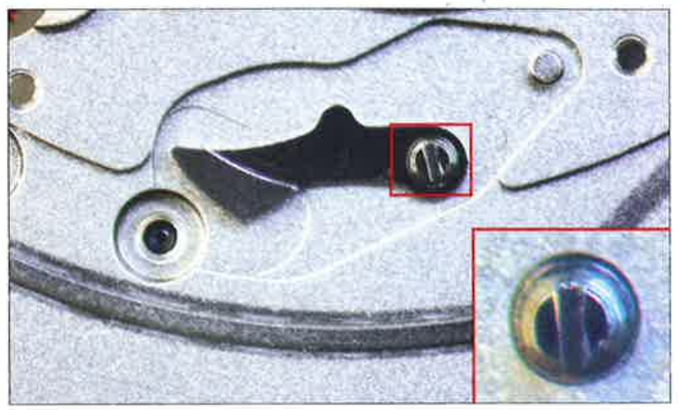
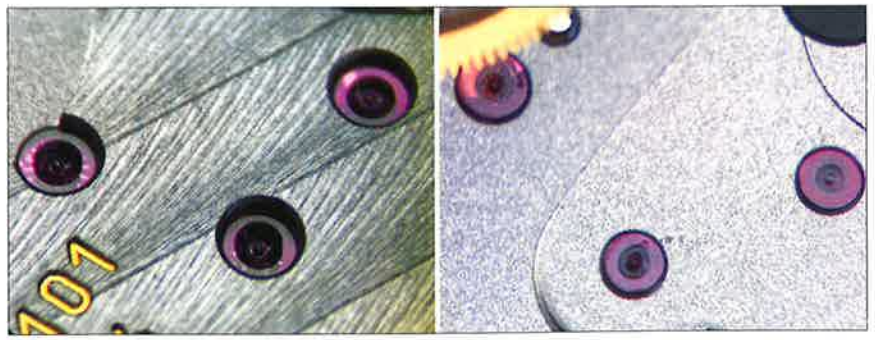


Figure 9. The date jumper pivot is eccentric, for fine adjustment to the date display.



Figures 10A and B. The oiling is consistent and very neat. See also Figure 11.

General Observations

As might be expected, the watch as obtained was in excellent service order, the calibre being in production for only just over a year. The oiling was neat and precise, **Figures 10A and B**. There appeared to be just the merest hint of lubrication on the upper pallet pivot jewel. The stone faces were cleanly oiled with a proper line of lubricant, **Figure 11**. The train was oiled with different grades as far as I could determine, and the keyless work and self-winding work had liberal amounts of thick oil and grease where appropriate. I did not examine inside the barrel or the spring, because the barrel is thin-walled for additional run-time and typically, should never be serviced.

In terms of the cosmetic finish, we have to remember that this is a £3,200 watch, made in-house by an independent company. Watches that are replete with hand-applied black polishing, engraved balance cocks (which Nomos also does in some calibres) and so on would normally start at five to ten times this figure. The pre-assembly work is all done by hand: for example springing the balance, setting the pallet stones, grading the escapements, setting the springs into the studs and

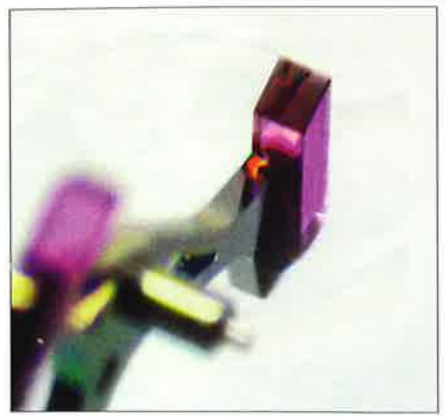


Figure 11.

preparing the jewels for pressing into the plates. The company spent 11 million Euros developing the swing system escapement alone. Most of the components have what I would classify as a perfectly decent and visually appealing finish. It is clear by inspecting this watch where Nomos has spent its money and energies: on getting the technology absolutely right, with sufficient but not obsessive attention to high craft.

The steel wheels are hobbed; in the case of stepped wheels, one at a time. Many of the flat steel parts such as the set-hands work are made on a blanking press, which has been the industry standard for this type of component for over 100 years. Sometimes parts that are blanked bear characteristic, almost imperceptible evidence of their flat-sheet parentage. I am comfortable with all of this; there are watches that are vastly more expensive that are no more than Swiss generic movements planted into Asian cases, or vice-versa. At Nomos the investment in people and technology is palpable. The finishing where visible, and in many cases where not visible, is done to a self-respecting high standard. The screws are well finished and most have beautifully polished tips, **Figures 12A and B**. The finishing patterns and frosting are even and consistent.

This Tangente neomatik is excellently made, is the flag-bearer of an enormous amount of investment into real horology, and in short does a superb job of condensing everything that is good about Nomos.

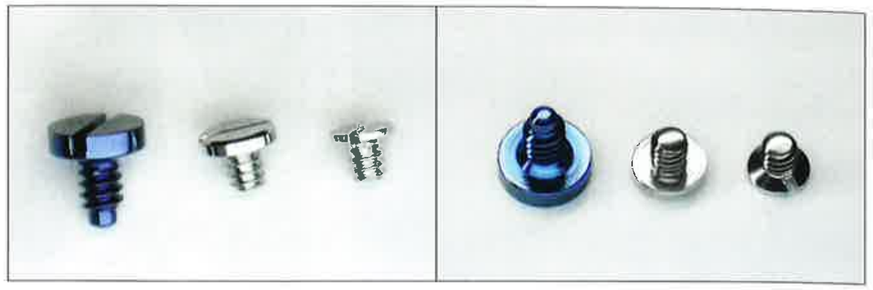


Figure 12A and B. The finish on the screws.

The DUW 6101 in Detail

Some Features of the Nomos Swing System Escapement

In this version of the watch, the pallet frame has been pierced so as to lighten it. The shellac is neatly hand-applied, with none left on the upper and lower faces of the rubies. An interesting feature is the reduction of the material thickness near the fork, seen as steps when viewed end-on, **Figure 13**. This maintains beam stiffness whilst further reducing inertia. Theodor Prenzel showed me a very detailed computer analysis of different weights of pallet frame, and how their relative flexibility made an enormous difference to the amount of energy transmitted to the balance.

The balance springs are all blued, albeit of an undisclosed alloy, **Figure 14**. These are fitted to the Etachron-style studs with hot-melt glue. The photo, **Figure 15**, was taken down the ocular of a microscope at Nomos. A little bead of glue is placed; the operator can then swing a high-current electric heater arm into play; this switches on as it comes close and needs only a moment's contact with the stud to melt the glue.

Figure 13.

Figure 14.

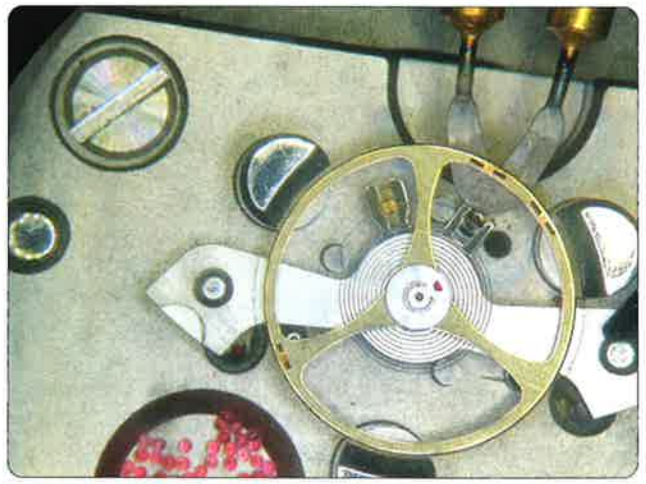


Figure 15.

The Automatic Winding Train and Double-Click Wheel

The watch has no ratchet click in the normal way. The Nomos double-click wheel does triple-duty as a reverser for the two-way automatic work, a back-stop for the mainspring in the manner of a click, and by the same process practically blocks the winding rotor from further motion once the watch is fully wound.

The directions of motion are explained in this side view of the double-click wheel, **Figure 16**. The central arbor has an integral pinion at its lower end. Above this freely rides a spur wheel recessed on its upper face, and with two holes for the pivots of two steel clicks. Next is a ratchet with pronounced teeth. The clicks and ratchets are not visible in the photo. The wheel turns freely on the arbor but the ratchet is pressed solidly onto it. A steel disc is pressed down just far enough to stop the clicks riding up. Another identical assembly of spur wheel, ratchet and clicks is next assembled, facing the first one, so that the central disc keeps all the clicks from dropping out of their holes. A steel boss caps the assembly and keeps it all together. The two ratchets face the same way, so that the spur wheels with their clicks catch the ratchets in one direction (clockwise when viewed from above), and ride over them in the other.

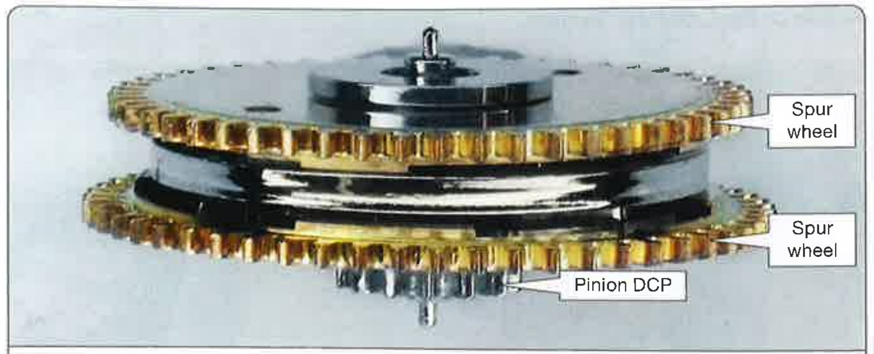
The two spur wheels are not quite identical; the upper is slightly smaller than the lower, **Figure 17**.

Let's first study the action of the automatic winding. The train starts with the wheel affixed to the rotor. This gears with the brass upper wheel **G1** in the removable wheel and pinion stack. The steel lower pinion **G2** engages in *two* places: 1) with the upper spur wheel **DC1** of the double-click wheel, and 2) with a brass idler wheel **H1** off to one side. The idler is affixed to a lower steel wheel **H2**, and this engages with the lower spur wheel **DC2** in the double-click wheel.

When the rotor turns clockwise, so does the upper spur wheel. This drives the central arbor clockwise, and its lower pinion **DCP** with it. This drives the train, ultimately winding the barrel arbor clockwise.

At the same time, however, the lower spur **DC2** is driven in the opposite direction because it's being driven through the idler **H2**. Turning anti-clockwise, it simply free-wheels over the internal clicks.

When the rotor turns anti-clockwise, now the upper spur **DC1** also turns in the same way, and it rides over its clicks. The lower spur, **DC2**, now being driven clockwise, catches the clicks and drives the pinion clockwise. The barrel arbor is turned clockwise.



Note 1. *Given the direction of the ratchet, when either spur wheel moves clockwise it will attempt to drive the lower pinion clockwise with it. Conversely, when the pinion is being driven anti-clockwise, it will tend to drive the spur wheels along with it.*

Figure 16.

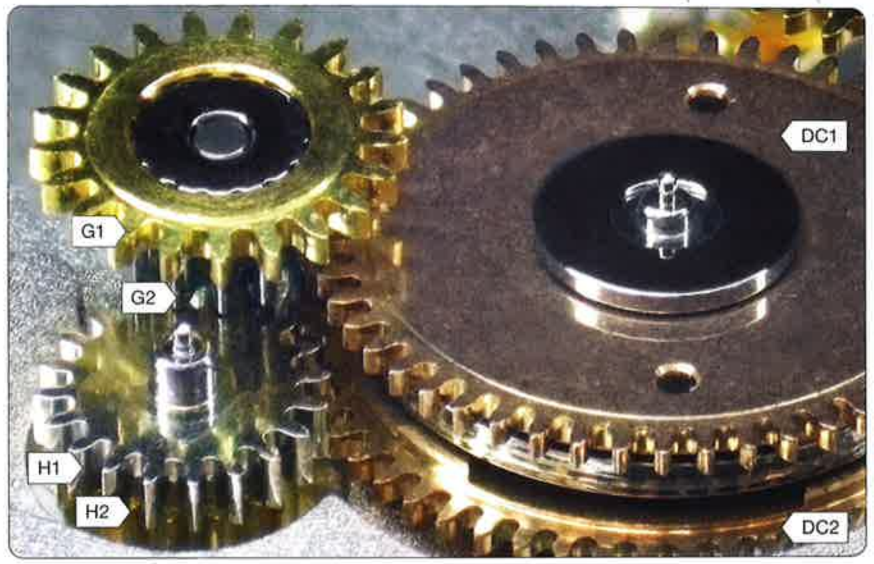


Figure 17.

With the reversing action now out of the way, what about the rotor lock? With sufficient torque in the barrel, the lower pinion becomes harder and harder to turn. The gear ratios are arranged so that there simply isn't enough drive left in the rotor to move any of the wheels until the watch runs down somewhat.

Nomos states that the self-winding takes only 10 degrees to effect a reversal; that is, the system experiences only 10 degrees of lost motion in shake and backlash before winding begins in the opposite direction. An article in *WatchTime* compares this with 27 degrees in the ETA calibre 2824 and 42 degrees in Rolex calibre 3135.[1] They declare that less power is therefore required to drive the Nomos than these other movements. However, as R. W. Pipe suggests in *The Automatic Watch*: 'If the rotor is coupled very tightly to the winding train (in other words with less free run/smaller reversing angle), a relatively large effort is required to move the train and mainspring from rest, but a lighter rotor coupled less tightly can build momentum before engaging and achieve the same result with less strain on the system. In any event, the Nomos system is very free in its action and winding both directions potentially halves the required strain on the system for a given amount of winding.'[2]

Finally, we come to the matter of the double-click wheel acting as a backstop to the mainspring. If we consider that when not being wound, the mainspring arbor experiences permanent anti-clockwise torque and will tend to drive the self-winding train backwards. If we follow the train upstream from that point, we note that under these conditions, the lower pinion **DCP** will also tend anti-clockwise. Remembering **Note 1** above, **DCP** moving anti-clockwise will try to carry the spur wheels **DC1** and **DC2** with it. This would tend to carry both idlers **G** and **H** clockwise.

This is impossible, however, because they are also geared to each other, and therefore the system locks up.

Action of the Calendar System

Figure 18.

Figure 19.

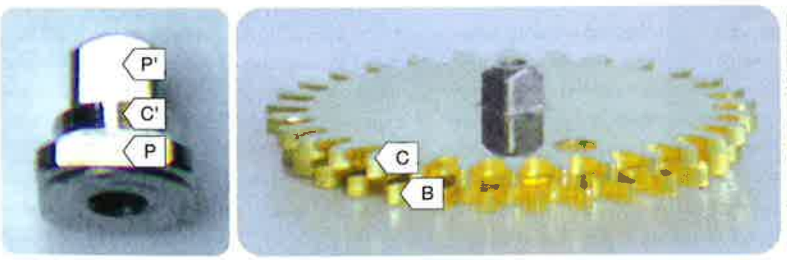
Figures 18 and 19 show the train of wheels leading off from the hour wheel. Wheel **A** is of a double layer, with 12 teeth on the upper and 14 on the lower layer. Each layer drives its own wheel, stacked co-axially, a lower wheel **B** (28 teeth) and an upper wheel **C** (30 teeth). These are the final wheels in the date train. **B** is squared to a pipe **P** (See **Figures 20A and B**) that rides freely on a steel pin set into the plate. The upper wheel, **C**, rides freely above **B** on the round boss **C'** of the pipe. The pipe has an additional square **P'** onto which the Reuleaux triangle **R** fits. Nomos calls this part the 'program disk'. **B**, **P** and **R** therefore move as one.

The upper wheel **C** has a hole in it. Into this hole goes the pivot of the stirrup **S**. The stirrup and cam are shown in **Figure 21**, upside-down so as to show the pivot position.

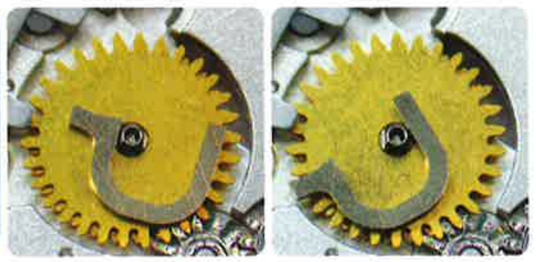
In **Figures 22A and B**, the cam has been removed, and the stirrup shown in its extreme positions. Although in reality it would never move quite as much, this illustrates that the part can have a large range of motion under the influence of the cam.

Wheels **B** and **C** have a ratio of 2:2.5 with respect to each other, meaning that the lower wheel **B** makes five revolutions per day and the upper one, **C**, makes four revolutions per day, and they fully coincide only once per day.

Figure 21.



Figures 20A and B.



Figures 22A and B.

Acknowledgements

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Action of the Calendar System

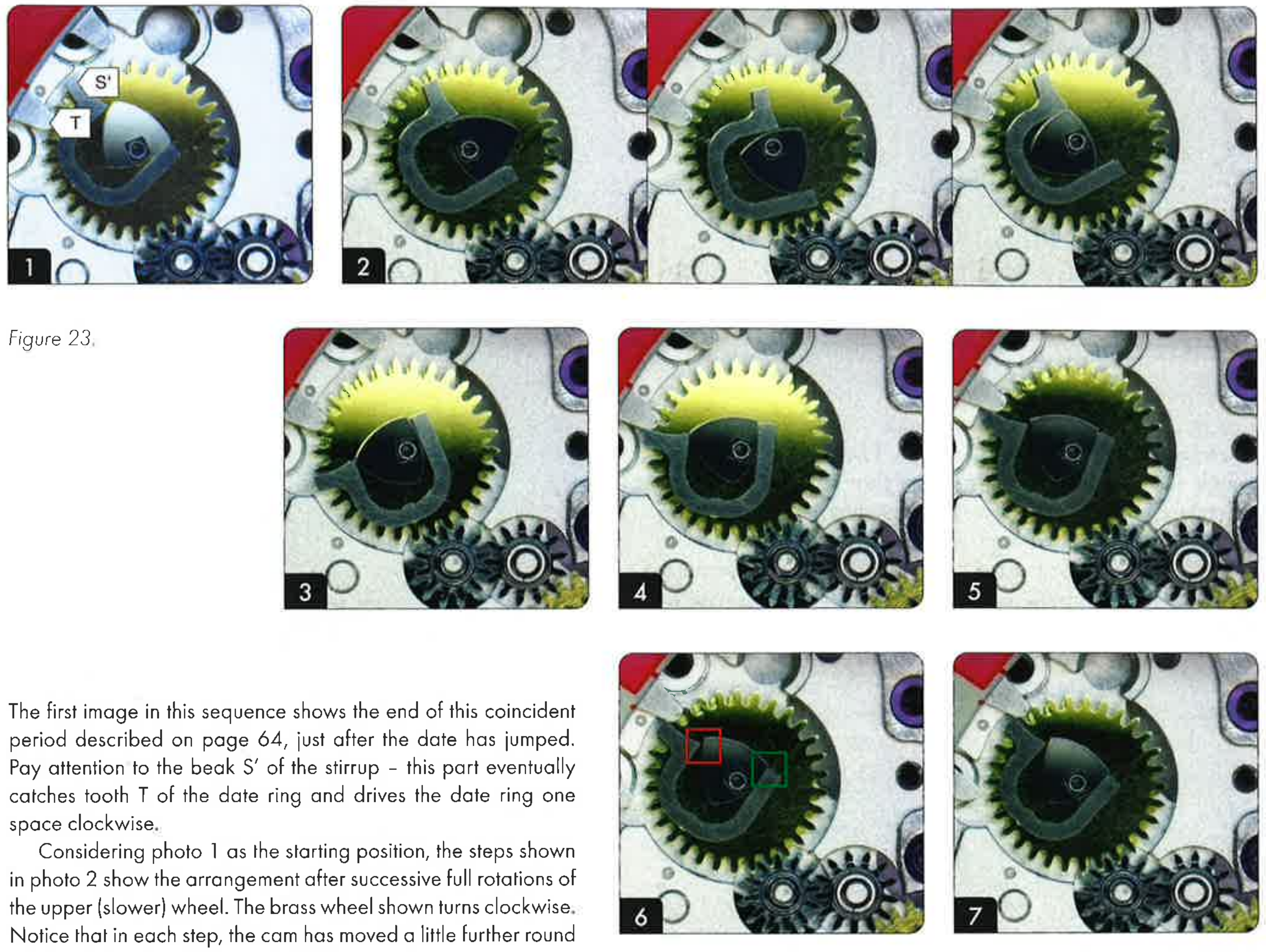

Figure 23.

The first image in this sequence shows the end of this coincident period described on page 64, just after the date has jumped. Pay attention to the beak S' of the stirrup – this part eventually catches tooth T of the date ring and drives the date ring one space clockwise.

Considering photo 1 as the starting position, the steps shown in photo 2 show the arrangement after successive full rotations of the upper (slower) wheel. The brass wheel shown turns clockwise. Notice that in each step, the cam has moved a little further round relative to the stirrup.

Notice also the pronounced movement of the stirrup's beak S' as the high lobe of the cam pushes it first one way and then the other.

Position 3: The high lobe of the cam has pushed the beak as far to the left as it can. The beak is just approaching the date ring tooth T.

Positions 4–6: The two have just made contact, but notice that the high lobe of the cam has also begun to retreat from the stirrup. Notice how, over these few degrees, the lower corner of the cam (indicated by the green box) catches the free end of the stirrup, and draws it back ever so slightly. This takes up all the free play, and allows the cam to provide a solid abutment for the stirrup against the inertia of the date ring and the force of its jumper spring. Most crucially, it also allows the stirrup a little clearance (indicated by the red box) to fall away in case the user attempts sets the date forward while the system is engaged. At this moment, the date ring is just about to jump; elsewhere, another of its teeth is just about to ride over the crest of its jumper.

Position 7: The date ring just about to jump, after which the mechanism will recede as it continues to turn clockwise. For the next 45 minutes or so, the user-set rapid date change will not be operable.

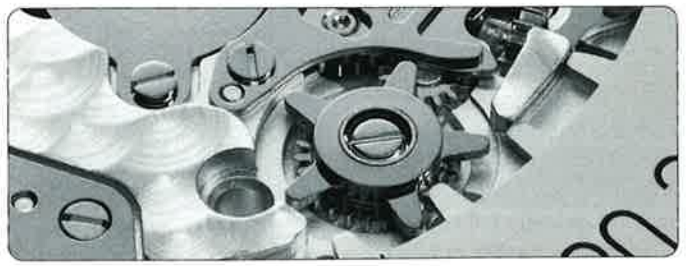

Figure 24.

The user-set rapid date correction is via the crown pulled to the middle position. A short train of wheels drives the date-correction wheel onto which is mounted a five-pointed star, **Figure 24**. To avoid the user damaging the watch by forcing a date correction while the main system is engaged, the star is sandwiched with a spring like a wave washer between its drive wheel and its upper steel cap. Any attempt to turn this wheel 45 minutes either side of midnight causes it to simply slip, with no harm ensuing to the movement. This wheel and its driver are not connected to the set-hands work unless the crown is pulled into the middle position. At other times they are totally free. They thus advance along with the date ring at midnight.

ENDNOTES

1. 'Nomos Glashütte Tangente Neonatik Reviewed', Martina Richter, *WatchTime*, 7 May 2018, https://www.watchtime.com/reviews/the-new-neo-nomos-glashutte-tangente-neomatik-reviewed (accessed 4 December 2019).
2. R. W. Pipe, *The Automatic Watch* (London: Heywood, 1952), pp19–20.