From the Workbench

What Ticks?

QP examines just what it is that makes a watch tick. Within the often daunting interior, three component groups are ever present: the main spring, going train and escapement.

Energy

The energy of a wristwatch accumulates in the mainspring. For hand-wound watches this comes from turning the crown, while an automatic (self-winding) uses your wrist's movement to generate revelations of the winding barrel. The mainspring itself is a marvel of material science, the result of years of accumulated research and experimentation. Usually made of a special alloy using beryllium, cobalt, chromium, nickel and iron (there have also been experiments with more exotic materials such as Zerodur, a type of high tech glass), the spring needs to be antimagnetic, reasonably insensitive to temperature and able to keep its 'springiness' even after many thousands of windings.

The amount of energy stored in the mainspring is described as the watch's 'autonomy'. Simply put it is the length of time that a watch will go on ticking after being rewound. Some of the older models have only 36 hours, while today 40–48 is the norm. Some watch houses have pushed the autonomy envelope a long way, Chopard have developed watches utilising four winding barrels to produce 9 days of autonomy, Patek uses two large barrels supplying 10 days and Ulysse Nardin have one large spring, as used in the Freak, to produce about 7 days' power.

Letting go – the gear train

The gears of the watch have two basic functions: stepping down the tremendous forces held within the mainspring for the delicate gears, and the distribution of this energy from the mainspring to the escapement. Simply put, each tick of the escapement is one tiny packet of energy, sent from the spring via an arrangement of gears.

The gears in a wristwatch are somewhat mundane in comparison with the highly active escapement, which more easily captures the imagination, especially when view through the glass-backed case. Achieving regularity in the cutting, shaping and polishing of the teeth has always been a critical issue for watchmakers, particularly the pinions, with their high-profile teeth requiring exceptional accuracy. This was one of the first areas in which machines introduced to guarantee precision. Calculating the correct ratios and sizes for gears is a highly complex procedure, even with computers to help.

Additionally, gears that turn rapidly or that must carry large stresses will be seated in jewels, both to protect them and to hold a microscopic pool of oil for lubrication which to turn; other slow-turning gears will simply be seated without jewels between the baseplate and a bridge. Typically these parts are hardened brass, but can also be gold or even crystal.

Altogether, the set of gears distributing energy from the winding barrel is called the 'going train'. Typically only three gears separate the mainspring and the heart of the watch, the escapement.

The great escape

The escapement comprises the balance wheel, the balance spring, anchor and escape wheel, has one job: to allow energy to 'escape' in a regular fashion and advance the hands moment by moment. Basically the escapement locks and unlocks the gear train with each turn of the balance spring. Any imperfection here leads directly to loss of accuracy. For that reason, research into improving, refining and developing the watch escapement has been on going since the 17th century. New and very 21st Century designs and materials, which include silicon and diamond, are already to be found in some watches and will gradually become more commonplace.

Matters naturally get more complicated when pushers, extra crowns (as with an alarm watch) or minute-repeater slides have to be accommodated or when the design requires contrasting materials or finishes.

Water Resistance

Just like a good piece of plumbing, a watch requires gaskets, sealers, glues and rings to keep water out – it is therefore not surprising that watch designs devote much attention to these aspects. Water resistance is also the most incomprehensible aspect of watch manufacture for many owners. Over the course of time the gaskets and sealants begin to loose their elasticity. Swimming, even if you are not diving in deep water, creates motion, which in turn causes rapid and repeated variations in he ambient pressure on the watchcase. For this reason, a watch with a nominal 50 m water resistance will not even happily survive a swim on the surface of the water. Even 100 m rated watches can suffer the same fate after a few years of regular wear in the shower or sauna. The advantage of the bigger, more robust diver's watches, with over 300 – 1,000 m water resistance, is not so much their raw rating as the safety margin that it implies. Three years of abuse can simply be soaked up by the reserve of capability.

My Kingdom for a crown

The crown is the place where water can most easily get in. Despite all of the internal protective rings available to it, it can easily be bent by getting caught on a thread from clothing, when the time is being set, during winding or through a scrape with a wall or doorknob.

The screwed-in variety, used for most sporting watches, reduces this problem by making the crown more secure against knocks and blows – so long as it is actually screwed in! Even where water resistances is not an issue, the crown's delicacy is also the reason that some brands – such as Patek Philippe in their Calatrava series and their Travel Time Watch – have added shoulders either side of the crown to protect it, or use elaborate guards as with Panerai's Luminor watches.