Running Self Winding Clocks with the Model 1900 Series Batteries
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With the advent of the rail transportation industry came the challenge of keeping accurate time between broad varieties of locations. Alternating current line-operated electric clocks would not be available until much later. Even then, the reliability of the distributed power system would be relatively unproven until well into the 1940’s. There was a need for a centrally synchronized clock system to support the growth of the railroad as the predominant emerging public transportation system.

The advent of broadly distributed synchronized timekeeping was marked in the 1890’s by the emergence of the self winding clock. The concept was simple. A multiplicity of “Slave” clocks at numerous locations were synchronized by a “Master” clock at a central location. Masters located at different sites were synchronized by the Naval Observatory in Washington, DC. The synchronization signals (one per day for the masters in each time zone) were transmitted over Western Union’s telegraph lines to the clocks. The Self Winding Clock Company owned and leased the clocks. They would provide a service through Western Union to customers in need of accurate or synchronized timekeeping and charged appropriate fees for this service. Western Union would take care of maintenance (e.g., changing batteries etc).

In the most popular arrangement, two early 1½ volt carbon-zinc dry cells (measuring 2.5 inches round by 6.5 inches long) were hooked in series to produce 3 volts which powered an automatic winding mechanism or motor. Earlier units used Leclanche wet cells but these were later displaced by the dry cell. This kept the mainspring at constant torque, producing a very accurate clock. The winding mechanism would trigger generally once per hour, but other intervals were also used. On the average batteries would need to be changed about once per year or so.

Today, these self winding clocks are becoming collector’s items. The going prices at marts have exceeded $500 for many models—even more for regulators with precision mercury-filled pendulums and beautiful wood cases. Some long case styles are selling for over $2500 or more.

Powering these clocks can sometimes be a challenge. It was possible to buy the pair of 1½ volt EN-6 batteries used to power some of these clocks until Energizer discontinued them in late 2008. If you find them, and shelf life is not expired, the cost to change the battery could be near $45-$50 every time the batteries need changing for each clock you own. On the up side, these Energizer EN-6 cells have good capacity—as long as the cells are fresh. In reality they are internally a pair of 3-360 cells strapped in parallel. A 3-360 cell is very similar in construction and capacity to the common alkaline D battery.

Wall Voltage converters (wall warts). Wall warts are available for 120 volt operation, but these tie the clock near an outlet and detract from the nostalgia. Powering 24 volt and other voltage clocks is yet another matter. If you choose this approach, great care must be taken when purchasing wall voltage converters. Many collectors make the mistake of purchasing an unregulated wall wart. An unregulated wall wart will NOT output the proper voltage except under full load. For example, we ran into a customer recently that was powering a clock from a wall wart rated for 3 volts at 1 amp. He wondered why his platinum contacts were burning out. We measured the open circuit, unloaded output of the converter. It read 7.8 volts! Sure, under 1
amp load it measured 3 volts. But self winding clocks draw in the neighborhood of 0.2 amps. At this load, the wall wart would output 7 volts—much too high for our self winding clocks. The trick to success with wall warts is to buy a regulated unit rated for 3 volts at 1 amp or so. It is highly preferable today to buy Energy Star rated devices so that you’re not adding to the billions of dollars spent annually to generate electricity that is carelessly wasted as heat running unused, inefficient wall warts. Contact us if you would like to use this approach; we can supply you with an Energy Star rated converter exactly matched for your clock for a very affordable price.

What Voltage does my self winding clock need?

This is probably the most frequently asked question, and it is sometimes difficult to answer. The most commonly encountered model produced by the Self Winding Clock Co. of New York is the 3 volt vibrating motor Style F movement. Most American Clock Co., Imperial and Gregory (Sempire) impulse models likewise required 3 volts to wind. This applies to the majority, but not all. When in doubt, it is a good guess. We’ve put together a table summarizing what we know about the voltage and power requirements of various self winding clocks. It is only as complete as the combined information available in the literature, from personal experience, and from discussions with colleagues. There is a link on our website to the voltage table located at http://www.kensclockclinic.com/SWC.htm We are always interested in your feedback if you have examples of clocks with different requirements.

Battery Alternatives

Alkaline D Cells. To provide the 3 volts for the majority of vibrating motor Style F self winding clocks, a pair of Alkaline D cells are the obvious option. Alkaline technology has improved vastly over the years but battery impedance is still an issue. For this reason, best results are obtained with a pair of alkaline D cells in parallel to create 1.5 volts; two of this arrangement in series to yield 3 volts. Model 1900L is a very attractive, high-quality D cell holder that has two D cells in parallel internally along with protection from short circuits and mis-installations of the battery. It also offers a nostalgic, early 1900s antique look or alternatively a red label with attractive 1940s look for newer clocks, and provides a holder and connection method. This is important especially if the cells are visible from outside the clock; for example, through glass doors. See Figure below. These are much more attractive than a Tandy economy plastic battery holder with thin lead wires.
The theoretical capacity of an Energizer D cell is 18-20 Amp-Hr to 0.8 volts per cell. On the surface, this would run a clock for well over 2 years. However, most self winding clocks require relatively fresh cells to wind reliably. The cell capacity to where the clocks will not wind is only about 9000 hours to 1 volt per cell (under load) which translates to a run time on the order of 1 year with fresh cells. You won’t quite get double the capacity for double the cells due to impedance factors, but for over 1 year of service between changing cells, this is a great option. The Model 1900L is very similar in capacity to the now obsolete EN6 and should power most self winding clocks for about the same length of time. It’s our recommended replacement for the EN6.

**Lithium D Cells.** There is a UL-approved lithium technology that has the right voltage (3.6V), ultra-low self-discharge and high energy density suitable for powering vibrating motor self-winding clocks. This is the Lithium-thionyl chloride cell. See picture.

These cells are meant for low-drain standby applications such as powering commercial utility meters, beacon or emergency location transmitters, and military applications. A single D cell such as the Saft LS33600 Lithium cell would fit perfectly in the 1900. Installed in a 1900 holder (picture above) they can run a vibrating motor self winding clock for 1.5 to 2 years. Two 1900 cells in parallel equipped with the Saft LS33600 could run a clock for 3-4 years, theoretically! Their discharge curves are ruler-flat which would assure reliable winding and timekeeping over the full run time. More expensive than alkaline D cells, the Saft LS33600 cell would cost around $18 every 2 years per replacement.

While one such cell would power vibrating motor clocks manufactured by the Self Winding Clock Co., it would take two or more in parallel to power the rotary motor (Style A or B) self winders. This is because the impulse or motor starting amperage required would exceed the cell’s capacity. We don’t recommend the Lithium solution for Style A movements.

**Additional Voltages.** Additional products are available from Ken’s Clock Clinic for clocks that require voltages other than 3 volts. A 1900-3V contains a dual Alkaline D cell holder. Two such 1900-3V units in series could produce 6 volts. Three in series would give 9 volts.

The 1900-24V Kit is equipped with Alkaline D cells and an innovative, high-efficiency electronic voltage converter. The kit outputs the voltage necessary to power 24 volt self winding clocks very reliably, and without the use of an unsightly power cord—or worse yet—unsafe and outdated rectifiers and transformers dangerously wired inside the clock. See “More on Powering 24 volt clocks” below. With all of this, the kit still looks like an ordinary pair of No. 6 cells!

The collector will run across 24 volt Self Winding Clock Co. units periodically. They are great clocks, if you can get one. Many of them were used to provide the Bell System with a long distance billing system that charged in 6 second increments. They are often equipped with switches and synchronizers which were used in conjunction with other clocks to provide state of the art (at the time!) long distance call timing.

Users of alkaline and lithium cells should dispose of spent batteries responsibly.
Rechargeable Alternatives and the 1900R

With today’s focus on reusable energy sources, it is compelling to consider a product that can power our clocks without the need to throw away batteries. An extensive study of rechargeable batteries as alternatives to running self-winding clocks has been conducted. Below is a comparison table between numerous rechargeable technologies available today:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Typical Cost $/Watt-hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>NiCd</td>
<td>Can be deep discharged</td>
<td>Low cell voltage (1.2 volts)</td>
<td>$.80</td>
</tr>
<tr>
<td>NiMH</td>
<td>Higher energy density than NiCd</td>
<td>Poorest self-discharge (3 months)</td>
<td>$1.00</td>
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<tr>
<td></td>
<td></td>
<td>Very sensitive to over charging</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Standby use can damage battery</td>
<td></td>
</tr>
<tr>
<td>Li Ion</td>
<td>Best cell voltage (3.6 volts)</td>
<td>Safety considerations means expensive protection</td>
<td>$.90</td>
</tr>
<tr>
<td></td>
<td>Good self-discharge (10 months)</td>
<td>Most expensive battery of group</td>
<td></td>
</tr>
<tr>
<td>Cyclon Sealed Lead Acid (VRLA)</td>
<td>Better self-discharge (2 years)</td>
<td>Weight</td>
<td>$.30-$ .75*</td>
</tr>
<tr>
<td></td>
<td>Excellent tolerance to standby use</td>
<td>Possible venting in overcharge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tolerant to overcharge</td>
<td>Requires shutdown circuitry to prevent deep discharge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good cell voltage (2 volts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probably the safest cell overall</td>
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*Price depends on type of construction. Spiral cell nonspillable technology such as Cyclon offers optimum performance but is more expensive.

Bottom line is time-proven Cyclon SLA technology surpasses all others in every category except weight, and they’re relatively economical. Improvements in spiral cell nonspillable technology have established it as the best—and probably the only—choice where reliable service is a concern, such as hospital instrumentation, military installations, standby lighting systems, etc.

A rechargeable solution has the following advantages:

- Rechargeable batteries can be conveniently re-used for their service life (10 years or more claimed by the manufacturers of the Cyclon cells)
- Saves on inconvenience and cost of battery replacement, and is friendlier to the environment in the long run
- Does not have to be removed from the clock, preventing broken wires and, in some clocks, the need to remove the dial and hands from the clock

Safety Concerns. All rechargeable battery manufacturers warn against charging their batteries in a sealed container due to hydrogen production if over-charged. To be on the safe side, we recommend leaving doors or lids of the clock ajar during charging to avoid problems. If the battery is located on the top of the clock, there is no issue.

Battery Selection. In our opinion, the Cyclon battery is hands down the finest high-quality miniature VRLA rechargeable unit available. It has excellent long-term performance when used in intermittent standby applications because self-discharge is very low. It is rugged enough to be used in a vacuum and vents minimal hydrogen in comparison to other lead-acid technologies. It has the form factor to allow it to be packaged in a cylinder that replicates the original No. 6 dry cell. For these reasons, it has been selected as the power plant for our Model 1900R.
**Model 1900R.** This model is the twin brother to our nostalgic alkaline battery holder 1900. It is based on the Enersys Cyclon E cells (X cells in older units) which are built into a vintage No. 6 package. It includes a two-stage charger that is conveniently powered from line voltage. Battery management circuitry automatically shuts down the 1900R when the battery is spent to avoid deep discharge. It also includes a voltage converter that changes the 2.1 volt battery voltage into a constant, regulated 3.3 volts for the clock (the equivalent of two fresh No. 6 batteries in series). This assures the winding will be sure and rapid regardless of battery state of charge. This novel converter is state-of-the-art technology and is highly efficient. Until now, it was difficult, space inefficient, and/or uneconomical to provide this capability because the standby power wasted by the voltage converter would kill the battery and yield unacceptably short run time between charges. The newer 1900R (Model 1900R2, with 3000 series serial numbers) also has an ultracapacitor output, making it suitable to power any 3 volt vintage clock, including the impulse models.

The rechargeable 1900R is in many ways an ideal solution. It carries the vintage charm of the original battery, complimenting the clock’s heritage. It pays itself back because it is reusable. It is convenient to recharge, with visual indication that the battery is charging or charged. It doesn’t need to be removed from the clock to recharge, which avoids broken wires and even disassembly of the clock. The standard 1900R is a 3 volt output unit. This means that only one is needed to power 3 volt clocks. This simplifies the charging since only one cell needs to be charged.

**Challenging Clocks.** Many self winding clocks (e.g., Style A and B rotary motors, Style F with enclosed 3 volt motor, and impulse-style from American Clock Co.) require more amperage than a pair of alkaline D cells can deliver. The 1900R can deliver the amperage needed in every self winding clock application we have found. In fact the performance of the 1900R in powering impulse-style and Hipp-Toggle style clocks is unsurpassed in comparison to any other battery-based solution we have seen (assuming proper voltage, of course—which the 1900R provides).

The 1900R includes a line-powered charging unit which conveniently plugs into the top of the battery. Once plugged in, a red dot appears at the top of the front label when charging. This red indicator disappears when the battery is fully charged and ready to go for another 9-12 months.
More on Powering 24 volt Clocks

Some self winders used as masters and Bell System long distance call timers were originally powered from large battery arrangements available at the site. In these cases, the batteries were not installed in the clock, but were remotely located in closets and basements where they remained cool and out of the way, and where there was sufficient room for the 8 or 16 (or more) cell banks. Wires were run within the structure between the battery banks and the clocks. With the advent of the 1900-24V Kit and 1900R-24V, it is possible to power these clocks from an attractive battery unit and eliminate power cords and unsightly transformers that take away from the vintage look of the clock. It’s also infinitely safer than some of the unfortunate arrangements we’ve seen rigged to power these clocks. Here is a picture of our 24 volt Parlor clock powered by a 1900-24V Kit.

A 1900-24V Kit is are shown installed and running a 24 volt Parlor clock manufactured by the Self Winding Clock Co. of New York. This vibrating motor unit no longer requires the transformers and power cords it had when we received it. We removed an arrangement with exposed bare 120 volt wires that was quite frightening (see inset upper right) and certainly not vintage looking. We were then able to mount the clock high on our wall, out of the normal reach of any power outlets and untethered by wires. A rechargeable version is also available, the 1900R-24V.
Separate Battery Converters and Lantern Batteries

There are those individuals that prefer to run their self winding clock from a 6 volt Alkaline lantern battery. These advocates will argue that it is “good” for the clock. This approach has concerns. The most compelling is based on the square law relationship between energy dissipated in the motor (contacts, mechanical) and voltage applied. So, for a clock designed to run on 3 volts, applying 6 volts quadruples the energy that the motor must absorb during winding. This additional energy will accelerate failure. We’ve witnessed it time and time again with clocks we have seen coming in for restoration.

Many advocates of using 6 volt Lantern batteries say that they have run their clocks for years on them. We have seen clocks run on inappropriate voltages. The contacts are usually worn or burned substantially. Without looking at contacts under a microscope, the owner cannot “see” the damage that is occurring with the wrong voltage until it is too late. But, mathematics will predict that clocks run on the correct voltage will be preserved much longer.

Further, we have seen damaged winding ratchets, pawls and stripped winding wheels which were the result of powering these clocks from lantern batteries. The cost to replace these components is ever increasing since they must often be fabricated. Even parts movements are often found with these components damaged or defective. It isn’t worth it. Don’t use a lantern battery to power these clocks.

Many newer so-called “Western Union” clocks (1950’s vintage, FR300000 series serial numbers or thereabouts) use a miniature 3 volt enclosed DC motor. This delicate motor can be damaged with 6 volts!

It may be considered a purists position, but we advocate running the clock on the voltage it was originally designed for, to assure that they continue running for decades more for others to enjoy.