ELECTRIFYING, DEATH DEFYING AND GRATIFYING CLOCKS AT THE WEST COAST CLOCK & WATCH MUSEUM

-Ed Pasahow

Technology motivates innovative people to develop novel applications and solutions. At the beginning of the 20th Century, newly available electrical energy created an opportunity for clock makers to replace the weights and mainsprings previously used to power their products. These inventors hoped their conceptual breakthroughs would generate new market demand making their efforts successful and them wealthy. The availability of dry cell batteries, in particular, attracted a number of inventors. Motors of that period were not precise enough to accurately turn the clock hands, so completely new and unexpected power mechanisms evolved. The WCCWM collection contains two electrically powered clocks that took unexpected routes for driving the time telling. Another clock in the museum provided crucial timekeeping during wartime maneuvers and has a curious connection with the Nobel Prize. Finally, we'll investigate a clock that offered class and style to its owner's home or office shortly after the United States became a nation.

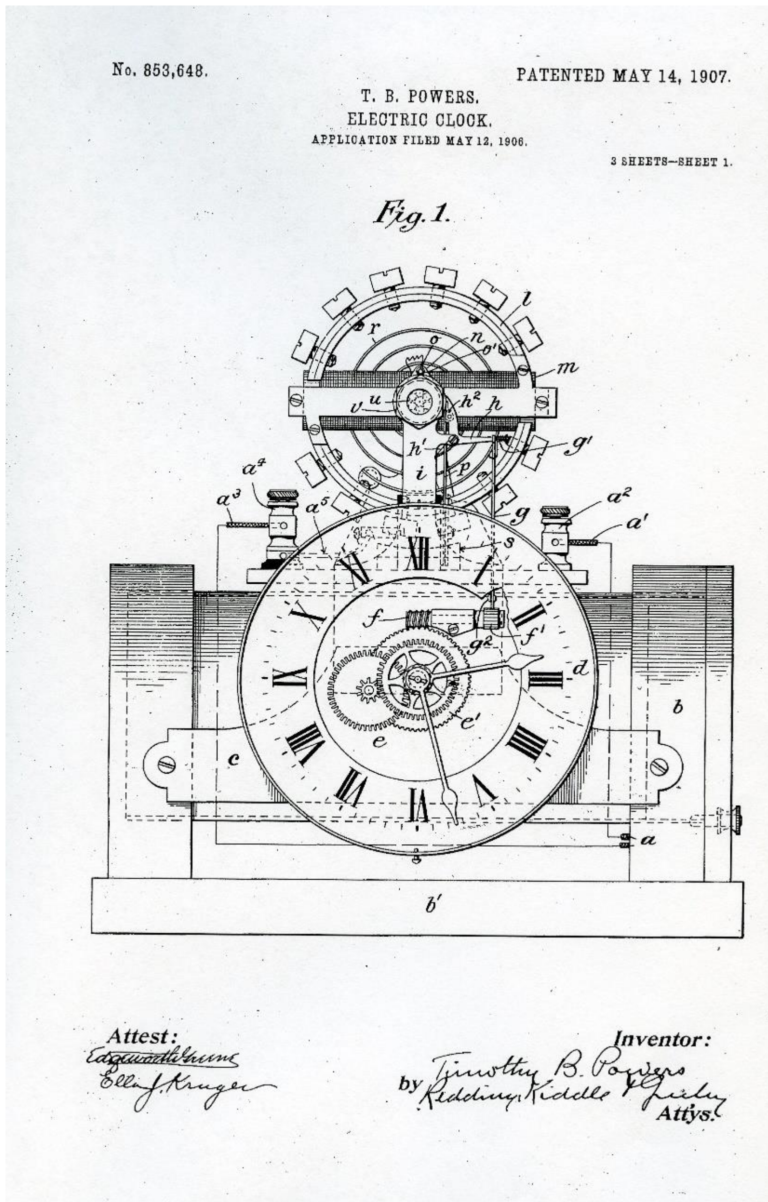
Eureka Clock

Eureka clock rearview

Timothy Bernard Powers' application of the electric dry cell battery to clock making was so advanced that it surprises us even today. If it showed up on the Amazon website as a steampunk instrument, it would probably attract many buyers. Powers patented various versions of his clock during the first and second decades of the new century. The one in front of us was patented in 1906. Powers turned production over to the Kutnow Brothers who manufactured about 10,000 of the clocks, mostly in England, over five years. Consumers evidently found the clock as inviting then as we would today and bought them all.

The porcelain clock dial is clearly printed with Arabic numerals for the hours and a tick-marked minute chapter ring. Blue steel, spade shaped hands mark the hours and minutes. The mechanism below the dial, however, detracts the viewer's attention from reading the time. What is that?

A balance-wheel motor moves the hands. The heavy oscillating balance wheel, which resembles a watch balance wheel on steroids, provides motive power. Centered in the balance is a spiral balance spring (hairspring), again like in a watch but much bigger. Let's look into how this works.



The balance wheel, with a diameter just under 3 inches, weighs about 12 ounces. A sandwich of brass and steel forms wheel rim. Called a bimetallic rim, it reduces distortions in the wheel resulting from changing temperatures. Any changes in the wheel's shape would change its momentum, which in turn yields inaccurate time.

Close examination shows that the wheel is cut dividing it in two sectors near the junction with the center spoke of the wheel. When temperature rises, brass on the outside of the rim expands more than steel on the inside causing the ends of each sector to curl inward reducing the balance wheel inertia. Conversely, falling temperatures expand the steel more than the brass so that the rim ends curl outward increasing the inertia. (This action can be compared to an ice skater executing a pirouette. A skater bringing the arms into the torso spins faster and extending the arms spins slower.) These inertial changes, coupled with the temperature response of other components such as the balance spring, tend to keep the wheel oscillation period constant. This rotational regularity is called isochronous movement; that is each rotation of the balance takes the same period of time.

Moving the rim screws inward or outward also adjusts the mass of the rim to compensate for some temperature changes and to insure that the center of gravity of the balance is the center for rotation. This process, called poising, is done using a poising tool, which resembles a miniature vise. The tool must be perfectly flat before starting the delicate poising operation. The balance wheel pivots rest on knife-edges of the tool jaws so the wheel can turn freely. The wheel is repeatedly spun before each screw adjustment until the wheel is equally likely to stop with any point on the rim uppermost.

Returning to the clock operation, the balance wheel pivots run in ball bearings to reduce friction. A wire coil is wound on the iron spoke running through the center of the balance creating an electromagnet when the battery in the clock base is energized. Current is supplied to the electromagnet only at the appropriate time to be attracted to the iron plate at the bottom of the clock. Knurled brass screws at each end support the iron plate.

Nudging the balance starts it swinging. Viewed from the front, when the balance oscillates counterclockwise, the electromagnet should not be energized on the upward swing because that would retard the motion. Carried by inertia, the balance reaches its maximum point of rotation and fully winds the balance spring. The energy stored in the spring then starts the balance rotating in the opposite direction. As the electromagnet approaches the iron plate, a contact closes the circuit producing an attraction and boosting the energy in the rotating balance. The balance continues in a clockwise direction until it reaches maximum again and the spring starts it back in the counterclockwise direction. Then the cycle repeats.

The clock has a timing chain of gears much like any other clock. An eccentric on the balance arbor (axle) contacts a roller, which in turn is mounted on a pivoting lever driving this gear chain. A ratchet mechanism on the lever moves the first gear in the timing chain forward one tooth on each balance rotation, which takes one second. As a result, the timing gears that move the clock hands have moved forward by one second.

Despite the care exercised in reducing the effects of temperature on the movement, the clock may still run fast or slow. Falling battery voltage, as the battery discharges, produces less attraction between the electromagnet and the iron plate affecting the rate as well. These and other factors necessitate regulating the clock. A star-shaped dial at the bottom of the clock allows the user to regulate the clock by changing the length of the balance spring. A longer spring reacts more slowly than a shorter spring.

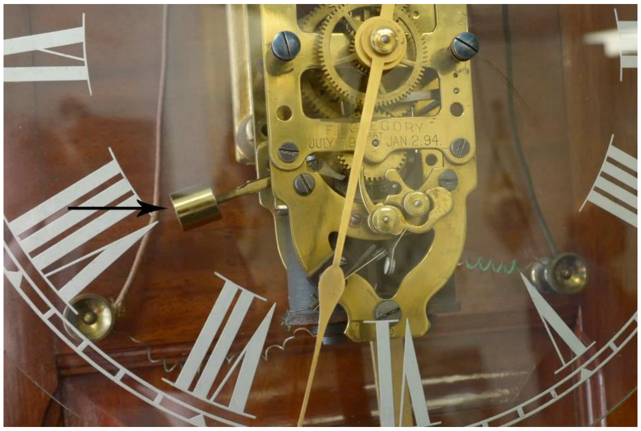
The Eureka clock attracted a lot of attention when it first sold. Unfortunately, the manufacturer did not provide training materials for clock repairers, and repair parts were no longer available after production stopped. Consequently, many of the clocks were damaged by clock repairers who did not know how to make them work, so few of the clocks survive today in operating condition. User frustration with this inadequate maintenance doomed the Eureka clock to an early demise after just a few years. The working example in the WCCWM is an exception that deserves our appreciation.

Gregory Wall Clock

This next clock owes its existence to the worldwide demand for Pacific Northwest timber during the 19th and 20th Centuries. Sawmills opened in many places in response to the robust market for timber. Port Gamble, WA was one of the mill locations. Port Gamble is an unincorporated community on the Kitsap Peninsula and was ideally located between woodlands and a bay leading to the Pacific Ocean. Sawmills continued operating there through 1995. Closing of the mills left the town dependent on tourist dollars, and in 2010, the population was 916. Today Port Gamble is recognized as a US National Historic Landmark for being one of the best-preserved western lumber centers.

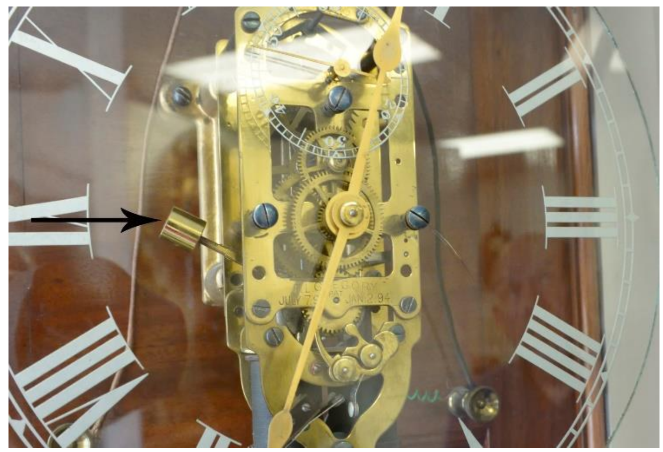
In its heyday, however, Port Gamble attracted well-to-do timber merchants who needed a place to stay. Opulent hotels sprang up to service these visitors. One of these hotels, established around 1895, was known for its elaborate hand-carved furnishings. This landmark building became the hub of civilized culture in those days. A wall clock, hand-carved to match the other furniture, was ordered from the F.L. Gregory Company of New York. This was

the first battery electric clock to make the sea voyage from New York around Cape Horn to Washington.



Gregory clock weight down

Gregory clock weight up



Not much is known about the history of F.L. Gregory nor his clocks, but we can note the patent dates of July 7, 1881 and January 2, 1894 on the movement. Cherry wood encases the clock. A transparent dial allows viewers to appreciate the fine details of the movement. Roman numerals mark the hours and a railroad chapter ring the minutes. A seconds subdial is just below 12:00. Brass, spade-shaped hands indicate the time. A brass pendulum regulates the clock, but how is it powered?

Barely noticeable in the elaborate construction of the clock, between 8:00 and 9:00, a small cylindrical weight on a lever provides the driving force for the clock. A battery behind the clock energizes a motor when the weight reaches its lowest point lifting it to the top again. Electrical wiring attached to brass connectors is visible at 4:00 and 8:00. Here too, we see a completely new way for electrifying timekeeping.

In the early 1980s, the hotel underwent renovation and all of the furnishings were moved to storage. Tragically, an arsonist caused fired destroyed the hotel. As a result, all of the furnishings, including this clock, were sold at auction.

Waltham Civil Date Indicator Aeronautical (CDIA)

This clock shows ample evidence of its arduous life. Built tough to go to war, this clock and many like it provided vital time reference to pilots during WW II. The aluminum case, secured by a four-screw bezel, holds a 37 size, eight-day, double barrel, 15-jewel movement. (The barrels contain the mainsprings, and two were required to provide power for the entire eight-day power reserve.)

The 2 ¾-inch dial had to be very legible under combat conditions in an aircraft, so the 24-hour black metal dial was painted with radium yellow fluorescent indexes and numerals comprising large even-hour Arabic numerals, small odd-hour numerals, and minute indexes in five-minute increments. The civil date (which is military speak for the calendar date) numerals and indexes are painted Munsell green. The time setting and winding knob is located at 15:00 on the bezel. Just above the knob is the push-button for setting the date.

Waltham produced approximately 134,000 CDIA clocks during the war. These timepieces appeared in the cockpits of such aircraft as the F6F Hellcat and B24 Liberator. The clocks were invaluable to the flyers who depended on them for timing course changes and movement coordination. There is, however, a tragic untold story behind these clocks.

The radium that excites the glowing indicators (for nighttime reading) is element 88 in the Periodic Table and it emits radiation – primarily in the form of alpha rays but also beta and gamma rays. The luminous paint is a mixture containing various ratios of radium, phosphorus, and zinc sulfide. Even after the dials no longer produce light because the zinc sulfide is exhausted, these dials are still radioactive because the half-life of radium is 1600 years.

Radium was used in dials until the 1960s. As long as the clock remains closed there is little hazard to the user. A person wearing a radium dial wristwatch continuously over a year receives a dose of 24 milisieverts (mSv). Exposure to 100 mSv a year is the lowest level at which any increase in cancer risk is evident. A cumulative dose of 1,000 mSv would probably cause a fatal cancer years later in five out of every hundred people exposed to it. However, if the clock case is opened, flaking radium paint is a health hazard. Inhaling or ingesting particles may deposit a high local dose leading to lung or gastrointestinal cancer. Commonsense in handling these clocks is essential.

The tragic part of this story involves the female factory workers who painted dials beginning in 1917 at facilities in Orange, NJ, Ottawa, IL, and Waterbury, CT. These women were told the paint was harmless and instructed to place their brushes in their mouths in order to give them a fine point. They were further told that attempting to point the brushes with rags or a water rinse wasted too much time and material. Of course, the plant owners and scientists familiar with the effects of radium avoided exposing themselves. The women were paid about 1 ½ cent for each dial they painted.

The outcome was that many of these women experienced anemia, bone fractures, and jaw necrosis -- a condition known today as "radium jaw." The contractors, in order to avoid paying damages, started a fake news campaign hiding the health hazards and instructed doctors and dentists who examined the women not to release their data. After extensive court cases, in 1928, these "radium girls" or their families finally received settlements of $10,000 plus $600 annually and coverage of their medical and legal costs. Following this lawsuit, radium dial painters received instruction in proper safety precautions and protective work clothing throughout the rest of the radium dial era.

So what's the Nobel Prize connection? Marie Curie received the Nobel Prize in Physics in 1903 and the Nobel Prize in Chemistry in 1911 for her work in radioactivity – including the discovery of radium. She died in 1934 of aplastic anemia caused by radiation exposure.

Levi Abel Hutchins tall case clock

The museum's Hutchins tall case clock dates from about 1790. The case is simple, yet elegant, Colonial style. That this clock was even manufactured is remarkable because its creators only stayed together a few years. Two brothers were the producers. Levi was born in Harvard, MA in 1761 to Gordon and Holly Hutchins. His brother, Abel, came along in 1763. The two boys led active lives. Levi served in the American Revolution playing the fife in his father's command. Levi was present at the Battle of Bunker Hill, but not as a participant because he was too young. Instead, he observed the battle from a safe distance.

In 1777, the brothers entered into a three-year apprenticeship with Simon Willard of Grafton, MA. Willard was a gifted clockmaker whose inventions provided the basis for many competitors to copy his creationsillegally. (Willard's biography appeared in the February-March 2017 issue of The Ignitor.) Levi learned much from his training and called Willard “ingenious.” Willard must have felt similar admiration for the Hutchins boys because, at the completion of their apprenticeship, he gave them a tall case clock they had built under his supervision. Levi followed this training with an additional eight-month watch repair apprenticeship in Abington, CT.

Levi was also a timepiece inventor. He is credited with constructing the first American alarm clock in 1787. This was not, however, the first alarm clock in the world because such clocks were frequently made elsewhere. Levi’s alarm was a large brass clock in a pine cabinet that was permanently set to ring only at 4:00 AM. It could be neither reset nor turned off. The minute hand of the clock triggered a bell to ring. The next morning your alarm clock jars you awake, try to think kindly of Levi.

The two brothers established a clock shop in Concord, NH on Main Street in 1786. They later moved the company to a farm about three miles away. The Hutchins was the first New Hampshire clockmakers to use brass in the wheels and other components of their products. Most other clockmakers based their designs on wooden parts because brass in Colonial America was heavily taxed, if it was available at all. Their enterprise must have been contentious. By 1803, the only thing they could mutually agree upon is that they never wanted to mutually produce clocks again and dissolved the partnership.

In the split-up, Abel retained the house and clock shop. Levi established a new shop on Main Street opposite Gale’s Tavern and continued making clocks until around 1838. A story that illustrates Levi’s character and may offer insights into why the brothers ended their business relationship involves a clock that he sold to a buyer from Vermont. The clock stopped working and returned for repair. Levi billed the buyer $2, but the owner refused to pay and sued Levi in court. Levy lost and was penalized $100, but he could not afford to pay. Instead, he counter-offered the customer an equivalent value in clocks that he had made. The owner turned down the offer, so Levi went to jail for 30 days rather than paying the debt. Actually, going to jail in those days was not so bad. It just meant boarding with a nice family in Hopkinton, NH. While in jail, Levi worked daily on his clocks and even kept the customer’s clock. The brothers’ died peaceably – Abel in 1853 and Levi in 1855. Both had enjoyed long, prosperous lives.

Now let’s return to the clock. Simple fretwork surmounts the hood of the clock. Three conical finals –two on each side and one in the center are notes of interest. They may, however, not be original. Straight pillars with brass bases and Doric capitals flank the dial. The dial is engraved on two sheets of solid silver riveted together. The upper arch contains the Hutchins brothers’ signature and the company location. Roman numerals designate the hours with only dots representing the minute chapter ring. Arabic numerals designate 15-minute intervals. A subdial at 12:00

reports the seconds and an aperture at 6:00 the date. Hand-cut cathedral style hands mark the passage of time.

The finely made movement is held between two solid brass plates that are supported by massive pillars at the corners. Winding holes on the dial provide power to the time keeping on the right and strike on the left. The clock runs for eight days after being fully wound. The hours are loudly struck on the substantial bell. Opening the case reveals the pendulum, which regulates the beat of the clock, and two weight canisters. Traditionally, clock owners would fill the weight canisters with molten lead. At this perilous time in the young nation's history, American patriots preferred to restrict their lead supply to making shot for their rifles and other munitions. Their prudence was amply justified by the soon to arrive War of 1812. In place of lead the Hutchins clock relied on sand for power. This prestigious clock most likely graced the home or office of a newly minted American citizen.

The clocks and watches in the WCCWM collection are not merely mechanical marvels for telling time. They also represent the stories of their creators and the times in which they were made and used. When you visit, ask the museum docents to share some of these stories with you.

I wish to thank Bob Peischl for suggesting the Hutchins clock and WCCWM curator Ernie Lopez for his knowledgeable assistance in preparing this article.