School Clock Systems of The Standard Electric Time Company

by J. Alan Bloore (CA)

Many will remember staring at the classroom clock waiting for the minute hand to jump forward signaling the end of the class. The bells would ring and we were free to move on.

Remarkably each clock in the system was on the same minute and every bell rang precisely at the same time. There is a good chance that the clocks in your school were made by The Standard Electric Time Company.

Who knew that we were indebted to Charles D. Warner for playing a major role in developing this underappreciated and seemingly simple way to monitor time? Charles D. Warner was born in Suffield, CT, in 1853 and by the age of 27 was the owner of a successful general store in Ansonia, CT (Figure 1). He was a trained watchmaker and jeweler and, with his experience in the new field of electricity, today would be considered an electrical engineer. He incorporated The Standard Electric Time Company on February 7, 1887, with headquarters in Waterbury, CT.

The years between the 1860s and the 1890s could be considered a golden era of innovation. Many remarkable changes took place that affected everyday

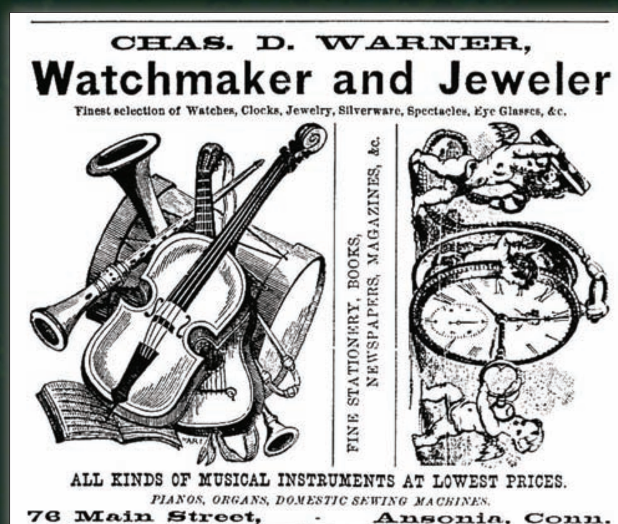

Figure 1.

This material was first presented at the 2008 Ward Francillon Symposium on Electric Horology held in Springfield, IL.

life. These changes were by-products of the Industrial Revolution. Things we cannot imagine being without. The railroads were moving people and goods between cities and eventually all the way across the country. The telegraph and telephone made it possible for people to communicate across great distances. The new phenomenon of electricity was used to power this communication and was employed to do work previously done manually. With all the amazing innovations taking place at about the same time, those with curious minds were free to use these new wonders as their drawing boards for inventions.

Precise time and timekeeping became a new industry and electricity played a prominent role in the new business of selling correct time. In recognition of how important it had become to agree exactly what time it was, and hoping to avoid intervention by Congress, the heads of the major railroads met on October 11, 1883, in Chicago to adopt the Standard Time System. The country was divided into four time zones and Standard Time was born.[1] With Standard Time established, each watch and clock needed to be synchronized periodically. If a system of clocks that were all connected to one central clock could be devised, it would ensure that all the clocks in the system read the same time and it would also simplify the synchronizing procedure. A synchronized system would consist of a central master clock and many auxiliary clocks at remote locations. These auxiliary clocks are called secondary or slave clocks. The master clock is a very accurate regulator that has the capacity to close an electrical circuit that will send an electrical impulse at regular intervals (usually once each minute) along wires that are connected to each secondary clock. The secondary clock movement does not need to be a complete clock mechanism but simply a set of motion works attached to a center shaft with a ratchet mechanism that is capable of moving the center shaft one unit of time per electrical impulse. Exact time was ensured at all locations. That is, if everything functioned properly.

The earliest master clocks were weight- or spring-driven regulators and were wound by hand. They were fitted with electrical contacts that when closed sent an electrical impulse to the secondary clocks.

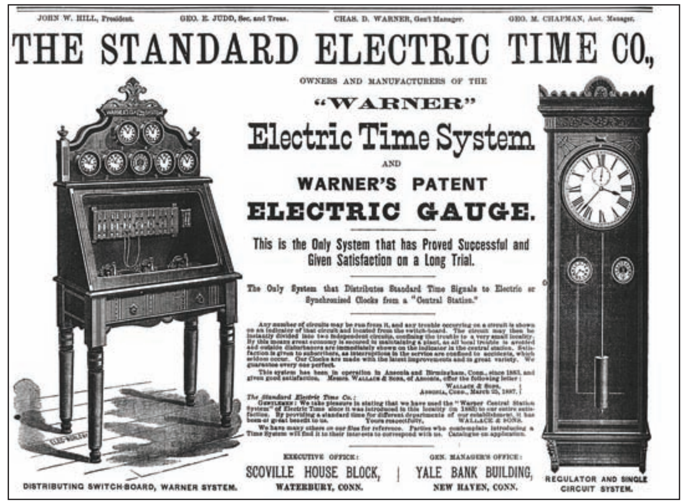

Figure 2.

Chester H. Ponds formed The Time Telegraph Company in 1882 and began to sell exact time systems to businesses and government entities. He received a patent for a self-winding clock movement in 1884. Now both the master clock and the secondary clocks were controlled electrically. Chester H. Ponds was a skilled instrument maker and electrician and was a director and secretary of the Gamewell Fire-Alarm Telegraph Company. One of his sales representatives at The Time Telegraph Company was Charles D. Warner. As so often happens, one who has experience working with a new system has ideas for improving the system, and Charles D. Warner is a great example. Warner licensed from The Time Telegraph Company the rights to operate a system of clocks for both Derby and Ansonia, CT. He had nearly 100 electric time dials (secondary clocks) connected to the main central station (master clock) in his store.[2] As early as 1884 Warner received patent number 309,114 for an electric gauge to check the strength of the current in clock circuits. In 1886 Warner received patent number 335,860 for an Electric Clock System with a central switchboard that controlled the operation of any number of secondary clocks and had the means to isolate any malfunctions on the circuit. The system included a battery gauge and at least one pilot clock as system monitors (Figure 2). Warner also recognized that for any time system to be successful the secondary clocks must be reliable. He invented a more reliable secondary clock movement and received patent number 363,440 for his Secondary Electric Clock Movement on May 24, 1887. He was so confident in these improvements that he left The Time Telegraph Company and in 1887 formed The Standard Electric Time Company (from here on referred to as Standard) to market his synchronized time system.

Charles D. Warner's business plan emphasized selling synchronized time systems to schools, factories, railroads, and government facilities. These installations were in individual buildings or in buildings in close proximity to each other. This did not involve connecting clocks over great distances. His approach eliminated or at least minimized problems caused by damaged transmission wires. He did not have to pay the costs of right of ways for transmission lines and repair, and installations were not in remote areas. Warner sold synchronized time. Every clock in the system displayed exactly the same time. It may not have been accurate to the second but all the clocks were synchronized.

In 1886 Chester H. Ponds was a principal in the formation of the Self Winding Clock Company. The Self Winding Clock Company used West-

Figure 3.

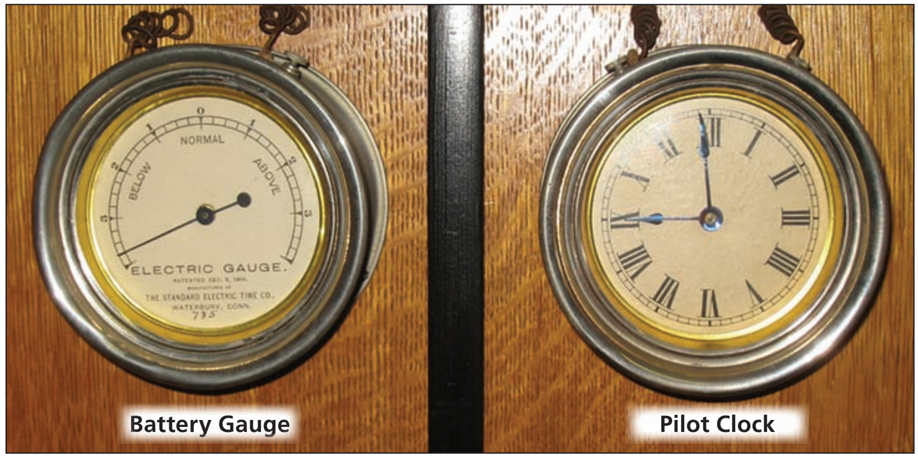

Figure 4.

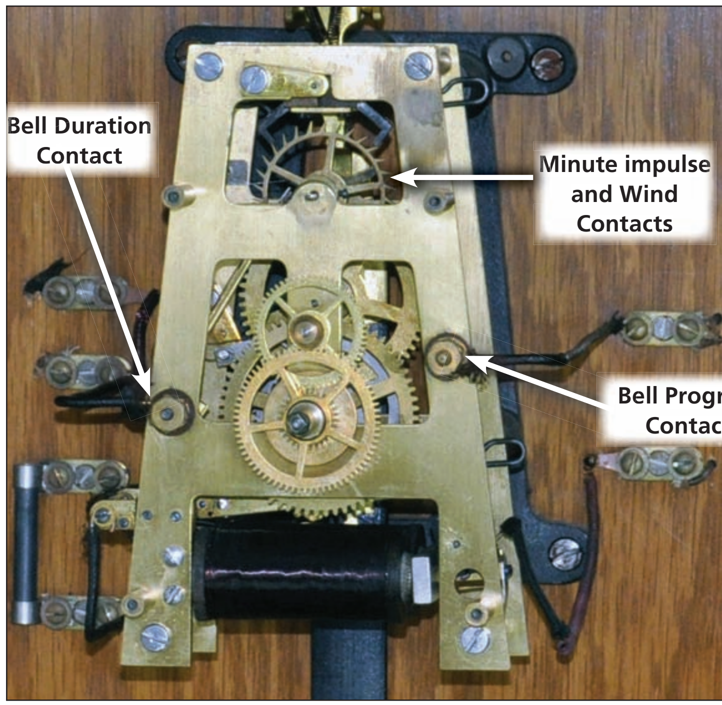

Figure 5.

ern Union Telegraph lines to transmit electrical impulses to customer clocks. They emphasized that the time they sold was absolutely accurate to the second. Their signals could be transmitted over great distances and were ensured to be accurate by virtue of their master clocks being synchronized daily with the Naval Observatory Regulator in Washington, DC.

Standard originally purchased regulators from the Self Winding Clock Company, E. Howard, or Seth Thomas. It then converted the regulators to master clocks by adding electrical components to wind the mainspring and impulse the secondary clocks. By about 1892 Standard had designed its own electrically wound master clock movement and began installing it in all Standard master clocks.

Warner's awareness that clock systems needed to be monitored from a central location was one of his most, if not the most, important contribution to the success of synchronized clock systems. A successful system would monitor the electrical potential and would be able to verify that the secondary clocks were advanced each minute. In a typical school installation this was done with a battery gauge and a pilot clock installed in the master clock (Figures 3 and 4).

The master clock movement was manufactured with front and back plates in somewhat of an "A" shape (Figure 5). The movement was available in 60-, 72-, 80-, and 120-beat configurations. The 60-beat, or seconds beat, configuration was the most accurate and would have been the clock of choice for most schools. Some 72-beat clocks were installed in smaller facilities with less complicated time systems. It was in a smaller case and would have been less expensive. The 80- and 120-beat clocks were housed in progressively smaller cases, were less accurate, and would have been used in less complicated installations and probably not in schools.

Figure 6.

Figure 7.

Figure 8.

All master clock movements were self winding and the mainspring was on the center arbor. The mainspring was kept fully wound by a 24 vdc (in some instances the voltage was different) impulse each minute to an armature that moved a pawl one click on a winding ratchet wheel. If power was lost, the movement was capable of running for about 50 minutes and then it would stop. This master clock movement was essentially unchanged for the entire production of Standard pendulum-regulated master clocks. By 1957 Standard discontinued the manufacture of pendulum-operated master clocks and continued to make only synchronous-motor-driven master clocks.

This circa 1918 master clock has 8 series clock circuits and a Warner electric gauge (Figure 6). The master clock was accompanied by a 6-circuit, 24-hour tape, bell program in a separate case (Figure 7). (The bell program will be explained later in this article.) This system would have been installed in a large school. Inside the master clock there is an on/off switch for each clock circuit on the back board and a test key for each secondary clock circuit on the bottom of the case. The wind and minute advance keys are at the bottom in the corners.

Most master clocks that were installed in schools contained the bell program mechanism inside the clock case (Figure 8). The case also may contain at least one pilot clock and a battery gauge (Figure 9). After about 1925 the design of the pilot clock cases changed and the plating went from nickel to brass. The series secondary movement in the pilot clock was unchanged. The brass electric gauge was now an ammeter. The early battery gauge simply indicated if the current in the series secondary clock circuit was “Below - Normal - Above” and provided no quantitative measurement. The change to an ammeter gave a more accurate measurement of the current in the clock circuit. This clock is dated 2-15-28 on the back.

All master clocks were built to order, so rarely will one see two master clocks that were outfitted exactly the same. The master clock was selected from a catalog, the required systems were selected, and then the clock was custom made.

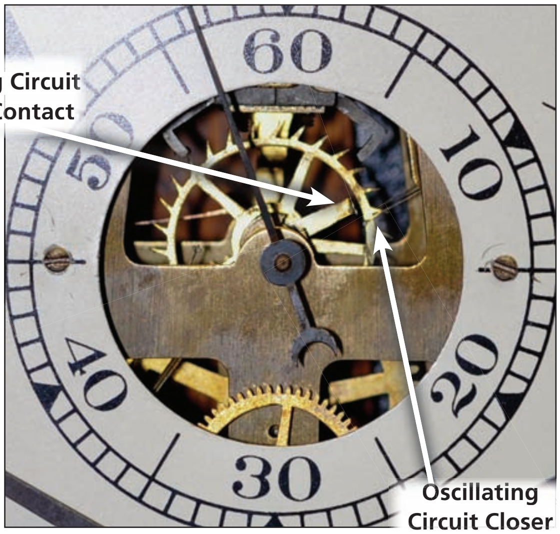

Figure 12. Oscillating contact.

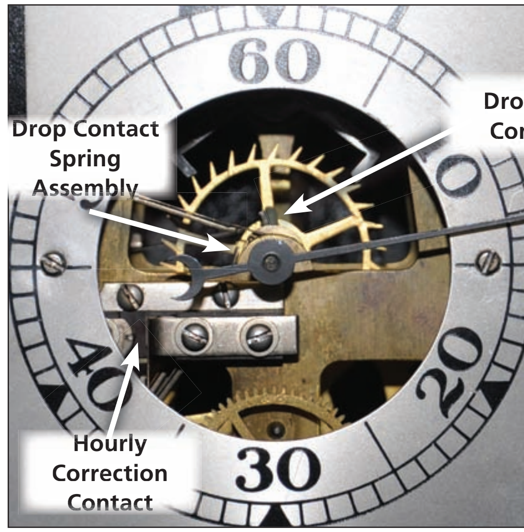

Figure 13. Drop off contact.

Wiring for all the components included in a synchronized time system were done on the back of the master clock case, and the external connections to the power supply, secondary clocks, and bells were made on the top of the case (Figures 10 and 11).

The function of the master clock is to accurately advance the secondary clocks each minute and to accurately time the ringing of the bells. In order to accomplish this, the clock must close circuits precisely and reliably. Charles D. Warner received a patent for the oscillating circuit closure in 1888 (Patent No. 387,703). This very circuit closure was used by Standard to wind the master clock and to signal the secondary clocks and ring the bells through the 1920s. The patented circuit closure consisted of two arms (oscillating circuit closures) on the arbor of the escape wheel and each of these arms met with a contact (rotary circuit closure) on the verge one time each minute (Figure 12). One contact, on the 59th second, energized the circuit(s) that advanced the secondary clocks and the other contact closed 30 seconds later to energize the winding coils that kept the master clock movement wound. The bell program contact also closed when the armature of the winding coil moved. The bell duration contact closed each minute for about seven seconds but only activated the bells when the bells were programmed to ring. In the 1930s Standard changed to Drop Off contacts that are on the arbor of the escape wheel and contact the drop contact spring assembly insulated from but mounted to


Figure 9.


Figure 10.


Figure 11.

Figure 14.

Figure 15.

Figure 18.

Figure 16.

Figure 17.

Figure 19.

the back plate of the movement (Figure 13). The bell contacts are platinum pins on the arbor of the escape wheel that contact spring assemblies mounted on the back and insulated from the back plate. This 1945 movement is equipped with the Automatic Reset System.

All secondary clocks are connected electrically to the master clock. The master clock has a contact switch that mechanically closes every minute completing an electric circuit and advancing the minute hand one minute. The earliest Standard secondary clock dials had "ELECTRIC TIME" in bold print and also included the term "Warner System." They were made of paper (Figure 14). Electricity was a new phenomena and Warner was aware of this as a selling point. When the company name was chosen, in addition to the word Electric, he also included Standard in the name as the universal system of Standard Time was recently implemented—a very progressive name for a forward thinking company.

Prior to 1900 the design of the dial changed. In addition to ELECTRIC the company name The Standard Electric Time Co. was used on the secondary clock dials. These dials were also made of paper and included the company location, Waterbury, Conn. (Figure 15). Standard moved to Springfield, MA, in 1912, and clock dates can be approximated by this, because secondary clocks that have Springfield, Mass. were made sometime after 1912. Within a few years all dials were painted on metal. The earliest secondary clocks were available in wood cases, usually oak (Figure 16). In 1921 Standard incorporated a separate company in California, The Standard Electric Time Company of California. This company was active for a few years, and some secondary (and master clock) dials will be seen with this company name (Figure 17).

Most commonly the secondary clocks were in square cases, but were available in round wood cases at a greater cost. Over the years the case designs became simpler. A 1914 Standard catalog shows most secondary clocks available were in wood cases, but a look at a 1926 Standard catalog reveals more metal cases were available. In the 1930s and 1940s it became more common to equip schools and buildings with the now less expensive, metal cased secondary clocks, and by 1950 secondary clocks were almost exclusively metal cased (Figures 18 and 19).

The previous six secondary clock pictures represent the most common types that one might have seen in a

Figure 20.

Figure 21. 1887.

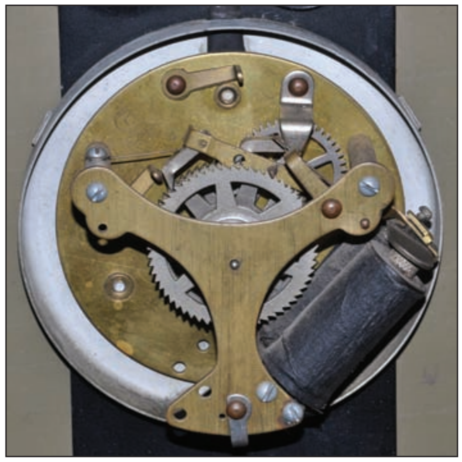

Figure 22. 1966.

classroom over the years. Standard had many other styles of secondary clocks, from enormous gymnasium clocks with reinforcing wire in the glass, to very small and very large wood case clocks, to boiler room clocks, to elegant clocks with bronze or marble dials and raised numerals, to mantel clocks, to a succession of styles of pilot clocks, to 1950s- and 1960s-style metal clocks (Figure 20). Over the years almost any style of clock to fit any décor was available as a secondary clock.

Reliable and accurate secondary clocks were essential to the success of the newly formed Standard. Previous designs of secondary clock movements were likely to be affected by electrical surges or slight variations in voltage and often proved to be unreliable. Warner's secondary clock movement design was very reliable, easy to adjust, and relatively inexpensive to produce. Figures 21 and 22 show that Standard used this very mechanism in secondary clocks with minimal changes for 80 years.

Below are the three major types of electrical components that will be found in Standard secondary clock movements manufactured up to World War II. On the left is a series movement that needs approximately 1.5 vdc to advance the minute hand (Figure 23). Series clocks have an approximately 120-ohm resistor wired in parallel with the coils. These clocks are connected in series and usually consisted of up to 15 clocks on a circuit and were energized with 24 vdc. In the center is a secondary clock that would be installed in multiple with

Figure 23. Series.

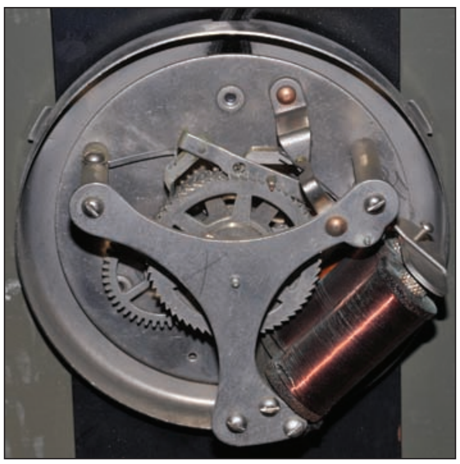

Figure 24. 24 vdc.

Figure 25. AR-3 24 vdc.

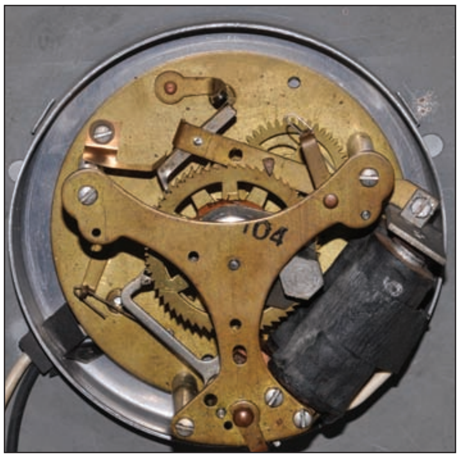

Figure 26. AR2 24 & 48 vdc.

wiring going directly to the master clock or a terminal and requires 24 vdc (some multiple clocks are 12 vdc) to advance (Figure 24). The movement on the right is referred to as an AR3 movement. This movement has two sets of coils (Figure 25). The pair of coils on the right is energized with 24 vdc and will advance the minute hand. The pair of coils on the left is also energized with 24 vdc but only on the 59th minute of each hour by a separate contact switch on the master clock. When energized, the minute hand will automatically reset to the 59th minute if by chance it was not exactly correct. This system required three wires to each secondary clock and hence the name AR3 (Automatic Reset 3 wire). While the design of the mechanical portion of the secondary movement changed very little, the electrical components were improved over the years. Originally, clock circuits derived their energy from batteries and there was a limit to how much energy was available. The only difference between series coils and multiple coils was the size of the winding wire. The series secondary clock coils were wound with much heavier wire to reduce resistance. The change from secondary clocks wired in series circuits to 24 vdc multiple wiring was made possible as electrical energy became more available and reliable and thus it was possible to get more clocks on a circuit. When a series secondary clock failed, the entire circuit was affected, much like old Christmas tree lights; when one goes, they all go. Once clocks could be wired in multiple, each clock was independent of the others. With adequate energy available, the engineers then developed methods of correcting any individual clock that may have varied from the master clock. For Standard this led to the additional set of correction coils in AR3 secondary clocks.

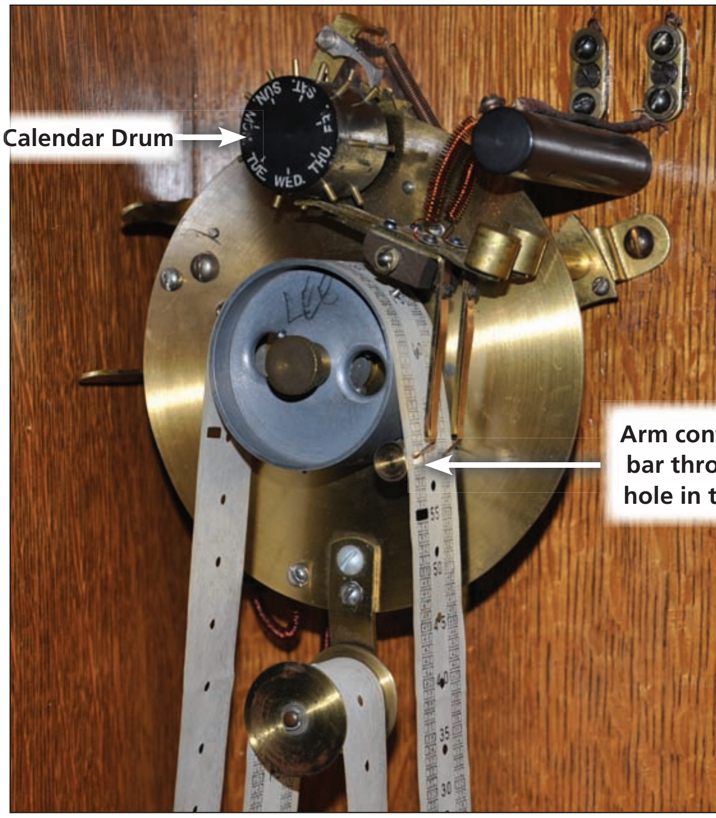

Figure 27.

After World War II it appears that most secondary clock movements were manufactured with brass-colored plates and most of them were capable of hourly correction but utilized only one set of coils (Figure 26). When the coils were energized with 24 vdc the top armature would advance the clock hands one minute, but if energized with 48 vdc the top and bottom armatures would release the hands and a counterweight

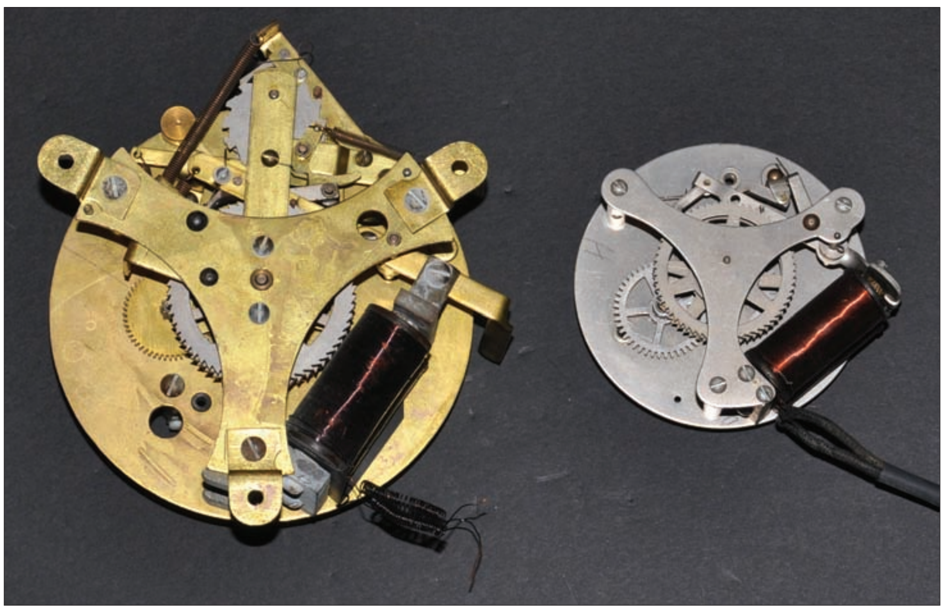

Figure 28.

Figure 29. Size comparison between a synchronous master clock and a pendulum-regulated master clock.

Figure 30.

would reset the minute hand to the 59th minute. These clocks were designated AR2 clocks (Automatic Reset 2 wire). This was originally done during World War II as copper wire was in short supply but was continued after the war to keep costs down. The AR2 system was apparently not as trouble free as the AR3 two pairs of coils correction systems.

An integral part of a synchronized clock system in a school (and in some factories) involved ringing of the bells. Most Standard master clocks had installed inside the case a minute impulse program clock fitted with a center wheel and pulleys that support a paper tape. The moving paper tape acts as an insulator between a metal contact arm and a metal bar. The tape can be programmed to select the proper minute the bells are to ring by simply punching a hole in the tape at the specified time. At the selected time the hole in the paper tape permits the metal arm to contact the metal bar, completing a circuit and energizing the bell circuit. These paper tapes made a complete revolution in 12 hours (some systems used 24 hour tapes). The program clocks have a calendar drum with pins to disengage the contact arms at night and on the weekends (Figure 27).

Each minute the master clock advances the bell program mechanism in the same manner as a secondary clock. The design of the program movement is the same as Warner's patented secondary clock movement; however, the program mechanism is much larger, as moving the tapes and turning the calendar drum requires much more energy than moving the hands of a typical secondary clock (Figure 28). This same larger movement in the bell program (No. 2 Movement) is also used in large secondary clocks with dials from 15" to 30".

As early as the mid-1930s Standard began to make some master clocks that were driven by a synchronous motor rather than a pendulum-regulated, spring-driven movement. While "Eyebrow"-type master clocks are slightly over 5 feet tall, a synchronous motor master clock case could be much smaller. The case only needed to be large enough to accommodate the bell program tapes and not a pendulum.

The master clock would have the same capabilities but would be much smaller albeit much less impressive (Figures 29 and 30). Notice the pictured master movement is the typical "A"-shaped movement with a synchronous motor driving the motion works. The circuit closures are comparable to ones used in pendulum-type master clocks and are equally efficient in controlling the secondary clocks, the bell program unit, and ringing the bells.

A look at company catalogs provides insight to the enormous increase in electrical components that were added over the years to the portfolio of items that could be included

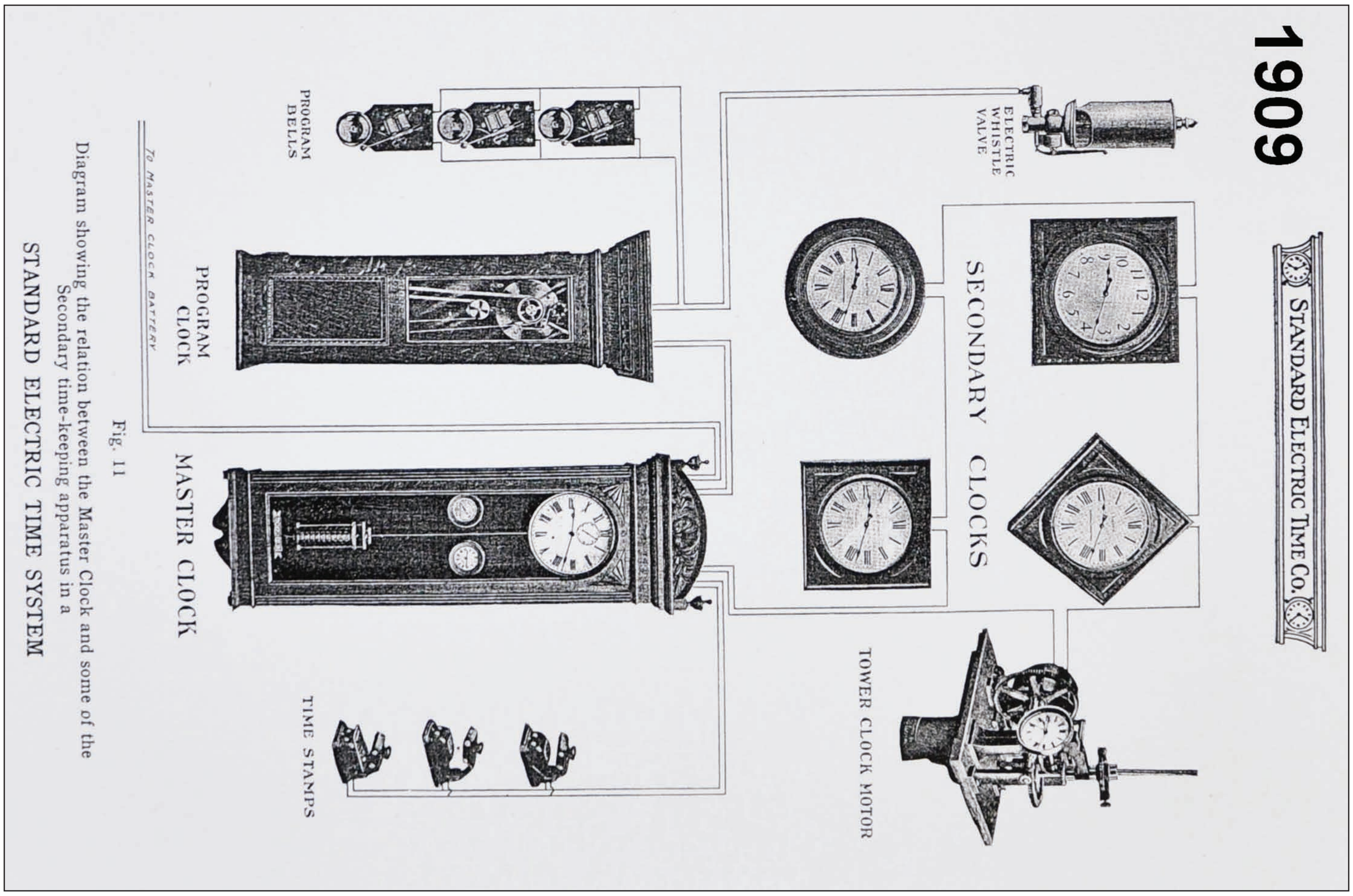

Figure 31.

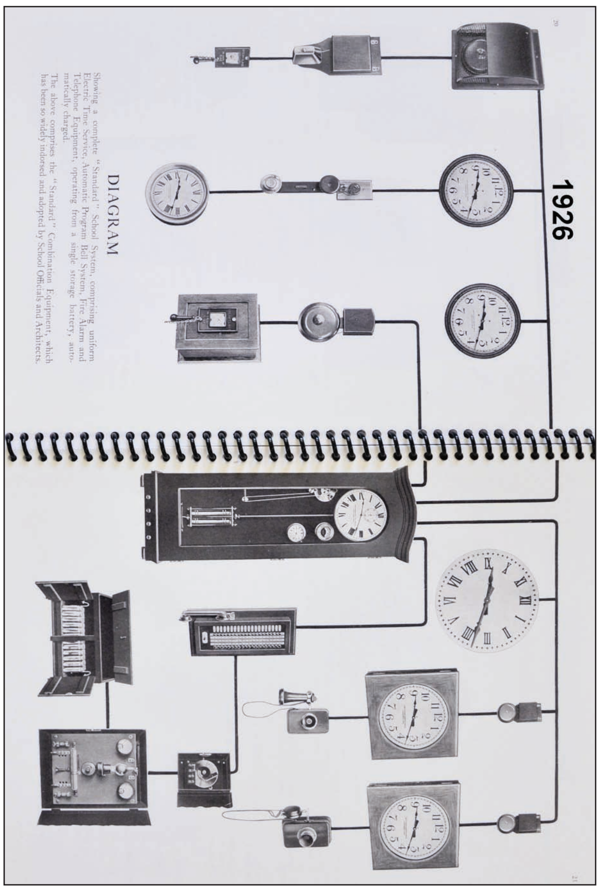

Figure 32.

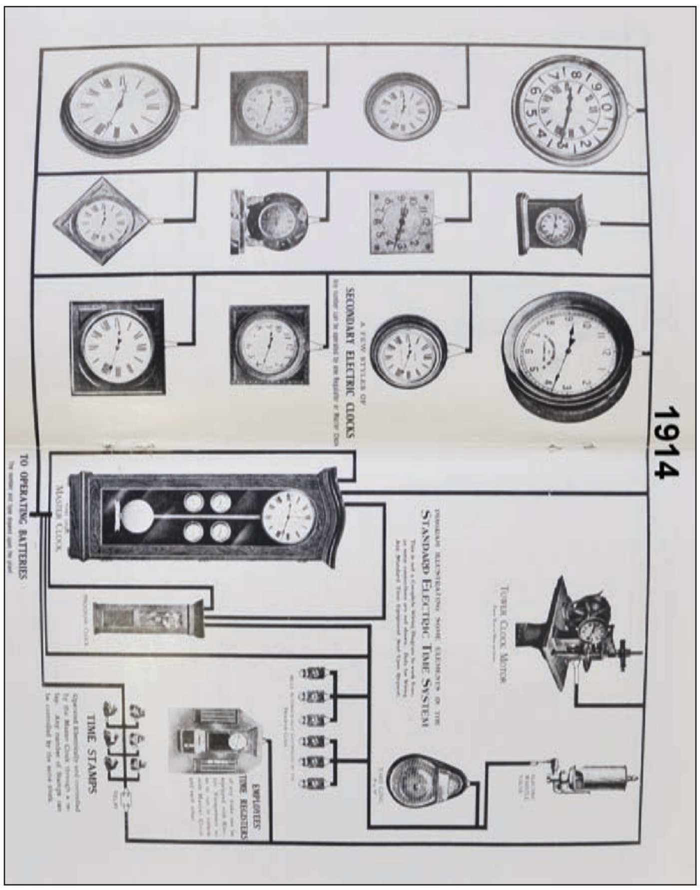

Figure 33.

Figure 34.

in the clock systems that Standard offered. The 1909 catalog pictures the master clock and some secondary timekeepers that would be synchronized by the master clock (Figure 31). The master clock is in an elegantly designed case and is accompanied by an equally elegant bell program in a separate case. There are a few secondary clock case designs to pick from. All are quite ornate.

In the 1914 Catalog Standard was offering the master clock in an early configuration of the classic "Eyebrow"-type case, and there were many more secondary clock styles to choose from (Figure 32). The system could include employee time registers, in addition to time stamps, and was capable of controlling the bells with the accompanying program clock.

The 1926 Catalog reveals how Standard expanded the types of additional systems that could be installed at the same time that the clock system was installed (Figure 33). Requirements for the clock systems could be met and the systems could be enlarged to include telephone systems, paging systems, intercoms, and fire systems. The school, factory, or government facility could have all the latest in electronic wizardry in one package. All the necessary wir-

Figure 35.

ing could be done at one time. It was a perfect opportunity for Standard to greatly expand its product line.

Standard catalogs had lists of installations they had completed, and over the years these lists included installations in most, if not all, of the larger cities in the country.

These clock systems relied on an adequate and reliable supply of electrical energy. The earliest systems derived their power from wet cells, which were cumbersome as they were quite large and there was the possibility of chemical spills. These batteries usually would power the system for at least one year. By the 1890s dry cells became available. They were much smaller and easier to handle; more power could be added and the systems could be enlarged. The dry cells also could be expected to last at least one year.

Once alternating current was available most customers chose to power their systems with it using rectifiers to change AC to low-voltage DC current. For systems that were battery powered the alternating current could be employed to charge the

Figure 36.

batteries. Interestingly the availability of AC current, either rectified to DC or charging batteries, proved to be the impetus for expansion of Standard's DC systems. Now an installation could be as small as a one-room schoolhouse or as large as the clock system installed in the Department of Agriculture Building in Washington, DC, which had 1775 secondary clocks all controlled by one master clock.

The Standard Electric Time Company was incorporated in 1887 and by 1892 had moved to larger quarters in Waterbury, CT. In 1893 Warner hired an ambitious 19-year-old named George L. Riggs. Unlike Warner, Riggs was not a clockmaker or an electrician but proved to be a very astute businessman. Within a few years Riggs had mastered all aspects of manufacturing and the operation of Standard and by the age of 23 had taken over the company (Figure 34) The early 1890s were difficult economic times and the controlling interests in Standard had changed hands a few times. Warner apparently wanted out of the business and in 1897 Riggs purchased the company for $6,000 and assumed all debt. Riggs was not just an investor looking to make a profit on an investment but was committed to the success of Standard. He expanded the product line and by 1910 Standard had branch offices in Boston, New York, Chicago, and all the way west to San Francisco. In 1912 he moved his manufacturing

Figure 37.

to a larger facility, with a potentially more skilled work force, in Springfield, MA. In Springfield Standard was able to manufacture its entire line of clock mechanisms and electrical components and manufactured all the cases. Riggs focused primarily on the educational market. New schools were being built and older schools were being modernized. All these schools needed synchronized clock systems and Standard was the acknowledged leader in school clock systems. As electricity became more reliable and available, it was a natural for the clock system installer to offer intercom, telephone, and alarm systems in conjunction with the basic clock system.

Riggs continued to run Standard until his death in December 1928 and was succeeded by his wife, Frances Riggs, as the president of Standard. Mrs. Riggs joined Standard as a receptionist in 1916 and married George Riggs in 1923. She became a member of the board of directors in 1924 and was elected secretary in 1925. She was well prepared to run the company. She was president of the company and chief operating officer for almost 40 years and operated it through good times and bad—through the difficult times of the Depression and the challenging times of World War II. By the early 1950s the company had diversified with products for measuring flow rates in pipelines to electronic calling and monitoring systems for hospitals. At one time Standard employed more than 400 people. The core business remained the synchronized time systems that put them at the top of the industry. Standard was sold to Johnson Controls in 1968 and was subsequently sold to Faraday, Inc., a company specializing in fire protection systems, in 1978. Standard production was continued in Springfield until 1982 when the facility was closed and everything was moved to Tecumseh, MI. Even though the machinery for manufacturing clock mechanisms was moved, no new Standard clock parts were made after the move to Michigan. The lone exception was the production of paper tapes for bell programs. In 2002 Faraday stopped selling anything under the Standard name. Up until that time The Standard Electric Time Company was America's oldest continuously operating manufacturer of electric clocks.

The last wood-case pendulum-regulated master clock was manufactured in 1957. By 1950 most master clocks were powered with a synchronous motor and were housed in a metal case (Figure 35). Many secondary clocks made after 1960 had synchronous movements. Any secondary clock with a sweep second hand has a synchronous movement (Figure 36). The days of the elegant wood-case clocks were over.

By the 1950s Standard had reduced the secondary clock case designs to a few simple metal cases. This did not adversely affect sales, as Standard

Figure 38. The author's collection of clocks, many of which are from the Standard Electric Time Co.

shipped approximately 2,000 minute impulse secondary clocks per month in the 1950s through the middle 1960s. Between 1936 and 1966 Standard shipped more than 500,000 secondary clocks.[3]

The author estimates that more of The Standard Electric Time Company clock systems were selected to be installed in schools and universities throughout the country than the combined total of all other clock company systems. The old production records did not survive company transitions, but it appears that between 1890 and 1960 The Standard Electric Time Company must have installed more than one half of all clock systems in the educational market.

Figure 37 is a picture of pre-1915 Standard Electric Time master clocks and pre-1930 secondary clocks. The simplicity and reliability of the mechanisms and the elegance and grace of design reflected a pride in workmanship and a less cost-conscious world. The line of clocks for synchronized clock systems by the late 1950s were all installed in metal cases. These "modern" clocks were able to function as well or better than the "older" clocks, but unfortunately the old days of service and maintenance had been replaced with a dispose-and-replace mentality. I hope others will join me in preserving these elegant "old reliables."

About the Author

Alan Bloore has been a collector of electromechanical clocks for more than 30 years. His primary interest is in clocks that are part of synchronized time systems. He has several master clocks and secondary (slave) clocks installed in his home, and he keeps his clocks running at all times. The Standard Electric Time Company clocks make up a good part of his collection.

Alan and his wife Kay have 5 children and 11 grandchildren. He has recently retired after 40 years of practice as an orthodontist in Beverly Hills, CA. They live in Santa Monica, CA. Alan has been a member of the NAWCC since 1979 and is currently secretary of Western Electrics Chapter 133. He can be reached at jabloore@aol.com.

Acknowledgments

I thank David Rooney for allowing me to tap into his encyclopedic knowledge of facts related to the history of The Standard Electric Time Company and for advice in the preparation of this manuscript. I also thank Jeffrey Wood for his wonderful online resource full of information related to The Standard Electric Time Company (clockhistory.com/setclocks). Finally, I thank Curtis Wood for his help in making the mystery of electronic circuitry understandable enough to run my clock systems at home.

Notes

1. I. A. Bartky. *Selling The True Time*. Stanford, CA: Stanford University Press, 2000.

2. "Ansonia Section." *The Historical, Statistical and Industrial Review of the State of Connecticut*, 391, Part III, 1884.

3. W. T. Thrasher. *Shipping List*. Bristol, CT: Archives of The Standard Electric Time Co., American Clock and Watch Museum, 1936 through 1966.