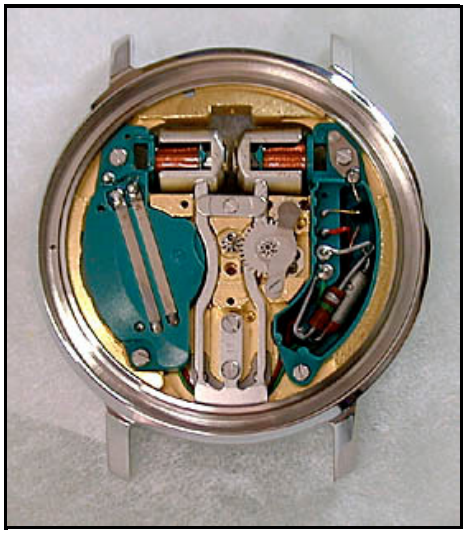
DIRECT DRIVE: THE REMARKABLE BULOVA ACCUTRON CALIBER 214

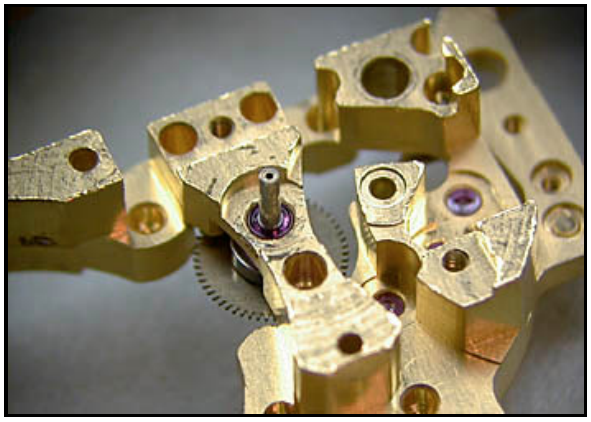
By Walt Odets



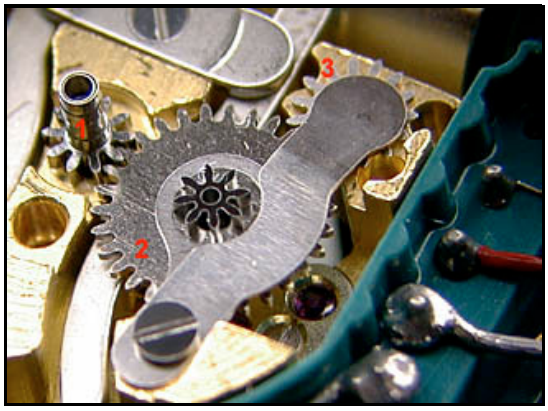
The very brief technical superiority of the Accutron watch is, perhaps, one of the best known facts about the design. The Accutron improved immensely upon the early "electronic" watch, which replaced the mainspring with a battery but established rate with a convention balance and balance spring. The Accutron was, in turn, quickly supplanted by "quartz" designs, which established rate by applying battery current to a quartz crystal and, using the resulting vibration as a reference, powered the analog gear train with a stepper motor. In the conventional wisdom, the much higher quartz frequency made the tuning fork of the Accutron obsolete. What is overlooked in this explanation is that the Accutron did something that has, to my knowledge, never been done before or since. It took the bold step of actually powering the movement with its own escapement. It was as if the balance wheel of a conventional, mechanical watch were used to power the gear train. This was a remarkable idea.

On first examination, one of the most startling aspects of the Accutron is how much traditional, high grade watchmaking is involved in its design and execution. It uses an extremely well-made, traditional, machined brass ebauche (**left**) with a highly jeweled gear train. Most of the gear train uses conical pivots with pierced and cap jewels, and nearly half the gear train is shock protected.

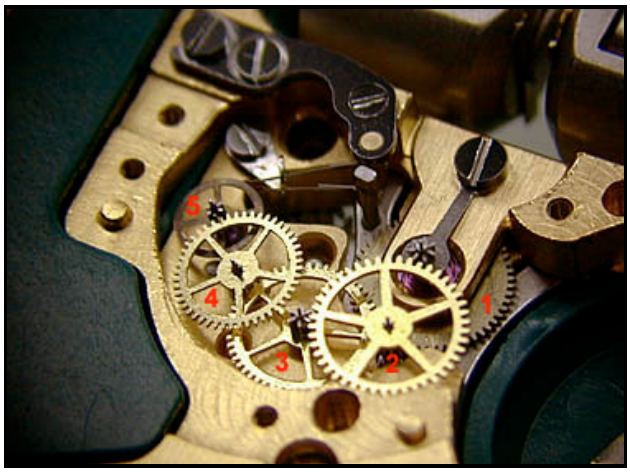
A detail of the ebauche, with jeweled "center" wheel, is shown **left**.



On the dial side of the movement (**right**) we find a conventional cannon pinion (**1**) to carry the minute hand hand, as well as a minute wheel (**2**) to drive the hour hand. Even the hand-setting mechanism employs an intermediate wheel (**3**) that could be lifted from the most traditional of mechanical movements.



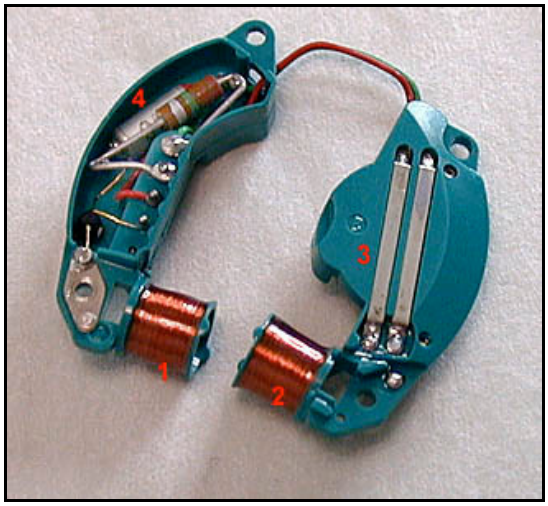
The gear train of the Accutron resembles that of a high-grade mechanical movement (**right**). We might even imagine that we were observing a center wheel (**1**), third wheel (**2**), fourth wheel (**3**), escape wheel (**4**), and . . . well, it's not a balance wheel, its the *drive wheel* (**5**). More about that drive wheel in a moment.



With the wheel train bridge in place, we see the remarkable jeweling of the movement. The drive wheel (**1**) and (now in Accutron parlance) second wheel (**2**) each use four jewels and shock protection top and bottom. The third, fourth, and center wheels (**3**, **4**, and **5** are fully jeweled with cylindrical pivots. Note the chaton for the center wheel (**5**). This is a high-precision, low drag gear train.

THE ELECTRONICS

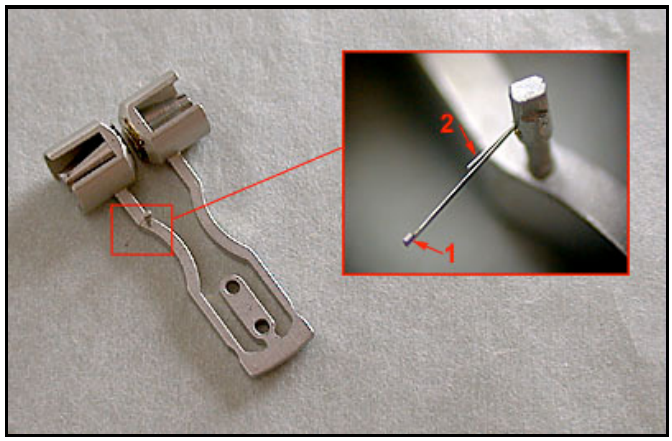
By contemporary standards, the electronics of the Accutron are simple, even primitive (**right**). Almost as if acknowledging the basic mechanical nature of the design, all electronics are neatly isolated from the rest of the movement in a pair of plastic "kidneys" joined by a simple pair of wires. The coils (**1** and **2**) to activate the tuning fork are integrated into the kidneys. One kidney serves largely as a battery compartment (**3**), and the other kidney (**4**) contains a discrete transistor, one resistor, a capacitor, and a few hand-soldered connections. How simple!



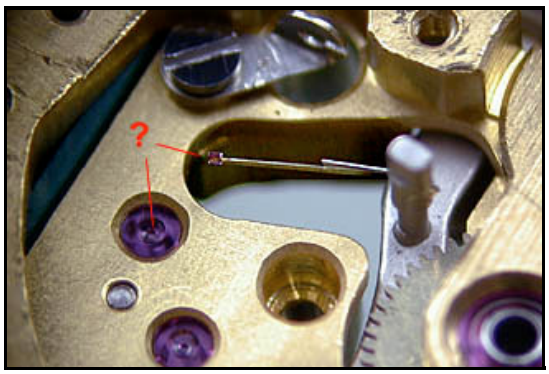
How delightful!

THE TUNING FORK

The tuning fork is a relatively traditional piece, measuring 25 millimeters in length (**right**). On its left arm, it carries a small post, and, attached to the post, a tiny, square-jeweled pawl (**inset**, **1**) and return spring (**2**).



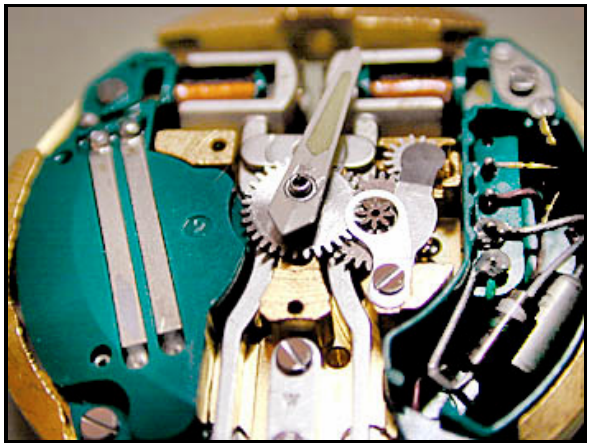
The tuning fork and pawl can be seen (**right**) mounted in the ebauche.



And this, of course, leads us to the subject of . . .

THAT DRIVE WHEEL . . .

Having hit upon the, then novel, idea of establishing rate with an electronically vibrated tuning fork, the engineers had next to consider translating that reference into--*movement* of the movement. How would a frequency



standard derived from the minuscule vibrations of a tuning fork actually translate into both timing and powering the hands of a watch?

A traditional escapement might alternately arrest and release the power of the mainspring at relatively consistent rates. As with later quartz watches, a frequency stabilized circuit might stop and start a stepping motor. But there was no mainspring in the Accutron. Stepper motors, and the circuitry to drive them were then unavailable at anything approaching prices suitable for a wristwatch. The not so obvious answer was to *turn it all around* and *go direct*. .

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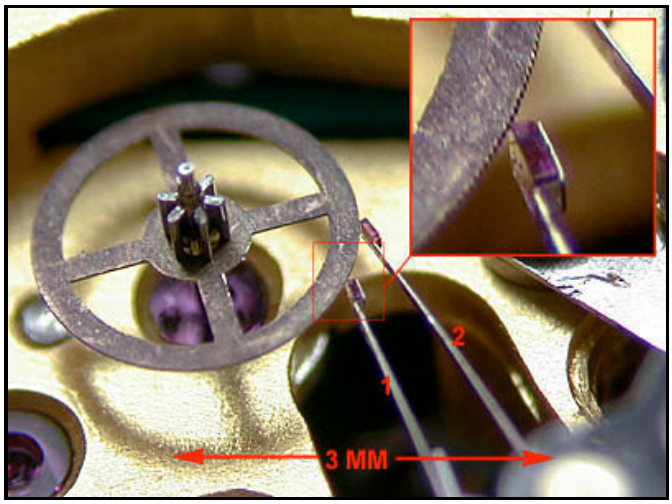
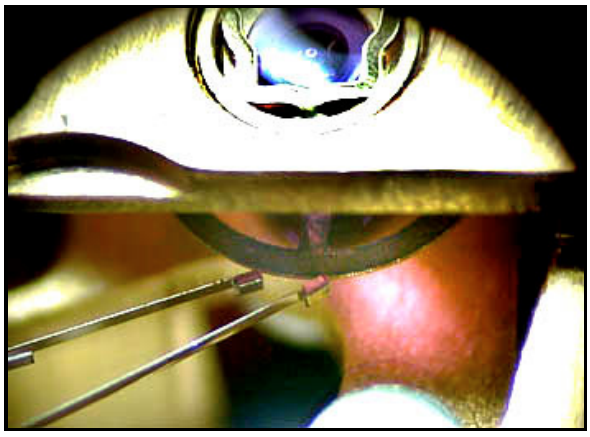
Bulova engineers arrived at the remarkable and bold decision to quite *literally* power the gear train of the watch with the vibrations of the tuning fork (**right**). The vibrating arm of the fork would oscillate an attached pawl (**1**) back and forth and the pawl would advance a micro-toothed wheel--tooth by tooth. A second pawl anchored to the ebauche (**2**), would serve as a ratchet to prevent reverse movement of the drive wheel. It is here that the Accutron finds itself unique among timekeepers. The frequency standard itself is also the motive force of the movement.





CONCLUSIONS

To this day, the 40 year old Accutron stands as an interesting and important contribution to horology. The aerie smoothness of the seconds hand (those are *micro* teeth on the drive wheel) and the audible hum of the tuning fork are unique among wristwatches. The Accutron is a much more than decent piece of

work in traditional horological terms. Compared to most contemporary quartz-referenced wristwatches, the caliber 214 is *magnificently* constructed.

Available in a variety of case styles--including the most-favored SpaceView model, which reveals the technology through the dial--for under US$300, the Accutron caliber 214 is a worthy addition to any collection of timepieces.