IBM Clocks before Computers

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Author's note: This material was first presented at the 2014 Greater Los Angeles Regional held in Pasadena, CA.

It may seem improbable, but the venerable International Business Machine Corp. (IBM), the company that gave the world the personal computer and artificial intelligence, started out, at least in part, as a business and industrial clock manufacturer. These clocks were made by International Time Recording Co. (ITR) that represented several American time clock manufacturers in 1900. The clocks were very fine spring-driven manually wound employee time recorder clocks. By 1909, and two years before becoming part of IBM, ITR of New York entered the burgeoning world of electrically wound and electrically synchronized clocks. The company added to its inventory an electromechanical master clock and secondary clock systems (Figure 1). The ITR electric clock systems managed by a master clock (Figure 2) were in direct competition with electromechanical clock industry leaders, Standard Electric Time Co. of Waterbury, CT (later of Springfield, MA) (Figure 3) and Self Winding Clock Co. of New York, which was an independent company but also was associated with Western Union Time Services (Figure 4). IBM system clocks ultimately set the standard for synchronized time systems.

CTR Is Formed and Later Becomes IBM

International Business Machine Corp. (IBM) was originally called Computing-Tabulating-Recording Co. (CTR) and was created as a holding com-

NEW ENGLAND SALES DEPARTMENT

1909

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Figure 1, left. Earliest International Time Recording Co. advertising Electric Clock Systems, ca. 1909.

Figure 2. International Time Recording Co. master clock, ca. 1915.

Figure 3, left. Standard Electric Time Co. master clock, ca. 1915.
Figure 4. Self Winding Clock Co. master clock, ca. 1915.

pany by merging separate, leading-edge technology companies in 1911 (Figure 5).

The merger was directed by financier Charles R. Flint (1850-1934). Flint was known as the "Father of Trusts." In 1892 he merged several companies to form US Rubber, and in 1899 he merged several chewing gum companies to form American Chicle Co. Flint's most notable merger was the formation of CTR. After the merger of the four technology companies, he remained with the company as a member of the board of directors and stayed on the IBM board until he retired in 1930.

International Time Recording Co. (ITR) of Endicott, NY, was the clock manufacturing, sales, and service division of what was to become IBM. It was the recording part of CTR. The other formative companies were Computing Scale Co. of America, Tabulating Machine Co., and Bundy Manufacturing Co.

The computing part of CTR was Computing Scale Co. of America in Dayton, OH. The company was started by Dayton, OH, businessmen Edward Canby and Orange O. Ozias in 1891. They purchased patents for the newly invented computing scale and eventually added several other scale companies to their commercial scale business.

In today's vernacular the word "computing" would not be accurate. The scales had totals preprinted on the proprietor's side of the scale, and although the scales did not do any actual calculating of costs, total charges were immediately figured. The costs were simply based on weight and costs per measured units. Nonetheless, early on this company was successful and remained part of IBM until it was sold to Hobart Manufacturing Co. in 1934.

The tabulating part of CTR was Tabulating Machine

Co. of Washington, DC. It was formed by tabulating machine inventor Herman Hollerith (1860-1929) and is the reason IBM exists today. Hollerith is considered the father of modern machine data processing. He specialized in the development of punched-card, data-processing equipment.

Hollerith's series of patents on tabulating machine technology, first applied for in 1884, drew on his work at the US Census Bureau from 1879 to 1882. The US government used his tabulating machines for the 1900 Census calculations. After completing the project in far shorter time than believed possible, industry took notice of the potential of his automatic punching, tabulating, and sorting machines. After selling Tabulating Machine Co. to CTR, Hollerith became a member of the board of directors and served as a consulting engineer at CTR until he retired ten years later.

In addition to the three merging companies representing the letters in the abbreviation of CTR, adding machine manufacturer Bundy Manufacturing Co. of Endicott, NY, was included. ITR had obtained the Bundy time recorder business in 1900, but by 1905 Harlow E. Bundy (1845-1916), who was a prolific inventor, was now manufacturing adding machines. Bundy joined CTR and eventually became vice president of the company.

What this all means is that IBM, which formally changed its name from CTR to IBM in 1924, started out as a clock, scale, tabulator, and adding machine manufacturer.

Figure 5. Computing-Tabulating-Recording Co. magazine advertisement. International Time Recording Division gets top billing above the Computing and Tabulating divisions.

International Time Recording Co.

ITR was incorporated in 1900 to market time recorders manufactured by three separate companies. Bundy Manufacturing Co. made key recorders, Willard & Frick Co. made card recorders, and Standard Time Stamp Co. made time stamps and card recorders. ITR was formed by George W. Fairchild (1854-1924). He joined the Bundy Manufacturing Co. as an investor and director in 1896. By 1900 Fairchild had implemented a series of mergers and acquisitions of time clock-related businesses to form ITR and served as its president.

Fairchild was a farm worker, master printer, newspaper publisher, businessman, investor, and six-term Republican congressman representing the 34th District of New York from 1907 to 1919. When ITR became part of CTR in 1911, Fairchild became CTR's chair and remained in that position until his death in 1924.

In 1914 CTR founder Charles R. Flint recruited Thomas J. Watson Sr. (1874-1956), formerly of National Cash Register Co., to help lead the company. Within 11 months of joining CTR, Watson became its president. He served as president until Fairchild's death in 1924, at which time he was promoted to chief executive officer and remained in that position until his death in 1956. One of the first things Watson did as chief executive officer was to change the parent company name to International Business Machine Corp., a name that had been used since 1917 in Canadian and later South American subsidiaries. The new name befit his goal of creating a truly international company. Watson was, in large part, responsible for IBM developing into a highly respected progressive and innovative worldwide corporation. He apparently was a super salesman and motivator and was instrumental in establishing a very strong research and development program within the company. He implemented generous sales incentives, and IBM was among the first companies to put employees on salary rather than hourly pay, to offer paid vacations, and to provide health and life insurance. His focus was on quality products and unrivaled customer service. His favorite slogan "THINK" became a mantra for CTR and then IBM employees.

An in-depth history of the formation of ITR and of the time clocks it manufactured was written by Joseph Gensheimer and published in the *NAWCC Bulletin* in five separate issues. The comprehensive Gensheimer articles were primarily about time clocks and did not include definitive information about electric self-winding master clocks and secondary clocks. As early as 1905 ITR recorders could be linked together electrically. This was a rudimentary first step in the goal of creating an electrically powered synchronized time system. This article is about IBM developing the reliable self-winding master clock and secondary clocks that made it possible to create a truly synchronized and ultimately automatically corrected time system.

ITR, just prior to the formation of IBM, entered the world of electromechanical timekeeping. Each of the companies that were merged in 1911 to form CTR operated as independent entities. At the time of formation and until the early 1930s the Time Equipment Division, as ITR was referred to, contributed the most to overall company revenue. Adding electromechanical clocks to the division greatly enhanced the number of clock-related items that the sales force could promote.

In 1920 ITR published a catalog detailing the components and extolling the virtues of "Electric Time Systems" (Figure 6). The catalog states: "Electric Time Systems are now recognized as an essential part of the equipment of all modern buildings, such as schools, hotels, banks, public buildings, factories, railroad terminals, court houses, etc." In addition to being excellent timekeepers and equipped with, at least for the time, leading-edge technology, the electromechanical clocks of ITR can be elegant display pieces. Shown from left in Figure 7 are two metal case secondary clocks; 72-, 120-, and 60-beat minute impulse master clocks; and a 60-beat motor wind master clock. One of the nicest features of these clocks is you can always run them but never have to wind them.

Master Clock—Director

All synchronized time systems need just one director. The director is the master clock. Secondary clocks, also referred to as slave clocks, are the most commonly used auxiliaries and can be used in almost unlimited numbers. Master clocks also can simultaneously control employee time recorders, time stamps, cost recorders, and clock mechanisms that ring bells. All these other auxiliaries have a clock mechanism that serves as the time source. Each auxiliary is connected to the master clock via a pair of wires and receives an electrical impulse from the master clock each minute to advance the secondary unit one minute. Often extensive systems will use relays to minimize wear on the contacts and more efficiently manage the electrical energy (Figure 8).

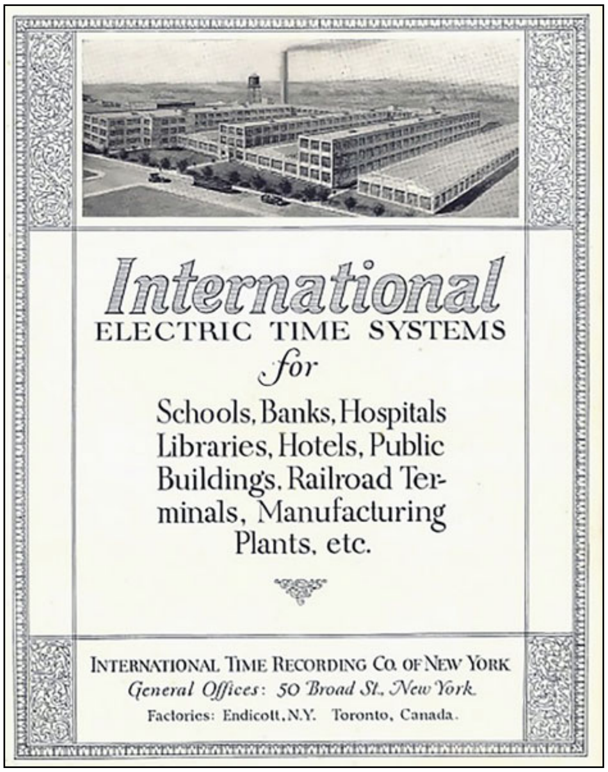


Figure 6, left. Advertising brochure for International Time Recording Electric Time Systems. This was the future of ITR.

Figure 7. From left, two International Time Recording Co. metal case secondary clocks; 72-, 120-, and 60-beat minute impulse master clocks, and a 60-beat motor wind master clock.

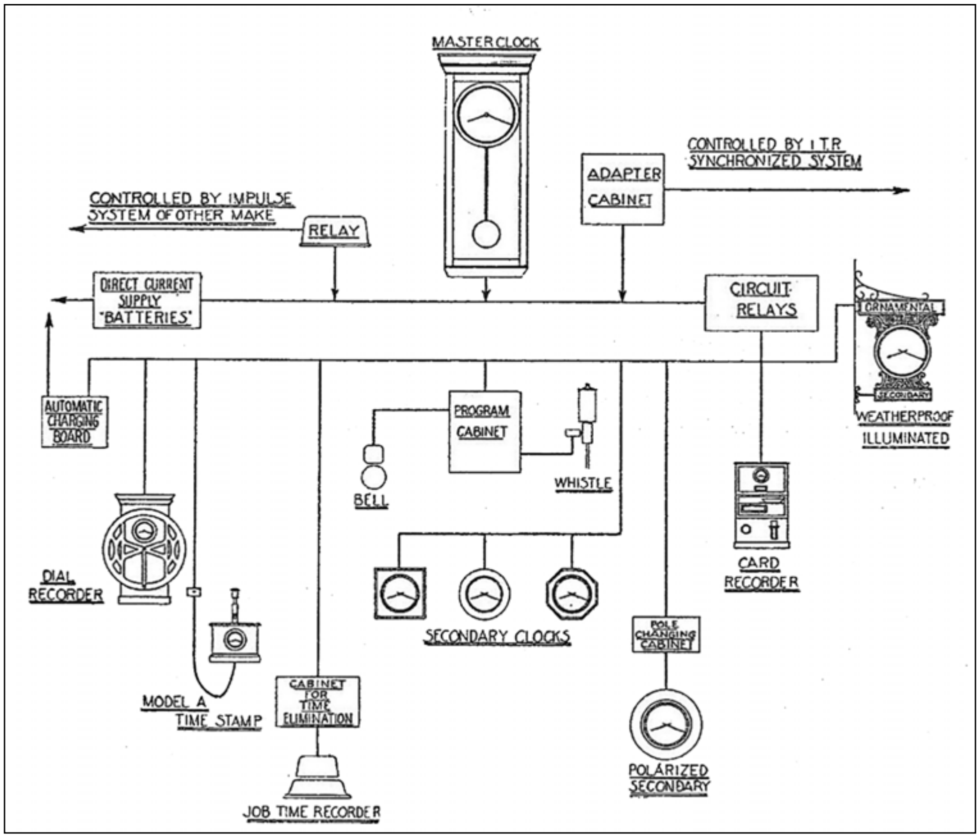


Figure 8. Wiring diagram for a typical master clock-regulated synchronized time.

Master Clock Movements

Electromechanical master clock movements are single-train movements with the winding accomplished by electric power rather than manual winding. Conventional clock movements are powered by springs or weights that are manually rewound periodically and held in an energized position by the retaining click. The power to drive a conventional movement is dissipated over days or weeks or even months. Minute impulse electromechanical master clock movements are powered by a spring, and the energy is maintained by the retaining click or pawl. However, on the master clock a small mainspring placed directly on the center shaft is used. In the absence of automatic rewinding, the power to drive the movement will be totally dissipated, depending on the manufacturer, in a little less than one hour to as many as 12 hours. The master clock movement uses a small mainspring that delivers a light force and uses a constant driving force by virtue of the mainspring being fully wound at all times. This should result in an accurate timepiece. These clocks are in fact very accurate and as a result of light constant driving forces show minimal wear.

The self-winding minute impulse movements are kept fully wound by rewinding the mainspring each minute after it has run one minute. The winding coils on the movement are energized each minute by the automatic closure of an electrical switch, usually referred to as a contact, generating a magnetic field that attracts an armature to the coils. An arm attached to the armature lifts a pawl that moves the winding ratchet wheel one tooth. That one tooth rewinding action replaces the one minute of running time and the mainspring is again fully wound. The click or retaining pawl maintains each advancement of the winding ratchet wheel. The accuracy of the movement can be precisely regulated by adjusting the length of the pendulum. The movements have Graham deadbeat escapements, and many have a micrometer beat adjuster. Most master clock movements operate on 24 volts DC (system voltages are DC and can be from 6 to 120 volts, most commonly 24 volts). Master clocks were made with 60-, 72-, 80-, or 120-beat movements.

ITR Master Clock Movement

The earliest ITR master clock and secondary clock movements appear to be examples of good research and further development. ITR research seemingly involved establishing the competitor that had the best-selling and functioning equipment and then using that as a basis for developing its product line.

When examining the earliest ITR master clock movements (Figure 9), I was always intrigued by the similarity to the movement and electrical components of master clock movements made by Standard Electric Time Co. (SET). They are clearly based on SET movements with

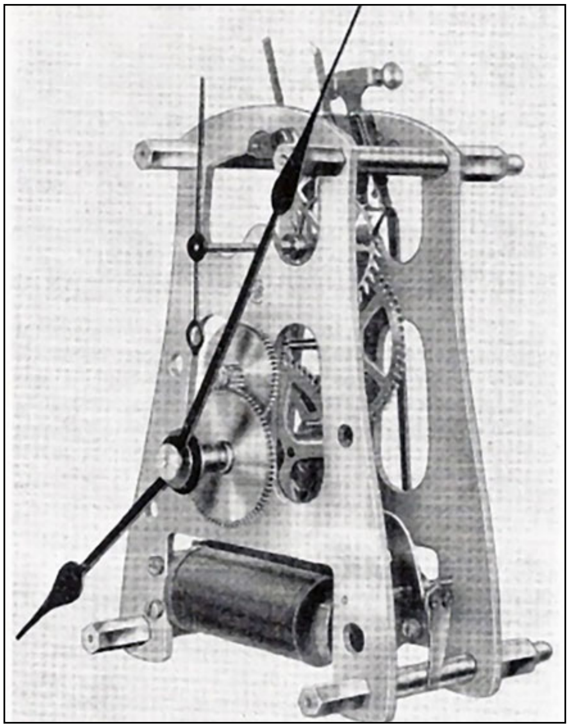


Figure 9. A 1910 cut of the original International Time Recording Co. master clock movement.

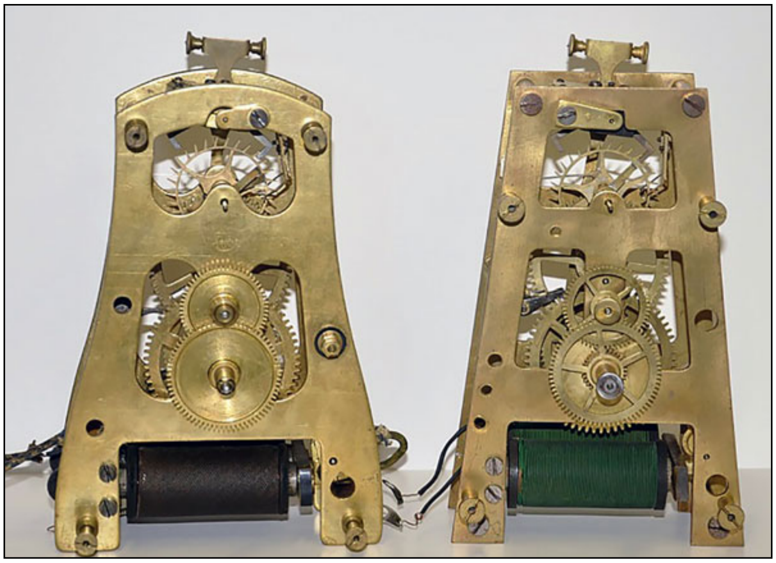


Figure 10. Ca. 1910 International Time Recording Co. master clock movement (left) and ca. 1910 Standard Electric Time Co. master clock movement. The ITR plate design is refined but the layout is exactly the same as SET.

notable enhancements to the master clock movement. The ITR version was laid out the same but had heavier and more elegantly designed plates, much more robust components, and was more finely finished (Figures 10-11). The ITR and SET secondary clock movements were essentially the same. An explanation of the similarity came in a letter of historical recollections from a former 50-year SET employee who recalled that the head of the SET Boston office in 1909 was enticed to move to Endicott, NY, with all his knowledge of SET electromechanical devices and to work for ITR (Figure 12).

ITR Improves the Master Clock Movement

If the electrical coils fail to be energized, the winding operation does not occur. One of the vulnerabilities of early ITR electromechanical master clocks (Figure 13A) is the contact points that make and break every minute to rewind the self-winding master clock mainspring and additional contact or contacts that make and break to advance the connected auxiliaries (Figures 13B-13D). If the contacts do not operate reliably, the clocks in the system will not be accurate and could stop operating. The SET designed contacts are on the verge and escape wheel. This also was the original ITR design, but within a few years this contact mechanism was redesigned. ITR moved the minute contact mechanism on master clock movements away

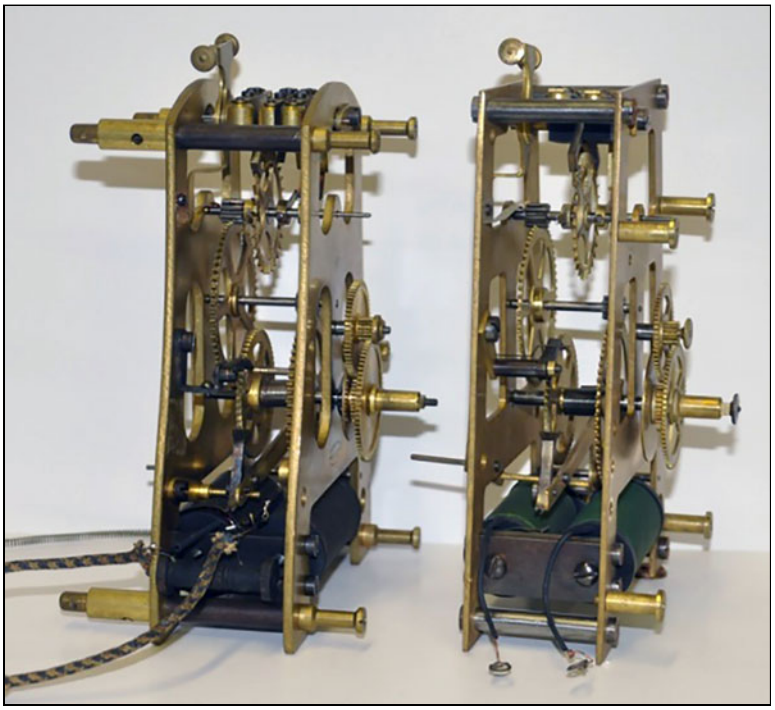
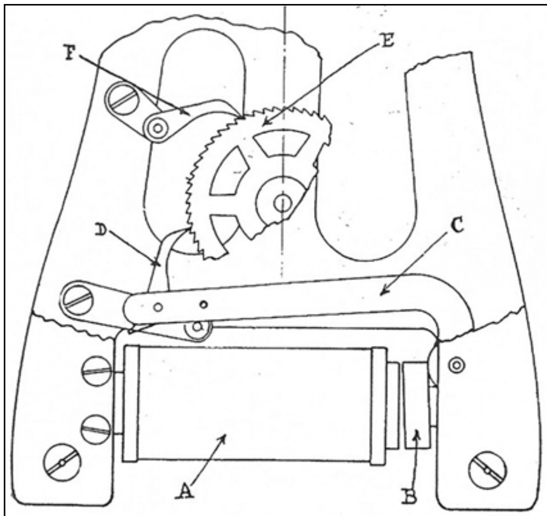


Figure 11. Early International Time Recording Co. electrical components and self-winding mechanism are patterned after the Standard Electric Time Co. master movement. The ITR plates are heavier, the wheels are thicker, and the movement is more finely finished.



WINDING ARRANGEMENT

A—Electromagnet.

B—Magnet Armature moves to face of magnet each minute impulse.

C—Lever arm attached to armature, lifts pawl D.

D—Pawl moves ratchet E one notch when magnet operates.

E—Ratchet having 59 teeth, so that 60 impulses insure fully wound clock spring at all times.

F—Locking pawl to hold spring, attached to E, in tension.

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Builders of Electric Time Systems

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Figure 12. Image detailing the winding operation of the International Time Recording Co. minute impulse master clock movement.

from the verge and escape wheel to an additional arbor and wheel within the clock plates (Figures 14A-14B). In addition to being more reliable, this eliminated any force directly on the time train. An extension of the additional arbor protrudes through the front plate and is fitted with a cam. Two slightly different length arms rest on the cam, and when the shortest arm drops off the cam lobe, it closes the contact (Figure 14C). The contact closes each minute. Unlike the SET contact, the ITR contact is insulated from and mounted to the movement. This contact is much more positive, and the electrical current is not conducted through the movement. The single ITR minute contact simultaneously winds the mainspring and advances any auxiliaries.

ITR also improved the mainspring on the master clock movement. SET and early ITR masters were powered by a tiny helical coil spring wound around the center shaft. The spring could only run the clock for about 52 minutes when fully wound if the power was cut off. Within a few years ITR changed to a more conventional steel mainspring on the center shaft. This spring will run the master clock for about 12 hours if the power is lost.

The action of the winding pawl advancing the ratchet wheel at each impulse was also improved. Previously, the pawl pushed the ratchet wheel forward one tooth. After a modification, shown in the 1938 service instruction manual, the position of the pivot of the winding armature is lowered, so that during the winding action the pawl is carried back one tooth and a return spring pulls the ratchet wheel forward, winding the mainspring. A further modification to the winding operation consisted of increasing the length of the arm holding the return spring.

Secondary Clock Movements—More Reliability

Any facility that requires several timepieces is a candidate for a synchronized time system. Schools are one of the most likely places to have a multiple clock system. Many of us have fond recollections of staring at a classroom clock waiting for the minute hand to jump forward to signal the end of the class. The bells would ring and we would move on. If you can remember this, then your school was equipped with a master clock that was responsible for the well-choreographed moving of the clock hands forward and timing the ringing of the bells. Some schools were equipped with a master clock and secondary clocks as early as the 1890s, and by 1910, when ITR began to offer its time systems to schools and factories, electric synchronized time systems were becoming the state of the art and even a must-have system. All secondary clocks are connected to the master clock via a pair of wires. Retrofitting established buildings that did not have wiring installed would be difficult, but almost all new construction included provisions for a clock system. A secondary clock could be installed anywhere that wires could be provided and, best of all, no winding would ever be needed. Originally, most secondary clocks were made with elegant wood cases and came in several styles. The wood cases became less ornate through the years, and

Figure 13A. International Time Recording Co. Model C, ca. 1915, 60- beat minute impulse master clock with pilot clock, miliamp gauge and time stamp relay.

Figure 13B. International Time Recording Co. minute impulse movement with wires to wind the movement and operate connected auxiliaries. Each operation (component) is controlled through a contact.

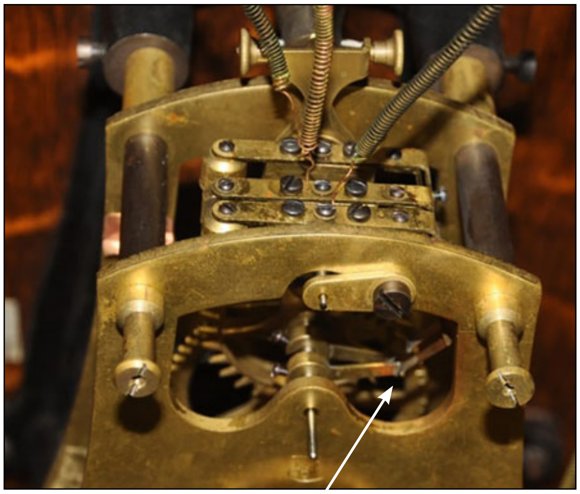


Figure 13C. Wire connections for three oscillating contacts. One set of contacts is shown touching (closed). The contact is for ± one second.

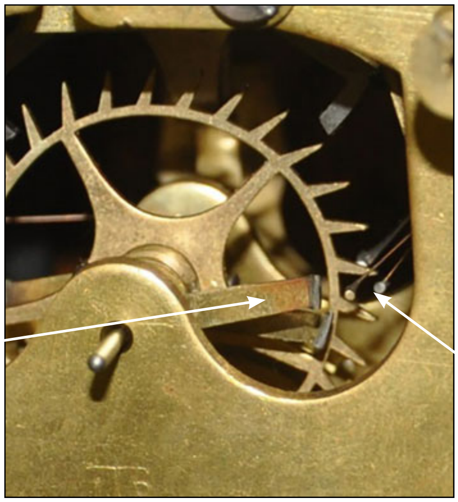


Figure 13D, right. One of three separate rotating circuit closers on the escape wheel arbor. The three closers make contact with three separate oscillating contact closers on the verge.

eventually the clocks were made with metal cases. An image from a 1920s catalog shows the most common wood case secondary clock (Figure 15).

The secondary clock is not a fully functioning clock but simply a set of motion works with a dial and clock hands that are propelled by a ratchet wheel. Each electrical impulse from the master clock to the secondary clock coils moves the ratchet wheel and advances the hands. A study of ITR secondary clocks reveals three different dials and four different movements. Each of the four pictured ITR secondary clocks has a dial that reads "INTERNATIONAL TIME RECORDING COMPANY OF NEW YORK ENDICOTT, N.Y." (Figure 16A). The two earliest have ITR logos above the hand shaft and initially the dials were made of paper.

In addition to different dial designs, ITR secondary clocks will be found with four different movements. Each of the pictured secondary clocks has a different movement. The earliest ITR secondary movements are essentially copies of a SET secondary clock movement (Figure 16B). This is ITR's earliest secondary movement (Figure 16C). SET had used its design since 1887, and although reliable, ITR looked for more reliability.

In 1918 ITR purchased Monarch Telephone Co. for its electric clock system and began using its secondary clock movement in ITR secondary clocks (Figure 16D). This was at best a lateral move rather than a clear improvement. By the early 1920s ITR had perfected its own polarizing and minute impulse (Figures 16E-16F) secondary clock movements. These were significant improvements over other secondary clock movements in the industry.

Electricity and Reliability

By the early 1920s the master clock movement with the ITR designed minute contacts and the ITR secondary clock movements were reliable, yet one weak link remained in the synchronized time system. It was beyond the control of IBM; it was the power supply. Periodically,

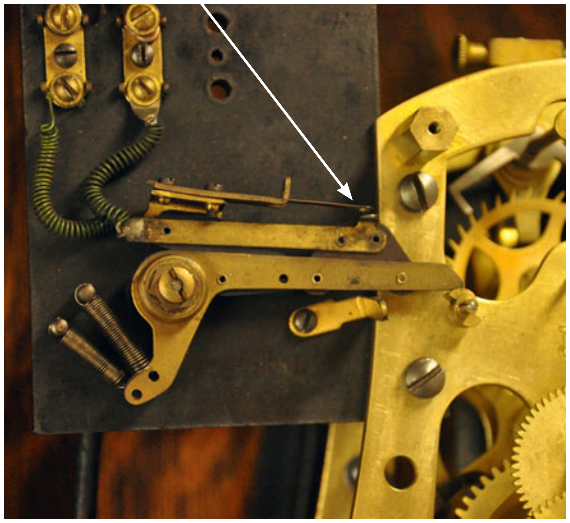


Figure 14B, left. International Time Recording Co. minute impulse movement with redesigned contact closer on insulated block. The contacts are outside the movement plates.
Figure 14C. ITR contact closes each minute as shortest arm (behind front arm) drops off cam lobe. Contact closes for two seconds to wind the mainspring and advance any secondary clocks.

Figure 14A, left. International Time Recording Co. Model B, ca. 1922, 72-beat minute impulse master clock.

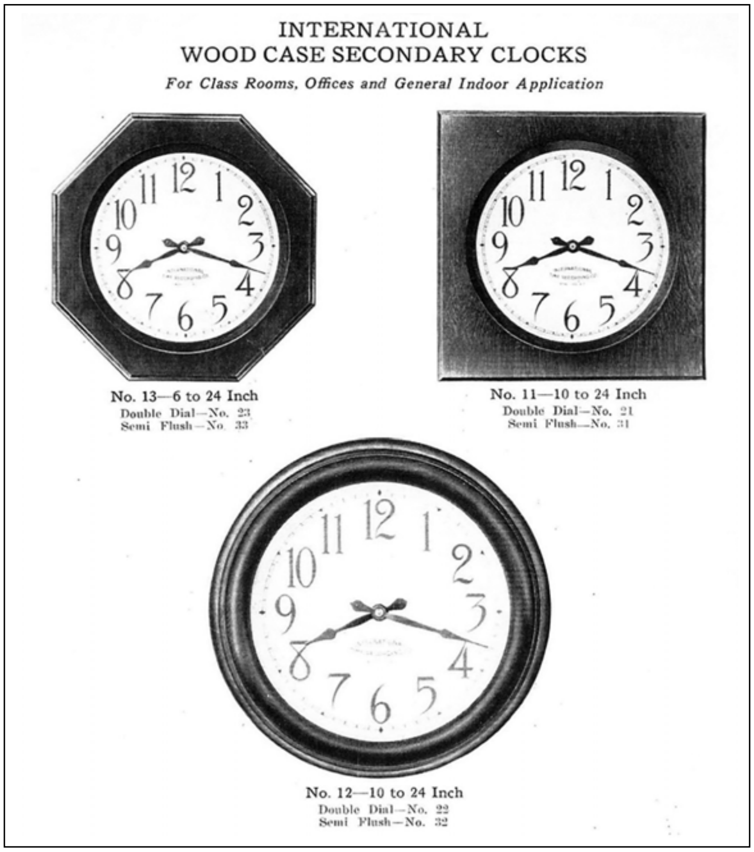


Figure 15. Catalog image from the 1920s showing wood case secondary clocks. Most secondary clocks of that era were in wood cases. Later, most secondary clocks came in metal cases.

temporary interruptions in the power supply resulted in the secondary clocks falling behind. Because the master clock is spring driven, it would continue to keep time for many hours without power, but the secondary clocks would not advance without the electrical impulse each minute. Any irregularities in the time provided by secondary clocks would have to be corrected manually. The ultimate synchronized system could correct itself automatically.

Automatic Correction—Industry First

The time service company that could devise an automatic correction system to compensate for these power irregularities would have a tremendous sales advantage. It could advertise a revolutionary system in which clocks out of sync with the master clock would be corrected automatically by the master clock. With its emphasis on research and development, IBM had developed the first such system by 1924. It was termed the "self-regulating system." Figure 17 is the patent drawing for the second generation of the IBM self-regulating system and the design that subsequently is seen on all of its master clocks. At first the self-regulating system was mounted on a Bakelite frame but later on brass.

To operate the self-regulating system, the master clock was fitted with a series of additional switches and contacts that were controlled by arms riding on a specially machined two-faced cam on the minute hand shaft. Time was synchronized on the 59th minute of every hour. At 59 minutes and ten seconds the master clock advance switch closed. This activated a two-second contact that generated an additional 20+/- one-minute impulses (Figure

Figure 16A. International Time Recording Co. secondary clocks are found with four different movements. The dials are printed with the ITR name. The two earliest types also have ITR logos.

Figure 16B. Standard Electric Time Co. secondary clock movement patented in 1887. International Time Recording Co. used this design for its first secondary clock movement.

Figure 16C. The earliest International Time Recording Co. secondary clock movement was essentially a copy of the Standard Electric Time Co. secondary movement.

Figure 16D. Monarch Telephone Co. secondary clock movement. International Time Recording Co. purchased the company in 1918 and used the Monarch secondary movement in ITR secondary clocks.

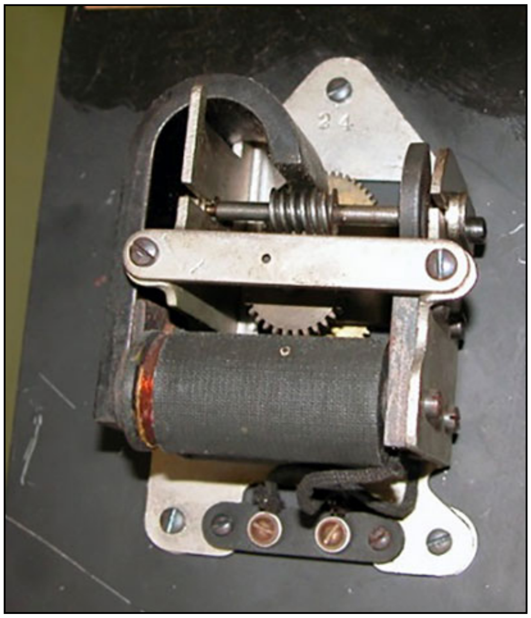


Figure 16E. International Time Recording Co. designed a polarizing secondary clock movement that featured a silent movement, but its use required a modification to the ITR master clock movement.

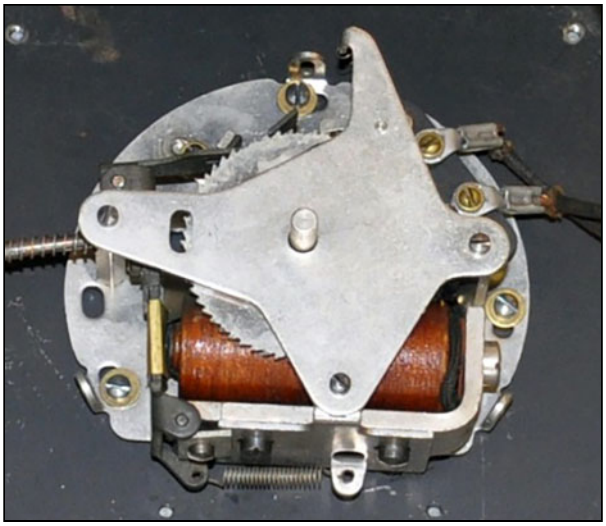


Figure 16F. International Time Recording Co. designed a reliable ratchet and pawl secondary movement.

18). Any secondary clock that was behind would advance one minute per impulse. Once the secondary clock reached the 59th minute the impulse line in the secondary clock was automatically switched from line A to line B. Conversely, if for some reason a secondary clock was ahead, at the 59th minute the secondary clock would switch from line A to line B and wait for the time to be correct. Every hour the master clock generates the extra impulses just past the 59th minute but the switch on the secondary movement determines if the impulses are accepted. On the hour the secondary movement accepts the minute impulse on the B line and does so for 5 minutes. At 4 minutes past the hour the secondary switch moves the impulse back to line A. This timing necessitated a third wire to the secondary movement and the 3 wire secondary movement has a leaf switch that moves the impulse from line A to line B and then back (Figure 29C). The secondary clock wires are a common wire (C) and two impulse wires (A and B). This switching system is remarkably reliable and accurate. Most new installations were equipped with this revolutionary system, and some existing systems were retrofitted. It was many years before competing time system companies developed automatic correction systems, and none are even close to as effective. The customer now could count on all clocks to reliably display exactly the same time even if there were periodic electrical interruptions.

Master Clocks

Clock systems were custom designed for customers to fit their unique requirements and then each master clock was custom made (Figure 19). Each synchronized system needed a master clock and then any number of desired auxiliaries (i.e., secondary clocks, time stamps, bell programs, recorders, the necessary relays, and any charging equipment). Most of the system auxiliaries were off-the-shelf items.

A catalog illustration of the four major types of master clocks that were available in the 1920s is shown in Figure 20.

IBM master clocks were available with 120-, 80-, 72-, and 60-beat self-winding movements and also in a 60-beat motor-wind weight-driven movement. Customers made their selections from catalogs. Over the years the model names changed and case styles were updated. Originally, master clocks were referred to as Type A, B, C, and D. Usually, they were cased in elegant wood cases. Later, the master clocks were cataloged as No. 10, No. 12, No. 13, and No. 14. These are all minute wound and in finely crafted wood cases. The same master clocks were later cataloged as Series 220, 230, 240, and 250. By the late 1930s the master clocks were

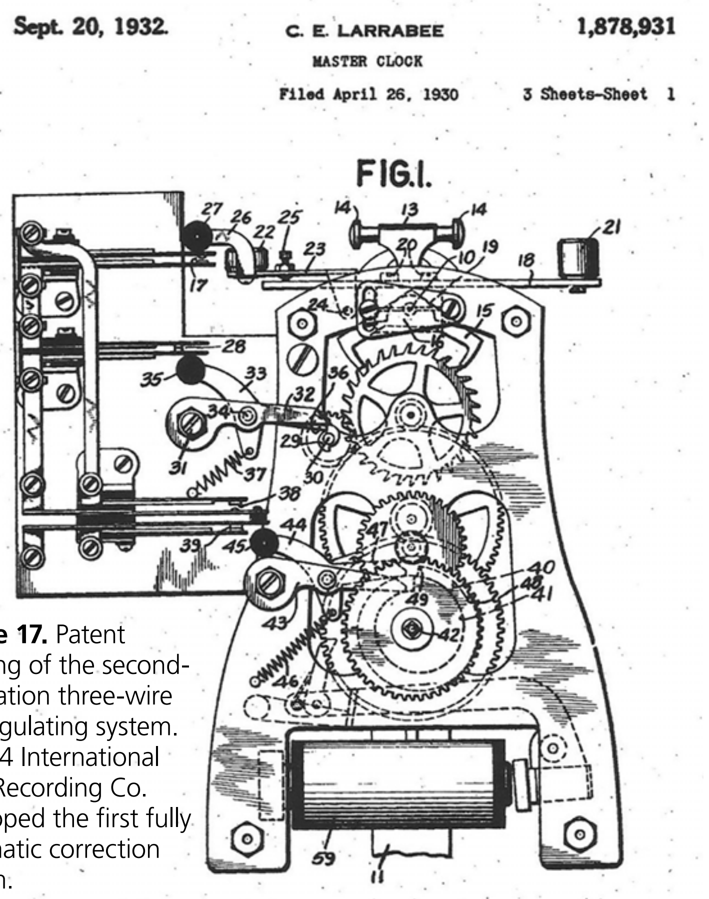


Figure 17. Patent drawing of the second-generation three-wire self-regulating system. In 1924 International Time Recording Co. developed the first fully automatic correction system.

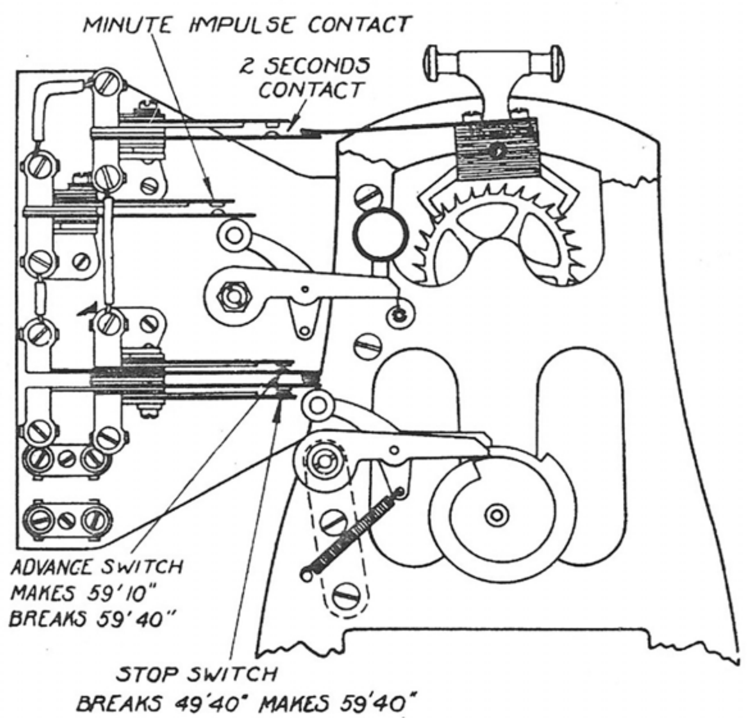


Figure 18. Diagram of master clock switches and contacts for sending out the minute impulses and for the additional 20+/- impulses at the end of each hour. Secondary clock movements have the A B switch. Secondary clocks accept impulses on line A thru the 59th minute and then automatically switch to line B. Secondaries switch back to line A at 4 minutes after the hour. The master clocks generates the impulses and the secondary clock switch decides how many impulses to accept.

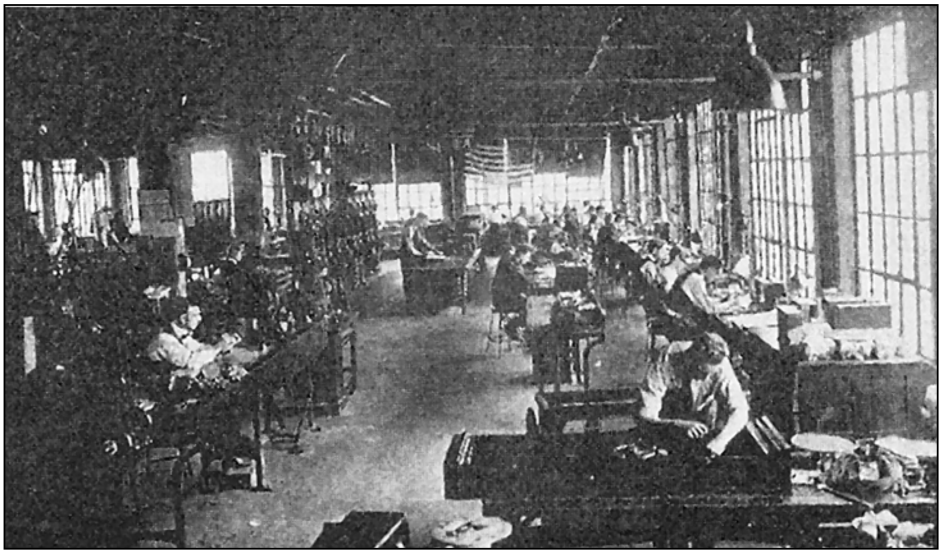


Figure 19. Post-World War I photo of a master clock being assembled at the International Time Recording Co. factory in Endicott, NY. Each master clock was made to order.

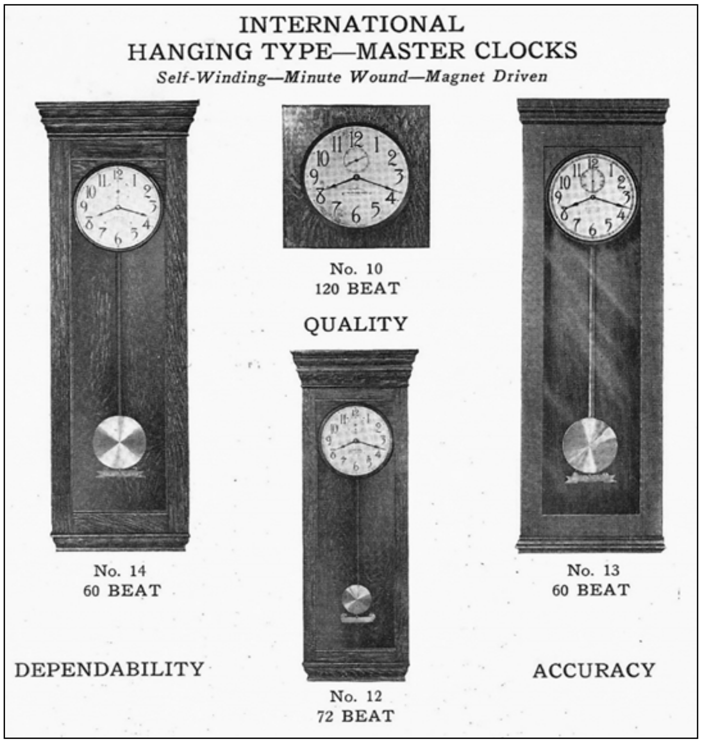


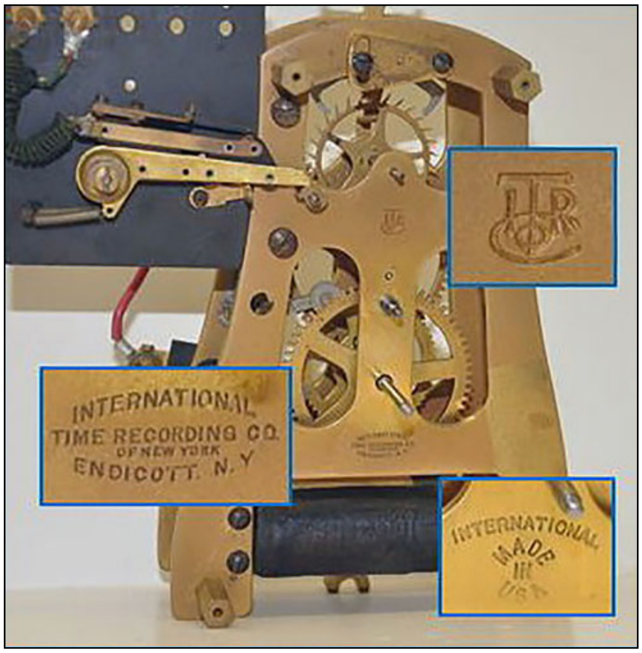
Figure 20. Ca. 1920s catalog image of International Time Recording Co. master clocks. The movements are minute impulse self-winding and available in 60-, 72-, and 120-beat configurations. A weight-driven self-winding master clock movement was available at additional cost.

offered in more contemporary art deco wood cases and were cataloged as Type 25 and Type 35. Finally, a master clock was made in what would today be termed a midcentury case and is cataloged as a Type 35 and the same case with a radio signal correction mechanism is cataloged as Type 37. The weight-driven motor-wound masters were cataloged as either Type D, Models 15 and 16 and Series 260 and 270 and Type 35. Master clocks containing program machines were cataloged as Model 13, Model 15, and Model 17. There are several slight variations in the master clock model numbering. These model numbers are helpful in establishing the vintage and authenticity of clocks because ITR and then IBM were careful to attach a guarantee sticker with a unique serial number on every time service product. Each master clock case had a brass identification plate with model and serial numbers imprinted. Most often the attached documentation with serial numbers has remained with the item.

Steel-cased, 72-beat industrial master clocks with a transformer and rectifier appear periodically. The clock movement has the usual IBM contacts; however, it does not have hands or a conventional clock dial, but rather a round 3½-inch minute wheel. This clock is Model 18-9. These may have been made during World War II.

While US-made master clock movement front plates were not stamped with serial numbers, they did have the company name imprinted. The earliest movements have an ITR logo below the seconds arbor and the statement "INTERNATIONAL TIME RECORDING CO. OF NEW YORK ENDICOTT N.Y." below the center shaft. Later, only the company name and city were stamped on the front plate and below the center shaft. Finally, the front plates were simply stamped "INTERNATIONAL MADE IN USA" (see lower insert Figure 21A). Movements made in England for the European market were stamped with serial numbers and "INTERNATIONAL MADE IN ENGLAND" (Figure 21B). With more data it may be possible to use the serial number information to approximate the manufacturing date of the English movements.

In 1917 IBM opened its first office in Toronto, Ontario, Canada, and formed under the name of International Business Machines Corp. of Canada. That apparently was the first use of the name International Business Machines Corp. that would be adopted company-wide in



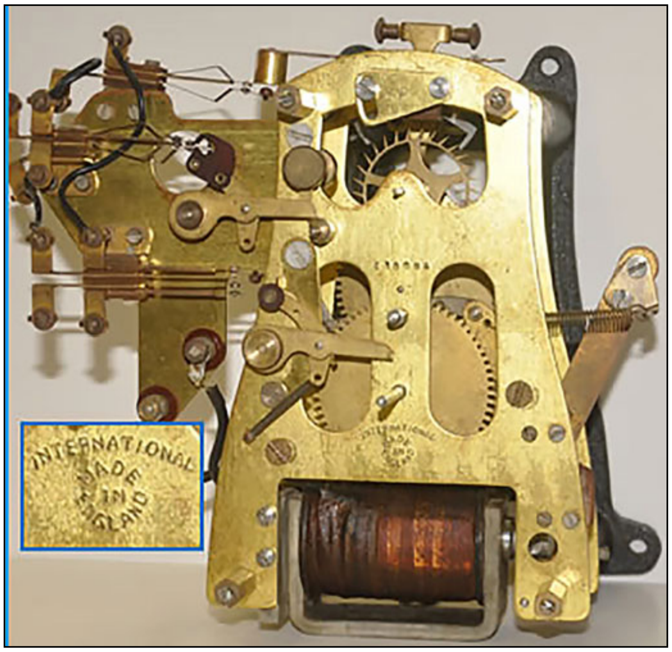


Figure 21A, left. The earliest International Time Recording Co. master movements were imprinted in two places. Later movements had only "INTERNATIONAL TIME RECORDER ENDICOTT" and finally "INTERNATIONAL MADE IN USA" and no serial numbers.
Figure 21B. International master movement made in England. Serial number on front plate "E18084" and "MADE IN ENGLAND." Movement was the same as US-made, except it is wound with a single large coil.

1924. Clocks were assembled in Toronto from parts made in the United States and shipped to the Toronto facility. The master clock plates were stamped "Made in the US," but the clock dials read "International Business Machines Co., Limited Toronto, Canada," or simply "International" or "IBM." Early secondary clock dials read "International Business Machines, Toronto." Later dials presumably simply read "International" and "IBM."

Canadian master clocks had serial numbered metal identification tags affixed to the cases, and early secondary clocks had paper information and guarantee labels in the cases. Later secondary clocks had a different type of metallic stick on identification tag. Serial number information for Canadian clocks does not coincide with the published US dating data, and presently I am not aware of any key to dating Canadian serial numbers. IBM Canada continued making master, secondary, and recorder clocks until 1964 and continued servicing its accounts until 1969.

ITR-International-IBM Master Clock Power

The earliest master clocks relied on batteries for power. Most systems operated on 24 volts DC, and the current was supplied via wires from storage batteries in a utility room. Case styles changed over the years, reflecting different aesthetic values. While the cases changed, the basic construction and appearance of the master clock movement remained the same throughout the 50 years of production. The self-regulating features added to the movement made the clock mechanism look much more complicated. The time portion of the mechanism remained simple, and the master clock could be operated without using any of the self-regulating features.

A 1927 IBM grandfather-style master clock (Figure 22A) is equipped with the first-generation self-regulating system (Figure 22B). The weight-driven movement is automatically rewound about every two days by a 110 volt AC motor. If power is lost, the clock will run for approximately eight days. A separate power supply is required for the secondary clocks and is in a remote location.

Large clock systems, such as the one in Figure 23A, reportedly from the University of Alberta in Edmonton, Alberta, Canada, consisted of a master clock and separate program cabinet. The program cabinet contained a metal disk bell program device, crescent-shaped duration timers, necessary relays, and switches to ring the bells and advance the secondary clocks. This master clock is weight driven, self-winding, and self-regulating. An accumulator is attached to the bottom of the movement (Figure 23B). If there is a power interruption, the accumulator, as the name suggests, is designed to count the number of missed or accumulated electrical impulses for up to 12 hours and correct the auxiliaries once the power has been restored. The AC current to wind the master clock and the DC current for the systems are supplied from sources outside the cases.

Even as alternating current became more available and reliable, these synchronized systems were still operated on direct current. However, with AC power readily available, it was much more practical to install the transformer and rectifier in the clock case. The transformer changed 110 volts AC to 24 volts AC and the rectifier changed the

Figure 22A. International self-winding weight-driven clock in a grandfather clock-type case. This is a master clock "Colonial" Model 272.

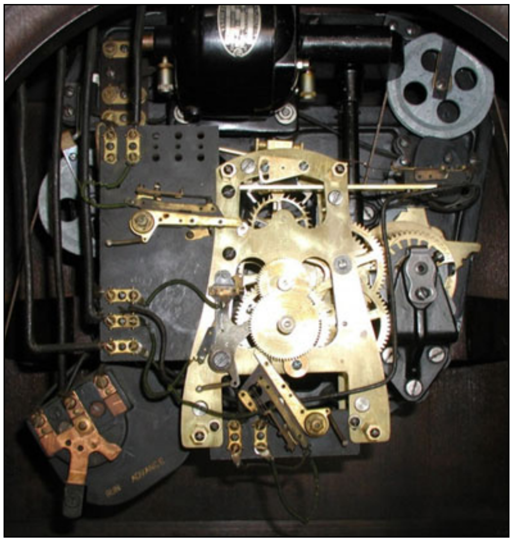


Figure 22B. The movement is weight driven, and the weights are automatically wound up every two days by a 110 volt AC motor. The secondary clock impulse contact and the early version self-regulating contacts are attached to the IBM movement.

AC current to the required 24 volts DC current (Figure 24A).

A self-regulating master clock from 1932 shown in Figure 24A has the second version of the self-regulating system. The additional coil on the top of the movement on the right side is a synchronizer attachment to synchronize this master clock (termed a sub-master) to a highly accurate controlling master clock (termed the grand master) by regulating the swing of the pendulum. This is accomplished by an armature lever momentarily stopping the escape wheel when the coil is energized (Figure 24B). These sub-master clocks are regulated to run slightly fast and then retarded each hour. When schools and factories required relatively small systems, all the required components could be installed in the clock case. The 72-beat 1939 self-regulating master clock contains the power supply and a programmable drum for ringing bells along with relays and necessary switches for advanc-

Figure 23A. International Time Recording Co. master clock with separate program cabinet (left). International weight-driven master movement with impulse accumulator.

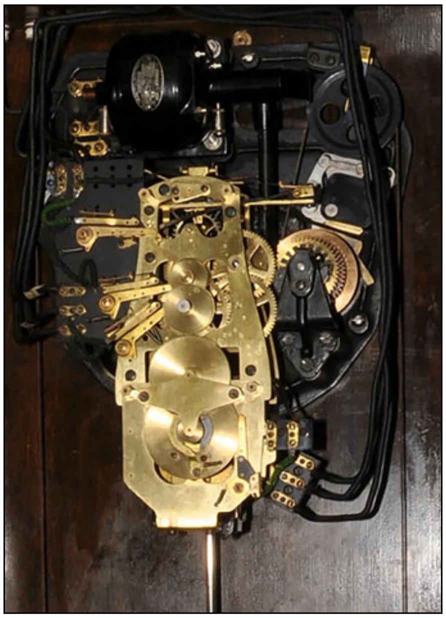


Figure 23B. International weight-driven master movement with impulse accumulator.

ing secondary clocks (Figures 25A-25B). The self-regulating components are now mounted on a metal rather than Bakelite frame.

A synchronous motor-winding method was introduced in 1954. The mainspring was still wound by turning the winding ratchet wheel, but a synchronous clock motor replaced the minute impulse winding coils. The one rotation-per-minute motor turned an eccentric wheel that lifted the winding pawl one tooth each minute, and with tension from a return spring the mainspring was continually kept fully wound.

Many original minute impulse spring-driven movements were converted to motor wind. This winding method was used on IBM's last foray into pendulum-regulated master clocks. It was the Type 37 Radio-supervised master time controller (Figure 26A). To ensure absolute accuracy, these master clocks were automatically synchronized with radio signals broadcast by the National Bureau of Standards. A radio receiver

Figure 24A, left. Ca. 1932 Model 17 7 International master clock. By the 1930s the master clock cases are much plainer. **Figure 24B.** While the clock system is still 24 volts DC, many IBM master clocks now have the transformer and rectifier in the case.

Figure 25A, left. Model 15 school master clock with a programmable disk for timing the ringing of the bells.

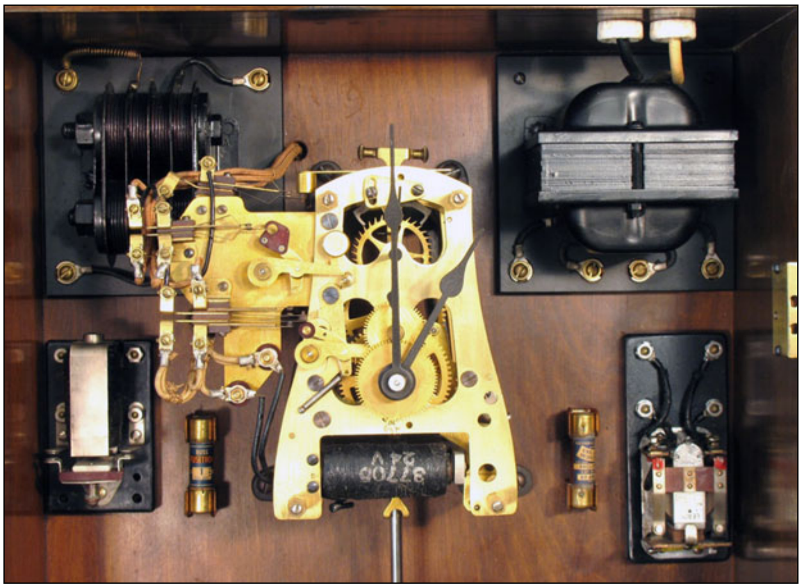


Figure 25B. A 72-beat master clock movement with transformer, rectifier, and relays in the case.

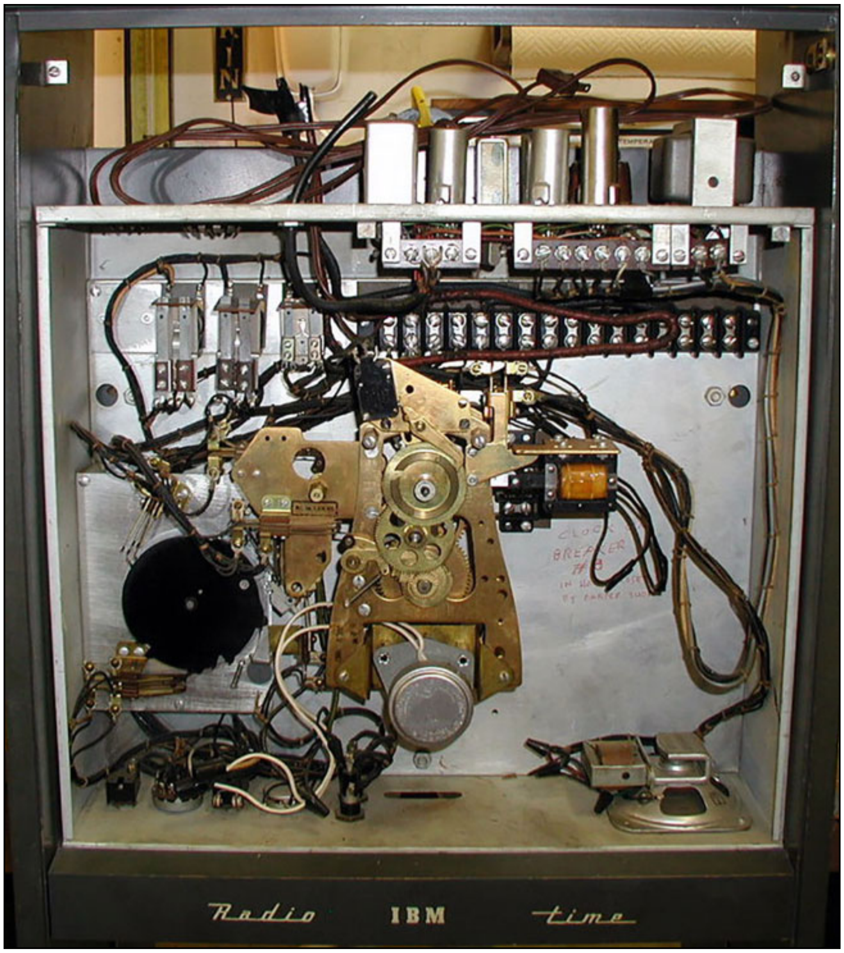


Figure 26A, left. Type 37, 1956, Radio-supervised master time controller automatically synchronized by hourly radio signal broadcast from WWV or WWVH.
Figure 26B. Type 37 master clock movement with synchronous motor to wind the mainspring. Radio receiver for synchronization mounted within the case.

was contained within the master clock case, and an externally mounted antenna received the hourly time signal broadcast from WWV or WWVH (Figure 26B). The clock accuracy was within one second as long as at least one signal per day was received.

Pendulums

Until the correction feature was added to the master clock, the accuracy of the 60-beat master clock was related to the quality of the movement and the type of pendulum. All IBM movements were made to the same high standards, so the main variable would be the quality of the pendulum ordered with the time system. Wood rod brass bob pendulums were the least expensive and were rated to 30 seconds per month. The mercurial compensating pendulums were the most accurate and rated to 10 seconds per month and the Invar pendulum to 15 seconds per month.

Figure 27A is a compilation of the various pendulums and accompanying beat scales (oldest on the left) that would be seen in ITR and IBM 60-beat master clocks. The bobs (top left to right) go from polished brass to satin brass to shiny nickeled and the beat scales from ITR to International Business Machines to IBM. The bottom left is a two-glass vialed mercurial pendulum with an International beat scale, next a sealed mercurial pendulum and late International beat scale, and finally an Invar pendulum with an understated IBM beat scale.

The 72-, 80-, and earliest 120-beat clocks all came with wood rod bob pendulums. A 72-beat invar rod, metal cylinder pendulum was used on industrial and program clocks (Figure 27B).

The back of the International and IBM 60-beat pendulum bob has a distinctive channel for the pendulum stick and includes a slot for the rating nut (Figure 27C).

AC Motors Lead to Clocks with No Pendulums

As alternating current became more reliable, there was less reason for the safeguard of having a spring-driven pendulum-regulated clock controlling a synchronized time system. By the late 1940s IBM unveiled a new master clock movement that used a marine escapement rather

Figure 27A. Various pendulums and beat scales used by IBM during the 50 years of master clock production.

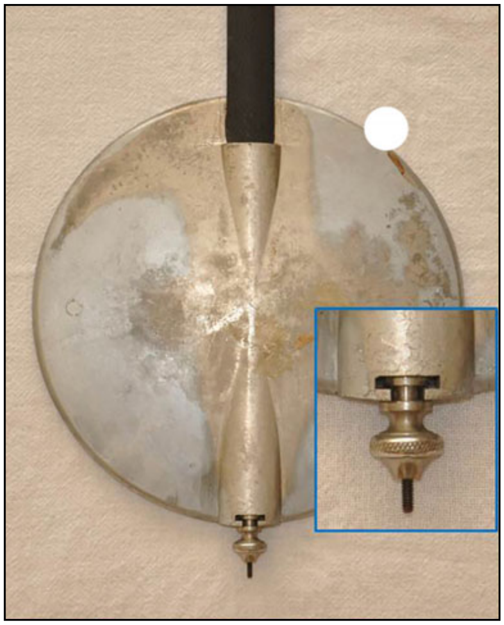


Figure 27C. Back view of IBM pendulum bob with distinctive path for wood rod and rating nut.

Figure 27B. Pendulums and beat scales used in 72-, 80-, and 120-beat IBM master clocks.

than a pendulum. It was spring driven and wound by a synchronous clock motor. The movement was IBM Type 090 master time control movement, and it had the same capacity for controlling auxiliaries as its previous master clocks. This movement eliminated the need for a large master clock case because there was no pendulum. Figure 28A is a size comparison of a pendulum-regulated master clock and the new synchronous motor wound marine escapement master clock.

An IBM master time and program control clock Model 91-4 from December 1948 with the case removed (Figure 28B) reveals a marine escapement movement with self-regulating contacts, the power supply, six-circuit program signal control, relays, switches, and fuses—all this in a 21" x 15" x 5" case. The IBM 91-4 does everything the big master clocks do but not with much style.

IBM offered master clock systems powered by synchronous motors with a balance wheel escapement as a backup by the mid-1950s. Some master time and control clocks were designed to operate secondary clocks with AC motors, and now some secondary clocks could have sweep seconds hands. That is another era in synchronized clock systems and is beyond the scope of this article. It is hoped another collector will finish the story of IBM's involvement in the history of synchronized time for sale.

Secondary Clock Dials and Three-Wire Movements

A Model 35 IBM art deco-style master clock is pictured with four secondary clocks in Figure 29A. Each secondary clock has a different name imprinted on the dial and represents the various types of dial lettering used during the production of these clocks. The top three clocks have dials with three different eras of IBM company names. The earliest secondary clocks made by ITR have dials that read "International Time Recording Co. of New York, Endicott, NY" (top). After 1924, when Computing-Tabulating-Recording Co. became International Business Machines Corp., dials were imprinted International (second from top). After World War II the dials read IBM (third from top). After the sale of the Time Equipment Division of IBM to Simplex Time Recorder Co. in 1958, clocks appeared with Simplex on the dials (bottom).

In addition to differences in secondary clock dials,

Figure 28A, left. Size comparison between a pendulum-regulated master clock and synchronous motor master clock.
Figure 28B. Model 91-4 master time and program control clock from December 1948. Synchronous motor wound spring with marine escapement.

self-regulating secondary clock movements came in four different types. The earliest three-wire self-regulating secondary clock movements were modified ITR ratchet and pawl movements that had the regulating mechanism added to the movement (Figure 29B). These movements appeared around 1925. Patented in 1931 was the remarkably reliable rotor-type secondary clock movement. This movement was far superior to any other in the industry and was used for many years (Figure 29C).

International also made a single-coil secondary clock movement that had a ratchet and pawl-like action with self-regulating contacts (Figure 29D). The single coil movements made in England have serial numbers stamped on the front plates, but as of now, the serial numbers do not reveal any production information.

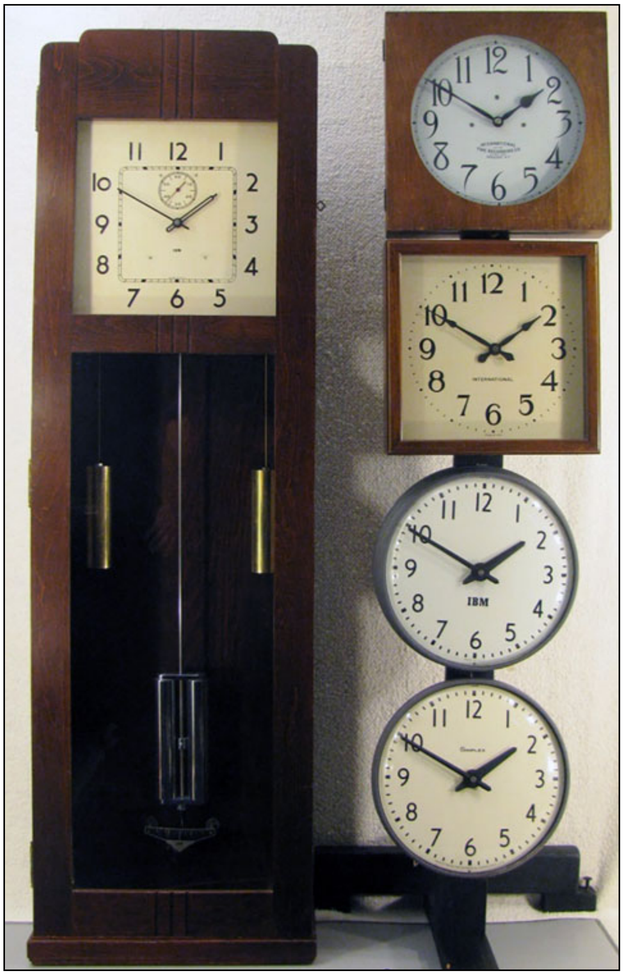
The final IBM secondary clock movement must have appeared in the 1950s and seems to operate well, but it could have been developed as a cost-saving and possibly space-saving measure (Figure 29E). This movement had a much simpler construction and was composed of less expensive materials.

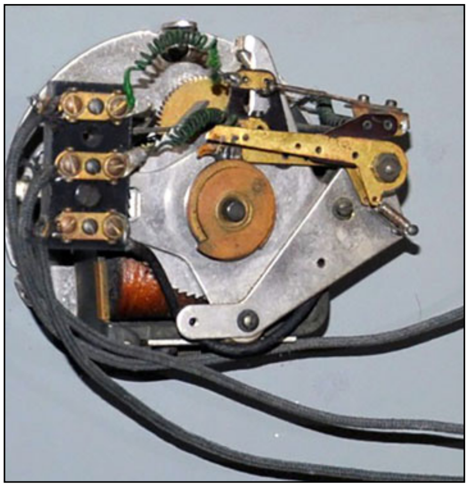
Other types of IBM clocks that appear as independent timepieces are actually secondary clocks. A wheel-type employee recorder and the time stamp have secondary clock mechanisms and are part of synchronized time systems (Figures 30A-30B). The drum-type program mechanisms, whether in master clocks or in separate cases, are advanced once each minute by a modified secondary clock mechanism that receives the minute impulse from a master clock (Figure 30C).

Serial Numbers and Dates of Shipment

ITR and then IBM time service items all were guaranteed for one year, and all items had a unique serial number (Figure 31). A look at the list of serial numbers reveals that from the inception of assigning serial numbers in 1916 to the end of 1949 the Time Service division of IBM shipped 1,000,000 clock-related items. The numbering reverted to 10,000 in 1950 and by 1955 an additional 500,000 items were shipped.

ITR and IBM master clocks had an identification plate installed in the case that specified the model number and serial number (Figure 32A). The earliest secondary clocks had paper labels that specified whom the clock was shipped to, date, style number, order number, and serial number (Figure 32B). Later labels added the voltage. These also included IBM patent dates and patent numbers (Figure 32C). The final paper label had wiring diagrams, and the serial numbers were coded with the month and year of shipping. This type of label appeared in 1941 (Figure 32D).





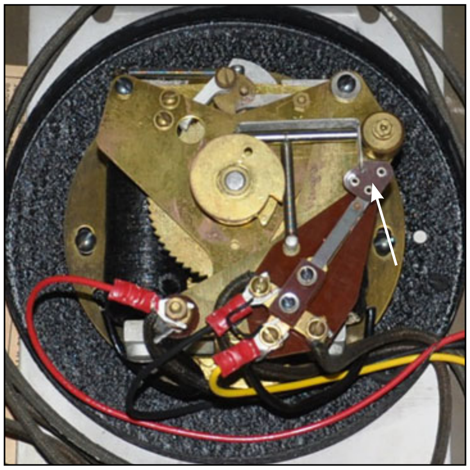
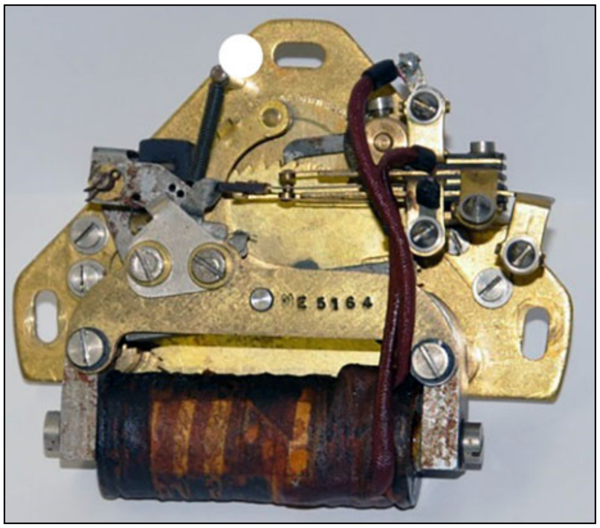


Figure 29A, left. Model 35 IBM art deco-style master clock with four secondary clocks. The secondary clocks each have different company lettering, and each has a three-wire self-regulating secondary movement.
Figure 29B, top right. The earliest three-wire self-regulating movements appeared in 1925.
Figure 29C, bottom right. The rotor-type self-regulating movement was patented in 1931 and was far superior to any other secondary clock movement. The arrow points to the AB switch.



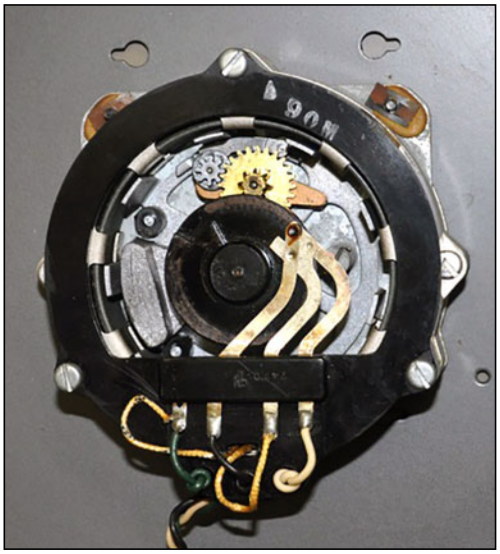


Figure 29D, left. Single-coil secondary clock movement. Movements made in England have serial numbers on front plate. Single-coil three-wire correction.
Figure 29E. The final three-wire self-regulating movement appeared in the 1950s and probably was designed as a cost-saving measure.

Figure 30A. Wheel-type employee recorder that is a secondary clock.

Figure 30B. Time stamp secondary clock.

Figure 30C. Bell program disk mechanism is advanced each minute like a secondary clock.

Secondary Clock Cases Change

The majority of the serial-numbered items sold by IBM were secondary clocks. The beautiful wood case clocks gave way to less expensive metal case clocks. The latter were mounted on the wall and the movement fit within the case. Finally, the wall-mounted clocks were supplanted by smaller metal case clocks that fit flush against the wall, and the mechanism and cover fit into specially designed electrical boxes. Figure 33 shows the fronts and the backs of typical IBM wall-mounted and flush-mounted secondary clocks.

IBM Enters Late, Excels, and Exits Early

When International Time Recording Co. was formed in 1900, it included the manufacturing facilities of several successful clock companies with an experienced workforce. The design and manufacturing of the master clocks, secondary clocks, and other auxiliaries were done in its Endicott, NY, plant.

ITR had experience in manufacturing robust, reliable, spring-driven movements so building clock hardware was not a problem. ITR designed and manufactured a master clock movement with heavy, elegantly shaped, rolled brass plates. The wheels and pinions were thicker and more finely finished than most competitors (the one exception was the very fine self-winding movements made by E. Howard Clock Co.). The clock components were drilled and polished rather than stamped. The movement manufacturing was the easiest part of entering the revolutionary and burgeoning world of electrically wound self-winding clock systems. Electrical components also had to be designed and manufactured. When ITR entered the electromechanical clock market around 1909, several other companies were offering electrically synchronized clock systems. The two leading companies were Standard Electric Time Co. and Self Winding Clock Co. They each had 20 years of experience building the necessary electrical components to make reliable self-winding master clocks and secondary clocks.

By the late 1890s SET and SWCC had perfected their respective master clock movements, and each made only minor modifications to their master clock movements over the next 60-plus years. SET and SWCC relied on different methods to keep the mainspring fully wound and to impulse the secondary clocks.

Original Serial Number	Reconditioned Number	Recordolocks	
55, 000			Shipped prior to Dec. 1916
145, 000			Shipped during Dec. 1917
167, 000			Shipped during Dec. 1918
193, 000			Shipped during Dec. 1919
219, 000			Shipped during Dec. 1920
228, 000			Shipped during Dec. 1921
240, 000			Shipped during Dec. 1922
265, 000			Shipped during Dec. 1923
285, 000			Shipped during Dec. 1924
305, 000			Shipped during Dec. 1925
325, 000			Shipped during Dec. 1926
345, 000			Shipped during Dec. 1927
365, 000	R 10502		Shipped during Dec. 1928
395, 000	R 11018		Shipped during Dec. 1929
415, 000	R 11616		Shipped during Dec. 1930
435, 000	R 12056		Shipped during Dec. 1931
445, 000	R 12188	700157	Shipped during Dec. 1932
462, 000	R 12438	700897	Shipped during Dec. 1933
475, 000	R 12941	701259	Shipped during Dec. 1934
490, 000	R 13482	703445	Shipped during Dec. 1935
512, 000	R 14263	703894	Shipped during Dec. 1936
536, 000	R 15171	704401	Shipped during Dec. 1937
556, 000		704634	Shipped during Dec. 1938
585, 000		704749	Shipped during Dec. 1939
608, 000		704952	Shipped during Dec. 1940
649, 000		705168	Shipped during Dec. 1941
685, 000		705200	Shipped during Dec. 1942
713, 000		705211	Shipped during Dec. 1943
734, 000		705230	Shipped during Dec. 1944
767, 000		705300	Shipped during Dec. 1945
825, 000		705734	Shipped during Dec. 1946
884, 000		706301	Shipped during Dec. 1947
935, 000		706800	Shipped during Dec. 1948
999, 000		707300	Shipped during Dec. 1949
90, 000		*	Shipped during Dec. 1950
164, 000		*	Shipped during Dec. 1951
251, 000		*	Shipped during Dec. 1952
344, 000		*	Shipped during Dec. 1953
440, 000		*	Shipped during Dec. 1954
535, 000		*	Shipped during Dec. 1955

Recordolocks after 1949 are serial numbered along with other TE units.

Machine Serial No. 999, 999 shipped December 1949. New numbers started with 10, 000 January 1950.

* * * *

TE Customer Engineering Memorandum

March 14, 1956 No. 379

PROPOSED TE CEM

SUBJECT: TE SUFFIX AGE CODES - GENERAL
(Note: This CEM supersedes CEM #236, destroy CEM #236)

PURPOSE: To advise of changes in alphabetic designations of years and to bring serial number list up to date.

INFORMATION: The suffix following the serial numbers on TE equipment provides a quick indication of the month and year of shipment of TE units, beginning with units shipped during 1940.

MONTH	YEAR
A - January	A - 1940
B - February	B - 1941
C - March	D - 1942
D - April	E - 1943
E - May	F - 1944
H - June	G - 1945
J - July	H - 1946
K - August	J - 1947
L - September	K - 1948
M - October	L - 1949
P - November	M - 1950
S - December	N - 1951
	P - 1952
	R - 1953
	S - 1954
	T - 1955
	U - 1956
	V - 1957
	W - 1958
	X - 1959
	Y - 1960
	Z - 1961

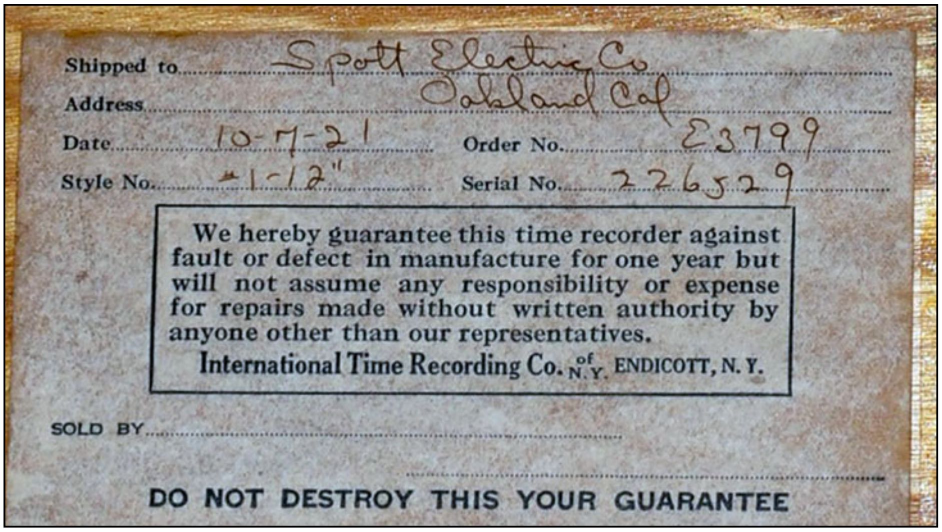
EXAMPLE: 8500-5 106955 JN (July 1951)

Previous to 1940 the year of manufacture was indicated by serial numbers without suffix.

IBM

Figures 31A and 31B. List of International Time Recording Co. and IBM serial numbers with date of shipment from 1916 to 1961. A total of about 1.5 million clock-related items were shipped.

Figure 32A. Master clocks had an identification plate with model and serial numbers.

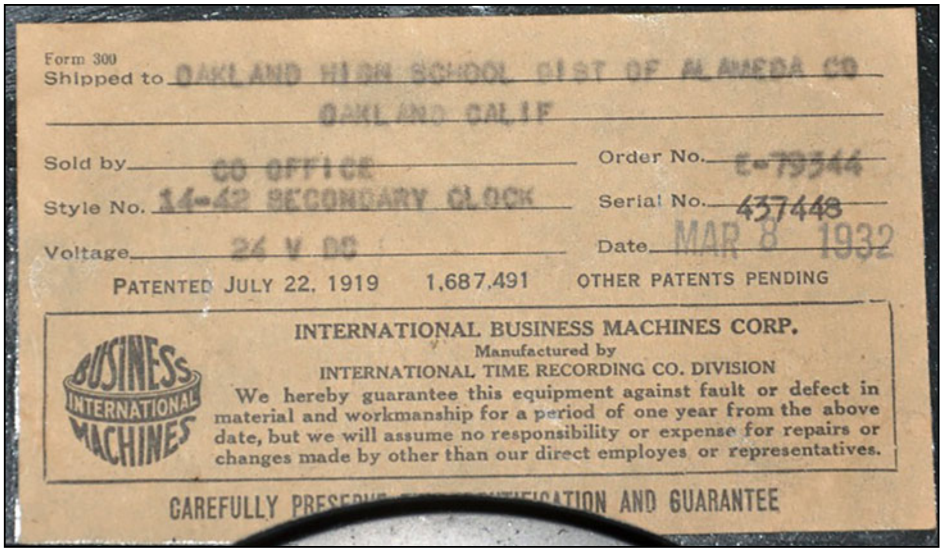

Shipped to Spott Electric Co
Address Oakland Cal
Date 10-7-21 Order No. E3799
Style No. #1-12" Serial No. 226529

We hereby guarantee this time recorder against fault or defect in manufacture for one year but will not assume any responsibility or expense for repairs made without written authority by anyone other than our representatives.
International Time Recording Co. of N.Y. ENDICOTT, N. Y.

SOLD BY

DO NOT DESTROY THIS YOUR GUARANTEE

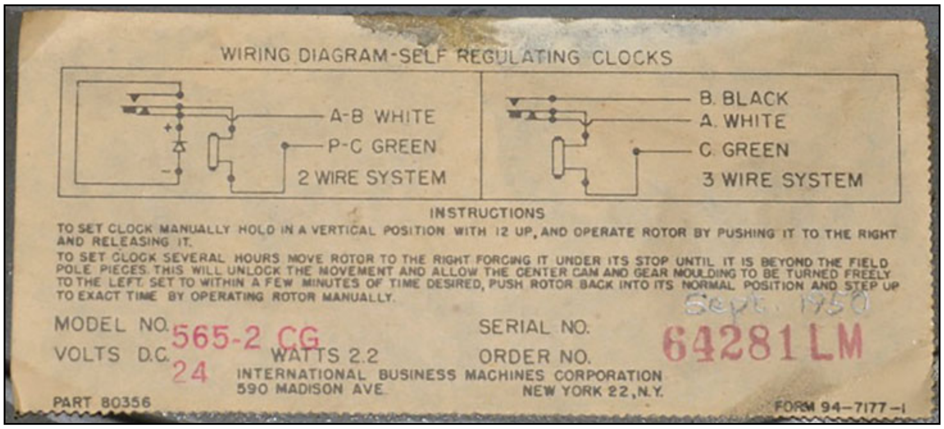
Figure 32B. Secondary clocks had a paper identification label. The earliest labels included whom the item was shipped to, date, style, and serial number.


Form 300
Shipped to OAKLAND HIGH SCHOOL DIST OF ALAMEDA CO
OAKLAND CALIF
Sold by CO OFFICE Order No. E-79544
Style No. 14-42 SECONDARY CLOCK Serial No. 437448
Voltage 24 V DC Date MAR 8 1932
PATENTED JULY 22, 1919 1,687,491 OTHER PATENTS PENDING

INTERNATIONAL BUSINESS MACHINES CORP.
Manufactured by
INTERNATIONAL TIME RECORDING CO. DIVISION
We hereby guarantee this equipment against fault or defect in material and workmanship for a period of one year from the above date, but we will assume no responsibility or expense for repairs or changes made by other than our direct employes or representatives.

CAREFULLY PRES… …ATION AND GUARANTEE

Figure 32C. Later paper labels added the voltage and IBM patent information.


WIRING DIAGRAM-SELF REGULATING CLOCKS

INSTRUCTIONS
TO SET CLOCK MANUALLY HOLD IN A VERTICAL POSITION WITH 12 UP, AND OPERATE ROTOR BY PUSHING IT TO THE RIGHT AND RELEASING IT.
TO SET CLOCK SEVERAL HOURS MOVE ROTOR TO THE RIGHT FORCING IT UNDER ITS STOP UNTIL IT IS BEYOND THE FIELD POLE PIECES. THIS WILL UNLOCK THE MOVEMENT AND ALLOW THE CENTER CAM AND GEAR MOULDING TO BE TURNED FREELY TO THE LEFT. SET TO WITHIN A FEW MINUTES OF TIME DESIRED, PUSH ROTOR BACK INTO ITS NORMAL POSITION AND STEP UP TO EXACT TIME BY OPERATING ROTOR MANUALLY.

MODEL NO. 565-2 CG SERIAL NO. 64281 LM Sept. 1950
VOLTS D.C. 24 WATTS 2.2 ORDER NO.
INTERNATIONAL BUSINESS MACHINES CORPORATION
590 MADISON AVE NEW YORK 22, N.Y.
PART 80356 FORM 94-7177-1

Figure 32D. The final paper label had wiring diagrams, and the serial numbers were coded with the month and year of shipping.

The SET self-winding movement has contacts that close each minute. The minute impulse method to wind the master clock mainspring and advance the secondary clocks was eventually used by most major US companies.

SWCC was the exception. Its movement rewinds once each hour when a winding contact on the center shaft is closed, activating a vibrating armature. The up-and-down motion of the armature turns a ratchet wheel and winds the mainspring. The SWCC secondary clocks (termed subsidiary clocks by SWCC), which were conventional pendulum-operated clocks, were synchronized once each hour. (In 1909 SWCC received a patent for a 30-second impulse secondary clock movement, so it could also market an impulse system.) ITR chose the minute impulse wind and advance design for its master clock system.

Help and direction in the design of the electrical components of the new ITR master clock movement came when an experienced SET employee, Herbert Hammond, was convinced to join ITR. At that time SET was the country's leading supplier of master clock and secondary clock systems and had a proven master clock and secondary clock design. The first ITR movements, which were essentially copies of SET movements, appeared in 1909 in ITR's first offering of a synchronized electric clock system. Quickly ITR, and finally as IBM, made significant refinements to the movement and the electrical components. By 1925 IBM had designed a revolutionary new secondary movement with the industry's first self-regulating system. The master clock would now automatically correct any secondary clocks that, as a result of electrical interruptions, did not agree with the master clock time. IBM could now offer the straight impulse system (two wires) and the hourly self-regulated master clock system (three wires).

Several US companies were in the time service business with their

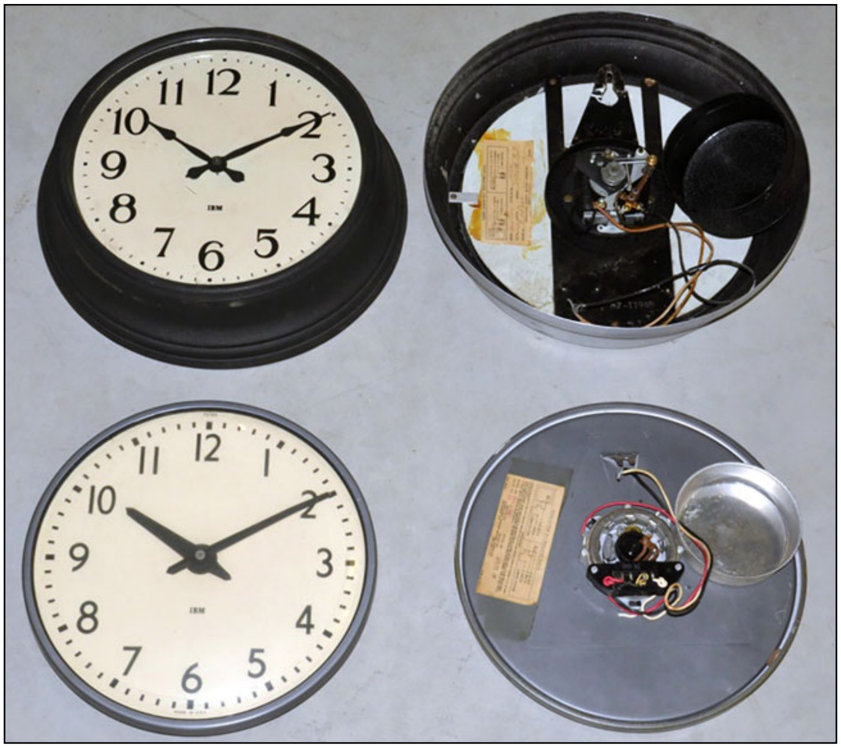


Figure 33. By the mid-1930s most secondary clocks were metal and wall mounted (top). By the 1950s secondary clocks were metal and flush mounted.

own self-winding master clock and impulse secondary clock systems. Some preceded IBM, such as Time Telegraph Co., SET, Blodgett Co., Fred Frick Co., and E. Howard Clock Co. Some appeared around the same time, such as SWCC (with an impulse secondary clock), Stromberg Electric Co., Landis Manufacturing Co., O. B. McClintock, Monarch Telephone Co., Joseph Mayer Co., and after, Pacific Electric Clock Co., Seth Thomas Clock Co., Cincinnati Time Recorder Co., and finally Holtzer-Cabot Co. IBM, SET, and Cincinnati each had self-winding, weight-driven master clock movements, and these movements were fitted with the same minute impulse contacts as its impulse wind master clock movements. Of the competing synchronizing time system companies, only SET, Landis-Cincinnati, Stromberg, and Holtzer-Cabot developed automatic correction systems. The IBM correction system was the first and the finest.

As early as the 1930s IBM recognized that the tabulating part of the original Computing-Tabulating-Recording Co. was its future. The Time Equipment Division, as ITR was called, was IBM's major source of revenue up to the 1930s, but by 1958 that division was generating less than 3 percent of company revenue. IBM and its predecessor companies had made clocks and other time-recording products for 70 years, but IBM sold the Time Equipment Division in 1958 to Simplex Time Recorder Co. This marked the end of a most interesting relationship between the legendary IBM and clock manufacturing.

With IBM's quest for developing the best products and providing the best service, its synchronized time systems certainly met those goals. IBM entered the clock world before electricity was readily available. It was instrumental in modifying clock mechanisms to benefit from electrical power and found ways to resolve irregularities in system clocks that occurred as the result of the idiosyncrasies of electric power. This technology was absolutely of the highest caliber for the time. However, further technology would ultimately make these clock systems almost obsolete. IBM seems to have known more than 50 years ago that clock systems would dramatically change. Maybe the company had an idea that twenty-first-century clock systems could consist of battery-powered quartz clocks synchronized by an atomic clock signal. The sale of the Time Equipment Division was definitely prophetic.

About IBM

As a clock collector, I take great pride in the realization that the very fine employee time-recording clocks and electrically synchronized clock systems made by ITR helped establish the world famous and highly respected International Business Machine Corp. of today. One hundred years ago the company was a pioneer in developing electric time systems into a highly innovative new industry. While electricity made it possible for a master clock to operate secondary clocks, interruptions in the electrical service resulted in those same clocks falling behind the master clock.

By the time ITR's name became IBM, it had developed a solution. It devised a way for the master clock to automatically generate extra impulses to synchronize any incorrect clock. Industrial clocks manufactured by IBM are without equal and the correction system it invented remains the finest.

Today IBM, a multinational technology and consulting corporation, is a national treasure. In 2012 *Fortune* magazine ranked IBM as the second-largest employer in the country with 435,000 employees, 100,000 of them working in the United States. For 20 consecutive years IBM has been awarded more US patents than any company in the world. In 2012 IBM invested $6 billion in research. For IBM, innovation has always been at the forefront. Among other things, IBM invented the floppy disk, the hard disk drive, the magnetic stripe card, the automatic teller machine, the universal product code, and Watson artificial intelligence. A friend of our planet, IBM was ranked as the No. 1 green company in the country by *Newsweek* magazine.

Can Master Clocks and Secondary Clocks from Different Companies Be Operated Together?

The answer is yes as long as the voltages are the same, the number of impulses per minute is the same, and the polarity is not reversed with each impulse. American-made systems are usually single polarity, 24 volts DC, and the secondary clocks are impulsed one time per minute.

Figure 34. Master clock at Ford Motor Co. plant. The system of 700 clocks was run by a Standard Electric Time master clock but was updated by IBM as indicated by all the IBM pilot clocks on the left. Components from different manufacturers are seen in many systems.

Any number of secondary clocks from any maker can be connected to a 24 volt system as long as power is adequate.

It is important to know the required voltage of a secondary clock. Care must be taken when adding very early secondary clocks to a 24 volt system as they may be from a series system and only require two or three volts. The series systems were usually 24 volts but had eight to 12 clocks connected in series just like old Christmas tree lights. In a series system, just like the lights, when one goes out they all go out. Many early Standard Electric Time Co. secondary clocks are series clocks. To include an SET series secondary clock safely in a 24 volt system, a 100 ohm resistor needs to be connected in series to the SET secondary clock movement.

I know it is possible to mix and match manufacturers; I have done just that for many years. I recently came across a picture that reveals it also can be done in massive clock system installations. The photograph in Figure 34 is from Ford Motor Co. and shows the Rouge facility master clock that controls its extensive 700-clock system. The master clock is a pre-1920 SET master clock that, as the news release states, “sends out minute electric impulses to all wall and time recording clocks.” A close look at the photograph also reveals that each of the individual pilot clocks along the left side is an ITR clock, indicating that the entire system was updated by ITR at some time before the photograph was taken in 1945. So here an SET master clock is running ITR clocks. Clearly, a mix of company components works.

Don’t Let Master Clocks Intimidate

Master clock movements can look intimidating, but remember they are simply a spring-driven, single-train movement with an electric winder. Most of the scary wiring is related to auxiliaries, and usually the movement needs just two wires to keep the mainspring wound (Figures 35-36). Secondary clocks are even simpler. A secondary clock is only a partial clock that needs an electric charge to move the hands. These electromechanical clocks are robust industrial-strength clocks. You almost can’t hurt them and they will not hurt you.

If you are interested in these clocks, there is help available. The best source is the NAWCC message board. Look under Horological Education, next to the category Clocks and finally select Electric Horology. NAWCC Chapter 78 and Chapter 133 have a main interest in electric horology and can be reached through their Chapter secretaries.

References

Computing Tabulating Recording Company. Wikipedia. http://en.wikipedia.org/wiki/Computing_Tabulating_Recording_Company.

Dow, C. A. *Recollections of Chet Dow, Standard Electric Time Co. service technician*, circa 1950. http://clockhistory.com/setclocks/odds_ends/index.html.

Gensheimer, J. M. “Even More Questions and Answers on

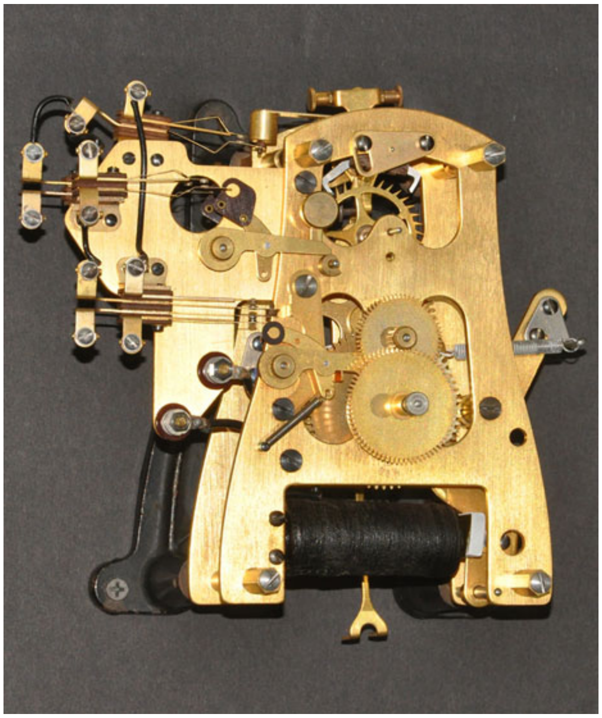


Figure 35. IBM master movement complete with wind and self-regulating contacts. See Figure 25B with all system wiring connected.

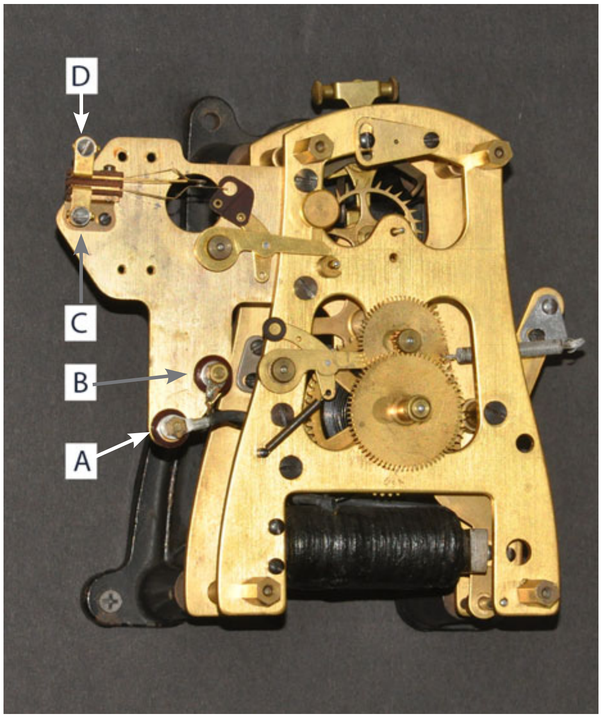


Figure 36. IBM master movement with only the wind contact. To operate the movement, use a jumper wire from B to C and DC voltage (usually 24 volt DC) at A and D.

Time Recorders and Master Clocks." *NAWCC Bulletin*, No. 354 (February 2005): 51-61.

—. "The International Time Recording Company." *NAWCC Bulletin*, No. 296 (June 1995): 291-303.

—. "More Time Recording Questions and Answers." *NAWCC Bulletin*, No. 339 (August 2002): 434-445.

—. "Recording Time—More History of the International Time Recording Company." *NAWCC Bulletin*, No. 303 (August 1996): 463-478.

—. "Time Recording Questions and Answers." *NAWCC Bulletin*, No. 332 (June 2001): 337-345.

"IBM Granted Most US Patents for 20th Straight Year." *Bloomberg Report*, January 10, 2013.

IBM, P. R. "Sale of Time Equipment Division to Simplex Time Recorder Company," 1958.

"Tabulating Concerns Unite." *New York Times,* June 10, 1911.

Acknowledgments

Thank you to electric horology wizard and former IBM employee Les Lesovsky for his insightful help in the preparation and editing of this article.

Thank you to Joseph Gensheimer for encouraging me to write the story of IBM master and secondary clocks and thank you for reviewing the manuscript.

Thank you to NAWCC Electric Horology message board editor and for many years IBM clock systems service technician Harold Bain for insight into IBM's operations in Canada.

Finally, thank you to Ernie Jensen for his expert help in understanding the sophisticated IBM self-regulating system wiring and for photographs of some of the clocks included in this article.

About the Author

J. Alan Bloore is a retired orthodontist who has collected electromechanical clocks for over 40 years. He is primarily interested in clocks that are part of synchronized time systems.

He has several master clock systems operating in his home and believes that the IBM systems are the finest. He previously authored two *NAWCC Bulletin* articles about Standard Electric Time Company clocks: "School Clock Systems of the Standard Electric Time Company" (April 2011) and the "Bad Robot Clock System: Mid Century Clock System in a High Tech Setting" (October 2011).

Self Winding Clock Co. has also been the subject of two *Watch and Clock Bulletin* articles, "The Self Winding Clock Company and the Ubiquitous Style "F" movement" (May/June 2012) and "The ABC's of the Self Winding Clock Company's Rotary Movement" (November/December 2012).

Bloore has been a member of the NAWCC since 1979 and is membership chair of Western Electric Chapter 133 and a contributor to its website at www.oldtimemachines.com. He can be reached at jabloore@aol.com.