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CHAPTER #78

NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXV #1, MARCH 2000

Fellow Horologists:

This issue continues the ELGIN OBSERVATORY series, and the story of the Reifler clocks that were installed there. An additional sidelight to our information appeared in the NAWCC Bulletin of December 1999, page 826, regarding the Riefler clock donated to our museum by Tom & Clara LaRose, along with some background information. On the same subject, we owe an apology to Elmer Crum for our printing his informative letter in our last issue without editing and correcting it for grammatical & typographic errors which it contained as a result of his efforts to get the information to us before the printing deadline for that journal.

Also included herein, is a fascinating 1883 patent by George F. Ballou for an Electrical Winding Device for clocks. An interesting bit of history guaranteed to educate and entertain!

It's "clean-up" time again for the Mart Ads, so please advise our Mart Editor and Chapter Historian, Dr. George Feinstein about your desire to maintain or change your ad copy. Failure to contact him will result in the permanent deletion of your ad, so act promptly. (The mailing address appears on the Mart pages.)

Our plea for material for future journals continues... Please help us to continue to provide an informative and interesting journal.

An interesting quote: "Give me a lever long enough and a place to stand, and I can move the world."
—Archimedes

Good reading ahead, enjoy this issue.

Martin Swetsky, FNAWCC, President)
Harvey Schmidt, FNAWCC, Secretary-Treasurer) Co-editors
Dr. George Feinstein, Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

Continued from December, 1999 issue.

ment of a battery powered electric wrist watch in their Research and Development divisions. As the development progressed, it became apparent a means for suppressing electric contact sparking would be necessary. It was found that a diode would accomplish this function. At that time, a few diodes about the size of a peanut were available commercially. A diode 2 m/m square and .021 inches thick was necessary for this watch. It was concluded that the Research Department would have to roll up its sleeves and embark upon the production of these diodes. The Observatory primary functions along with its radio laboratory were just coasting along, being kept alive for advertising purposes, so therefore the semi-conductor laboratory was set up in the Observatory under C.N. Challacombe Ph.D. Assistant Director of Research and Development and Robert C. Miller Observatory Supervisor. Changes in the physical interior of the building took place to accomodate equipment necessary to carry on this work. The doorway into the north side of the basement was opened up from a standard size door to a garage size door to accomodate the housing of a large type induction heating furnace and a vacuum system. The area that had been used for the timing and regulating Lady and Lord Elgin watches was converted into an electrical measuring laboratory and model making room. Production started with refining (purification) of raw germanium, a white metalic element discovered by a German chemist, Winkler, in 1886. With the induction heating unit and the vacuum system operative along with the receipt of raw germanium, it was but a short time until the melting of germanium within a vacuum chamber was perfected and PURE germanium was available for the fabricating of diodes to the prescribed dimensions for the electric watch. At this same time the Bell Telephone Laboratories in New York had entered into the semi-conductor production field and had set up a cross licensing agreement covering the production of germanium crystals and the fabrication of semi-conductors. This license agreement allowed the exchange of information pertaining to the subject. Elgin became associated with Bell Laboratories, also maintained a fellowship in the semi-conductor field at Battelle Memorial Institute, Columbus, Ohio along with an Atomic battery development with Walter Kidde Co., Garden City, N.Y. Elgin experienced an outstanding break through in the technique of sawing (slicing) the germanium into small chips needed in the semi-conductor production. The only means available for the sawing was confined to the cutting of a single piece at one time. Elgin adapted a gang saw unit that had been used for the sawing of jewels and with some modifications were able to saw twenty pieces at one time. The Bell Laboratories became very excited regarding this means of increasing sawing production and sent several of their engineers to the Elgin Observatory semi-conductor Laboratory to witness this operation and study its design. Elgin now had a source for diodes for the electric watch that was in the development stage. The Observatory office became a well-stocked library relating to the rapidly developing seim-conductor field with Challacombe and Miller closely following these developments. 1957-E.N.W. Co., funds for research and development work were dwindling therefore one of the first cut backs hit the Observatory semi-conductor laboratory, the doors closing in 1957.

A few personal comments by the writer:
"With the semi-conductor development coupled with the printed circuit boards very inexpensive watches are being produced which are selling at prices from five to fifty dollars depending upon the type of casing. These watches are outstanding for their accuracy in time keeping. Elgin was on the threshhold of the greatest development of time keepers (watches) since the days when the hog bristle was found suitable as a vibrating unit. It is conceivable to see that Elgin may have become a very dominant factor in the time field again and

continued to keep Elgin on the map. "Twenty-
4 twenty hind sight."

1958-The F.C.C. was petitioned for a permit to dismantle the experimental transmitting station, which was granted, the license surrendered. The final transmission "73" sign-off occurred on October 14, 1958 following over thirty years in service. This terminated Neldigh's connection with the Observatory-Chief Radio Engineer.

1958-1960-Since the closing down of the radio transmitting station, the Observatory became inactive in every way. In November, 1960, the building, equipment and grounds were deeded over to the Elgin School Board U-46 District as a gift from the E.N.W. Co. The ceremony of turning over the keys to the building took place on the front lawn. Mr. George J. Daly, Jr., Chief Executive Officer handed the keys to Mr. Ashley E. Arnold, President of the School Board, witnessed by Mr. Harold E. Corr, E.N.W. Co., President of Administration along with Mr. Orrin G. Thompson, Superintendent of Elgin Schools and Mr. Richard S. Stettner, a School Board member.

Ray S. Neidigh
July 15, 1982

ACKNOWLEDGMENTS

The writer wishes to acknowledge the co-operation of the following persons: Mr. C.N. Challacombe, Mr. Robert L. Eberly Mr. Robert C. Miller, Mr. Bruce Rice and Mr. Nathaniel Warner, all residents of Elgin at the present time, for their promp replies to my inquiries regarding their services in the Elgin Observatory. It has been the desire of the writer to make this history of the Elgin Observatory as factfu as possible and the dates and information regarding their duties made this possible. I thank each and every one.

Ray S. Neidigh
July 15, 1982

The Army, Navy and in latter years, the Air Forces were purchasing precision time pieces from the various watch making companies in the U.S., on a contract basis. The accepted time pieces had to meet very rigid performance tests in various temperatures and positions. It was soon discovered that more space for this testing program was needed, resulting in the construction and equipping of the building known as the Rating Room. Many time pieces for railroad employees passed through the Rating Room procedures. With the Observatory time service coupled with the Rating Room testing laboratory E.N.W. Co., became very successful in meeting contract specifications for these watches. The demand for and the production of precision time pieces for the government services had become a sizeable part of the E.N.W. Co., watch production. Soon after the opening of the Observatory (February 1910), the company constructed a small building which was located between the Power House and the south end of the river wing of the main factory building and it was known as the Rating Room Building. Mr. Urie was in charge of the watch rating which along with the position of Assistant Director of the Observatory. Following the retirement of Prof. Payne and Mr. Uries appointment of Superintendent of Research and Inspection the Observatory and Rating Room became a function of Research and Inspection. The Observatory staff was responsible for the operation of both units, the Observatory and the Rating Room. The ticker lines from the Observatory terminated in the Rating Room and from here were distributed to various sections where they were used for the timing and regulation of watches in production. "Timed From The Stars". The Rating Room was a two-story building. The second floor housed the refrigerating units for supplying lower temperatures within the testing chambers. High, low, and normal temperatures were thermostatic controlled within these chambers. The testing chambers were on the first floor along with office space the ticker line switch board and a chronograph. All watch testing was chronograph recorded. Each test chamber contained four specially designed racks holding one hundred watches apiece. Watches could be placed in various testing positions by mechanical movement of the rack holders. The upstairs above the office became the very first radio laboratory, dating from late in the year 1921. At this time the Naval Observatory was transmitting time signals on what was referred then to long waves (the peak development of the art at this time). A receiving antenna was constructed using four wires each four hundred feet long terminating into a single lead wire entering the Rating Room at the northeast corner of the building through a heavy disconnect switch so when not in use the antenna could be grounded for safety against lightning. The four wires were attached to a spreader at each end, the spreaders being sixteen feet long. The antenna was suspended between the front building clock tower and the power house chimney, the lead-in being taken off the chimney end of the antenna and carried overhead to the Rating Room. The position of the antenna was high with a free, unobstructed spread above the buildings. The earliest receiver employed was a crystal detector with loading coils and variable tuning condensers for tuning long wave transmitting stations. It was built by the Telefunken Electric Co., of Germany. (Vintage about 1916). This was replaced by a receiver built by the DeForest Radio Equipment Co., which employed vacuum tubes, a detector followed by two stages of amplification. Honey-comb coils with variable coupling plus variable condensers were used for a signal pick up. Once per day our Observatory time standard was compared with the signals from the Naval Observatory. U.S. Government time signal broadcasts were now the time standard for the nation. Mr. Urie had become somewhat of a nationally and international figure in the recording of time signals. He contributed many articles on the subject to various scientific magazines throughout the world. Certain times of the year he had recorded the time signals from the Paris Observatory along with the signals from the Naval Observatory in Washington, D.C., the Naval Base on the California coast and the Pearl Harbor base in the Pacific. As the radio art of transmitting developed, it was not long until time signals were being transmitted via short wave. This provided us, with a means of recording these signals in our radio laboratory in the Observatory. Signals were being transmitted on an hourly basis and finally on a continuous twenty-four hour basis via WWV. We now had a means of recording Naval Observatory time signals along with our star observations. In recent years, the rapid development of science has required accurate time not just to the second but to very small fractions of a second. Time marches on - what a true statement.

METEROLOGICAL DATA

Shortly following Mr. Urie's appointment as Director of the Observatory, he terminated the Observatory as a co-operative station of the U.S. Weather Bureau. The "Weather Quad-Recorder" was a very interesting recording instrument. A printed paper for approximately thirty inches long and ten inches wide was wound around a drum which was dirven by a clock motor making a complete revolution in twenty-four hours. A series of inked pens rested upon this chart and were actuated by relays connected to the instruments mounted on the roof of the building. The amount of sunshine, cloudiness and darkness, the amount of rainfall, the direction of the wind each minute along with the velocity of the wind. Temperatures were read on the instruments located in the shelter house. Observatory meterological data was conveyed to the Springfield, Illinois office of the U.S. Weather Bureau.

The writer is drawing upon his childhood introduction to transmitted time signals. No doubt following President Theodore Roosevelt's direction to the U.S. Bureau of Standards to provide a time standard for the nation the Western Union Telegraph Co., played a very important role in the distribution of time throughout the nation. Their telegraphic lines of communication covered the nation, with public offices in most cities and in practically every railroad station in the nation alongside the railroad telegraphic lines. Being exposed to these telegraphic services in my father's offices, I recall hearing these time signals coming through each day via the Western Union wires. The signals (sounder clicks) ending at exactly 17 hours 00 minutes 00 seconds G.M.T. I recall persons needing correct time such as watch repairmen, etc., congregating at my father's office with their master time keepers to check them with the Naval Observatory time which was the time standard for the nation. Western Union also provided a commercial time service to any business house so desiring this service. They would install a wall clock having a dial approximately sixteen inches in diameter with a full sweep second hand. This clock was connected to their wires and would be automatically corrected each day at the same time the time signals were transmitted via their telegraphic lines. Each clock carried an enameled plaque above the dial opening in the case reading - U.S. OBSERVATORY TIME by WESTERN UNION. These clocks were installed on a monthly rental contract I recall seeing these clocks in many of the good barber shops (when these places were mens' domain) in show windows of jewelry stores, etc..

SANITARY DISTRICT OF ELGIN
ELGIN, ILLINOIS

March 20, 1928.

Mr. F. D. Urie.
Director of Elgin National Watch Co. Observatory,
Elgin, Illinois.

Dear Mr. Urie;

On Monday, March 19, 1928. I ran a level line from Bench Mark #2 of the City of Elgin, located in the trianglar park which is bounded by Villa, Prairie and Chapel Streets to the Observatory of the Elgin National Watch Company with the following results;

Elgin Bench Mark #2	- -	761.89 E. C. D.
Top center line of concrete sill of S.E. window of office room of the Elgin Nat. Watch Company Observatory.	-	800.58 E. C. D.

To change from Elgin City Datum (E.C.D.) to Mean Sea Level (M.S.L.) subtract 19.896 because Elgin City Datum is that much lower than Mean Sea Level.

Therefore the point on the "Top center line of concrete sill of S.E. window of office room of the Elgin National Watch Company Observatory is approximately 780.68 Ft. more or less above Mean Sea Level.

Trusting this will answer your inquiry, I remain

Yours very truly,

E. E. Smith

District Superintendent

EES/AS

SANITARY DISTRICT OF ELGIN
ELGIN, ILLINOIS

Difference in Elevation of Elgin City Datum and Mean Sea Level

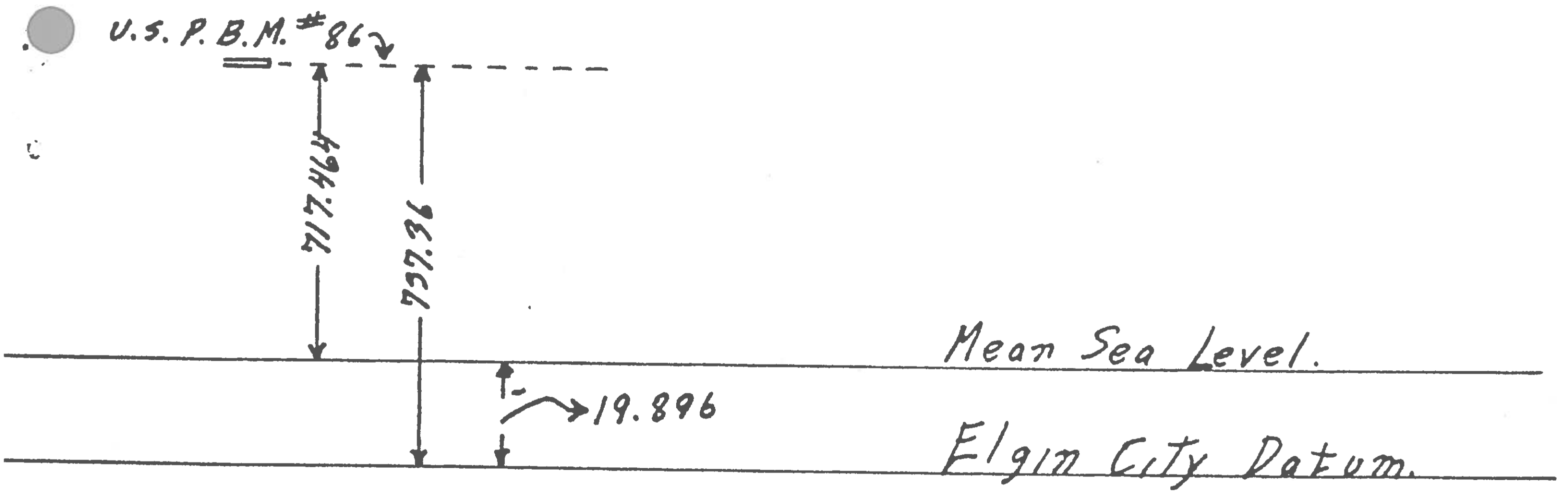
Elevation of U.S.P.B.M. #86 - - 717.464 Mean Sea Level.

Elgin City Datum 737.36 Ft. below said U.S.P.B.M. #86.

Therefore to change from Elgin City Datum To Mean Sea Level the difference of 19.896 must be subtracted from the Elgin City Datum elevation.

Therefore to change from Mean Sea Level to Elgin City Datum the difference of 19.896 must be added to Mean Sea Level elevation.

The following diagram illustrates this difference,



RIEFLER CLOCKS.

REPAIR WORK ON RIEFLER CLOCKS.

TO OPEN UP CLOCKS.

A - Open up the air valve and remove glass jar covering the movement.

B - Before doing any work on clock after upper jar is removed, raise up the lever on back side and top of movement as this disengages the pendulum and tighten the four locking screws. This is done to prevent any damage being done to the steel knife edges that the pendulum rests on while in motion.

C - To remove hands pull them toward you. Note position of the minute hand so that when replacing it will be opposite the weight which is a counter balance to the hand.

D - The winding current may be cut off at the binding post on the left side of movement.

E - Winding contacts should be cleaned by filing but care must be taken to prevent knocking out the jewel which breaks the winding current. It is located on the lower bar of the two winding bars.

F - The contact which operates the chronograph is located on the upper left hand corner of movement. It is threaded and has a one wing locking nut to hold it in place. This point should be filed clean.

G - The click which runs on the outside edge of wheel that contains the maintaining spring has a small wire coil spring attached causing the click to bear against the wheel. To tighten this spring remove the upper winding bar. This maintaining spring supplies the power for the clock while the winding lever is moving upwards.

H - To clean and overhaul the entire clock the pendulum, microscope and hygrometer are removed. Disconnect wires, noting color code so as to be able to replace in same position. Remove four bolts holding movement to glass flange and lift movement off bottom glass jar. The thermometer and barometer also have to be removed before removing the movement.

Note: Stop clock pendulum when raising air pressure to prevent pendulum from swinging off ???

TAKING DOWN CLOCK No. 220.

See that clock No. 240 is set correct and in good running order.

Set a chronometer to Sidereal time and run it in the vault as a safe guard.

Open winding and relay switches on switch board.

Open air valve on clock.

Remove glass hood, instruments and pendulum.

After cleaning and oiling replace in proper order.

Set time to time of clock No. 240.

Check winding time.

Make clock comparison at once MEAN TIME TO SIDEREAL TIME.

Check beat of pendulum.

Check chronograph break and adjust contact on clock.

Run for twenty four hours and make another comparison and determine rate of clock No. 220.

Divide this rate by .018 which will give the number of M/M to lower the pressure in the jar, so clock will run at nearly zero rate.

Seal clock up and lower pressure to proper point.

Let clock run for a couple days before observing for rate determination.

NOTE:

If mean time to sidereal comparison shows quite a large daily correction for clock No. 220 this may be eliminated by setting No. 220 fast or slow (as the case may be) on clock No. 240 the required number of seconds. Make another comparison at once before sealing up clock and determine for certain that the minute hand of clock No. 220 is properly set.

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per of M/M to lower
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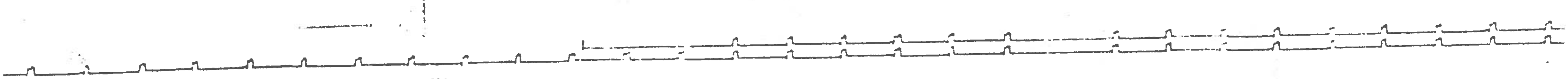
Chronographic Record of Clock No. 220 in Best Aug-20-1929



To be continued.

(No Model.)

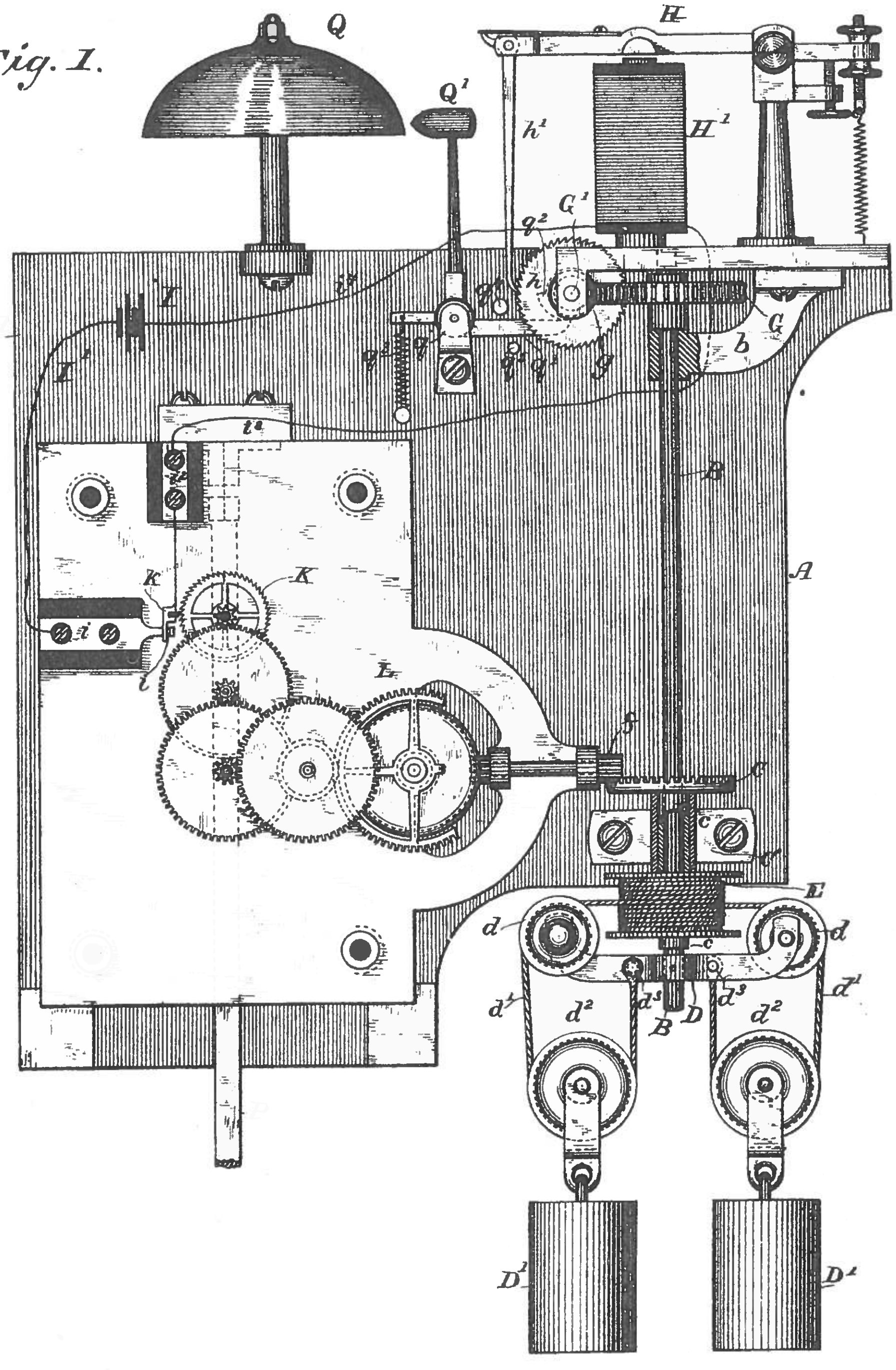
3 Sheets—Sheet 1.

G. F. BALLOU.

ELECTRIC DEVICE FOR WINDING CLOCKS.

No. 277,104. Patented May 8, 1883.

Fig. 1.



Witnesses:
Shunkle
anney

INVENTOR
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By his Attorneys.
Baldwin Hopkins, Peyton.

(No Model.)

3 Sheets—Sheet 2.

G. F. BALLOU.

ELECTRIC DEVICE FOR WINDING CLOCKS.

No. 277,104.

Patented May 8, 1883.

Fig. 3.

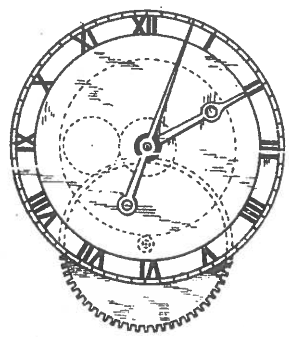


Fig. 2.

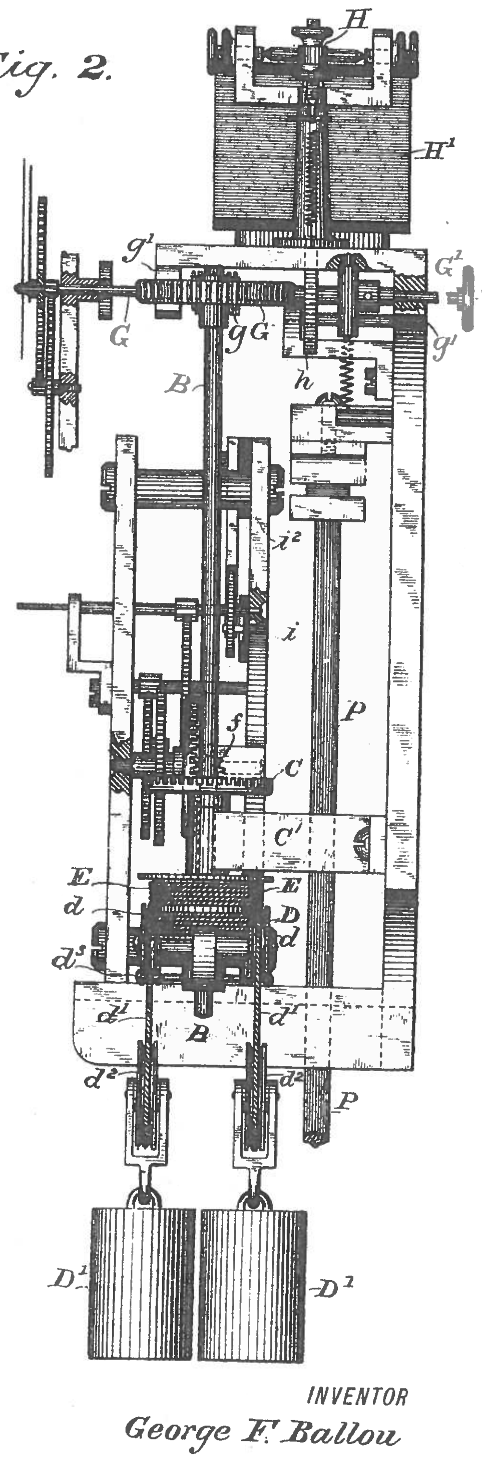
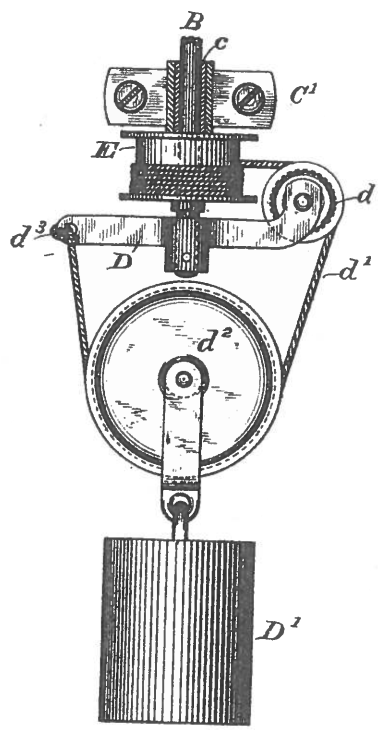


Fig. 4.



WITNESSES

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N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

3 Sheets—Sheet 3.

G. F. BALLOU.

ELECTRIC DEVICE FOR WINDING CLOCKS.

No. 277,104. Patented May 8, 1883.

Fig. 6.

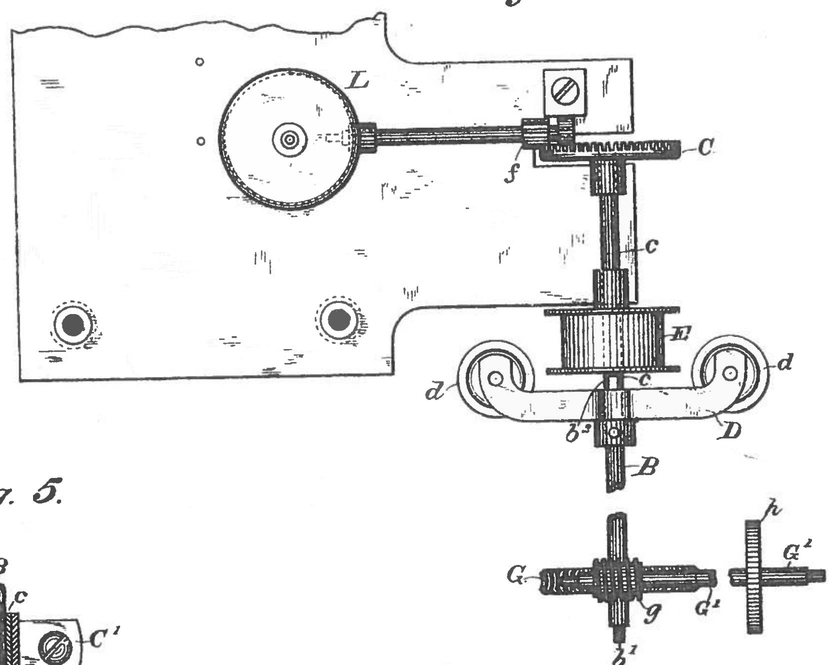


Fig. 5.

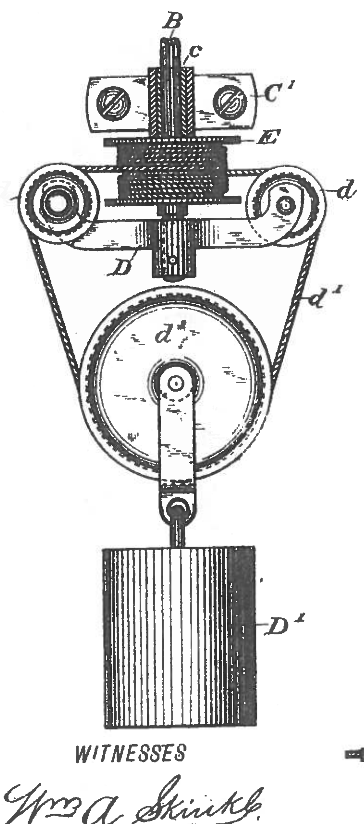
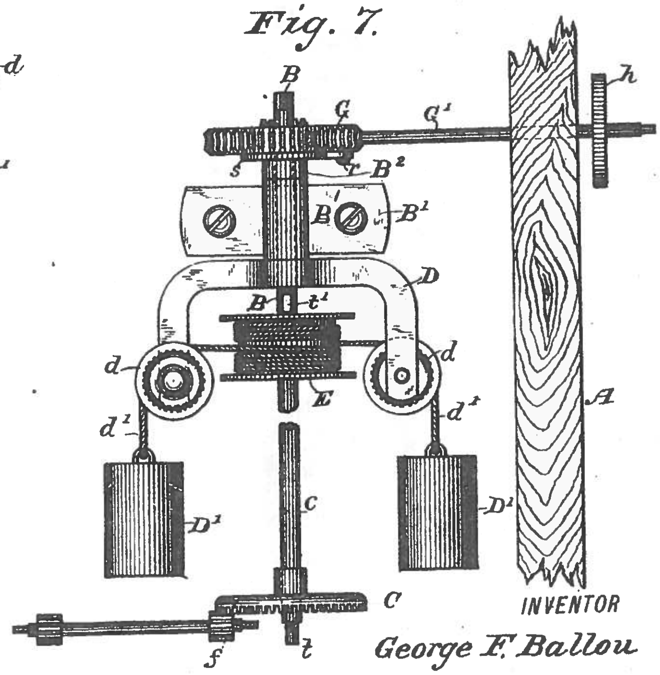


Fig. 7.



WITNESSES

Wm. A. Skinkle

Wm. J. Tanner

INVENTOR

George F. Ballou

By his Attorneys

Baldwin, Hopkins, & Peyton.

UNITED STATES PATENT OFFICE.

GEORGE F. BALLOU, OF WALTHAM, MASSACHUSETTS.

ELECTRIC DEVICE FOR WINDING CLOCKS.

SPECIFICATION forming part of Letters Patent No. 277,104, dated May 8, 1883.

Application filed July 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. BALLOU, of Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Clocks, of which the following is a specification.

My invention comprehends an electric clock-winding apparatus which keeps the clock constantly wound by a continuous action which takes place as the clock is running without in any manner affecting the strain of the weight upon the train. The latter feature of my invention—the winding of the clock without modifying the force of the weights upon the train—is applicable to clocks generally which are run by weights. The importance of such an organization and operation will be appreciated by those skilled in the art. The evil effects which result from relieving the train from the force of the weight of a clock in winding it are well understood, and ways of avoiding it by the use of "maintaining springs," which keep the train under tension during the winding, have been devised. No such spring or any supplementary weight is employed in my invention, no change is made from one force to another, which necessarily involves a modifying influence, but the clock-weight itself at all times exerts its constant uniform pull or strain upon the clock-train.

My invention will be found specially valuable in astronomical and other clocks, which are required to be of the greatest delicacy. As the clock is kept constantly automatically wound by a continuous uniform action and the strain of the weight upon the train is never changed, the liability of variation is reduced to the minimum, and the accuracy of the clock is increased in a very marked degree.

My invention further contemplates certain other minor improvements in construction and organization more or less incidental to the two main features above.

The details of my invention will now be fully set forth.

In the accompanying drawings, which illustrate my invention in the form now best known to me, Figure 1 is a front elevation of so much of the clock-work and frame of a clock with my improvements applied as is necessary to illustrate the invention. Fig. 2 is a side elevation of the same. Fig. 3 is a detail view of the winding indicating-dial. Fig. 4 is a detail view showing an arrangement of the barrel and cord where I employ a single weight. Fig. 5 is a view of a somewhat similar organization where a single weight is employed. Fig. 6 is a detail elevation showing a modified construction in which the winding actuating-shaft is placed below the barrel of the clock instead of above it, as in Figs. 1 and 2; and Fig. 7 is a detail elevation showing the winding-shaft passing outside of the clock-frame, so that the electric part of the apparatus may be removed from the clock-work, if desired.

Referring specially to Figs. 1 and 2, A is a portion of the frame-work of the clock upon which the clock-train frame and the other parts of the mechanism are mounted. A vertical shaft, B, having its upper bearing in a bracket, b, passes centrally through the crown-wheel C and its elongated sleeve-hub c, and carries at its lower end the weight-frame D. The hub c of the crown-wheel has its bearing in a bracket, C′, secured on the frame A. The barrel E of the clock mechanism is secured rigidly to the lower end of the sleeve c of the the crown-wheel C, the sleeve preferably passing through the barrel, as indicated in the drawings. The vertical shaft B therefore passes centrally through the crown-wheel C and through the barrel E, and revolves with the weight-frame D independently of them. The weight-frame, which is a small transverse frame secured centrally upon the shaft B, is provided with pulleys d d at each end. The weight-cords d' are attached to opposite sides of the barrel E, and then pass over the pulleys d on the ends of the weight-frame, around pulleys d^2, connected with the weights D′, and are then connected to the weight-frame at d^3. The cords being wound upon the barrel by the revolution of the weight-frame in a manner to be described, the pull of both weights will tend to revolve the drum in the same direction. As the drum is vertical and concentrically arranged with reference to the shaft B, which carries the weight-frame, it will be obvious that by revolving the shaft B in the proper direction the weight-frame will revolve beneath the barrel, and will wind the cords thereon without at all removing or in any way modifying the strains of the weights upon the barrel and train. The crown-wheel C gears with the pinion f, which actuates the clock-train in the usual manner. This is well understood, and needs no special description in this connection.

By the organization above described it will be perceived that the strain of the weights is kept constantly upon the barrel and train of the clock as well when the clock is being wound as at other times. The upright shaft B may extend up through the top of the clock-case and be actuated by a key in the ordinary manner at stated intervals to wind the clock, or by gearing the shaft may be wound from the side or bottom, as is most convenient. In either case, however, an ordinary ratchet-and-pawl arrangement, such as is shown in Fig. 7, and hereinafter described, should connect the worm-wheel G with the shaft, so as to permit the shaft to be rotated by the key without affecting the worm. In order, however, to keep the clock constantly wound by a continuous action, I employ an automatic electric winding arrangement, which I will now describe. The upright shaft B carries at its upper end a worm-wheel, G, which gears with a corresponding small worm, g, on the shaft G′, mounted on suitable bearings, g' g', in the clock-case. The shaft G′ carries a ratchet-wheel, h, which is actuated by a spring push-rod, h', carried at the outer end of the vibrating-armature H of the electro-magnet H′. Each vibration of the armature will revolve the ratchet-wheel one tooth, and through the shaft G′, worm g, worm-wheel G, shaft B, and weight-frame D will wind the clock. The electric circuit runs from the battery I, by wire I′, to the insulated circuit-plate i, circuit-breaker i', insulated plate i^2, by wire i^3, to coil of the electro-magnet, and by wire i^4 from the electro-magnet to the opposite pole of the battery. Each swing of the pendulum P will operate an escapement and permit the break-wheel K to revolve one tooth. The passage of this tooth past the insulated snubbing-tooth k of the circuit-breaker causes a break and make in the circuit, which produces a vibration of the armature H, and a consequent revolution of the ratchet-wheel h, a partial rotation of the weight-frame D, and a consequent winding of the weight-cord on the barrel of the clock. The scape-wheel may be on the same shaft with the break-wheel K. The details of the escapement may be of any well-known character. It is deemed unnecessary to show and describe them.

The number of teeth in the break-wheel K, the ratchet-wheel h, the worms, and the other gearing should be arranged with reference to each other, so that the makes and breaks in the circuit will cause a rotation of the weight-frame D relatively to the rotation of the barrel, which will be just sufficient to keep the cords wound upon the barrel in a uniform position and the weights at a constant unvarying height. Thus, as the barrel turns and the clock runs, the cords will be constantly wound with an equivalent speed, and the clock can never run down. Any expert can arrange the gearing to accomplish this result. Thus the ratchet-wheel h might have one hundred and fifty teeth and the break-wheel thirty teeth, and be revolved once a minute. It would thus take five minutes for the ratchet-wheel to make one revolution. The worm-wheel G may have, say, two hundred and eighty-eight teeth. If the wheel L is arranged to be revolved once in twenty-four hours, or one thousand four hundred and forty minutes, the gearing properly timed, and the battery I is kept in good order, and no accidents occur, the weight-frame will revolve in the same time, and consequently the clock will be kept uniformly wound. The drawings show different numbers of teeth on the wheels from those above given; but the point is immaterial.

As before remarked, in order to wind the clock by an ordinary key under the organization shown in Figs. 1 and 2, the end of the shaft B might be squared and arranged so as to project above the top of the clock-case; or it might be wound from the side of the clock by suitable gearing, the worm-wheel being connected to the shaft by an ordinary ratchet-and-pawl arrangement; or the end of the shaft G′ may project beyond the clock-case and be squared or provided with a thumb-piece, G^2, by which the shaft may be actuated, in which case the push-rod h' will slip on the ratchet-wheel and permit the winding without disturbing the electric winding part of the apparatus. It is desirable to have such an ordinary key-winding arrangement in connection with a continuous automatic electric winder, so that the clock may be wound in case of any accident to the electric part of the apparatus.

In order to tell whether the electric winding apparatus is operating, it is best that an indicating apparatus should be provided. I have shown two forms of such apparatus in the accompanying drawings.

In Figs. 2 and 3 an ordinary time-dial, provided with hour and minute hands, is mounted upon the shaft G′, which carries the electric clock-winding mechanism. The hands of this auxiliary indicating-dial are so geared as to move at the same rate as the regular time-indicating hands on the dial-face of the clock, which latter are not represented in the drawings, as their illustration seems unnecessary. If any accident should happen to the battery or winding mechanism, the hands on the auxiliary indicating-dial would stop, and it could therefore be readily perceived by a comparison of the two dials how long and at just what time the winding mechanism had ceased to operate. The gearing to actuate the hands of the indicating-dial isochronously with those of the ordinary time-dial can be arranged in any suitable usual manner. It is deemed unnecessary to describe it in detail.

In Fig. 1 of the drawings I have shown another indicating apparatus, consisting of an alarm-bell, which is sounded once in each revolution of the ratchet-wheel h—that is to say, every five minutes. The arrangement is as follows: The bell Q is mounted on the top of the clock-case, and the hammer Q′ is pivoted in a bracket, q, on the inside of the clock-case. A right-angle extension or arm, q', of the hammer-lever projects laterally under the ratchet-wheel shaft G′ and is gradually raised at each revolution of the shaft by a cam, q^2. The effect of this is to draw the hammer away from the bell; but upon the arm riding past the lip of the cam a coil-spring, q^3, draws the hammer down upon the bell and sounds the alarm. The arm q' vibrates between two studs, q^4 q^5. When the hammer is drawn forward by the spring to strike the bell the arm q' will strike the stud q^4 before the hammer reaches the bell; but the hammer-lever is sufficiently yielding and the leverage is such that the hammer will spring over far enough to sound the bell. In case it is desired to throw the bell out of action, the spring q^3 may be released and the hammer tilted back so as to rest upon the stop q^5, where it will be out of action. Other forms of indicators may be employed without departing from the broad principle of my invention.

In Fig. 4 I have shown an arrangement in which a single weight, D′, is employed. In this organization a single-weight cord, d', is attached to the barrel, passes over the pulley d on the weight-frame under the pulley d^2, carried by the weight, and is attached to the frame at d^3. The effect will be the same as that of the double-weight arrangement illustrated in Figs. 1 and 2. The figure does not need further description.

A single weight is also employed in the organization shown in Fig. 5. In that figure the weight-cord passes over the pulley d^2, carried by the weight up over the pulleys d d on the weight-frame, and its ends are then secured to the opposite side of the barrel, as in Fig. 1. The effect is the same as in Fig. 1.

In Fig. 6 the vertical winding-shaft B extends downward any suitable distance relatively to the clock mechanism, and carries near its lower end the worm-wheel G. The horizontal shaft G′, carrying the ratchet-wheel h, which is actuated by the electric winding mechanism, may be extended laterally any suitable distance from the clock-case, so as to remove the electric part of the apparatus from the works of the clock, which may be found advantageous in some cases. In this organization the lower end of the shaft B can have its bearing in a suitable stepping at b', while its upper end may have its bearing within a sleeve or bracket, which forms the bearing for the crown-wheel C; or the upper end of the shaft may have its bearing at b^2, in the lower end of the shaft or sleeve c, which carries the crown-wheel C and the barrel of the clock. Any suitable arrangement will answer, and it is immaterial so far as the organization is concerned, provided that the bearings are such that the rotation of the shaft B will not have any effect upon the barrel. In the arrangement shown in this figure the weight-frame is similar to that shown in Fig. 1; but, for convenience of illustration, the weights and cords have been omitted. The end of the shaft G′, which extends out through the clock-case, may be squared at its end for the reception of an ordinary winding-key.

Fig. 7 illustrates an arrangement in which the winding-shaft B is extended up to or through the top of the clock-case, while the shaft G′, which is actuated by the electric winding apparatus, extends out laterally through the side of the case, so that the electric part of the apparatus may be removed from the clock-work. Under this organization the shaft B has its bearings in a tubular bracket or sleeve, B′, the shaft being provided with a bearing-collar, B^2, which sustains it in place. The worm-wheel G is placed loosely upon the shaft B, but is locked with it when revolved in one direction by a pawl, r, on the wheel which engages in a ratchet, s, secured on the shaft. The ratchet and bearing-collar B^2 may be formed in a single piece and securely pinned to the shaft. The shaft c, which carries the barrel E, has its lower bearing in any suitable stepping at t, while its upper end has its bearing in the lower end of the shaft B at t'. The weight-frame in this organization is of an inverted construction, the arms which carry the pulleys d depending and the barrel revolving between them. The cords from the weights pass up over the pulleys, and their ends are attached to opposite sides of the barrel. The operation is the same as that of the weights and frame in the other figures of the drawings. The upper end of the shaft B is shown as squared for the reception of an ordinary winding-key. The ratchet-and-pawl arrangement r s causes the worm-wheel D to revolve the shaft B and wind up the clock when the shaft G′ is actuated by the electric apparatus. When, however, an ordinary winding-key is applied to the squared end of the shaft B, the ratchet and pawl r s permit the shaft B to revolve independently of the worm-wheel G, so as to revolve the weight-frame and wind up the clock irrespective of the electric apparatus. The ratchet and pawl hold the shaft B and prevent it from turning back.

The general operation and arrangement of the other parts of the apparatus are the same as that under the organization shown in Fig. 1, the position of the several parts, so far as shown in this figure, being indicated by corresponding reference-letters.

In the weight-frames illustrated in the different figures of the drawings the pulleys at each end or side of the frame are placed at the opposite diagonal corners, so that the pulleys will be in line with tangents drawn from the opposite sides of the barrel in opposite directions. This insures a direct pull of the cord on the barrel and avoids the cramping of the parts.

Other modifications than those already described and indicated in the drawings will readily suggest themselves to those skilled in the art; and it will of course be obvious that many such changes may be made without departing from the principle of my invention, the broad features of which have been briefly indicated at the beginning of this specification. So far as a mere modification in the character of the weights employed is concerned it will be obvious under the organizations shown in Figs. 1, 6, and 7 that a single solid cylindrical weight might be employed, the cords being attached to it at opposite points.

In case of any accident to the battery, or where the necessity for replacing the battery arises, there would be a loss of a certain number of movements of the armature-lever which actuates the winding mechanism. This loss could be made up very readily by placing a break-key in the circuit, which could be actuated to wind the weights to the proper position. The loss in any event would be a very small one, the change of the battery only requiring a few moments' work; or the loss could be made up by operating the shafts B or G′ by an ordinary key, as described.

I am aware that Letters Patent No. 31,242, granted January 29, 1861, describe a weight-clock which is kept constantly wound. In that clock, however, the clock-train was driven at different points at intervals, first from one winding-drum and then from another. Such an arrangement necessarily involves a loss of motion and imparts a shock through the train when the two driving-gears are alternately thrown into operation. The strain of the weight is therefore not kept without variation upon the train.

What I claim as my invention is—

1. The combination of the clock mechanism, the vertical barrel, the weight-frame, and automatic electric winding mechanism which rotates the weight-frame and winds up the clock.

2. The combination of the clock mechanism, the vertical barrel, the weight-frame, an electric circuit, a circuit-breaker, and an electro-magnetic step-by-step actuating mechanism operated by each break and make in the circuit to rotate the weight-frame and wind up the clock, substantially as set forth.

3. The combination of the clock mechanism, the vertical barrel, the shaft carrying the weight-frame arranged concentrically with the barrel, the weight-frame, the counter-shaft G′, the gearing, the ratchet-wheel on the counter-shaft, an electric circuit, a circuit-breaker actuated by each movement of the escapement, and the electric step-by-step mechanism, actuated by each break and make in the circuit to revolve the ratchet-wheel and rotate the weight-frame to wind up the clock, substantially as set forth.

4. The combination of clock mechanism, weight-sustaining devices which enable the weights to exert a never-varying constant strain upon the train, and automatic electric mechanism for winding the clock without modifying the strain of the weight upon the train, substantially as set forth.

5. The combination of clock mechanism, a vertical actuating-barrel, and an independently-rotatable weight-frame.

6. The combination, substantially as set forth, of the clock mechanism, the vertical barrel, to which the weight cord or cords are attached, the weight-frame which supports the weights, and mechanism for revolving the weight-frame independently of the barrel to wind the cords on the barrel without removing the strain of the weights from the clock-train.

7. The combination of the clock mechanism, the vertical barrel, the winding-shaft arranged concentrically with the barrel, the weight-frame carried by the shaft, the weights and cords, and means for rotating the winding-shaft to wind up the clock without removing the strain of the weight from the train, substantially as set forth.

8. The combination of clock mechanism, clock-weight-sustaining devices which maintain the strain of the weight constantly and without variation on the train, and means for winding the clock without changing the strain of the weight upon the train.

9. The combination of the clock mechanism, automatic electric-winding mechanism which operates continuously to keep the clock wound as the clock is running, and an indicating device to indicate that the winding mechanism is operating, substantially as set forth.

10. The combination of the clock mechanism, the automatic winding mechanism, which operates continuously to keep the clock wound, and an auxiliary indicating-dial, the hands of which are actuated by the winding mechanism and are geared to move isochronously with the regular dial-hands of the clock, substantially as and for the purpose set forth.

In testimony whereof I have hereunto subscribed my name.

GEO. F. BALLOU.

Witnesses:
W. R. WILLS,
CHARLES F. STONE.

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THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78

NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXV #2, JUNE 2000

Fellow Horologists:

The REIFLER/ELGIN saga is completed in this journal issue. An end to a truly fascinating series covering a period in horological history of interest and importance, when accurate timekeeping required the knowledge of astronomy as well as mathematics. A tribute to the abilities of the pioneers of that era.

Also included is an original article by our member, MONROE H. POSTMAN describing his Selsyn controlled master/slave clock system. This material was provided to us by Mr. Postman quite a while ago and had been misplaced, only recently coming to light again for our edification. Our thanks for this understanding in the delay of publishing the manuscript.

The Electrical Horology Society has been graced with a program slot at the upcoming NAWCC National Convention in Philadelphia, to be held in early July. For those members planning to attend, check your program schedule for the exact time and room location for this meeting. We promise an enjoyable and informative program, so don't miss it.

The chapter journal is still in need of material for future issues... Remember, we will edit and format your submission, so fear not if you feel that your material will be less than professional. Some ideas may include notes on repair tips and parts fabrication for items nolonger available. We also encourage questions and answers for a new feature to be included regularly. Please contribute!

This issue's quote: "There are no shortcuts to anyplace worth going, or for anything worth doing."
—Anon.

Good reading ahead...

Martin Swetsky, FNAWCC, President)
Harvey Schmidt, FNAWCC, Secretary-Treasurer) Co-editors
Dr. George Feinstein, Chapter Historian)

Continued from March, 2000 issue.

ADJUSTING LEVEL ON LEVEL HANGER.

Place the level on the proper points of support leaving the screws fairly loose.

Place hanger on horizontal axis of the level trier. Raise or lower the trier also at same time raise or lower the adjusting end of the level until the bubble will be some place out on the scale when the hanger is reversed.

Now adjust by moving the trier and the free end of the level the same amounts so as to bring the bubble near the center of the level. This adjustment should be made in very small amounts. Each change should be checked by reversing the level. In other words split the difference between the trier and the free end of the level each time

When the bubble is in the center of the level with level in both positions tighten the locking screws.

It will be necessary to make a few more adjustments after tightening the locking screws due to the strain placed upon the center screw. These adjustments will not amount to more than two to three degrees change on the gear of the level trier.

When the bubble will read the same value with the level in both positions it is evident that the horizontal axis of the trier is perfectly level and that the position of the level on the hanger is correct.

These adjustments should be made at a time when the temperature in level trier room will remain fairly uniform thru out the time of adjustment.

It is advisable to leave the level hangar on the trier axis for twenty four hours. After this period adjust the trier until the level shows that the axis is level. Reverse the level and if the foregoing adjustments have been carefully made the level will repeat. It may be necessary to make a very slight change in adjustment after the twenty four period due to strain on the hanger in handling during the adjusting period.

It also is advisable to have the length of the bubble not to exceed ten to twelve divisions. When the adjustments are completed the bubble will read five or six divisions on each side of center. This length of bubble makes for easier and more accurate adjustment.

The level is now ready to be placed on the horizontal axis of the transit instrument.

It is now advisable to level the horizontal axis of the transit and reverse the circle. The horizontal axis is level when the adjustment on the base is such that the value of the level is the same circle east or circle west.

In leveling the axis of the transit (ELGIN) the two screws on the west end may be used for rough leveling. The final leveling screw is on the east end of the base. This is the only screw necessary to correct the horizontal axis before observing.

RESET TIME OF CLOCK No. 224

Before unsealing this clock determine the error of clock No. 237 by making a comparison between No. 220 and 237.

16	35	27	
22	18	25	
		17.64	
8	53	5.70	
28	11	48.34	
5	32	39.08	
22	39	9.26	
6	3	42.66	
16	35	26.60	
16	35	27.00	
	-	0.40	No. 237 and No. 220

Unseal No. 224 and clean, oil and replace movement.

Reset to time of No. 237. It may be advisable to set No. 224 about one second fast and leave it run unsealed for twelve hours. Make comparisons between No. 220 and 237 and between No. 220 and 224 again.

21	3	9		21	12	24	
2	46	51		2	56	7	
		17.68				17.68	
5	53	5.70		5	53	5.70	
8	40	14.38		8	49	30.38	
5	36	35.64		5	36	35.64	(No. 224 was set about one
3	3	38.74		3	12	54.74	second fast and will be left
6	0	30.08		6	0	31.60	to run without being sealed
21	3	8.66		21	12	23.14	for twelve hours.)
21	3	9.00		21	12	24.00	
	-	0.34	No. 220 and No. 237		-	0.86	No. 220 and No.224.

After twelve hours make another set of comparisons between No. 220 and No. 224. Also make comparison between No. 237 and No. 224.

7	36	6		7	41	56	
13	21	32		13	27	23	
		17.75				17.75	
5	53	5.70		5	53	5.70	
19	14	55.45		19	20	46.45	
5	36	35.64		5	36	35.64	
13	38	19.81		13	44	10.81	
6	2	14.06		6	2	15.02	
7	36	5.75		7	41	55.79	
7	36	6.00		7	41	56.00	
		- .25	No. 220 and No. 237			- .21	No. 220 and No. 224

Both comparisons show about the same correction and an inter comparison between No. 224 and No. 237 would not show any difference to speak of so No. 224 is ready to be sealed.

Difference between the two last No. 220 and No. 224 comparisons show that No. 224 is running slow .65 hundredths of one second, for a period of ten hours in this case, or at a rate of .065 seconds per hour which would be 1.560 seconds per day.

1.560 divided by .018 would give 86 the number of m/m it will be necessary to lower the pressure of No. 224 after sealing. The pressure should be lowered to about three m/m lower to allow for coasting. The pressure of the clock unsealed is equal to 754 minus 86 will give 668 m/m. The pressure should be set at 665.

Make a comparison now between No. 220 and No. 224.

9	49	4	
15	34	52	
		17.75	
5	53	5.70	
21	28	15.45	
5	36 m	35.64	
15	51	39.81	
6	2	35.90	
9	49	3.91	
9	49	4.00	
		- .09	No. 220 and No. 224. after sealing and lowering of pressure.

If possible get Washington comparison now.

The factory circuit may now be cut over on No. 224 instead of No. 237.

Make comparison between No. 220 and No. 224 at intervals of three hours. These comparisons will show the rate that No. 224 has taken at the pressure it is now running under.

Compute the rate for twenty four hours from the difference in corrections for the last three hours and vary the pressure until the clock has about a zero rate between comparisons.

13	10	22
18	56	43
		17.75
5	53	5.70
24	50	6.48
5	36	35.64
19	13	30.84
6	3	8.97
13	10	21.87
13	10	22.00
		- .13

Correction at 10 hours -.09
Correction at 13 hours -.13
Difference -.04

The clock is now gaining at the rate of .04 seconds for three hours or .32 seconds per day divided by .018 will give 18 m/m the pressure will have to be raised to slow up the clock enough to give it as near zero rate as possible.

Another comparison should be made in six hours to verify the rate the clock is now running at compared with the pressure change. It may be necessary to again vary the pressure.

The clock correction can be compared with signals from the Naval Observatory.

Dec. 15, 1927

Barometer

Station Pressure is the reading of the barometer with corrections for temperature, gravity and instrumental errors.

Barometer reading	29.392
Temperature correction	
Gravity correction	
Instrumental error	______
Station Pressure	

For all purposes we do not apply the above corrections to our barometer readings.

****

Pressure reduced to sea level for this station is the barometer reading plus the correction for elevation.

On March 20, 1928 our elevation was established as being 800.58 feet.

Barometer reading	29.392	
Elevation correction	.800	
	30.192	Pressure reduced to sea level.

Barometer at sea level reads thirty inches.(30)

If the observer is situated at any point above sea level the barometer unless corrected will read lower than the reading at sea level on account of the lessened pressure due to altitude. For instance suppose the observer to be at an altitude of 500 feet and the barometer reads 29.20 inches. If the station were at sea level instead of being 500 feet above the barometer would read 0.57 inches higher so the corrected reading would be 29.20 plus 0.57 or 29.77 inches.

Elgin Observatory elevation determined March 20, 1928 by Mr. E. E. Smith District Superintendent of the Sanitary District of Elgin. His level was run from Bench Mark #2 located in the triangular park which is bounded by Villa, Prairie and Chapel Streets.

Top center line of concrete sill of S.E. window of office room of the Elgin National Watch Company Observatory elevation is 800.58 feet

	800.58
Elgin City Datum	-19.896
	780.684

MEAN TIME TO SIDEREAL TIME

220 T Elgin		14h	45m	14s	
224 T Elgin		16	47	36	
Greenwich Mean Add		6			
Greenwich Mean Time		22	47	36	
Table No. 3	Add		3	44.66	Ephemeris
		22	51	20.66	
Table No. 1	Add	21	47	25.55	Sidereal Time R. A. of Mean Sun
		20	38	46.21	
Elgin Longitude	Minus	5	53	5.70	
Greenwich Sidereal T		14	45	40.51	
Elgin Sidereal T		14	45	14.00	
Elgin 220 C	Plus			26.51	

SIDEREAL TIME TO MEAN TIME

224 T Elgin		7	45	25	
220 T Elgin		9	48	25	
220 Correction	Minus			9.05	Plus or Minus
Elgin Longitude	Plus	5	53	5.70	
Greenwich Sidereal T		15	41	36.65	
Table No. 1	Minus	1	53	46.14	Sidereal Time R. A. of Mean SUN
		13	14	40.51	
	Minus	6			
Table No. 2	Minus		2	15.59	
Greenwich Mean Time		7	45	24.92	
Elgin Mean Time		7	45	25.00	
Elgin 224 Correction Minus				.08	

Reducing the Time of Moon Rise and Moon Set from the Ephemeris for Elgin.

Lat.	42 degrees	2 mins.	
Long.	5 hrs.	53 mins.	5.7 sec. West

Referring to page 750 of the Ephemeris for 1931 we find table No. X giving the time of moon rise for various latitudes.

Using Aug. 23 1931 as an example;

Aug. 23 for plus 40 degrees is 16 hrs 24 mins., and for plus 45 degrees it is 16 hrs 48 mins.

It is necessary to interpolate for latitude plus 42 deg., which amounts to a difference of 3/5.

The difference in time between 40 and 45 degrees being 24 mins we take 3/5 of 24 mins. and subtract it from 16 hrs 48 mins the time given for plus 45 degrees. This gives us the time of moon rise for 42 degrees lat.

Elgin is located seven minutes east of the 90th meridian so we have to subtract seven minutes from this value to reduce the time of moon rise to Elgin.

	Plus 40	Plus 45	Difference	3/5 of Dif.	Plus 42
Aug. 23	16:24	16:48	24 min	15 min	16:33

To obtain civil time in which the designations AM and PM are used write AM after the time if it is less than twelve hours; if greater than twelve hours subtract twelve hours from it and mark the result PM.

16:33 - 12:00 = 4:33 PM

To obtain the standard time at any station, increase the local time by the number of minutes the station is west of the standard meridian, or decrease the local time by the number of minutes the station is east of the standard meridian.

Elgin is seven minutes east of the standard meridian:

4:33 PM - 0:07 = 4 hrs 26 mins. PM time of Moon Rise Elgin.

Referring to page 750 of the Ephemeris for 1931 we find table No. X giving the time of moon set for various latitudes.

Using Aug. 24 1931 as an example;

Aug. 24 for plus 40 degrees is 1 hr 9 min., and for plus 45 degrees it is 0 hr 46 mins.

It is necessary to interpolate for latitude plus 42 deg., which amounts to a difference of 3/5.

The difference in time between 40 and 45 degrees being 23 mins. we take 3/5 of 23 mins. and add this to 0 hr 46 min the given time for 45 degrees. This gives us the time of moon set for 42 degrees latitude.

Elgin is located seven minutes east of the 90th meridian so we have to subtract seven minutes from this value to reduce the time of moon set to Elgin.

	Plus 40	Plus 45	Difference	3/5 of Dif.	Plus 42
Aug. 24	1:09	0:46	23 min	14 min	1:00

To obtain civil time in which the designations AM and PM are used write AM after the time if it is less than twelve hours; if greater than twelve hours, subtract twelve hours from it and mark the result PM.

1:00 is less than twelve hours so we write AM after the result.

To obtain the standard time at any given station, increase the local time by the number of minutes the station is west of the standard meridian, or decrease the local time by the number of minutes the station is east of the standard meridian.

Elgin is seven minutes east of the standard meridian:

1:00 AM - 0:07 = 12:53 AM time of Moon Set C.S.T.

Care must be taken when drawing up tables for time of moon rise and moon set not to date the moon set wrong.

Aug. 23 1931 moon rise is at 4:26 PM and moon set will be Aug. 24 at 12:53 AM.

Notes on clock corrections, comparisons and abbreviations.

Clock correction reading plus means that the time of clock is slow.
Clock correction reading minus means that the time of clock is fast.

If the hand of a clock points to 12:01 p.m. and the correct time is 12:00 noon the clock is one minute fast which is shown as minus one minute. Subtract one minute from the value of clock and the result is the correct time.

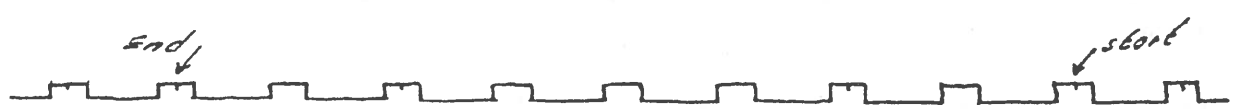
If the hand of a clock points to 11:59 A.M. and the correct time is 12:00 noon the clock is one minute slow which is shown as plus one minute. By adding one minute to the value of the clock the result is the correct time.

In clock comparisons	C is Rate
	ρ is Pressure

Elgin Observatory	altitude	802 feet above sea level,
	latitude	42 degrees 2 minutes plus North.
	longitude	5 hours 53 minutes 5.7 seconds West.
	meridian	88 degrees 16 minutes 25.5 seconds.

To compute the Meridian of a given place the longitude of given place is reduced from hours, minutes and seconds to degrees, minutes and seconds. 15 degrees of arc equal 1 hour. 360 degrees equal circle, divided by 24 equal 15 degrees.

Reading the chronograph records of clock comparisons begin to measure at end of the double breaks and measure to the starting point of double breaks. Read the sheet right to left.



multiply hours by 15 for degrees.
multiply minutes by 15 and divide by 60 for minutes.
multiply seconds by 15 and divide by 60 for seconds.
then add.

Volume of Riefler Clock Bell Jar.

Clock No. 224

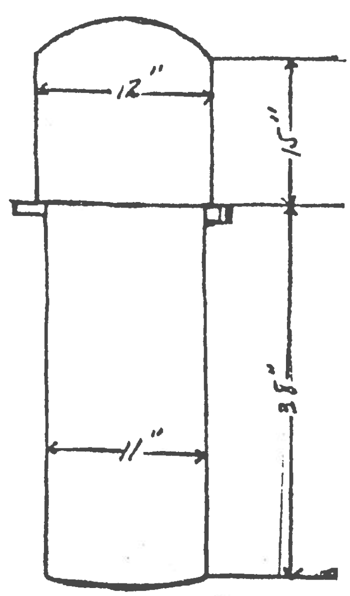
$$V = a \times \pi r^2$$

Top:	a = 15"	
	r = 6"	
Bottom:	a = 38"	
	r = 5.5"	

Top:	6^2	= 36	x 3.1416 = 113.09 x 15	= 1696.35 Cu. In.
Bottom:	5.5^2	= 30.25	x 3.1416 = 95.03 x 38	= 3671.14 Cu. In.
			Total	= 5367.49 Cu. In.

5367.49 ÷ 1728 = 3.106 Cu. feet of air in jar.
Weight of Cubic foot of air at atmospheric pressure at 80° = .073 (Kent)
3.106 x .073 = .226738 Weight of air in pounds.
.226738 ÷ 740 (m/m) = .000306 pounds of air in jar per one m/m air pressure based on air pressure of 740 m/m.

April 25 - 1930



Pier Data.

The pier upon which the transit instrument is mounted is 32 feet 6 inches long overall with a base 6 feet by 6 feet.

Mr. Malvern 6-6-35

Elgin Transit Telescope.

Azimuth:

To change azimuth from plus to minus loosen south screw and turn in the north screw.
A very small fraction of a turn is needed to make a change of one second.

Collimation:

Place the tube in a circle east position. (collimation adjusting screws on the south side)
Moving the west screw out and the east screw in will change the collimation factor towards the negative side.
Be sure to loosen the focus clamp before making this adjustment. It will be necessary to refocus after this adjustment.

Placing Transit in the Meridian.

Place the instrument upon the base and level off the base of the transit by adjusting the leveling screws.

From the tables of Apparent Places of Stars (circumpolar stars) in the Ephemeris look up the time of transit of Polaris - α Ursae Minoris for date on which adjustments are to be made. Also the declination may be had from these tables.

Level the horizontal axis. The level reading should be the same for circle East and circle West. Set declination circle. Polaris will be in the field for some time before meridian passage. This time may be used for adjusting focus and collimation.

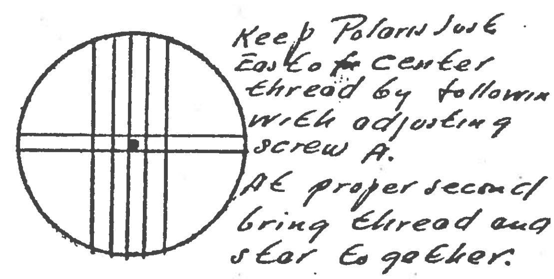
Set the chronometer to the exact sidereal time and bring Polaris on the center thread at the given instant.

This may be done by turning the adjusting screws on the base of the instrument. On the Elgin Transit these screws are on the West end of base.

It is advisable to keep Polaris just east of the center thread by following up with the adjusting screw. At start of last minute begin counting the seconds with the ticker and at the proper second move the adjusting screw so that Polaris and the center thread are together. Be sure to lock the adjusting screws.

If Polaris cannot be readily located replace the high power eyepiece with one of low power. Adjust base until Polaris is at a point in the field at which it can be seen with the high power eyepiece. Now replace the high power eyepiece and proceed.

Example.

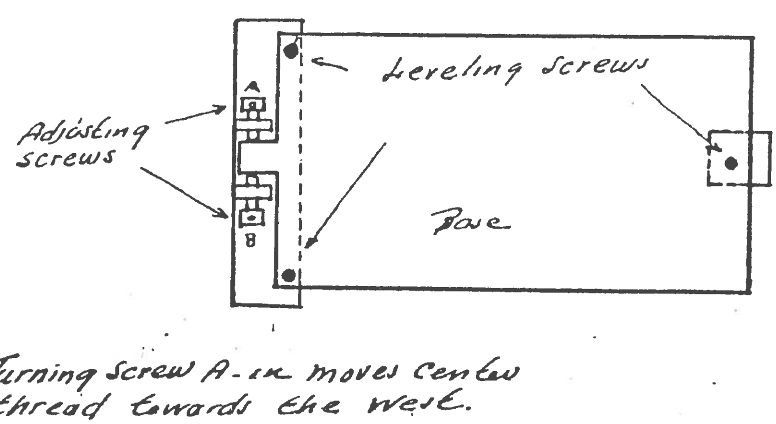


November 27.9 1933.

From table Apparent Star Places, Ephemeris page 317.

R.A. 1 h 39 m 40.12 s.

Declination	+88 d 57 m 13.71 s
Less	+42 2
Circle Reading at Elgin	46 d 55 m North



To determine time of transit of star across center thread when just one thread is recorded.
Refer: Campbell page # 130 also Observation Nr. 35 is Apr. 18.9 1933

Star CE - μ Leonis +26° 19' Have only first thread time.
Time on first thread 49^m 42.41

a	b	c
+0.31	+1.07	+1.11

From Campbell: I = ic
I = time across all threads
i = time between two threads
c = from star factor table

First determine time required for several stars to cross the field. This value divided by (c) for each star will give the time interval between threads. Of the several stars take the mean for this value.

Example.

α Ursae Major +70° 7'	10 Leonis Min +36° 41'	G Leonis +24° 5'	
29^m 12.13	30^m 51.81	42^m 48.19	
20.46	55.40	51.20	
28.43	58.79	54.21	
36.54	2.23	57.20	
44.88	5.58	0.33	
44.88	65.58	60.33	
12.13	51.81	48.19	
32.75	13.77	12.14	time interval between first and last thread

32.75 ÷ 2.94 = 11.14 (c = α Ursae Major = +2.94)
13.77 ÷ 1.24 = 11.10 (c = 10 Leonis Min = +1.24)
12.14 ÷ 1.10 = 11.04 (c = G Leonis = +1.10)
33.28 ÷ 3 = 11.10 mean time interval between two threads.

for i = 11.10 I = 11.10 x c for μ Leonis +26° 19' = + 1.11

Observed time first wire =	42.41^s
Second wire = + 11.10 x 1.11/4 =	45.49
Center wire = + 11.10 x 1.11/2 =	48.55
Fourth wire = + 11.10 x 1.11 x 3/4 =	51.63
Last wire = + 11.10 x 1.11 =	54.71
	242.79/5 = 48.55

Time on center wire 48.55
Correction for R.A. 59.72
-48.83 ΔT inst for μ Leonis +26° 19' = -48.83

(b)
Level Constant

Level Readings

	e	w				
C.E.	22.5	69.0	=	+91.5	(w+e)	
	e'	w'				
	69.0	22.5	=	+91.5	(w'+e')	
C.C.	e	w				(w+e) - (w'+e')
	21.5	68.0	=	+89.5	(w+e)	
	e'	w'				= -3.
	69.5	23.0	=	+92.5	(w'+e')	
	e	w				
C.W.	22.0	68.0	=	+90.0	(w+e)	
	e'	w'				= -2.5
	69.5	23.0	=	+92.5	(w'+e')	

$[(w + e) - (w'+e')] \times (-.10/4) = b$

$-3 \times (-.10/4) = +.075$

$-2.5 \times (-.10/4) = +.0625$

Example from Observation
March 3.9, 1930

(a)

The sign for (a) is determined by value of north and south stars after b and c are taken out.
If south star is high and north star is low sign is -.
If south star is low and north star is high sign is +.

Regulation of Clocks in Glass Bell Jars.

These clocks are regulated by the air pressure within the glass jar. This pressure is indicated by the barometer in the glass jar.

To cause the clock to run slower open the air valve on bottom of the jar letting air into the jar causing the pressure to rise. The increased amount of air in the jar offers greater resistance to the pendulum causing it to run slower.

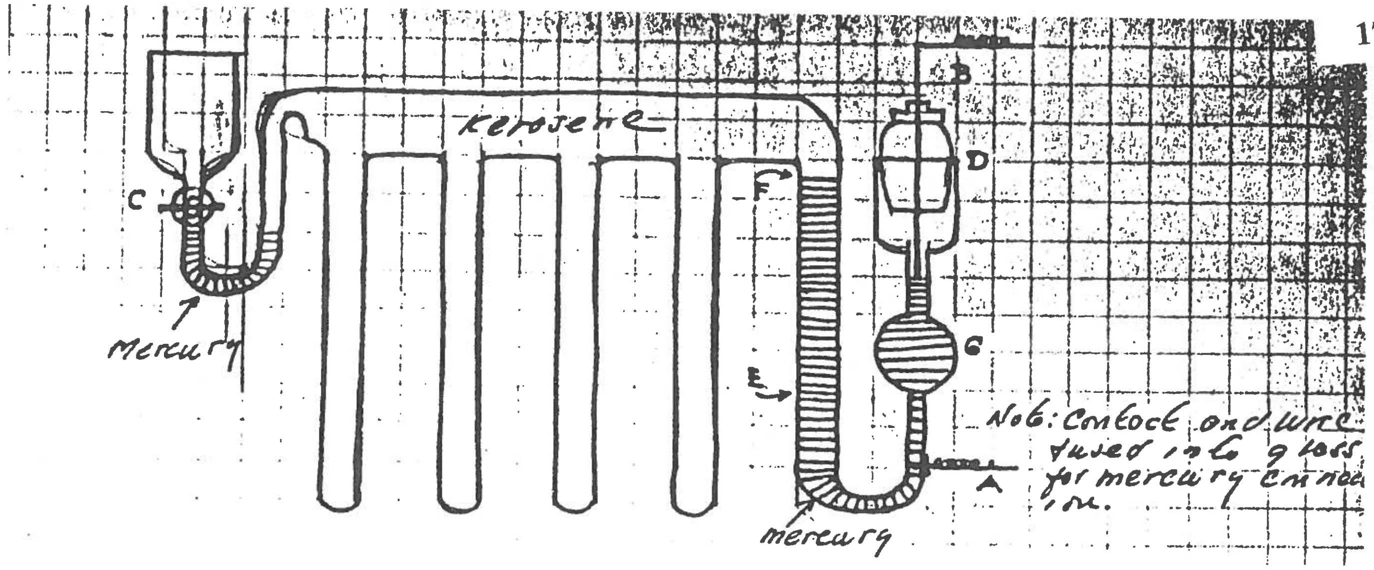
To cause the clock to run faster attach the air pump to the air valve on bottom of jar. Draw some of the air out of the jar causing the pressure to lower. The decreased pressure in the jar offers less resistance to the pendulum allowing it to run faster.

A change of 1 m/m in pressure will change the rate of the clock 0.018 seconds.

Note length of time is required for winding lever to trip. If it trips at a rate of 29 seconds or less the batteries on the winding circuit should be inspected. From thirty four to thirty eight seconds winding time is a very good rate. The lower the batteries are the faster the clocks will wind.

The temperature of the clock vault should be kept constant at all times. The Elgin vault is regulated at 81 degrees F. The temperature within the glass jars will then remain constant which is indicated by the thermometer enclosed within the glass jar.

If the relay lights will not keep the temperature correct add one or more banks of fixed lights. This usually depends on the outside temperature.



REFILLING THERMOSTAT WITH KEROSENE-MERCURY.

Disconnect connection A and remove cork with connection B. Open petcock C and drain into container from open end D. Separate kerosene from mercury and remove dirt from mercury with blotter scraping across the top surface of mercury.

Place kerosene in opening D. Place lips over opening forcing kerosene into tubes. Repeat this operation until all tubes are full except tube marked E. Pour mercury into opening D. When tube E is about half full of mercury close petcock C. Continue to fill with mercury until tube will not take anymore. Fill opening D to top with mercury. Let settle for a minute or so. Quickly open and close petcock C. Mercury then should reach the level marked F in tube E. With fine wire force mercury into stem and chamber marked G until mercury is connected and reaches the bottom of well D. Holding finger over opening D a small amount of mercury can be tilted into the petcock stem.

Now place thermostat in a temperature about three degrees higher than the operating point desired. Mercury will discharge into well D and can be removed with an eyedropper.

Now replace thermostat in clock vault for twenty four hours. Mercury then can be added thru opening D to bring the level in the stem up to the contact point. The thermostat should then be ready for service. Perhaps a slight adjustment of mercury within the stem leading to the contact point will be necessary.

WARNING: Handle the thermostat very carefully especially when the mercury is in tube E as the weight is quite noticeable and the stem could be easily broken off.

IMPORTANT: When refilling the thermostat do all the work in a lower temperature than the operating point desired. It was ninety in the vault when I wanted to reset it to operate at eighty nine so I placed the tube, kerosene and mercury in the wash bowl with cold running water passing around the tubes. This contracts the kerosene and mercury. In this contracted condition more can be placed in the tubes and air bubbles are not so liable to be formed in the tubes.

Ray L Neelegh[signature]
July 13-1936

Thermostat and Relays.

In case relay should cause trouble throw over the three pole double throw switch which places the other set of relays in the circuit.

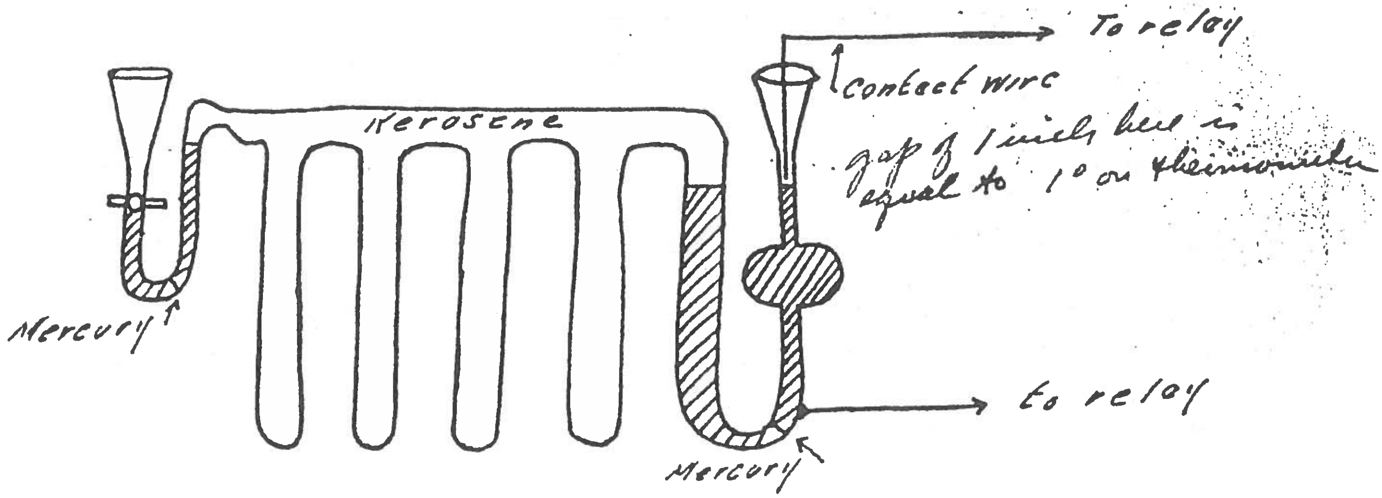
Thermostat relay may stick.

Carbons may fall out of the light relay.

Relay may fail to work due to the batteries being run down.

Wire jumper running from relay to the trip bar carrying the carbons may have been burned off.

Thermostat in the Clock Vault.



This thermostat is the most sensitive type known. A separation of .0001 inch will break the contact between the mercury and the contact wire which closes the relay circuit causing the light relay to operate making a contact in the light circuit which turns on the lights until the temperature is brought up again to 81 degrees. When the temperature has come up enough the kerosene expands forcing the mercury up making contact with the contact wire opening the circuit thru the light relays causing the lights to turn off.

By the use of alcohol instead of kerosene a more sensitive thermostat would result but this would not be satisfactory on account of the evaporation of the alcohol.

Monroe H. Postman

12/20/96

Harvey Schmidt, Editor
The Journal Of The Electrical Horology Society
75-80 179th St.,
Flushing, NY 11366

Dear Mr. Schmidt,

Enclosed is the article I mentioned. If there are any changes you would like in the text or format, please let me know and I would be happy to print new copy. I took the liberty to print page numbers on each sheet, but if you don't need them you can white them out. I hope that the photo prints ok as I was unable to achieve an acceptable scan. Your printer can probably screen it and convert it to black & white.

Yours Truly,

Monroe Postman

A Selsyn Master/Slave Clock

Monroe H. Postman
NAWCC# 27809

While browsing through the aisles at a recent Western Regional Mart in Oakland, California, I was attracted to an assemblage of wires and motors under Fred Bausch's table. Inasmuch as I have been an avid (compulsive?) collector of anything horological with wires, I immediately began examining it. Fred said "It's yours! I have been bringing it to marts for a long time and nobody has shown any interest in it." The lot (FIGURE 1) turned out to be a pair of Selsyn motors, one of which was driven by a one rpm Telechron motor. The other Selsyn had a gear box which was the motion works for an hour and a minute hand.

"What's a Selsyn motor?" you may rightfully ask, as this is a component not found in the clocks even electrical horologists collect. For those of you in the aerospace industry, the term "synchro" may be more familiar than "Selsyn" which was a trade mark of the General Electric Company for their line of synchro motors. (I learned about them in high school when I had the opportunity to purchase some in the local junk yard during W.W.II.)

"Selsyn" is shorthand for self-synchronous. When the stators of a pair of the motors are connected together and the rotors are connected to an AC power source (see Figure 2), rotation of one of the shafts causes the shaft on the other motor to rotate in synchronism. The synchronism extends to direction of rotation, angle of rotation and speed. Note that in Figure 2 one is an input device and the other is an indicator. Figure 3 shows the construction of a typical Selsyn motor. The overall diameter of these motors range from 3/4" to 6" (and probably more). The motors in this lot are 2 1/4" in diameter, and are model GE 2J1G1.

I searched texts (and the Internet) for more information about Selsyns. On the Internet, "Selsyn" has been appropriated by a software company for their new product. A friend did find a chapter in a text book[1] that described them and referenced an AIEE paper[2] which was written in 1934. From there I hoped to find earlier references and possibly a patent description. No such luck. The use of the Selsyn system certainly goes back to the 1920s, as the 1934 paper[3] describes applications such as the lighting control in the Chicago Civic Opera House and their use aboard ship for signaling from the bridge to the engine room (engine room telegraph) and for operating searchlights remotely. "In industry they are used to indicate or control the position of valves, etc., and for signaling between operating stations. In the power generating field they have been used for remote metering, measuring of water levels at different points, measuring of the contents of storage tanks, as remote tachometers, and for many miscellaneous purposes."[4] From reading this we may assume that, in 1934, Selsyns had been in use for quite a few years. I wouldn't be surprised if Nicola Tesla had been the inventor of the technique.

A detailed analysis of the Selsyn is offered by the AIEE paper[5] as follows:

"The two instruments of a Selsyn system as shown in Figure 2 will maintain duplicate positions, when either one or the other is moved, due to an action which can be explained as follows. When the rotating members (rotors) are in corresponding positions the voltage induced in the secondary winding of one instrument balances that induced in the secondary winding of the other. Therefore, no secondary current flows. If either instrument is turned out of the position of correspondence, the sum of the voltages is no longer zero and a current flows in the secondary windings. This produces a torque causing the other instrument to turn and restore the balance of the voltages. Thus, the duplicate positions are maintained."

I asked Fred about the source of this system and he told me that he had purchased a quantity of clock-related material from the Southern Pacific Railroad (SP) about fifteen years ago and this was part of it. A wiring diagram in the master box had been supplied by the surplus dealer, Dubin Electronics, Corona, NY., from whom SP had probably purchased the Selsyns. As these motors were designed for 400 Hz (cycles in those days!), it was suggested that the rotors of the two motors be wired in series (and in series with a 4 mfd capacitor) when connecting them to 60 Hz. A comment that "the Selsyn units may be run fairly warm without damage" was also included. The heating was due to the use of 60 Hz which increased the rated current considerably.

I wondered why the SP would use the Selsyn motors in the first place instead of one of the established master/slave systems of the day. From looking at the quality of the wiring, it may have just been an experiment to see if it would work. If it had been installed, I assume that it was for an application where the slave would be totally inaccessible and any adjustment of the hand position would have to be done remotely. It would have the advantage of not having any ratchet-type movements to wear out. The ability to be turned forward and back rapidly (there is a disconnect clutch on the synchronous motor drive) twice a year would seem to be a feature.

If anyone can provide more information on the history of Selsyn motors and/or the history of this particular application, I would appreciate hearing from you.

Notes

[1] *Electrical Machinery* Fitzgerald & Kingslry, McGraw-Hill, 1952
[2] Selsyn Instruments for Position Systems, Linville & Woodward, *Transactions of The American Institute of Electrical Engineers*, vol 53, pp. 953-960, 1934
[3,4,5] op. cit.

Monroe H. Postman
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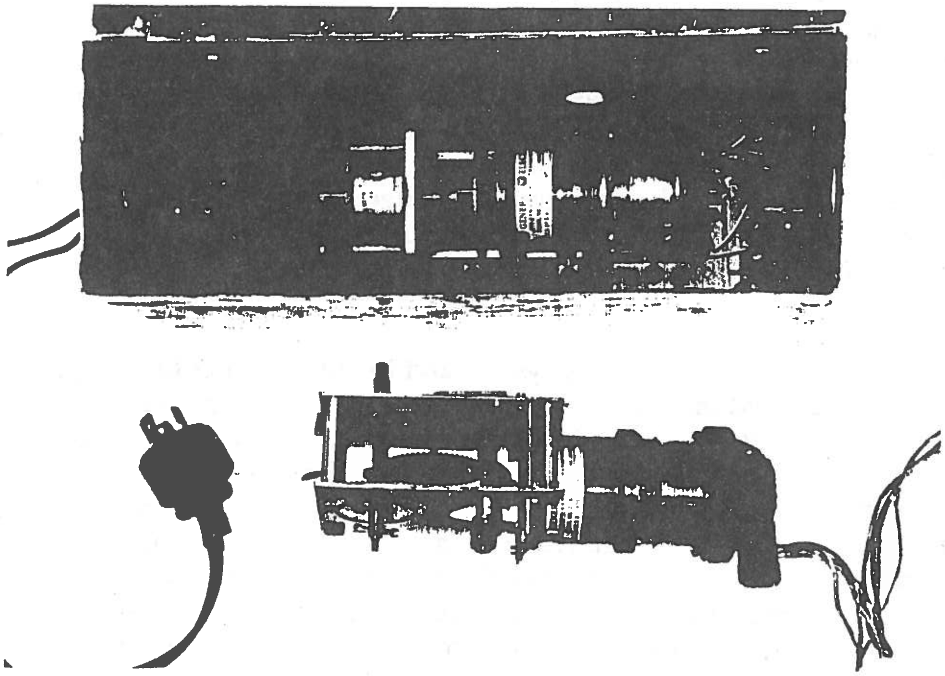

Figure 1

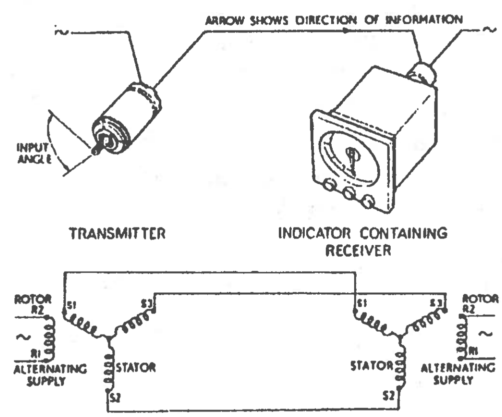

Figure 2

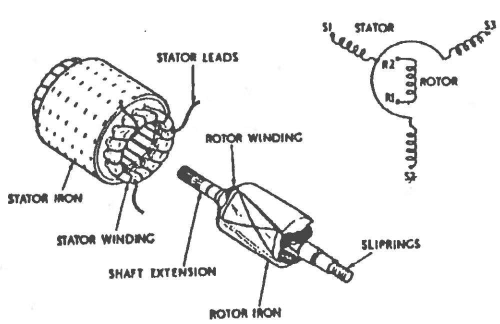

Figure 3

Replacement Field Coils for **SESSIONS** and **HAMMOND** synchronous clock movements.
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Requests for reprints of previously published material should be directed to the Chapter Historian:
Dr. George Feinstein 75-19 195th Street Flushing, NY 11366

--- MART ---

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THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78

NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXV #3, SEPTEMBER 2000

Fellow Horologists:

This journal issue promises to be one of our most outstanding, mainly due to the cooperation of those members that heeded our request for material, and so generously contributed the information enclosed. Our heartfelt thanks to them, along with the hope that they may serve as examples to the rest of us.

Mr. Robert A. Simon contributed the Gent & Co. manual titled "Hints for Users of Pul-Syn-Etic Impulse Clocks, Marine Type" with some additional photographs of the clock.
Mr. A. D. Harris, FBHI, of Great Britain has supplied a copy of a 1909 patent for the Frank Holden clock. Often seen with L&R or Rebesi names on the dials.
Mr. William F. Keller, *FNAWCC, provided a list of all known electric clock makers of Illinois, both synchronous and battery types, intended to supplement the general listing that was published in our journal some years ago.
Mr. Dennis Kaplan has provided an original article, "Reviving the Kundo Coil" for our edification.

This spirit of cooperation has been the driving force that has kept our chapter in the forefront of the non-geographic categories of the NAWCC. Our meetings, held at various regionals are always well attended, and are open to chapter members and non-members as well, witness our presentation at the Eastern States Regional in Syracuse in late July, with well over 30 in attendance! Anthony Prasil, Curator of the Hoffman Clock Museum in Rochester honored us with his presentation about Mathaus Hipp's Astronomical clocks. Hipp, as most of us are aware, is most known for his Hipp Toggle switch and impulse system, and not for his other horological contributions. Mr. Prasil's talk shed new light on Hipp's accomplishments, of interest to all electrical horology enthusiasts. Our thanks to Mr. Bill Ellison, FNAWCC, for taking on the job of program manager at the chapter meetings. Bill has been a director of Chapter 78 and has taken an active role in the affairs of the group for many years and can always be counted on when a job needs to be done!

Our quotefor this issue is most appropriate in the light of the foregoing. "In life, there are neither rewards or punishments, there are only consequences."

Good reading ahead, enjoy this issue.

Martin Swetsky, FNAWCC,......President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein,.................Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

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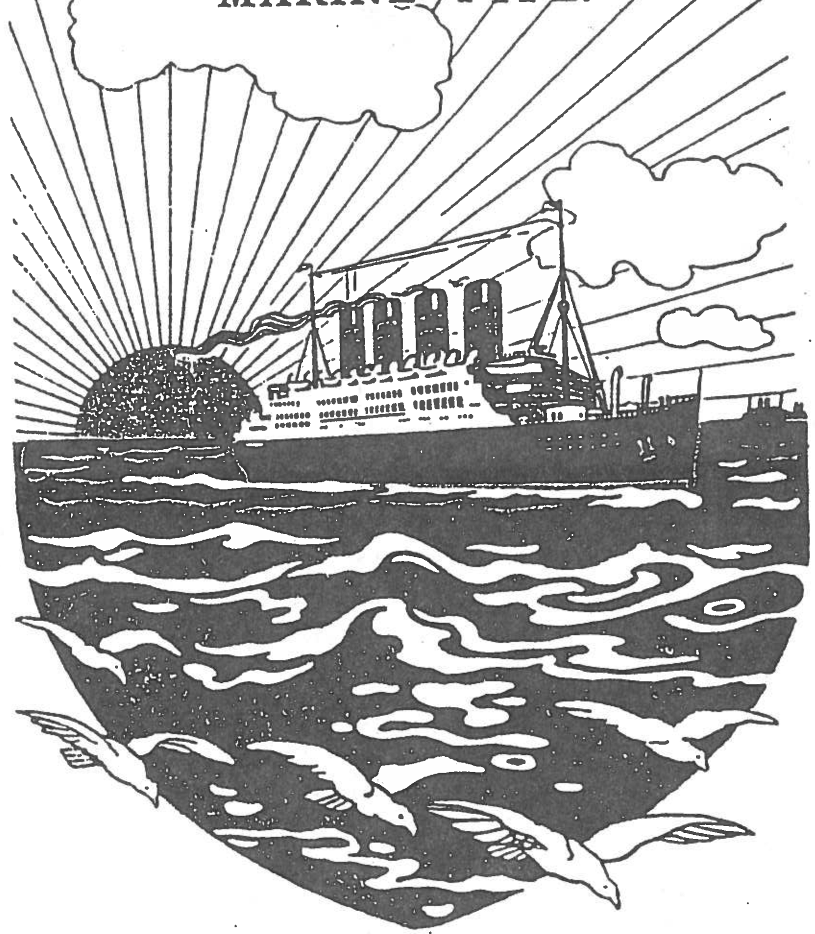

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PUL-SYN-ETIC
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HINTS FOR USERS OF
PUL-SYN-ETIC
Electric Impulse Clocks, Marine Type.

The outline herewith shown gives diagrammatically the arrangement of the Circuit, and it will be seen that all the Clocks are connected in simple series.

Incidentally it shows all the necessary Apparatus that goes to make up a modern Impulse Clock System—Marine Transmitter, Clocks, Potentiometer, and the connections for the Advance and Retard Mechanism.

If a Battery of Leclanche Cells or of Dry Cells or Accumulators is employed, it will be put into the Circuit where the Potentiometer is shown.

A varying number of Clocks may be found connected in the Circuit.

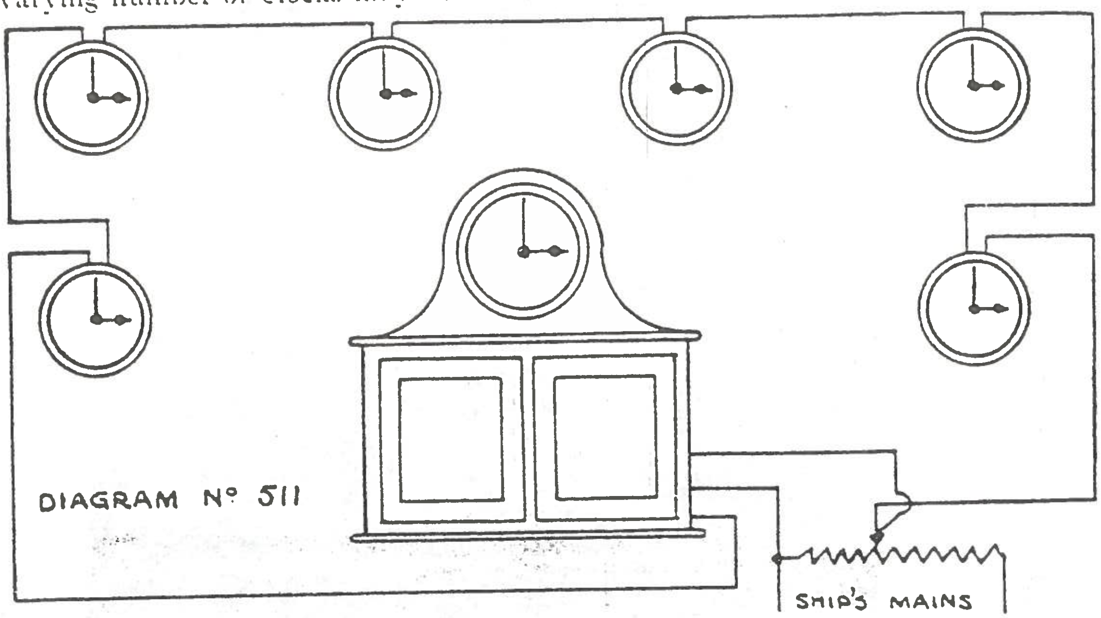


DIAGRAM No. C511.

A Circuit sometimes includes wiring led off in loops, and for this purpose a special Junction Box is often employed. With this when it is desired to cut out a loop, screw plugs can be inserted so that any particular circuit is shorted.

THE CIRCUIT.

(1).—As all Clocks are in series, in case of trouble, see that such series circuit is complete, free from intermittent faults. A broken wire or a cut wire is sometimes, but seldom, the cause of a faulty circuit, although workmen have been known to cut wires, not appreciating they were the Clock Circuit.

Loose Terminals are often the cause of any intermittent faults that do occur. This may be due to vibration. Test with a screwdriver, and see all terminals are quite tight. Appearances are often deceptive. Where sweating lugs have been employed, see they have not turned and made the terminals loose.

(2).—See that the Potentiometer or battery is all in order and that a current is always there, and that at each half minute the necessary current, i.e., 0.38 amp. is supplied to the Transmitter, also that it goes round the circuit.

The standard Current Impulse is of such short duration that an ordinary ammeter is useless, unless the contacts of the Transmitter are "made" for a definite time while the ammeter is read. Remember this when testing. A shilling inserted between contacts insures a good "make." Don't force the contacts together or you will spoil or break the escapement.

TANGENT

(3).—Don't at once blame the Transmitter. First, see the circuit is complete and the potentiometer or battery current is all in order; when so proved, then, and not till then, consider the Transmitter.

(4).—The Transmitter may be a great help in ascertaining the condition of the Clock Circuit. For instance, if the System has stopped for want of current, the Driving Lever " A " (Diagram C517) of the Transmitter is down, and the Contacts " E " and " D " are together in contact. This condition might indicate that any current there is insufficient to lift the Driving Lever.

(5).—If the Pilot Dial does move, it is an indication that current is flowing, but that it is insufficient to lift the Driving Lever. If the Pilot Dial does not move, it is an indication that the circuit is broken.

(6).—To test for such insufficient current, lift the Driving Lever by hand and see that the armature follows or attempts to follow. At the same time note if the Pilot Dial moves forward half a minute on the contact being broken at " E " " D."

(7).—A good test for a faulty Circuit is to set the Retard Mechanism of the Transmitter and attempt to Retard (by pressing Retard Key) and then see if the Driving Lever is lifted.

(8).—When the Retard Mechanism is in operation the Transmitter movement alone operates, and the Pilot Dial and the Clocks in the Ship's Circuit are not driven. " The Retard " operates on a Local Circuit, which includes a resistance equal to that of all the Clocks in the Circuit.

(9).—If in this experiment the Driving Lever is lifted by the Electro Magnet and the Transmitter does not start up, it can be so started by pressing the " Advance " Key once. This mechanically sets the Escapement ticking by " wiping " the Balance Wheel, and incidentally replaces the Retard Key, which must be again pressed if the experiment is to be continued.

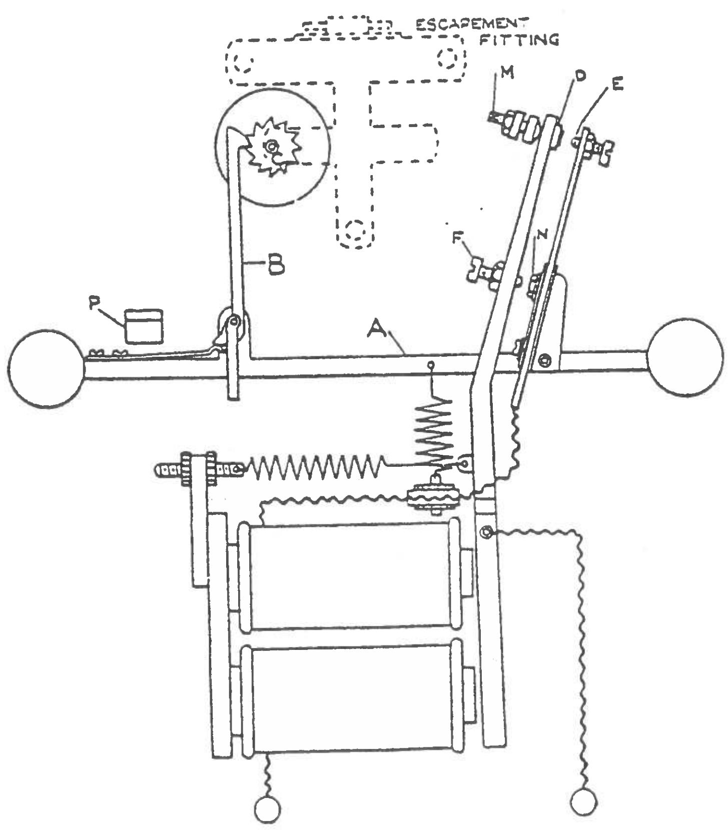


DIAGRAM C517

TRANSMITTER, Marine Type.

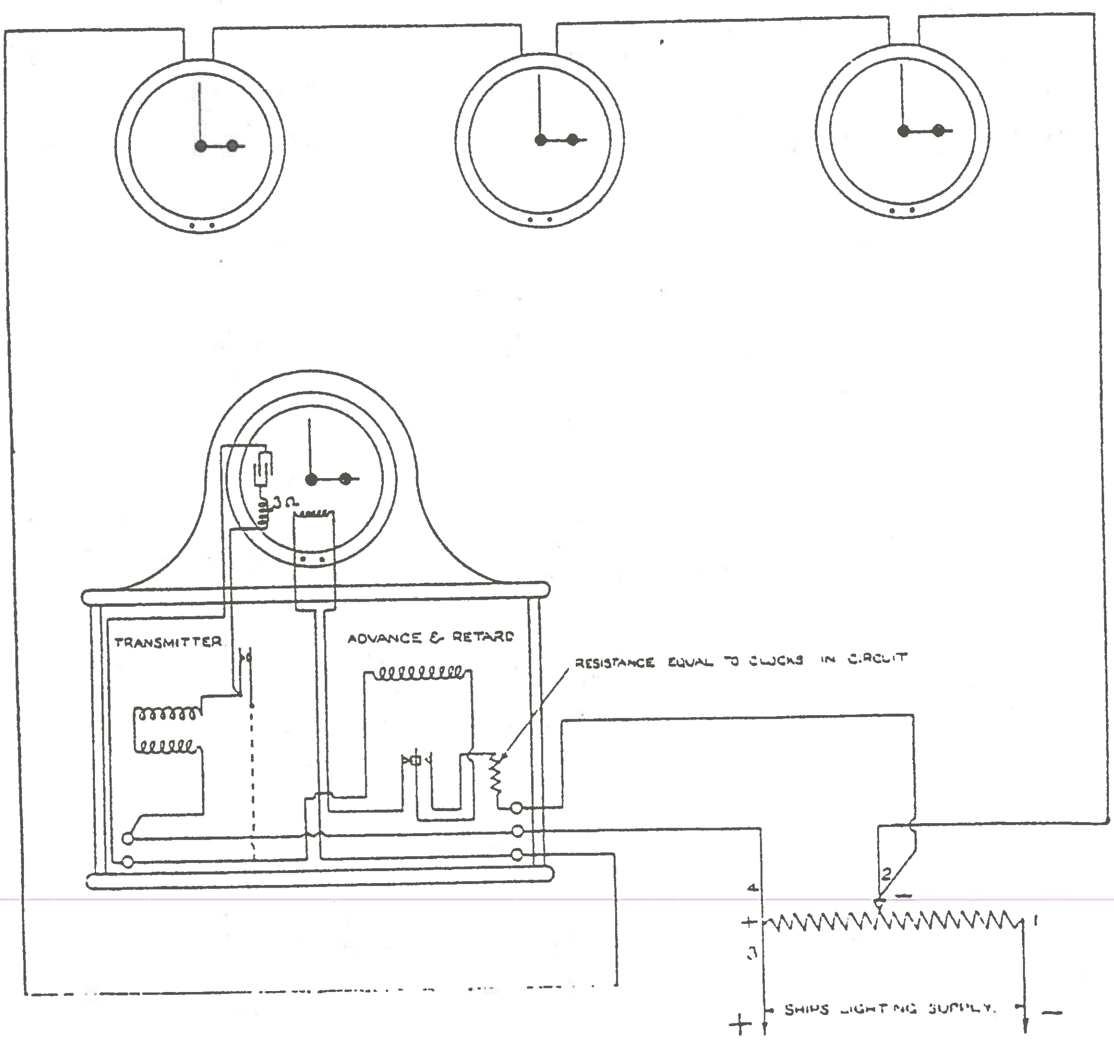
(10). —The chief duty of the Mechanism is to send at every half minute to the Ship's Clocks an electrical impulse from a source of electrical energy. This is effected by the time-keeping and contact-making Mechanism in the Transmitter.

(11).—*The Power for driving the Train of Wheels and Escapement is obtained by the Driving Lever " A " falling gradually. When it gets " down " contact is made between " D " and " E " and the Lever is immediately thrown up by the electro magnet. It will be seen the Pawl " B " hauls on to the ratchet wheel which drives the escapement fitting.*

The Contacts " D " and " E," besides energising the Electro Magnet, also send a current round the Impulse Clock Circuit, and move the Impulse Clocks one impulse.

(12). The functions of the Breaking Stops " F " and " X " are explained by reference made under the article on Re-adjustments, paragraph 20.

Reference to Diagrams C517 and C518 makes all this quite clear.



C518.

(13).—It will be noticed from the Diagram that when the Advance mechanism is in operation all the Impulse Clocks are in the circuit.

(14).—When the Retard Mechanism is operated the Pawl " B " still hauls on to the escapement, but a resistance is put into the circuit instead of the Impulse Clocks, thus the Transmitter operates for the given number of half minutes without either the Pilot Dial or the Ship's Clocks.

(15).—*When the Advance Mechanism operates, the Pawl " B " is thrown back, the Escapement stops and a Fan moves quickly instead of the Balance Wheel.*

The Advance Key has the faculty of wiping the balance wheel when operated, and so ensures its starting up.

(16).—The Escapement fitting, shown by dotted lines in Diagram C517, is the most delicate part of the Transmitter. Its bearings are jewelled, and this mechanism must be handled with great care, as a watch maker would handle it, and it must not be treated roughly. Particular attention is called to this mechanism when oiling (see paragraphs 23, and 30 to 37).

The Escapement fitting will require cleaning and oiling only just as does that of an ordinary Marine Mechanical Clock.

Transmitter, Marine Type.

TO RE-ADJUST ITS CONTACTS.

(17).—*Don't monkey with the Transmitter, but if for any reason Contact adjustments become necessary, note the following points carefully :—*

(18).—The adjustment of the Contacts must allow for the requisite amount of up and down movement of the Driving Lever " A," the object being to get sufficient movement to enable the Driving Pawl " B " to feed forward one tooth of the Ratchet Wheel at each downward stroke.

(19).—A gap of $\frac{3}{16}$", not more, between the Contacts " D " and " E " when the Driving Lever is pressed firmly against the felt stop " P " gives the requisite stroke.

The movement of the armature is limited by the poles of the Magnet on the one side and the fixed but adjustable stop " M " on the end of the armature on the other side, and this stop is adjustable only in order to obtain the necessary latitude of movement, namely, $\frac{3}{16}$".

The contact-breaking fixed but adjustable stop " F " on the armature performs an important function, and is set in the following manner :—

(20).—Hold the armature firmly against the poles of the Magnet and see if the point of the screw " F " presses against the head of the steel stud " N," which is opposite to it, and in so doing, see the Driving Lever rises up to the padded stop " P," and at the same time causes the contacts to separate $\frac{1}{32}$".

(21). These tests should be first made with the current entirely " off " and afterwards confirmed with the current " on," but in this latter case the key mechanism must be set to Retard, or otherwise any vibrating contact which may occur will set the Ship's Clocks out of step.

Transmitter, Marine Type.

SPARE ESCAPEMENT FITTING.

(22).—*A big responsibility depends on the Escapement Fitting of the Transmitter. (This is shown dotted in Diagram C517 below, and illustrated at Fig. C93.) Therefore, a Spare Escapement Fitting is, or should be, provided and available. It is generally provided and kept in a cradle fixed in the left-hand side of the Transmitter Case.*

(23).—*When the Escapement Fitting in use requires cleaning or other attention, remove it by unscrewing the three screws marked " X " in Fig. C93, and carefully push back the Hook or Pawl " B " in diagram, which engages the Ratchet Wheel sufficiently far to enable the removable part to be taken away. This must be done carefully and without force, and current must be cut off before attempting to remove an Escapement Fitting.*

(24).—*The Spare is then fixed in its place, and the Escapement Fitting which has been in use can be sent, carefully packed, to a watchmaker, or better still to the makers, Gent & Co., Ltd., Faraday Works, Leicester, England, for attention and overhaul. When returned, it should be secured and kept as the Spare Escapement Fitting.*

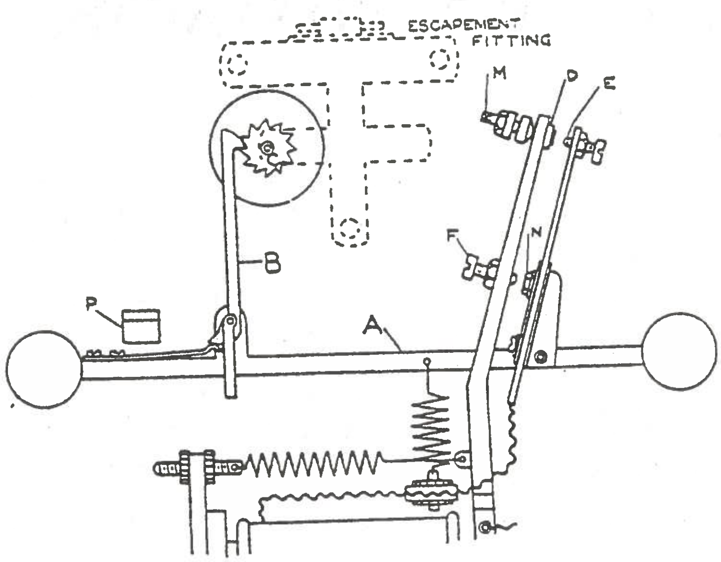


FIG. C517.

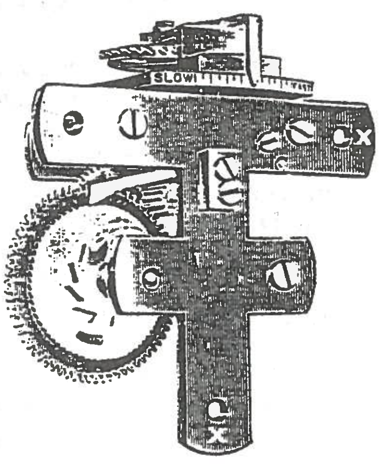


FIG. C93.
Escapement Fitting.
Cradle not shewn.

(25).--*If it is found that the Balance stops before the Contacts in Transmitter " DE " meet (and this after pressing the Advance Lever once, which starts up the Escapement) an obstruction must be looked for in the Escapement Fitting, and if it is not apparent what the undue friction or fault is with the Train or the Escapement, it should be sent to the makers, as suggested. Meanwhile, the Transmitter employs the Spare Part.*

Transmitter, Marine Type.

AUTOMATIC ADVANCE AND AUTOMATIC RETARD.

A further duty of the Marine Transmitter is to provide means of automatically advancing the Clocks when sailing East, or of automatically retarding the Clocks when sailing West.

(26). Such Mechanisms consist of a Setting Dial with its pinch-levers and two Keys marked "Advance" and "Retard." This Mechanism will be found in a separate compartment, generally on the right of the time-keeper, and the toothed wheel, when operated for Advance, takes one step for every time contact is made at "D E."

By means of the Pointer and its pinch-levers, the Mechanism can be set to any number of minutes Advance or Retard.

(27).—*If the Ship's Clocks have to be Advanced, press the Advance Key, and the Driving Lever "A." instead of descending slowly, will descend rapidly, controlled only by the Fan, and Contacts "D" and "E" meet approximately every second, so all the Ship's Clocks are rapidly "Advanced" the number of minutes allowed for on the Setting Dial. On reaching zero, the "Advance" is disengaged, and the Pawl "B" drives its ratchet wheel normally as before.*

(28).—*To Retard the Ship's Clocks, the Pointer and its pinch-levers are set to the desired number of minutes, and the Key marked "Retard" is pressed. The toothed wheel now advances in half-minute steps until the Pointer reaches zero, when the Retarding Key is automatically released and the Ship's Clocks are re-connected and driven in normal half-minute steps.* The effect of the Retard is to hold up the Ship's Clocks for the required period of time, a resistance being switched in the circuit in lieu of the impulse clocks.

The action of the parts of the Mechanism of the "Advance" and "Retard" can be readily seen, and any derangement should be speedily recognised.

(29).—"ADVANCE"—FAILING TO OPERATE. If the fan refuses to rotate when the "Advance" is set for advancing the Clocks, see if it is obstructed by carefully turning it by hand. If no definite obstruction is found, carefully wipe through the teeth of the pinion with the point of a sharpened skewer, as described, so as to be assured that the obstruction is not in the pinion. Also brush out the teeth of the wheel which drives the disc pinion. If no definite obstruction is found, oil the pivots of the fan and of the wheel which drives it, afterwards moving the spindles end-wise to work in the oil and work the dirt out. Remove superfluous oil with a clean duster.

Transmitter, Marine Type.

OILING

THE CLOCK MECHANISM.

(30).– *It must be remembered that this Mechanism is really a Clock and only Clock Oil may be used under any circumstances, and even this very sparingly. A piece of wire with a flattened end, about 18 Gauge, a hat pin or a hair pin forms the best oiler.*

(31).—All Pivots of the Mechanism must be oiled, one drop only for each pivotted part or studs on which such parts turn. The oiling must be carried out methodically, otherwise pivots are missed. Reach through the frame from the front to oil the back of pivots.

(32).—Before oiling anything, any dust seen in teeth of wheels must be brushed out (a dry tooth brush is useful for this purpose), and this can be done with advantage while the wheels are revolving. Dirty oil must also be wiped away from the pivots and parts, and for this use a clean duster free from fluff.

(33).—If the Wheels of the Escapement Fitting, shown at Fig. C93, refuse to rotate with the descent of the Driving Lever " A " and a definite obstruction is suspected, the Escapement Fitting should be removed and examined, but before removing the same put, say, a visiting card between the left-hand Contacts of the Retard Lever, and so prevent the flow of current, which will cause chattering at the Contacts all the time the Escapement Fitting is thus removed.

(34).—It may be found that there is dirt in the teeth of the wheels just where they are engaging the pinion. Any such dirt or dust must be carefully removed by the point of a wooden skewer or a piece of peg wood by carefully stroking between the teeth of wheel and pinion.

(35).—If an obstruction is found and removed, apply gentle pressure to the ratchet wheel in an anti-clockwise direction, and provided the Escapement Fitting is in order, the Balance Wheel should operate. Start the Balance Wheel with a gentle touch if necessary. If it still fails to operate, read paragraph 25.

(36).—The Escapement proper, with its horizontal Platform, only requires its Pivots oiling when it is cleaned by a Clock maker. The Steel Pallets may, however, be oiled only in the following manner :—

(37).– *While the Escapement is working, hold the tip of the oiler with its drop of oil close to the Scape Wheel so that the teeth of this wheel, in passing, each takes a little oil. The teeth should touch the drop of oil, but not the oiler. Sufficient oil thereby is passed on to the Steel Pallets.*

(38). –*The teeth of the Wheel Train must not be oiled, and be careful that no oil whatever gets on to the hair spring of the Balance.*

THE IMPULSE CLOCK PROPER.

(39). All Marine Impulse Clocks contain a Step-by-Step Mechanism similar to that illustrated at Fig. C9. When this is fixed in a case without exposed Terminals, two studs are provided at the bottom of the Clock front. These are illustrated clearly at Fig. C138.

(40).—By means of these Studs, the individual Clock can be " shorted " if fast, and advanced by means of a Dry Cell if slow. The studs are a precautionary arrangement to avoid the necessity of taking the Clock down in case adjustment of the clock hands is found necessary.

(41).—The Movement is set with an Ammeter in Circuit by the Makers, and it is essential that an Ammeter be used when any adjustment is made, and that the Movement will operate with a current of 0.20 amp., not more or less.

(42).—*Any adjustment made without the precaution of an Ammeter will only end in future trouble. The Re-adjusted Impulse Clock may operate on the Current as supplied by the transmitter, but if for any reason this falls very slightly below standard, then the misadjusted Clock again fails.*

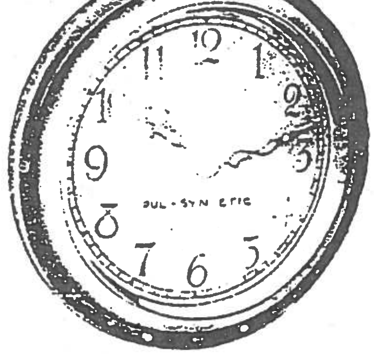


FIG. C138.

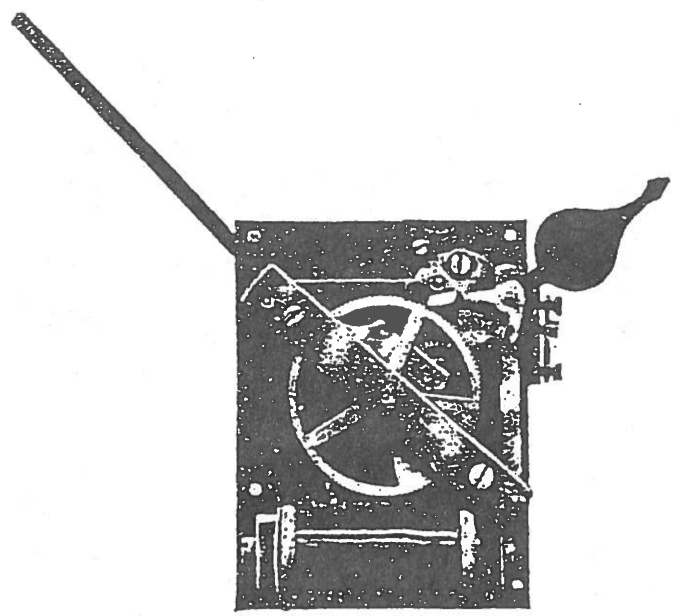
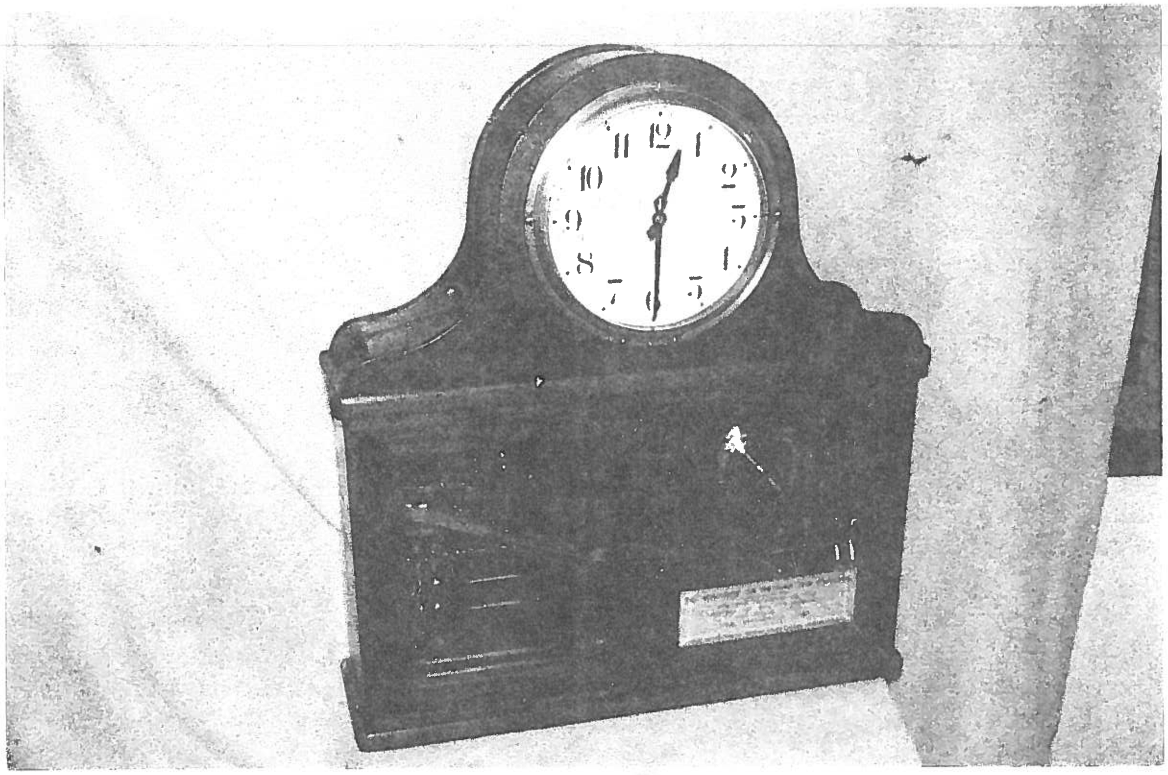
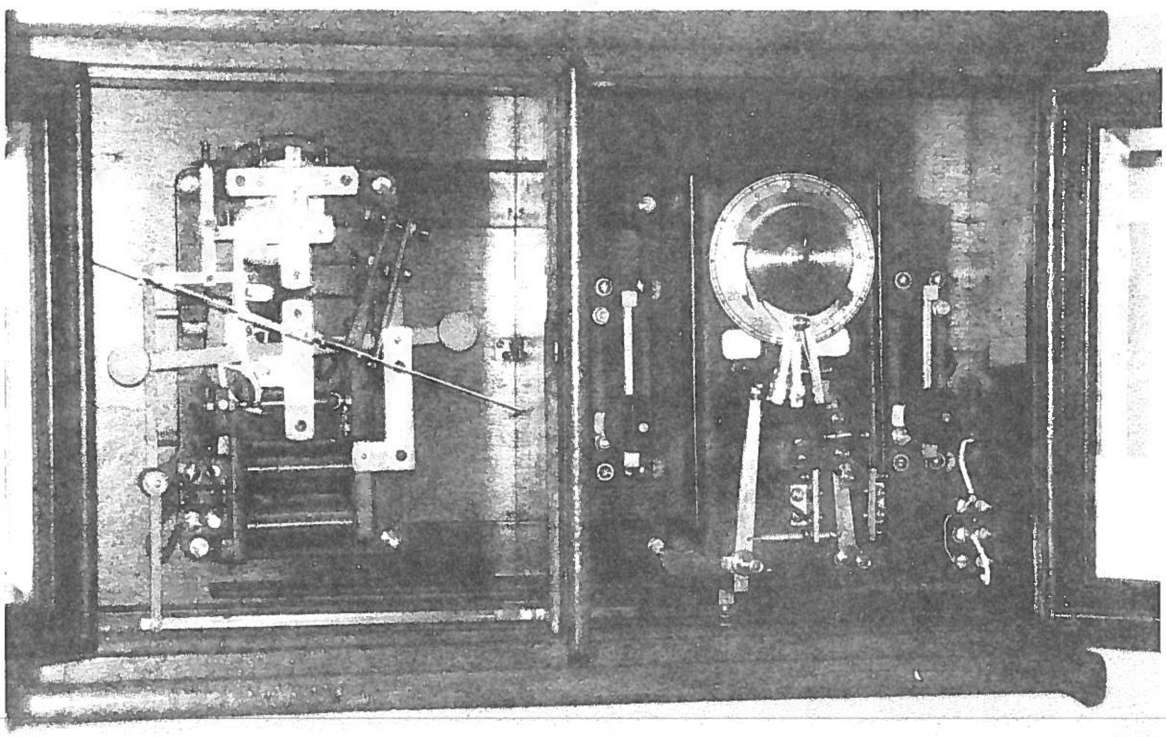


FIG. C9.

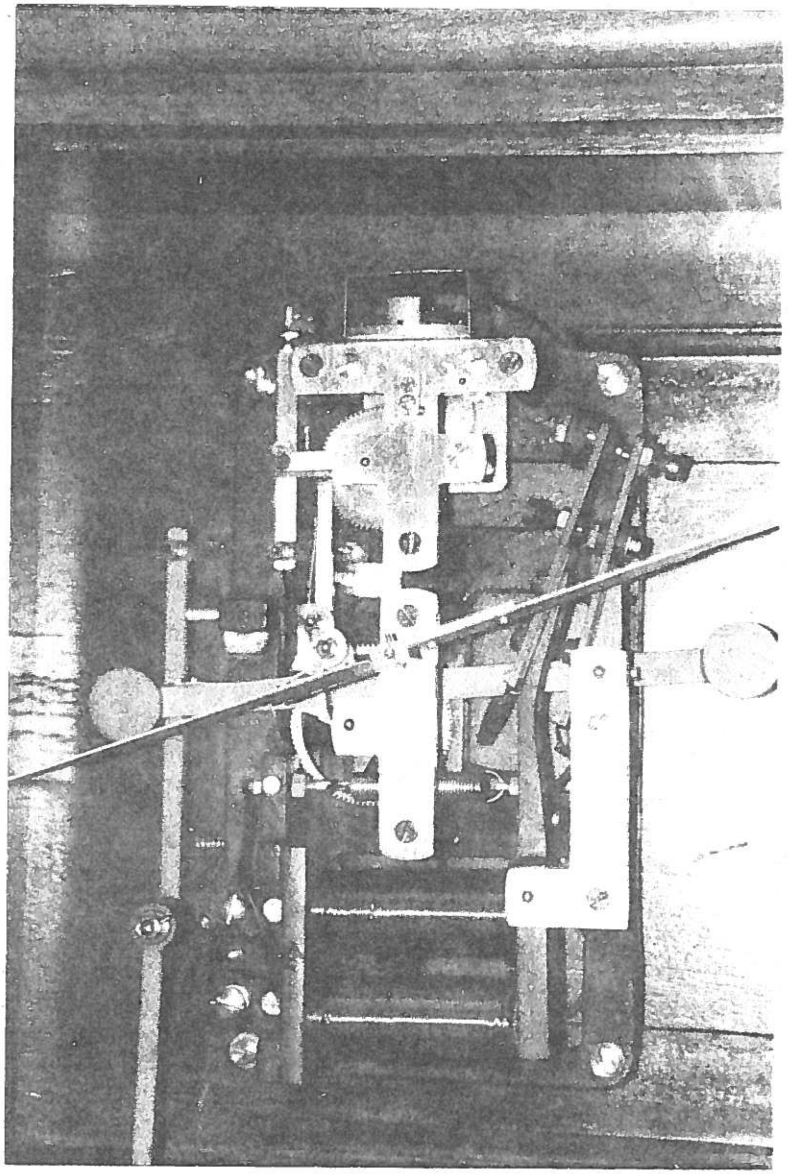
(43).—*The remarks about oiling in paragraph 30 apply equally to the Impulse Movements.*

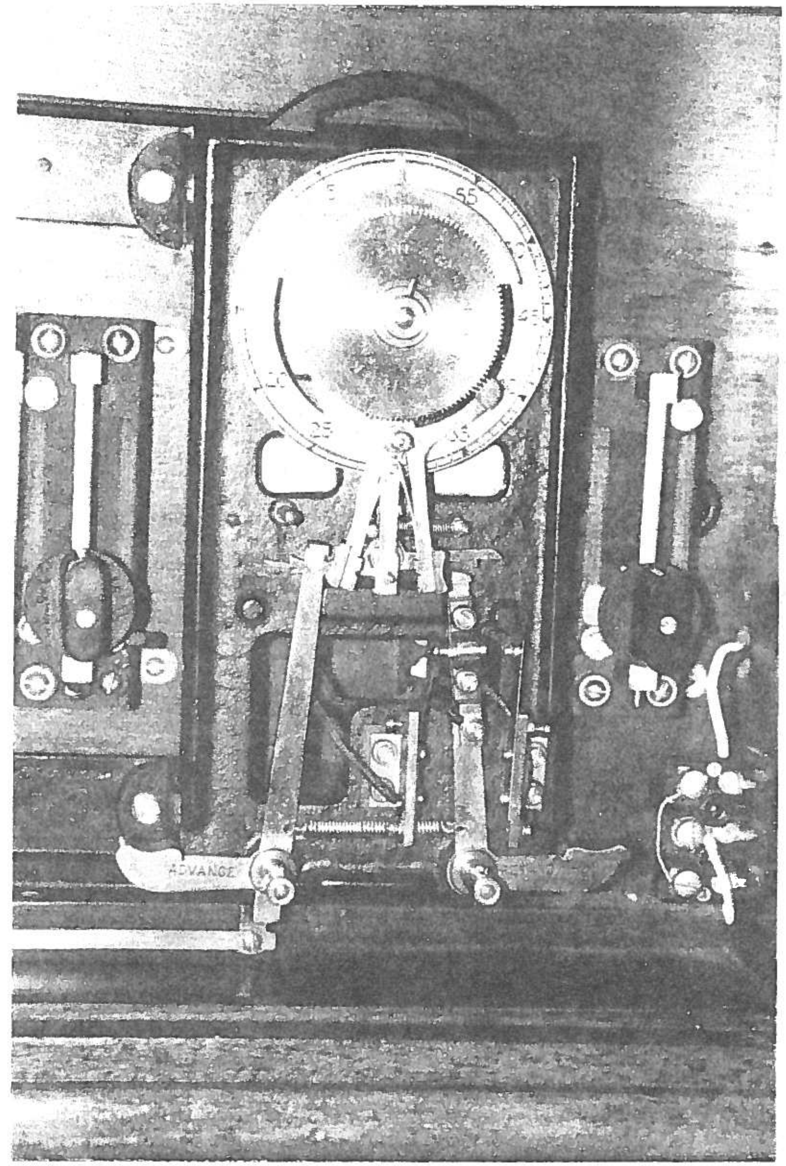
All Pivots, also the acting end of the Driving Spring and the Stud on which the Driving Pawl works, may be oiled, but the Ratchet Wheel and the driving ends of the Pawls may not be oiled in any circumstance. They must, however, be left perfectly clean. Any dust or dirt on these parts must be carefully removed. This remark particularly applies to the brass pin forming the forward stop of the Driving Pawl.





Gent & Co., Ltd.; Pul-Syn-Etic, Marine Type Electric Impulse Clock.





Gent & Co., Ltd.; Pul-Syn-Etic, Marine Type Electric Impulse Clock.

Nº 14,873 A.D. 1909

Date of Application, 26th June, 1909

Complete Specification Left, 24th Dec., 1909—Accepted, 23rd June, 1910

PROVISIONAL SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, Frank Holden, of 1, Harcourt Buildings, Temple, London, W.C., Electrical Engineer, do hereby declare the nature of this invention to be as follows:—

My invention relates to electric clocks and has for its object to provide an improved construction in which the sparking at the contacts when the balance-wheel or pendulum is energised is reduced to a minimum or entirely obviated.

My invention consists in energising the pendulum or balance wheel by making and breaking automatically the current in a coil which has relative movement with regard to a magnetic field, the arrangement preferably being such that the pendulum or balance-wheel receives its impulse when it has the highest velocity, that is, at the middle of its swing or oscillation, so that due to the large counter-electromotive force developed in the coil a highly efficient electromotive device is obtained and sparking at the contacts is reduced to a minimum. My invention further comprises an improved form of contact device in which the pendulum or balance-wheel carries a pivoted pin which hangs by gravity in a vertical position and which wipes over a fixed contact for energising the coil during a small portion of the swing or oscillation of the pendulum or balance-wheel.

In carrying my invention into effect, as applied for example to a pendulum clock, the pendulum is fitted at its lower end with a coil the self-induction of which is made as small as possible. This coil is adapted to swing in the field between the limbs of a permanent magnet, and the electromagnetic damping, resisting its motion in the magnetic field, is rendered as small as possible, for example by avoiding the use of a closed metal former for supporting the turns of the coil. On the side of the pendulum a light piece of flexible metal or a pin pivoted about a horizontal axis is fitted, this metal piece or pin being adapted to wipe over a pair of horizontally arranged metal pins. The metal piece or pivoted pin is insulated and connected to one end of the pendulum coil while the other end of the coil is connected to an intermediate point in a battery of cells. The horizontally arranged contact pins are also insulated and are connected respectively to the terminals of the battery. The pivoted pin may have a slotted pivotal mounting so that it is capable of a small amount of movement along its length.

The fixed contact pins are so placed with regard to the magnet that the vertical pivoted contact will engage with one or the other according to the direction of swing of the pendulum when the pendulum is at or about the middle of its swing. In this position the coil is energised and the pendulum receives its impulse, one impulse being given on each swing. Instead of a pair of horizontally arranged contacts and two batteries being used a single half-insulated horizontal contact and a single battery may be provided so that the circuit of the battery through the coil will only be closed by the pivoted contact once in a double swing.

The pendulum is arranged to actuate the clock train in any suitable manner, as for example, by operation of a pawl on a toothed ratchet-wheel geared to the clock train.

[Price 8d.]

PRICE 1/-

It will be obvious that instead of arranging the coil on the pendulum this coil might be fixed and the magnet carried by the pendulum and further instead of using a pendulum a balance-wheel might be fitted with the coil or magnet and also that instead of a permanent magnet an electro-magnet excited from the battery or other source may be used.

Dated this 25th day of June, 1909.

JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, FRANK HOLDEN, of 1, Harcourt Buildings, Temple, London, W.C., Electrical Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to improvements in an already known type of electric clock in which the current in a coil interacts with a magnetic field, the current being automatically made and broken to produce the oscillations of the pendulum which either carries the magnet or the coil.

In some clocks of this type hitherto proposed, the coil which swings with the pendulum surrounds and moves along a straight or curved magnet; that is to say, one in which the magnetic circuit is largely through air, and movable contacts have been provided adapted to remain in engagement with contacts on the pendulum over a considerable portion of the swing of the pendulum in each direction so that the coil is supplied with current for a considerable portion of each oscillation. In other forms of such clocks, a similar arrangement has been employed except that the coils have been fixed and the straight magnet attached to the pendulum. One disadvantage of such arrangements is that the current taken by the coil is relatively large so that if a primary battery is used as the source of supply it very soon becomes exhausted. A further disadvantage is that the energy supplied to the pendulum is small owing to the inefficient magnet and consequently the force required to actuate the switch mechanism interferes with the isochronism of the pendulum and therefore with good time-keeping. It has been proposed to overcome the latter difficulty by electro-dynamically actuating by the motion of the magnet carried by the pendulum, a pivoted switch which is in engagement with its contacts over a considerable portion of the range of oscillation of the pendulum. In this clock the magnet is of horse-shoe shape, one of the limbs being adapted to pass through the aperture in a fixed coil, the other limb being adapted to pass through a pivoted coil attached to the switch member, the result of which arrangement is that the circuit of the magnet cannot be closed and therefore the coil takes a relatively large current.

According to my invention, I avoid the above mentioned disadvantages by using a coil of thin cross-section and a magnet or magnet system in which the air-gap length is just sufficient to allow free clearance between the coil and the magnet; that is to say, the magnetic circuit of the magnet is practically closed, and I provide on the pendulum, or balance-wheel if such be used for making and breaking the current in the coil, a light contact adapted to engage and wipe over a fixed contact so that the coil receives current preferably at the middle of the oscillation of the pendulum and through a small angle in which the coil and field effectively interact. I therefore reduce the retarding force due to the engagement of the contacts to a very small amount and, owing to the construction and arrangement of magnet and coil, I make the driving force on the pendulum very large in comparison with such retarding force, so that its effect on the time-keeping of the clock is a minimum. Further, the construction enables much smaller magnets and coils to be used than have hitherto been possible. By energising the coil when it has its highest velocity, the large counter-electromotive force which is then developed reduces to a minimum the sparking at the contacts.

The accompanying drawings illustrate my invention:

Figure 1 being a front elevation of a pendulum type of clock,

Figure 2 a side elevation of the same,

Figure 3 a diagrammatic view of the connections.

Figure 4 shews our invention as applied to a balance-wheel type of clock and

Figure 5 is a plan view of the same.

In carrying our invention into effect, as illustrated, the pendulum *a* is fitted at its lower end with a coil *b*, of thin cross-section and preferably of rectangular shape. This coil is adapted to swing across the field between the limbs of two permanent magnets *c* and the electromagnetic damping, resisting its motion in the magnetic field, is rendered as small as possible by avoiding the use of a closed metal former for supporting the turns of the coil. The field gap of the magnets should be made as small as possible, consistent with allowing free working clearance between it and the magnet pole-faces so that an intense field is produced which is narrow in the direction of movement of the coil. The width of the coil should preferably be substantially the same as the total width of the magnetic field. On the side of the pendulum a light piece of metal or a pin *d* pivoted about a horizontal axis is fitted, this metal piece or pin being adapted to wipe over a pair of metal pins *e*. The metal piece or pivoted pin *d* is insulated from the pendulum and connected to one end of the coil *b* while the other end of the coil is connected to an intermediate point in a battery of cells *f* through the pendulum rod and the supporting column. The contact pins *e* are also insulated and are connected respectively to the terminals of the battery. The pivoted pin *d* may have a slotted pivotal mounting so that it is capable of a small amount of movement along its length.

The fixed contact pins *e* are so placed with regard to the magnets that the vertical pivoted contact will engage with one or the other according to the direction of swing of the pendulum when the pendulum is at or about the middle of its swing. In this position the coil is energised and the pendulum receives its impulse, one impulse being given on each swing. Instead of a pair of fixed contacts and two batteries being used, a single fixed contact and a single battery may be provided so that the circuit of the battery through the coil will only be closed by the pivoted contact once in a double swing.

The pendulum is arranged to actuate the clock train in any suitable manner, as, for example, by operation of a pawl *g* on a toothed ratchet-wheel *h* geared to the clock train.

The electrical connections will be clear from a consideration of Figure 3. The batteries A and B may be located within the base or in any other convenient position. One pole of the battery A is connected to one of the metal pins *e* and the other to the battery B. The other pole of battery B is connected to the other pin *e*. The pivoted pin *d* as above described makes contact with the pins *e* and is connected to one end of the coil *b* which in turn is connected through the pendulum rod and supporting column to a point C between the batteries.

In the modification illustrated in Figures 4 and 5, the coil *b* is carried on the periphery of a balance-wheel *k* mounted on a spindle *m*. The pivoted pin *d* is carried on a pin *n* projecting from the hub of the wheel. The wheel is normally held in and returned to its mid position by means of a spring *p*. The electrical connections in this modification are the same as those described above with reference to the first modification.

It will be obvious that instead of arranging the coil on the pendulum this coil might be fixed and a magnet or magnets carried by the pendulum and further, instead of using a pendulum, a balance-wheel might be fitted with the coil or magnet and also that instead of a permanent magnet an electro-magnet excited from the battery or other source may be used.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. In an electric clock of the type hereinbefore referred to, the employment of a thin coil in combination with a magnet having its magnetic circuit practically closed, producing a substantially uniform and intense field which is narrow in the direction of relative movement of the field and coil and a contact device adapted to energise the coil during the small portion of the total angle of oscillation, in which the coil and field interact, substantially as set forth.

2. In an electric clock as claimed in Claim 1, a pivoted contact carried by the pendulum or balance-wheel and arranged to engage and wipe over a fixed contact so as to make and break the electric circuit.

3. In an electric clock as claimed in Claim 1, a pivoted contact carried by the pendulum or balance-wheel arranged to engage a pair of fixed contacts so as to make and break the electric circuit twice during each complete stroke of the pendulum.

4. In an electric clock having a pendulum or balance wheel energised as claimed in Claim 1, a pair of magnets having short air-gaps and a moving coil adapted to pass through said gaps, the width of the coil being substantially the width of the magnetic field.

5. An electric clock comprising a pendulum, a pivoted contact carried thereby, a coil also carried by the pendulum, a pair of magnets having short field gaps through which the coil passes and a fixed contact adapted to be engaged by the pivoted contact carried by the pendulum to make and break the electric circuit.

6. An electric clock constructed, arranged and operating substantially as hereinbefore described and illustrated in the drawings.

Dated this 23rd day of December, 1909.

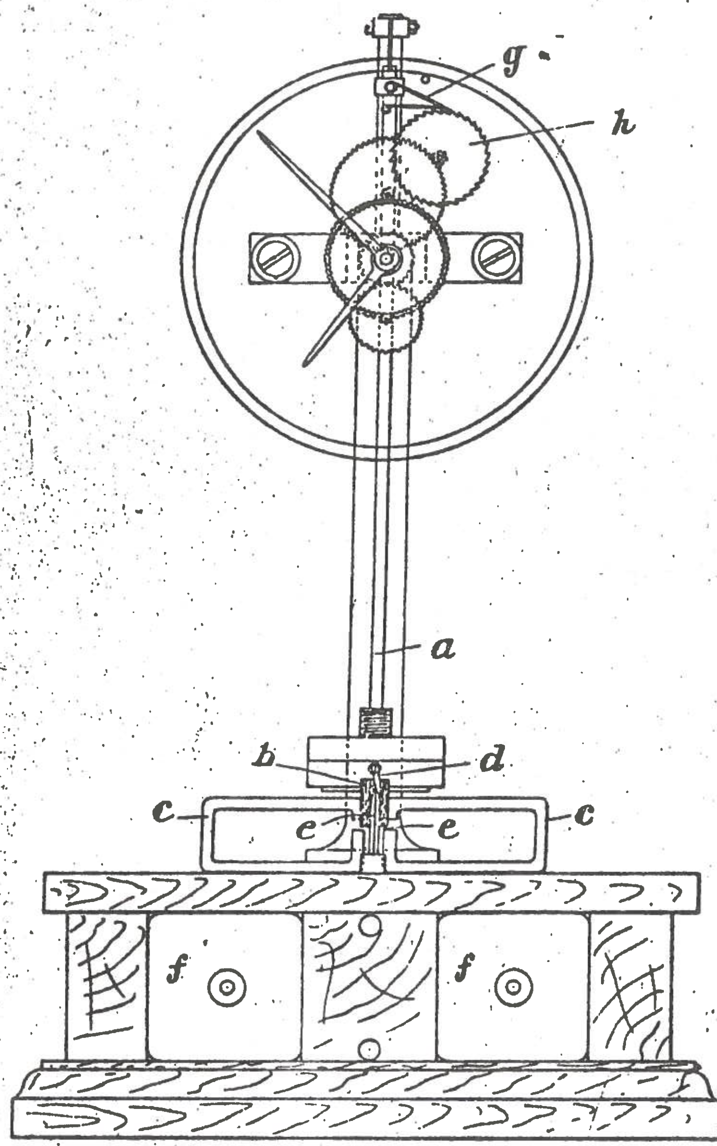
JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1910.

SHEET 1.

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1.



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(3 SHEETS)

SHEET 2.

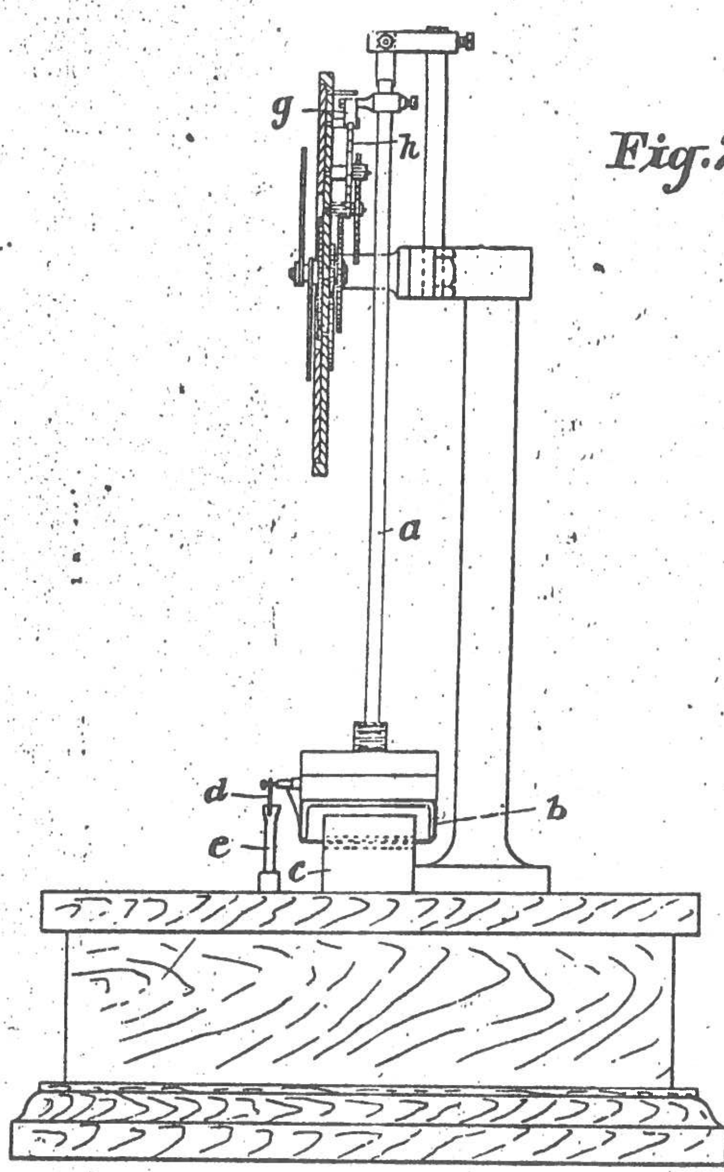


Fig. 2.

Fig. 3.

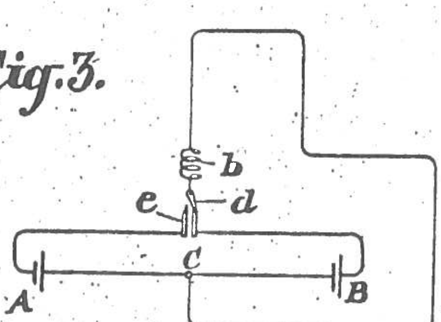
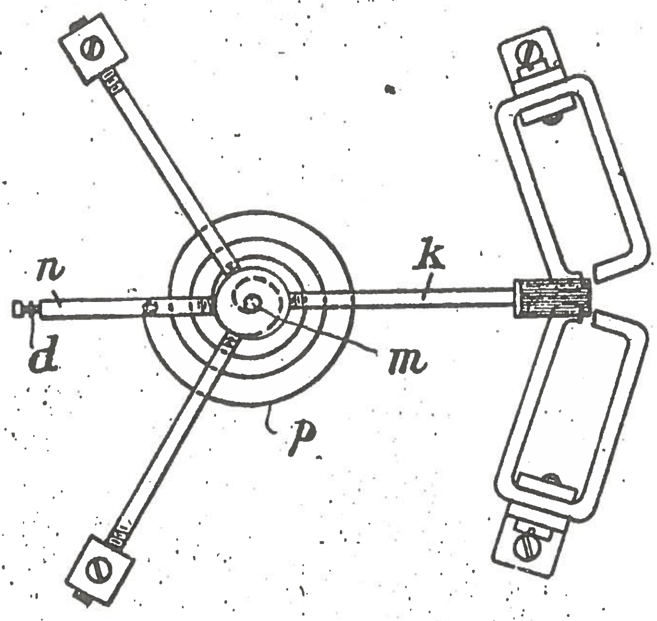


FIG 5



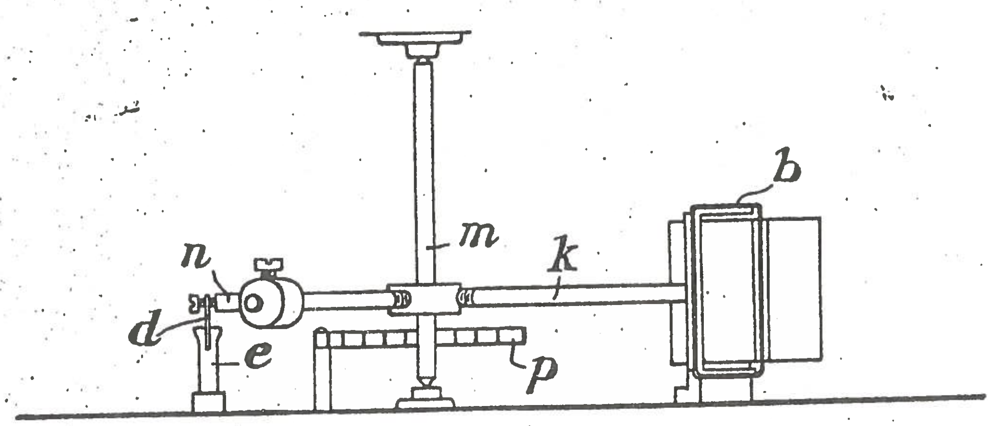


FIG. 4.

[This Drawing is a full-size reproduction of the Original.]

Chicagoland Chapter no. 3

National Association of Watch & Clock Collectors

Tempus Vitam Regit

Dear George:

Some years ago #78 distributed a list of electric clock manufacturers which included their years of operation and which you had prepared. All of us here have found it most useful and have been adding to it from time to time. The result is enclosed. Although it has no dates, you and your colleagues might find it of value. If not, feel free to toss it.

As you will see, there are some question marks. I have been in touch with John McGrory about them and will be writing Mel Kaye at his suggestion. We are particularly interested in trying to find out more about the NJ and NY firms on the list. Most of them are synchronous makers, but some like Duplex in Newark and Johnsonphone in NYC put out some most interesting advertising and Gibraltar in Jersey City seem to have had many "brands."

Best Regards,

William F. Keller

ILLINOIS ELECTRIC CLOCKMAKERS

(S) = Synchronous, AC
(B) = Battery

	Company	Location	Type	Comments
1.	Allied Products	Chicago	(S)	
2.	American Clock Co.	Chicago	(B)	
3.	American Flyer Manufacturing Co.	Chicago	(S)	
4.	Borg Instrument Co.	Chicago	(B - auto)	
5.	Ceramic Clock Co.	Chicago	(S)	
6.	Frank Curtis	Decatur	(B?)	
7.	Darche Electric Clock Co.	Chicago	(B)	
8.	Diamond Electric Clock Co.	Chicago	(S)	
9.	Electric Clock Co. of America	Chicago	(S)	
10.	Electric Pendulum Clock Co.	Chicago	(S)	

11.	Electric Time Recorder Co.	Chicago	(B?)	
12.	Elgin	Elgin	(S)	
13.	Fort Clock Co.	Chicago	(S)	
14.	Galter Products Co.	Chicago	(S)	
15.	Haddon Products, Inc.	Chicago	(S)	
16.	Hamilton Sangamo	Springfield	(S)	
17.	Hammond Clock Co.	Chicago	(S)	
18.	Herold Products Co.	Chicago	(S)	
19.	Howard Clock Co.	Chicago	(S)	
20.	J. C. Hug Manufacturing Co.	Highland	(S)	
21.	Imperial Clock Co.	Granite City & Collinsville	(B)	
22.	Jefferson Electric Co.	Belleville	(S)	
23.	Joliet Clock Manufacturing	Joliet	(B?)	
24.	B. E. Lawrence	Chicago	(S)	
25.	Mastercrafters Co.	Chicago	(S)	
26.	Masterchron Electric Co.	Chicago	(S)	
27.	Middlebury Clock Co.	Chicago	(S)	
28.	Minerallac Electric Co.	Chicago	(B)	
29.	Monarch Telephone Manufacturing	Chicago	(B)	
30.	National Self Winding	Champaign	(B)	
31.	Old Colony Clock Co.	Beardstown	(S)	"Janes"
32.	Program Clock Co.	?	(B)	
33.	Sangamo Electric Co.	Springfield	(Hybrid)	
34.	Sempire Clock Co.	Chicago	(B)	
35.	Sheldon - Int. Time Recorder	Chicago	(S)	
36.	Sohm Electric Clock Co.	Chicago	(B)	
37.	Spartus	Chicago	(S)	
38.	Stromberg Electric Manufacturing Co.	Chicago	(B & S)	
39.	Sunbeam Products	Chicago	(S)	
40.	Swing Clock Co.	Chicago	(S)	
41.	Trinity Electric Clock Co.	Chicago	(B)	
42.	United Clock Co.	Chicago	(B)	
43.	Universal Electric Clock Co.	Chicago	(S?)	
44.	Vidrio Products	Chicago	(S)	
45.	Western Clock Co.	La Salle -Peru	(B & S)	"Westclox"

To be continued.

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Requests for reprints of previously published material should be directed to the Chapter Historian:
Dr. George Feinstein 75-19 195th Street Flushing, NY 11366

Reviving A Kundo Coil

I think I found the last used Kundo coil for a repair last month, and right after, I received another repair with a coil that had weird characteristics. When energized, the pendulum would swing a small amount and stay there. I replaced the transistor with several, including a direct replacement, but it didn't have enough power to cause the pendulum to swing. As a matter of experimenting, I connected 1.5vdc directly to the impulse coil, and it too didn't have enough power. The pendulum would not swing till the coil saw at least 3vdc. Knowing that a repair or replacement was impossible, I was prompted to find another way. I have found 2 ways to make a non-working Kundo coil work again. The first is to use a circuit from a new quartz pendulum movement. By adding a potentiometer to correct the amplitude, this circuit works perfectly. This circuit will only work if neither of the two coils are open. If one of the coils are open, then an oscillating circuit will work. Using a 9vdc supply, and 2 potentiometers, one to adjust the rate, and the other at the output to tweak the amplitude, this circuit will send a pulse at a predetermined rate, thus pulling the magnet and allowing the clock to run. The oscillating circuit does not care which winding is used. For more information, contact me directly at 919-465-9800.

--- MART ---

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THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78

NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXVI #4, DECEMBER 2000

Fellow Horologists:

It's Good News time again! Dues are due and **still only $10!** It's Mart clean-up time with the next issue. Update or change your Mart ad, but **advise us,** otherwise any add one year or older will be deleted from the next issue of the Journal.

Bill Keller's listing of American Electric Clockmaker continues with a listing for states other than Illinois. If you have any additional material to supplement the listing, please forward to the editors. Credit will be given to all contributors (unless they wish to remain anonymous). If enough new information comes to light, we'll consider reprinting the entire list and make it available as a journal supplement.

We've received from our British benefactor, A. D. Harris, FBHI, a copy of Frank Holden 1910 clock patent, and an English language Bulle catalog of 1926. Many thanks, Mr. Harris.

This journal will also start a series on Matthaus Hipp's Astronomical regulators. Hipp's horological accomplishments, many hitherto unknown, confirms his status as a principal figure in electric clock making history. Were you aware of his activities in regard to a central time distributing system for the Swiss Postal Service in the 1860's?

Our quotation for this issue, "Opportunities are often disguised as hard work, so many people don't recognize them."

Good reading ahead, enjoy this issue.

Martin Swetsky, FNAWCC,......President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein,................Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

Continued from September, 2000 issue.

AMERICAN ELECTRIC CLOCK NAMES & MANUFACTURERS

(Other than Illinois)

	Company	Location	Type	Remarks
1.	Acme Electric	? , ?	?	
2.	Advance Timekeeping	Newark, NJ	?	
3.	Allied Manufacturing	Seattle, WA	?	
4.	American International Commerce Co.	New York, NY	?	
5.	Atlas	? , ?	?	
6.	Bangor Electric	Bangor, ME	(B)	
7.	Barr	Weedsport, NY	(B)	
8.	Blodgett Bros.	Boston, MA	?	
9.	Bond Electric Co.	Jersey City, NJ	?	
10.	Bulova Watch Co.	Flushing, NY	(B)	
11.	Brach-Delux Electric Clock Co.	Newark, NJ	?	
12.	Chauncey Jerome Clock Co.	New York, NY	?	
13.	Chelsea Clock Co.	Chelsea, MA	(B)	
14.	Chron-Art Electrical Mfg. Corp.	Jersey City, NJ	?	Chronart
15.	Cincinnati Time Recording	Cincinnati, OH	(B)	
16.	Connecticut Clock Co.	Hartford, CT	?	
17.	Continental Mfg. Co.	New York, NY	?	
18.	Drawbaugh	Harrisburg, PA	(B)	
19.	Duplex Timekeeper	Newark, NJ	?	Advanced Timekeeping, Inc.
20.	Electric Signal Clock Co.	Waynesboro, PA	?	
21.	Electroalarm	?, ?	?	
22.	Electro Clock Co.	Baltimore, MD	(B)	
23.	ETA	Tucson, AZ		
24.	Eureka Clock Co.	?, ?	?	
25.	EverHot, Swartzbaugh Mfg. Co.	Toledo, OH	?	
26.	EverReady (Amer. Novelty Mfg.)	New York, NY	?	
27.	Franklin Clock Co.	Ivyland, PA	?	
28.	Fred Frick Co.	Waynesboro, PA	(B)	
29.	General Electric Co.	Schenectady, NY	(S)	
30.	Gibraltar Clock Co.	Jersey City, NJ	?	

31.	Gisholt Manufacturing	Madison, WI	?
32.	Guardian, Inter. Tool & Die Co.	Minneapolis, MN	?
33.	Hansen Manufacturing	Princeton, IN	?
34.	Havlin, Kodel Electric	Cincinnati, OH	?
35.	Herschede Clock Co.	Cincinnati, OH	(S)
36.	E. Howard Clock Co.	Boston, MA	(B)
37.	E. Ingraham	Bristol, CT	?
38.	International Time Recording	Syracuse, NY	(B)
39.	James Remido Clock Co.	San Francisco, CA & Minden, NV	?
40.	Johnsonphone, Amer. Int. Commerce Co.	New York, NY	?
41.	Kalex	New York, NY	?
42.	Kenmore, Kodel Electric Co.	Cincinnati, OH	?
43.	Lackner Clock Co.	Cincinnati, OH	?
44.	Lux Manufacturing Co.	Waterbury, NY	?
45.	Manning Bowman	Meriden, CT	?
46.	Marlow & Co.	York, PA	?
47.	O. B. McClintock	Minneapolis, MN	?
48.	McGraw Edison	?, ?	(S)
49.	Measured Time	LaPorte, IN	?
50.	Merchant's Service Syndicate	Adrian, MI	?
51.	Miller Electric Clock	?, ?	?
52.	New Haven Clock Co.	New Haven, CT	?
53.	New York Standard Watch Co.	Jersey City, NJ	(B)
54.	No-Key Clock Co.	Wheeling, WV	(B)
55.	Numochron, PennWood Electric	Pittsburgh, PA	?
56.	Paragon Electric Co.	Two Rivers, WI	?
57.	Plymouth, Seth Thomas	Thomaston, CT	?
58.	Poole Manufacturing Co.	New York, NY	(B)
59.	Rempe Manufacturing Co.	Danville, PA	?
60.	REX	?, ?	?
61.	Rex-Cole	?, ?	?
62.	Salem Clock Co.	Hartford, CT	?
63.	Self Winding Clock Co.	New York, NY	(B)
64.	Sempire Clock Co.	St. Louis, MO	(B)
65.	Sessions Clock Co.	Bristol, CT	(S)

66.	Seth Thomas Clock Co.	Thomaston, CT	(B)
67.	South Bend Clock Co.	South Bend, IN	?
68.	Standard Electric Time	New Haven, CT	(B)
69.	Stanford Products	Daly City, CA	?
70.	Swift & Anderson	Boston, MA	?
71.	Switchman, RV Mfg.	Marshfield, MN	?
72.	Thrasher Clock Co.	Manchester, CT	(B)
73.	Tiffany Electric Mfg. Co.	New York, NY	?
74.	Timex Corp.	Middlebury, CT	?
75.	Twin Face Clock Co.	New York, NY	?
76.	Twinmill, Chron-Art Electrical Mfg. Co.	Jersey City, NJ	?
77.	United Metal Goods	Brooklyn, NY	?
78.	Wallace & Tiernan Products	Belleville, NJ	(B)
79.	Waltham Electric Clock Co.	Waltham, MA	?
80.	Warren Telechron	Ashland, MA	(S)
81.	Waterbury Clock Co.	Waterbury, CT	?
82.	Whitehall-Hammond	?, ?	?
83.	Windsor	?, ?	?

ELECTRICAL PRECISION

by Charles K. Aked

EARLY electric clocks were ignored by mechanical horologists in England, so it comes as no surprise that such clocks in use on the Continent were practically unknown except to a few British specialists, yet before the end of the 19th century an electrically maintained observatory regulator at Neuchâtel had surpassed the best of the mechanical regulators made up to that date.

The man who achieved this received his early training as a clockmaker in one of the schools of horology in Switzerland. His name is Matthaus Hipp, born in 1813, dying at the age of 80 years in 1893. At the age of 21 he set up in business at St. Gallen in Switzerland. In the course of his career he had addresses at Ulm, St. Aubin, Reutlingen, Berne and Neuchâtel. From the start he was interested in precision pendulum clocks and in 1834 he invented a clock in which the pendulum was only impulsed when the arc fell to a certain minimum level, upon which the pendulum released an arm which then allowed a toothed wheel to give an impulse to the pendulum. Hipp wrote a description of his clock in *Dinglers Polytechnisches Journal*, Volume 88, pages 258-264 and 441-446, with an engraved plate; under the title: "An automatically controlled clock which immediately indicates when any irregularity due to friction or the like occurs, even if it amounts to only one-thousandth part of a second, and which can overcome a hundred-fold greater resistance than any other clock. Invented by Matthaus Hipp, clockmaker in Reutlingen. He was awarded a silver medal in 1840 and a patent at Wurttemburg in February 1843, the year when his description was published; the second part of which shows how his invention may be applied to a balance.

It may be apocryphal, but it has been said that the first idea of using electricity to drive a pendulum came to Hipp during a bout of insomnia in 1834; however his first electrically driven clock with the famous "Hipp toggle" did not appear until 1842. By then Alexander Bain had demonstrated his electro-magnetically driven pendulum; both men being forestalled by Steinheil in Germany with the distribution of time by electricity in 1839. Hipp's toggle switch is unique in that it continued in successful use until the demise of electro-magnetically driven clocks.

Hipp continued to improve his design, culminating with its application to an astronomical regulator in which the pendulum swung in a very low pressure of air in a sealed glass cylinder, no oil being used on the operating parts, a feat not possible with a mechanical clock, apart from the difficulties in rewinding such a clock in a sealed case. The accuracy of Hipp's astronomical regulator was checked and recorded over a number of years by Dr. Hirsch, director of Neuchâtel Observatory, a great admirer of Hipp's clock, and rightly so because the workmanship of Hipp's electric clocks is first-class since he was a clockmaker first, and an electric clockmaker second. The quality of the workmanship of his electric clocks puts those made in other countries to shame, especially England. Dr. Adolphe Hirsch read several papers on the subject of Hipp's precision clocks to the *Societe des Sciences naturelles de Neuchâtel* under the title "La Pendule electrique de precision de M. Hipp", firstly in 1884, published with a folding plate in the same year; it was given a second edition in 1889. A new report was published in 1891, based on the lecture given on 28th May, 1891, at Neuchâtel but without the folding plate of the earlier pamphlets. The original paper was also published in the *Deutsche Uhrmacher Zeitung* of 1884, pages 78-81 and 86.

These sources are not readily available to the average reader and are very expensive to acquire because of their rarity today. Another disadvantage is that they are written in French or German. I have not been able to find these papers published in English previously. As the pamphlet in the writer's possession does not contain a description of the regulator, this is given first for convenience.

Hipp's arrangement for maintaining a pendulum in motion by electromagnetism was known on the Continent as the "electric escapement with pallet and counter pallet", and not as in England much later, the "Hipp

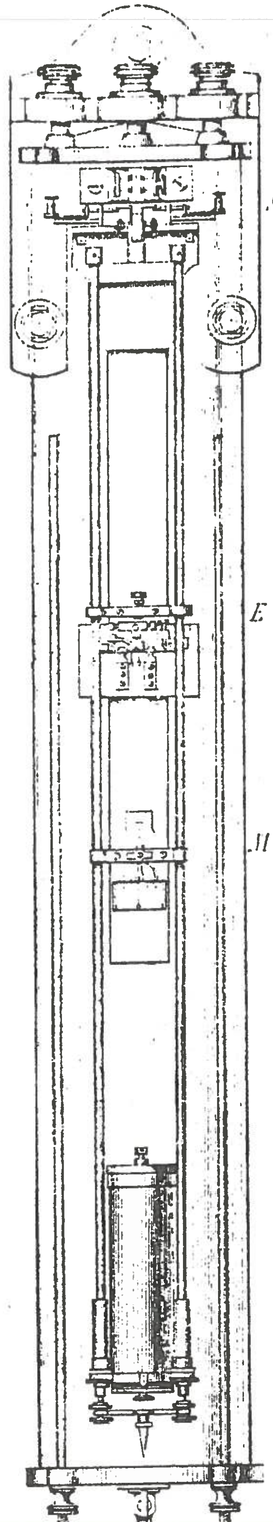


Fig. 1. General view of Hipp's precision electric regulator.

toggle". During the years 1877-84, he modified the arrangements to be able to apply it to an astronomical regulator for observatory use. His first model, designed and made for the observatory at Neuchâtel, was shown at the International Exhibition of Electricity, Paris 1881.

Fig. 1 gives an overall view of the regulator. As the Hipp toggle itself is only of use in an independent clock because the interval between impulses varies and cannot be used to control slave clocks, Hipp added a commutating switch arrangement to his pendulum, shown at S Fig. 1 and in Fig 2, placing the parts as high on the pendulum as possible to avoid interference with its motion, in fact attached to the lower cheeks of the pendulum suspension spring. A metal bridge suspended from an extension of the cheeks carries two parallel rods, a bridge about half way down the rods carries the so-called "electric escapement", see E Fig. 1, the separate switching arrangement used to maintain the pendulum itself in motion; lower still is the "electromagnet motor". Finally, at the end of the pendulum rods, a stirrup carries a steel cylinder containing mercury for temperature compensation.

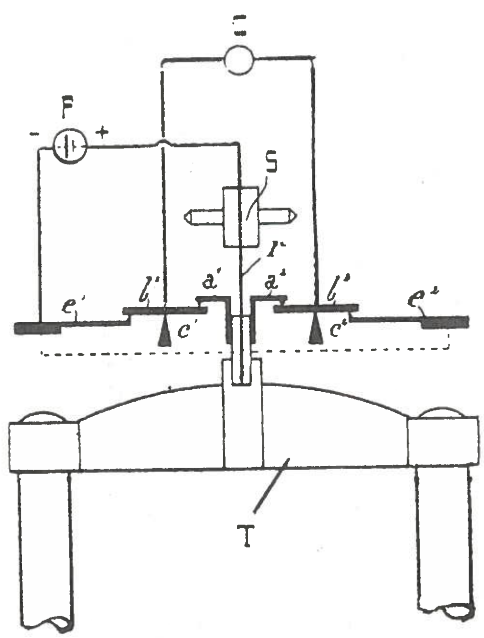


Fig. 2. Hipp's reversing contacts for producing impulses to slave clocks. Note that only one pair of inner and the opposite side outer contacts are closed at a time as the pendulum swings, and never assume the position where all the contacts are closed as shown here.

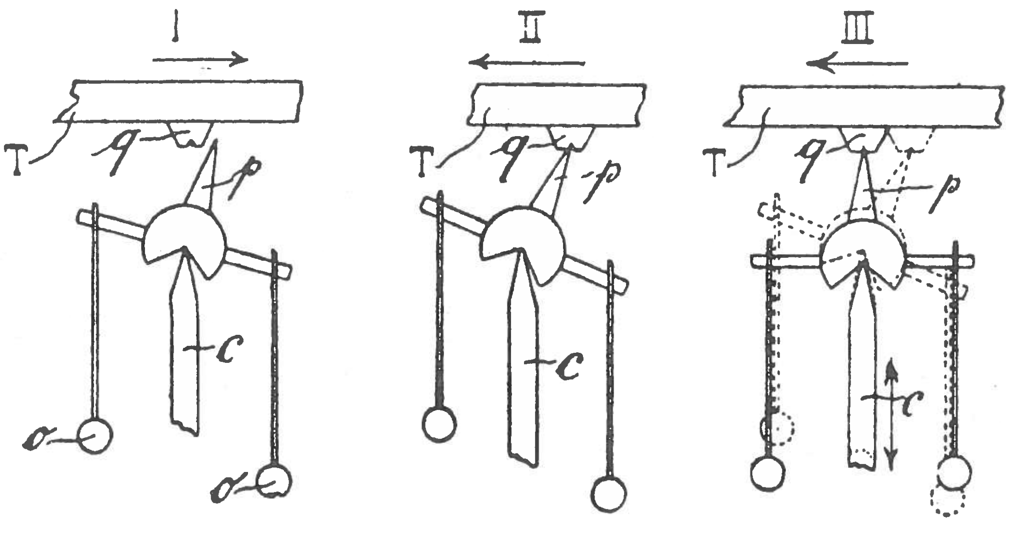


Fig. 3. The Hipp "electric escapement". It continuously monitors the arc of the pendulum and closes a pair of contacts when the minimum working arc is reached as a result of the working losses of the pendulum reducing the arc slowly.

Hipp's reversing contacts

Fig. 2 shows the arrangement of levers and contacts acting as a reversing switch or commutator under the reciprocating action imposed by the swinging pendulum. Each side of the suspension spring has a right-angled bracket fixed to it, electrical contacts are attached to the lower ends, these raise and lower the associated lever mounted on an iridium-platinum knife edge, also carrying contacts at each end. The outer contact touches a fixed contact on a spring when the lever is released, a small weight is used to bias the lever to one side. Thus as one lever is pressed down by its bracket on the pendulum the other rises and the current passing through the counter C (slave clock) at each swing of the pendulum. Pulses of current of opposite polarity are therefore transmitted to the circuit containing the slave clocks. Polarised or non-polarised slave clocks may be used.

The whole design is directed to the achievement of reliable contacting without abstracting energy from the pendulum, hence the knife edge supports for the levers and the fixing of the arrangement as near the centre of oscillation as possible. Although energy is expended in raising each lever, it is returned as the pendulum swing reverses, apart from friction losses, and these are very small.

Hipp's Electric Escapement

Fig. 3 shows the modified arrangement used by Hipp in his astronomical regulators, known as the pallet and counter-pallet electric escapement on the Continent. It differs from the usual arrangement because the trailer normally carried by the pendulum is replaced by a notched metal or garnet block, the trailer is placed upright on a metal cylinder fitted with two stones having triangular notches bearing upon a knife edge *c*. Above a certain minimum arc, the pallet is moved first to one side and then the other, being held there by counterweights *a*, pins on the pallet acting on the counterweights so that only one is acting at a time to bias the pallet.

At the critical minimum arc the lever *p* enters the notch in the block *q* so that as the pendulum swing reverses, the knife edge of *c* is forced downwards slowly, tilting a further lever which closes contacts to complete the circuit from the energising battery to the electromagnet used to impulse the pendulum by attracting a soft iron armature, see Fig. 4 and M in Fig. 1; and just as the centres of the armature and poles are about to coincide, the contacts open and the current from the battery ceases. Thus the pendulum receives considerable impulse acting very close to the centre point of the pendulum oscillation, a point most advantageous for good time-

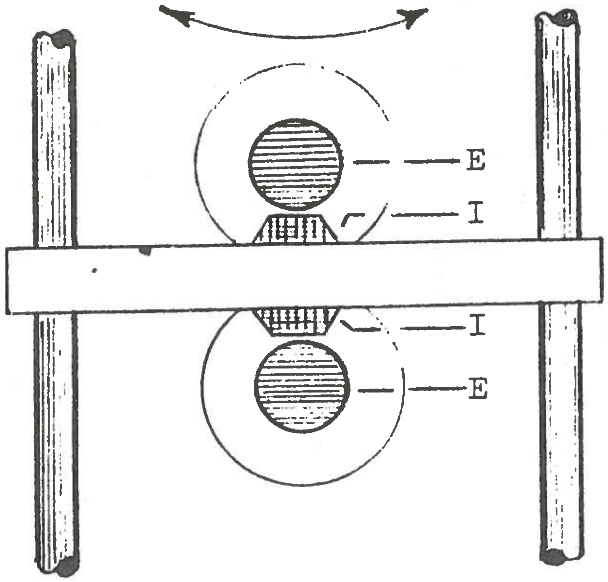


Fig. 4. Hipp's "electromagnet motor". I is a soft iron armature mounted on a brass bridge between the two pendulum rods, E is one of a pair of soft iron cores carrying a coil of copper wire which becomes a strong magnet when a current of electricity is passed through the coil. The pendulum is shown in the central position, the magnets are fixed to the clock frame.

keeping as it interferes least with the natural motion of the pendulum. The pendulum will continue to swing for a period of a minute or more before seeking another impulse, meanwhile it swings almost freely since the energy to move the reversing contacts and the pallet is very small. As the pendulum swings in an almost complete vacuum, the total losses are reduced to a fraction of a normal pendulum swinging in air.

Time is not indicated directly but has to be obtained by means of the counter C, or slave clock, therefore the arrangement shown in Fig. 1 is not strictly a clock in the sense we use today, it is an electrically maintained pendulum fitted with means for transmitting seconds pulses to slave clocks.

The preceding description had been much simplified in detail, if the reader wishes to pursue the matter further, Hipp's precision clock is described at length in *L'Electricité et ses applications a la Chronométrie* by A. Favarger, Neuchâtel, 1891 and 1924, second and third editions respectively. Another source is *L'Horloger Electricien* by G. Albert Berner, Bienne and Besançon, 1926.

In order to avoid the cost of resetting the tables, the original tables as published are given here, in the first table the first column gives the "Mean variation", the second "Number of observations". For the second table the columns are: "Daily going", "Temperature", "Manometric pressure in mm of mercury", "Duration between impulses in seconds", and "Remarks", respectively. In the final column the remarks are mostly about changing the batteries for the regulator and slave clocks, cleaning and oiling the counters, plus the mention of the disturbance of many clocks at the observatory on 4th and 5th February due to settlement of the ground.

The Precision Electric Clock of M. Hipp

Second notice communicated to the Society of Natural Sciences of Neuchâtel in the session of 28th May, 1891, by Dr. A. Hirsch.

It is seven years since I rendered an account of the remarkable clock with which the inventive genius of M. Hipp has enriched the instrumental resources of observatories, in it I gave a description and pointed out the essential merits of its original construction, which consist principally in avoiding the use of oil, in the ease with which it can be maintained under constant pressure, finally in the number of practical advantages which it offers to astronomers in operating the many clocks installed in the different observation rooms simultaneously, in addition to the registering of seconds on the chronograph.

I referred to all these points in the notice of 1884; and if I return to the same subject today, it is essentially to show that the results of the Hipp clock, already so remarkable then, are now even more perfect since we have succeeded in regulating the compensation perfectly and improved some other small details, so that the performance of the clock has given us the greatest satisfaction over the last two or three years.

It would be of little use to go into the details of the performance during the years 1884 to 1888, which included a number of experiments and the correction of the regulation, it is not until the end of July 1888, when the last regulation of the compensation had been made, that it is of interest to study the performance of the clock once more and to attempt to render a full account, as far as it is possible, of the causes to which one can attribute the remaining small variations of rate.

Covering the total period of seven years (1884-1891), I have restricted myself to setting out the results in a table, showing the performance from April 1884 to May 1891; giving the monthly averages of daily variation, together with the number of observations taken each month (see Table 1).

It can be seen from this table that the daily variation which, at the time of my first communication, was ± 0.06 second, has been reduced little by little down to about ± 0.032 second, and for the last three years, from the final regulation of the pendulum it is scarcely ever more than ± 0.023 second.

In order not to exagerate in recounting this remarkable regularity, it is necessary to say that the average of the daily variations indicated have profited from a type of compensation which, in the interest of the chronometric service, we carried out at the observatory for the intervening days between the two direct determinations of the time, in interpolating the rate of our clock for these days.

However, considering the great frequency of the determinations of the time, this influence should be inconsiderable, for since the annual number of the determinations of time, by means of the stars and the Sun, has been 245 during these last years, which represents on the average two determinations in three days, it is necessary to augment the indicated highest variation in the report by $\sqrt{3/2} : 1$, that is to say, a factor of 1.2, which gives a daily average variation ± 0.028 second.

Although this variation, from one day to another, of the daily rate of a clock or a chronometer, represents the best practical value for the astronomer and navigator, it is of interest to deduce the mean variation of the daily rate also over longer intervals, either five or seven days, avoiding all compensation; and we have chosen to sum up the weekly rates for convenience in abreviating the table of rates, which I kept to publish for the months of the last two years (see Table II), and in order to facilitate the calculations necessary to determine the principal coefficients of the rates.

Therefore, if one calculates the mean daily rates for the intervals of seven days, the mean variation for the period June 1888 to April 1891 is: ± 0.036 second.

Taking the average of these two values gives ± 0.032 second, in round figures ± 0.03 second for the mean variation of the Hipp clock, whereas seven years ago we found ± 0.06 second, which I then had hopes to see reduced to ± 0.05 second, and so our hopes have been more than realised.

Now this value of 0.03 second represents an astonishing regularity of rate. If, as I have remarked already in my first communication, one considers that this variation necessarily includes the inexactitude of three determinations of time which are deduced, including the correction errors of the instruments and the variability of the physiological time (reaction time) of the observer, there remains a minimal fraction which is due to the real changes of the clock. In effect, if one can evaluate the value from observations of the stars to 0.012 second, the probable error of a determination of the time, this already gives an uncertainty of rate of ± 0.017 second, and that for a variation of ± 0.024 second, and evaluating the same exercise for the observer, with a mean of 0.015 second for the personal equation variable, one finds that there remains for the part belonging to the clock itself to be as little more than ± 0.015 second.

Conversely, it is evident that it would not have been possible to establish this slight variation of the Hipp clock except for the precision and frequency with which we have succeeded in determining the time.

For the rest, it is evident that this regularity, now almost perfect rate of our clock is due in the first place to the considerable improvement that we have brought to the adjustment of the compensation (of the pendulum with temperature).

To be continued.

N° 14,126 A.D. 1910

Date of Application, 10th June, 1910

Complete Specification Left, 10th Jan., 1911—Accepted, 10th July, 1911

PROVISIONAL SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, FRANK HOLDEN, of No. 1, Harcourt Buildings, Temple, London, E.C., Electrical Engineer, do hereby declare the nature of this invention to be as follows:—

My invention relates to electric clocks more particularly of the kind described in my Patent Application No. 14,873 of 1909 and has for its object to provide an improved contact arrangement whereby chattering of the movable contact carried by the pendulum or balance-wheel is entirely prevented, thereby ensuring effective and certain closure of the circuit of the energising coil during the time of engagement with the fixed contacts.

According to my invention I construct the contacts of magnetic material and I magnetise both of these contacts. The magnetisation may be inductively produced by a magnetic field located in the neighbourhood of the point of engagement of the contacts or, more simply, by using a movable contact of a piece of steel such as watch-spring steel, which is magnetised before it is mounted on the pendulum. This piece of steel is provided at its upper end with a loop of silver, by means of which it is loosely hung upon a silver pin projecting from the pendulum. The lower end of the contact is tipped with silver or other suitable metal at the point where it engages the fixed contact or contacts and these fixed contacts are constructed of nickel or other suitable magnetic material, preferably coated with silver, so that when the movable steel contact member is carried by the pendulum into engagement with the fixed contacts it is magnetically prevented from rebounding from the contacts, thereby ensuring that the current in the coil is effectively made during the time of engagement.

Dated this 10th day of June, 1910.

JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Electric Clocks.

I, FRANK HOLDEN, of 1, Harcourt Buildings, Temple, London, E.C., Electrical Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to electric clocks of the kind in which the time-keeping element, that is the pendulum or balance wheel, carries a pivoted contact which by the motion of the said element, periodically engages a fixed contact, thereby closing the electric circuit which energises the time-keeping element.

[~~Price 8d.~~]

PRICE 1/-

An example of a clock to which my invention is more particularly applicable is given in my Patent No. 14,873 of 1909. Clocks constructed as described I find have a liability to variation in the amplitude of swing of the pendulum, apparently due primarily to the rebound of the contacts after touching which probably causes a variation in the duration of the time of actual contact. By means of my invention the electrical contact is made preferably definite, and invariable in character resulting in constancy of the amplitude of swing and incidentally in an increase of the electrical efficiency of the driving element.

According to my invention the moving and fixed contacts are magnetised so that when touching or nearly touching a magnetic attraction takes place between them of sufficient strength to prevent rebound, the consumption of energy in the contact mechanism being still so small as not to interfere with the time keeping properties of the clock.

In the accompanying drawing, illustrating my invention, I have shown in front elevation part of the pendulum clock illustrated in the patent specification above referred to. Referring now particularly to the drawing, *a* is the pendulum bob, *b* is the energising coil and *c* are the magnets through the fields of which the coil *b* is swung by the motion of the pendulum. The movable contact consists of a strip *d* of magnetic material, such as watch-spring steel, which is provided at its upper end with a loop *e* of silver, by means of which it is loosely hung upon a silver pin *f* projecting from the pendulum bob *a*. The lower end of the strip *d* is tipped with silver *g* or other suitable metal at the part which engages the fixed contacts *h* and *i* and these contacts are constructed of nickel or other suitable magnetic material preferably coated with silver strips *j* and *k* as shown. The electric connections for the coil and contacts (which are shown clearly in Fig. 3 of the specification above mentioned) have been omitted as they are unnecessary for the understanding of the present invention. By making the contact strip *d* of magnetic material which can be permanently magnetised or magnetised inductively by a separate field such as the stray fields of the magnets, the fixed contacts also being magnetic, the movable contact when brought into engagement with the fixed contacts by the pendulum is magnetically prevented from rebounding from the fixed contacts, thereby ensuring that the circuit of the coil is effectively completed during the time of engagement. Secured to the upper end of the fixed contacts is a piece of insulating material *m* for the purpose of limiting the period of actual contact between the fixed and moving contacts to a time corresponding to a small movement of the pendulum.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In an electric clock of the kind hereinbefore referred to, magnetically reinforcing the engagement of the electric circuit contacts.
2. In an electric clock of the kind hereinbefore referred to, the improve construction of electric circuit contacts substantially as hereinbefore described.

Dated this 10th day of January, 1911.

JOHN GRAY,
83, Cannon Street, London, E.C.,
Agent for the Applicant.

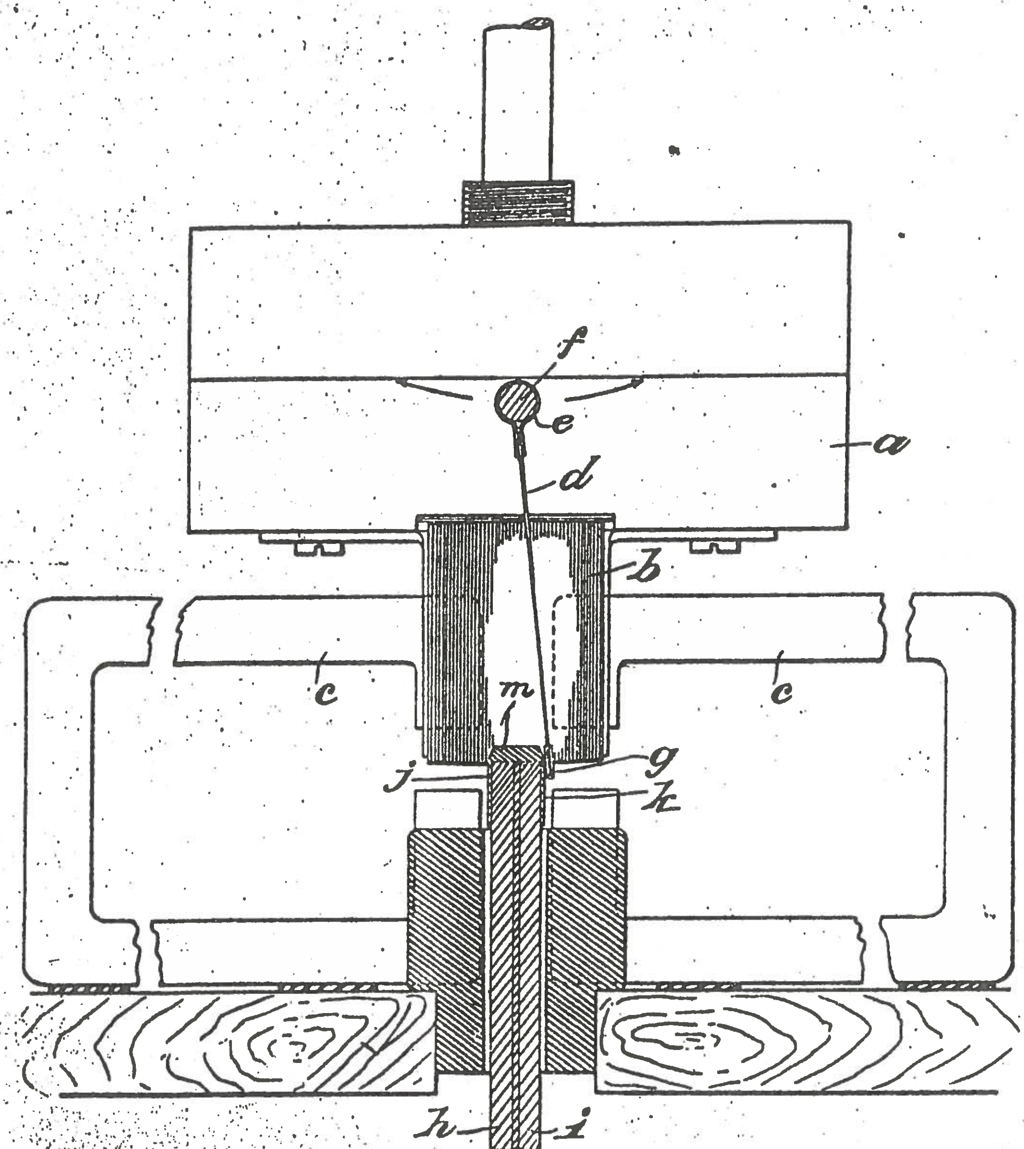
Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1911.

A.D. 1910. June 10. No. 14,126.

HOLDEN'S Complete Specification.

(1 SHEET)

[This Drawing is a reproduction of the Original on a reduced scale.]



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1926

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"Bulle-Clock"

The wonder timepiece

ESTABLISHED OVER 150 YEARS

J. E. Simms

Jeweller

CHIPPING NORTON

GRAND PRIX PARIS 1925

THE BULLE-CLOCK

From the many articles which have appeared in the technical press commenting favourably on the Bulle Clock, we give below an extract which was published in one of the leading scientific magazines.

ELECTRICITY IN THE SERVICE OF THE CLOCK MAKING INDUSTRY

It is rather astonishing that Electricity has not until now been called upon to play an important part in the evolution of time-keeping instruments, and to take the place, as motive force, of the springs and weights used in our clocks of yesterday, so doing away with the necessity for periodic winding. One must think that the question of the designment of a reliable electric clock was no simple problem, for although we know that many attempts have been made, from the very time of the invention of the telegraph, little progress seems to have been made towards a practical solution, and any models constructed left much to be desired. In the beginning, efforts were made on the principle of rewinding by electrical means, ordinary weight or spring-driven movements, but as this only mean a more complicated interior for a clock and no corresponding advantage, this indirect method soon came to be abandoned.

Photo Manuel.

Maurice FABRE-BULLE
dit FAVRE HEINRICH ✳
Horloger de la Marine de l'Etat
Hors Concours, Membre du Jury

Experiments turned in the right direction, on the day when it was found that electricity could be directly employed to keep up the oscillation of a pendulum, with perfect regularity, thus rendering unnecessary the train of gearing, etc..., which constituted an essential part of the ordinary mechanical clock. This discovery resulted in the appearance of time-keeping instruments of high precision, suitable for astronomical purposes but too complicated, too delicate and of too difficult a use to prove practical as ordinary domestic clocks.

An electric clock, if it is to be of service to «the man in the street», should be solidly constructed, be certain in its working, and demand no specialised knowledge, either for its installation or its care afterwards.

These conditions are now fulfilled, and the clock which we describe hereafter is no more susceptible to derangement by ordinary use, than is the receiver of a telephone set.

The «Bulle Clock», invented by Moulin and Favre-Bulle, depends for its movement on an electro-magnetic motor-system, the energy of which is 50.000 times greater than that produced by the unwinding of the spring of an ordinary watch. This energy is given by a small battery, such as used by electric bell installations etc..., and having a capacity of approximately 50 watt hours. As is known, 1 watt hour is equal to 3,600 Joules, and 1 Joule is equal to 9/81 of a Kilogrammetre, so that the total capacity of the battery, converted into mechanical energy, equals 18,000 Kilogrammetres. A force theoretically capable of raising a weight of 1 Kilo to a height of 18,000 metres. Practically there are losses by friction etc..., in the moving parts of the transmission, but nevertheless the small battery, as is proved by a comparison of its energy with that of a spiral spring.

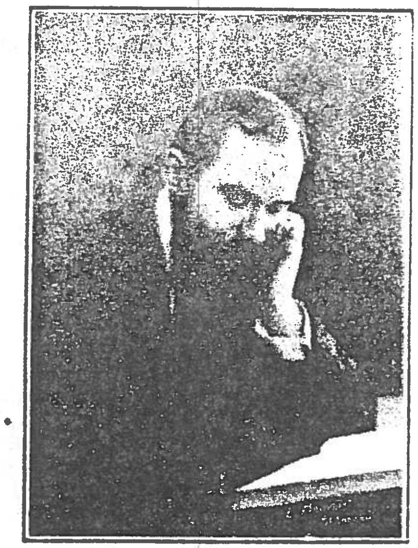


Photo Marvillier.

Marcel MOULIN ✳
(docteur ès Sciences)
Ex-professeur de chronométrie de la Faculté de Besançon

can maintain the motion of a clock for many years without rewinding or any intervention whatever.

In the system we mention, the motor consists of a solenoid forming the «weight» of the pendulum. Traversing the solenoid is a special steel bar, curved in a form to correspond with the arc described by the swing of the pendulum. The bar is fixed, while the solenoid is free to oscillate without rubbing against the bar by which it is traversed. The latter is magnetised in such a manner that either extremity presents one polarity, while the middle of its length presents the other politary, with the result that when the ends of the wire forming the solenoid are suitably connected to the battery, the solenoid is acted upon by a force compelling its movement from left to right. It will be appreciated that under such conditions, if a contact is introduced in the circuit, embracing the battery and the solenoid and if this contact is closed at equal periode, when the solenoid is moving in the direction indicated above, the latter receives successive impulses and the action can be likened to that of a child's swing. A pusch given each time the pendulum passes in the same direction, keeps up the motion. In the «Bulle-Clock» the successive contacts are assured by the pendulum itself, which also assures the rotation of the gearing, transmitting the movement to the hands.

The conditions obtained with the contact are highly favourable, as the emissions of current are short, though of a feeble intensity which the remarkable properties of the electro-magnetic motor reduce to a minimum at the instant of the rupture. Thus no sparking can occur, and the contact has rather the tendency to improve by use than otherwise.

The battery calls for no other attention than the addition of a few drops of water, because of the slow evaporation after years of work. The capacity of the battery supplied with a «Bulle-Clock» is sufficient to assure its drive for many years. A new battery can be placed very simply, and without any electrical knowledge whatever.

The practical application of electricity to our household clocks. marks a considerable improvement in the clock-making industry and the electric clock is undoubtedly the clock of the future, doing away, as it does, with troublesome breakdowns, irregularities, and the continual need of periodic re-winding.

THE BULLE CLOCK IS A SELF-CONTAINED ELECTRIC TIME-PIECE WHICH CAN BE PLACED WHERE DESIRED JUST AS AN ORDINARY CLOCK, AND QUITE INDEPENDENT OF WIRELESS OR THE LIGHTING CIRCUIT

The wonderful success of the Bulle Clock is due to the perfection of its system, and to the precision of every part used in its construction.

It gives the exact time always, and does not require rewinding. Should it be stopped, through accident, it will automatically re-start.

It is free from the many troubles to wich mechanical clocks are liable and its regularity is unaffected by either shocks or vibration.

Its consumption of electricity is reduced to the extreme limit.

A small concealed battery, cheap and easy to replace, ensures regular working for many years.

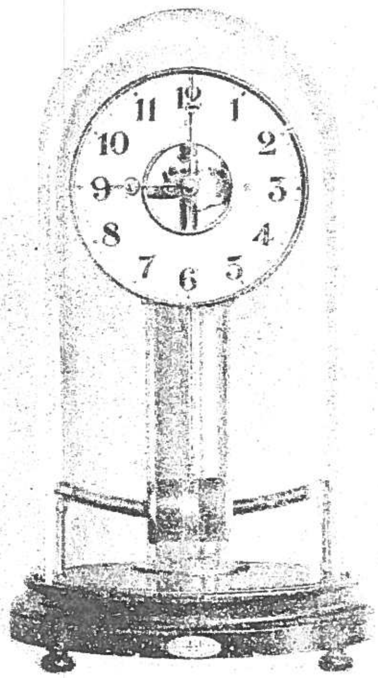
There is a variety of "Bulle-Clock" models wide enough to assure all tastes being satisfied.

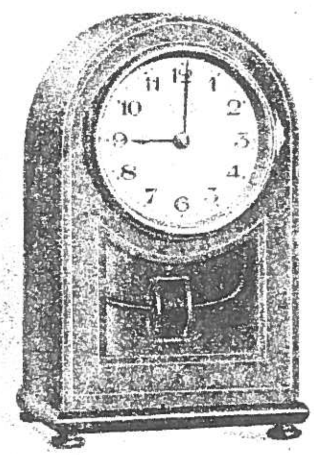
1

BULLF-CLOCK. -- **Model A.** (initial model) 6 in. dial.
height 16 in. diam. of base 9 in.
FIXED PRICE £ 4.4.0.

BULLE CLOCKETTE **No 100.** -- Mahogany. 3 1 2 in. dial.
height 9 in. width 6 in. depth 4 1 4 in.

MODELE A

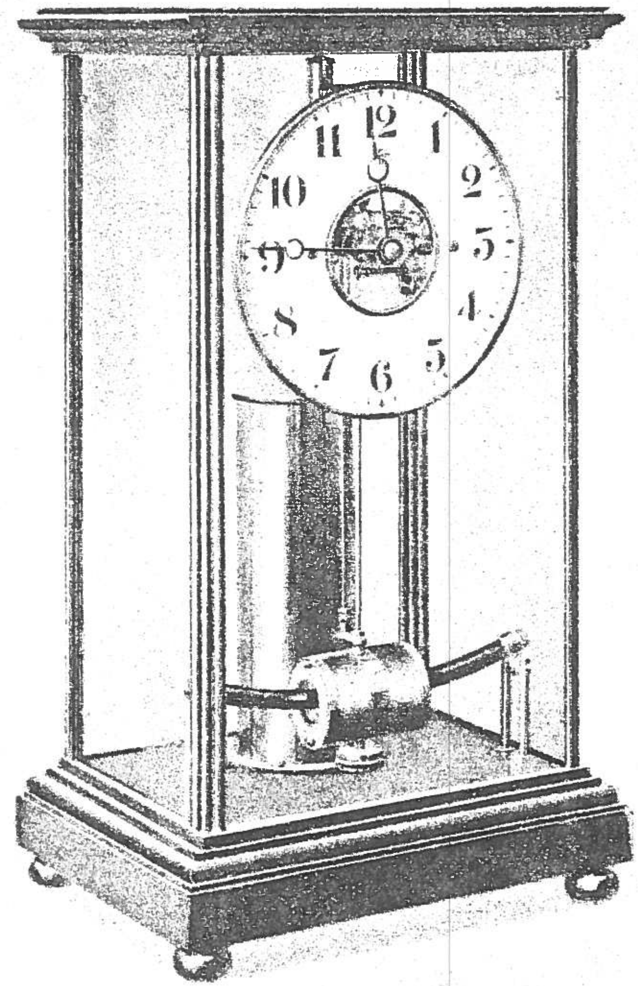




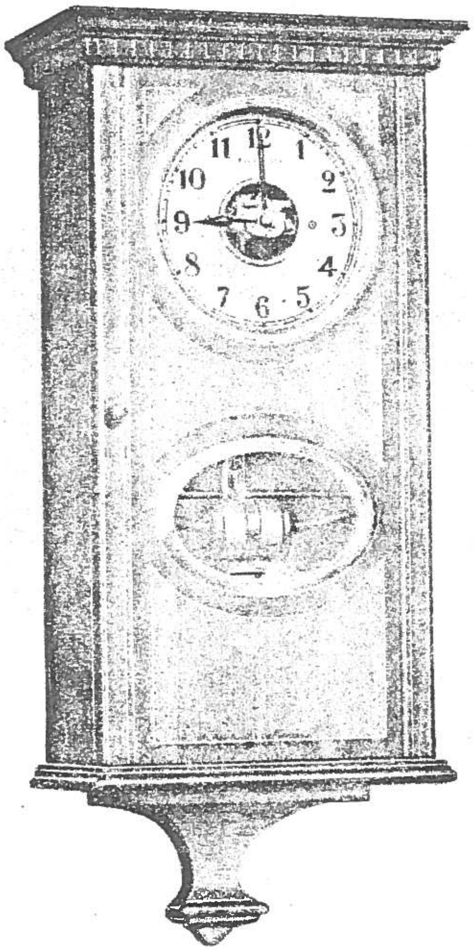
BULLE CLOCKETTE ACAJOU

2

BULLE CLOCKETTE. -- **Model F.** Square Glass Frame. 6 in. dial.
Mahogany Base — Rich gilt finish.
height 15 in. width 9 in. depth 6 1 2 in.
FIXED PRICE £ 6.6.0.

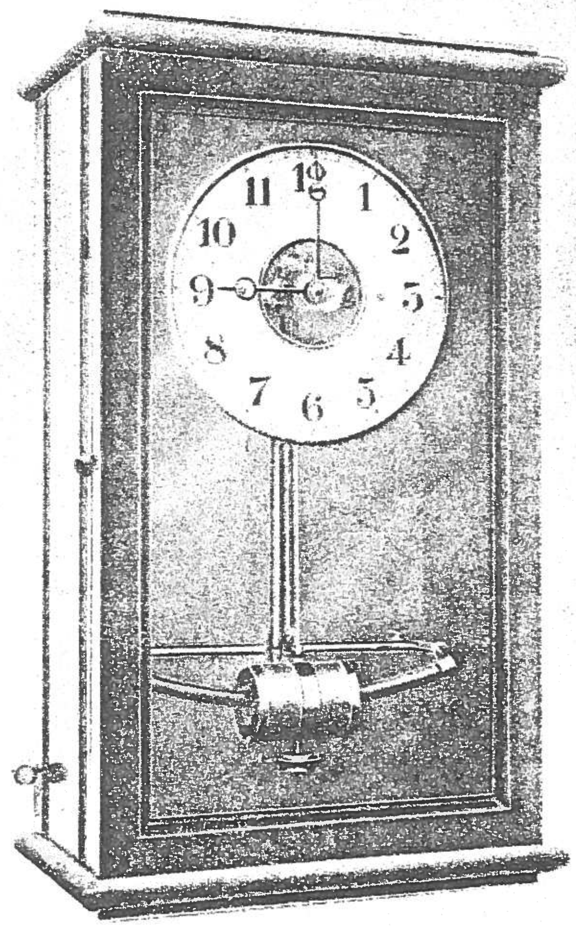


BULLE-CLOCK. — **Model B5** Wall Type. 6 in. dial. Mahogany, inlaid glass panel or plain.
height 23 in. width 10 in. depth 5 in.
FIXED PRICE £ **6.16.6.**



Same model in Oak. £ **6.6.0.**

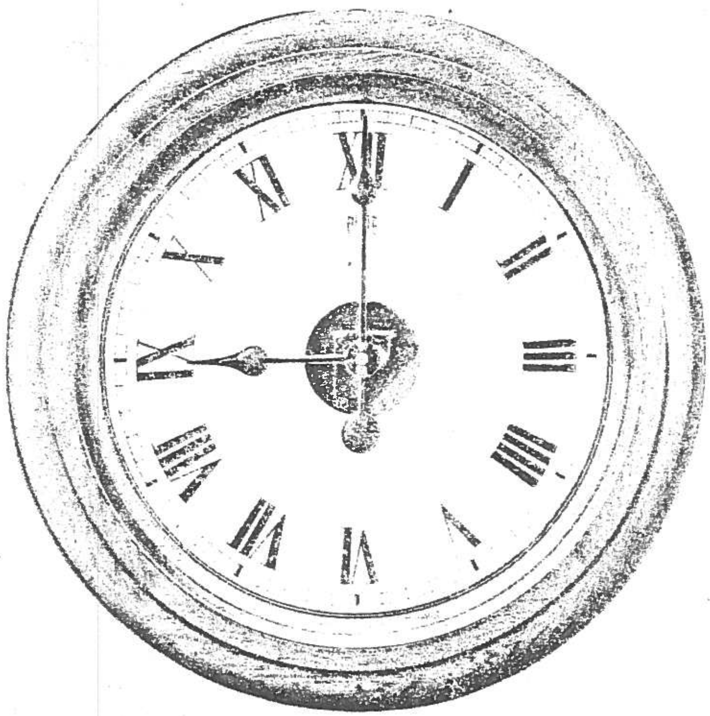
BULLE CLOCK. — **Model BA** Wall Type. Mahogany. 6 in. dial.
height 16 in. width 9 in. depth 5 in.
FIXED PRICE £ **5.5.0.**



5

BULLE CLOCK. — **Model E.** 12 in. dial clock. Mahogany or Oak.

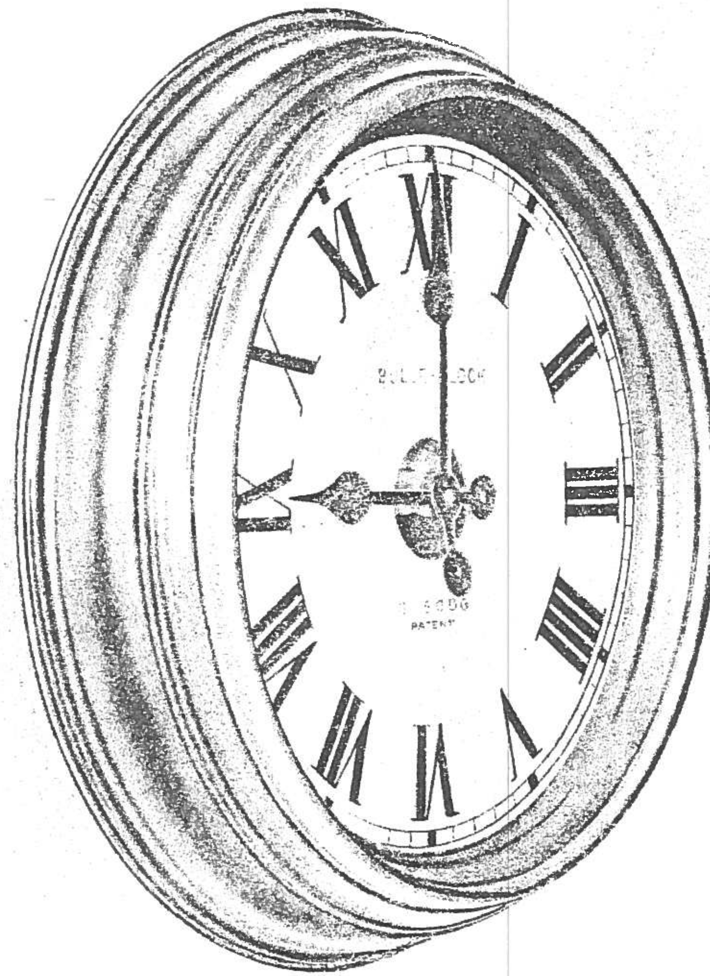
FIXED PRICE £ **4.14.6.**



6

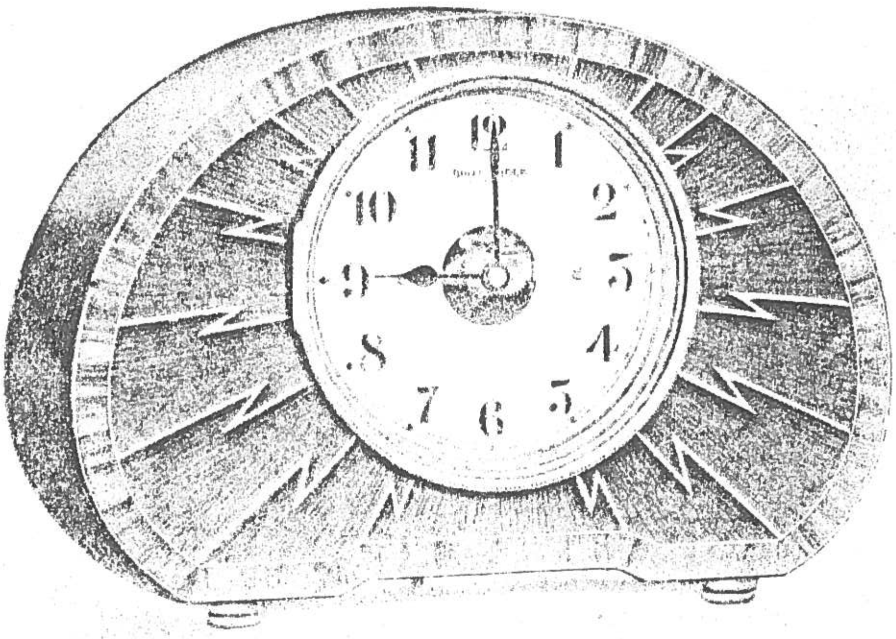
BULLE-CLOCK. — **Model EE.** Railway pattern. 12 in. dial clock.
Case, polished brass or varnished green or cream.

FIXED PRICE £ **6.16.6.**



BULLE-CLOCK. — **Model "XA"**. Paris Exihition model (Grand Prix). Mahogany & inlaid rosewood, 6 in. dial. height 9 1/2 in. width 13 in. depth 3 1/2 in.

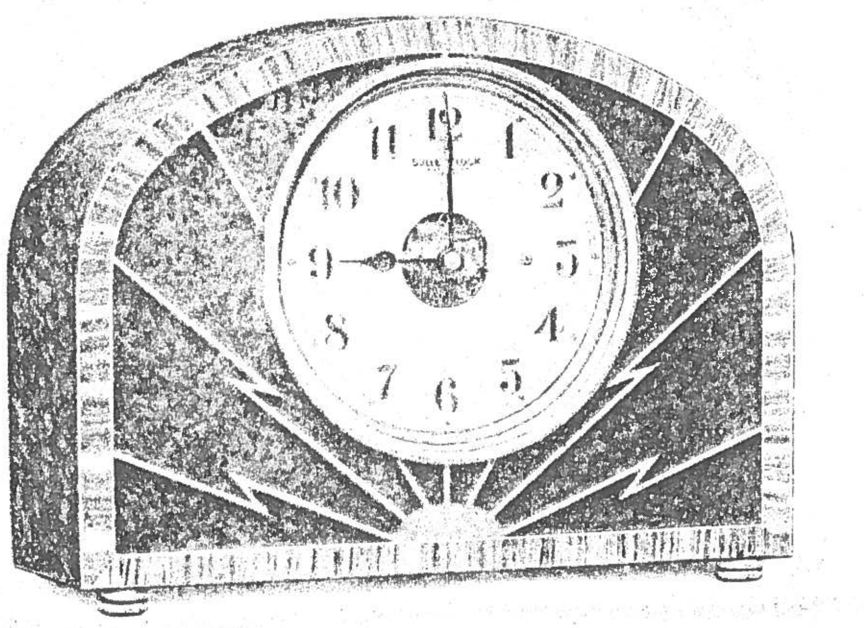
FIXED PRICE £ 6 15 0.



Same model in Marble £ 12.10.0.

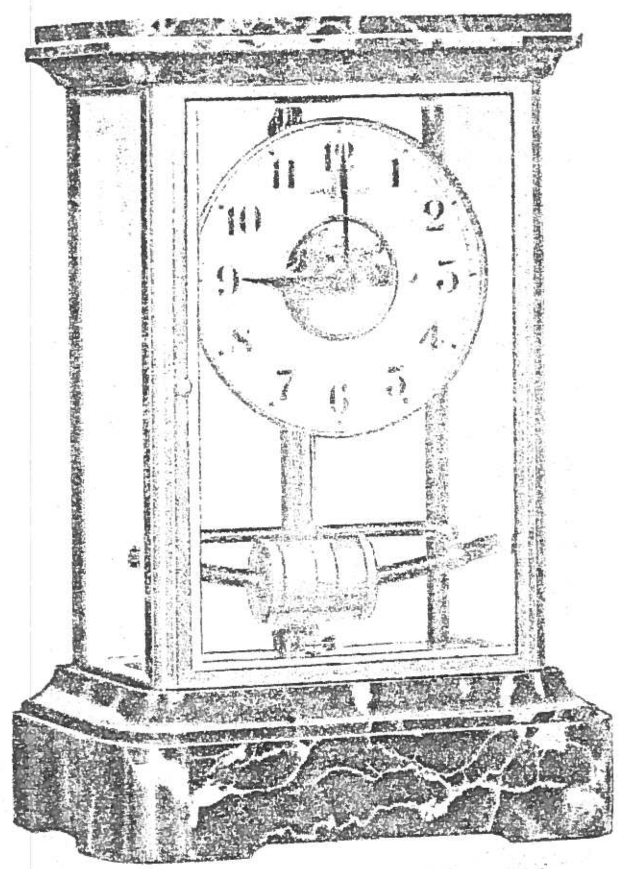
BULLE-CLOCK. — **Model XB.** Paris Exhibition Model (Grand Prix). Burr, mahogany & inlaid Rosewood, 6 in. dial. height 9 1/2 in. width 12 in. depth 3 3/4 in.

FIXED PRICE £ 7.0 0.



BULLE-CLOCK. — **Model "L".** Marble top and base, heavily gilt bronze frame, bevelled glasses, de luxe Model, 6 in. dial.
height 15 in. width 10 in. depth 4 1/2 in.

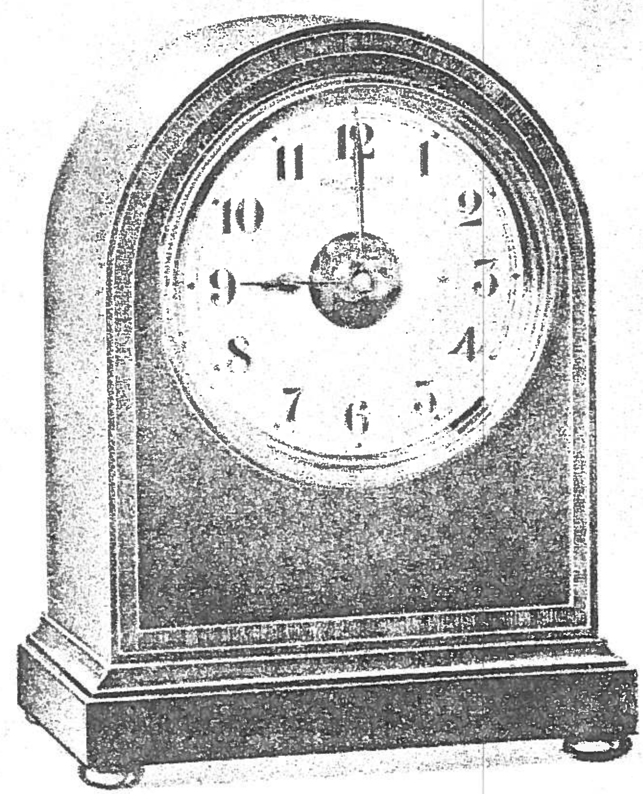
FIXED PRICE £ **15.0.0.**



Same model (Model H) all gilt bronze.
FIXED PRICE £ **10.10.0.**

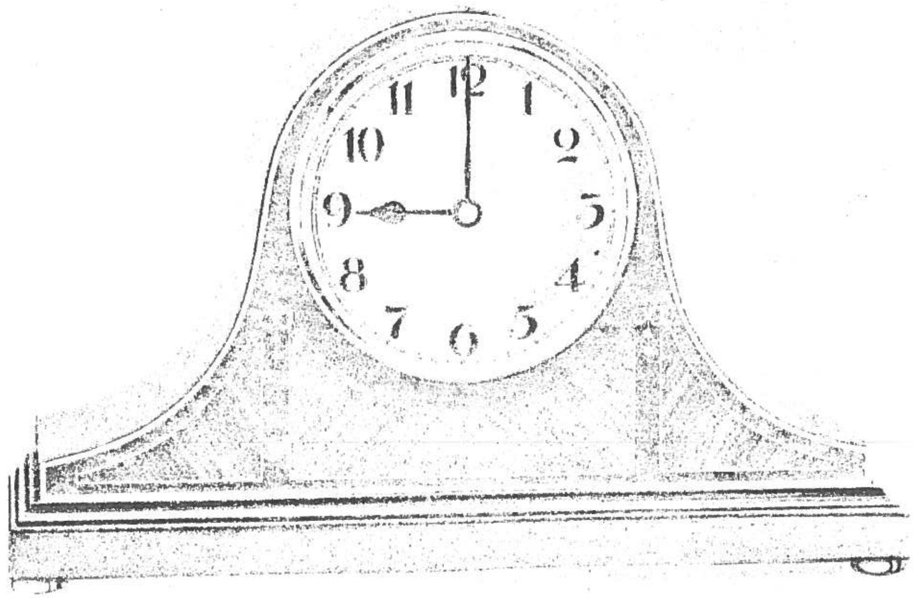
BULLE-CLOCK. — **Model N° 5.** Mahogany inlaid, 6 in. dial.
height 11 in. width 9 in. depth 5 in.

FIXED PRICE £ **5.7.6.**



Same shape **N° XC.** 5 in. dial. height . width . depth
FIXED PRICE mahogany £ **3.19.6.**
Precious knob or lemonwood £ **5.5.0.**

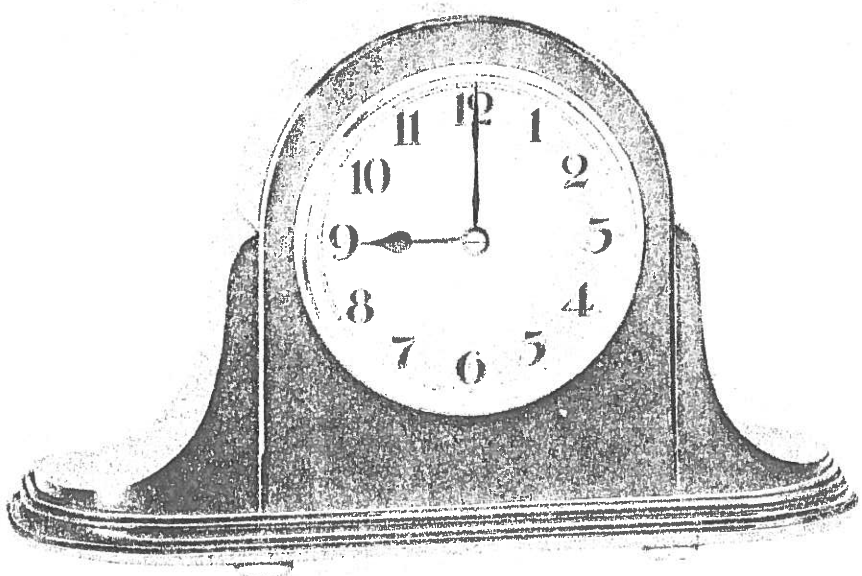
BULLE-CLOCK. — **Model N° 23**. Napoleon, walnut. White ivory inlaid.
height 10 in. width 16 in. depth 5 in.
FIXED PRICE £ **7.10.0.**



11

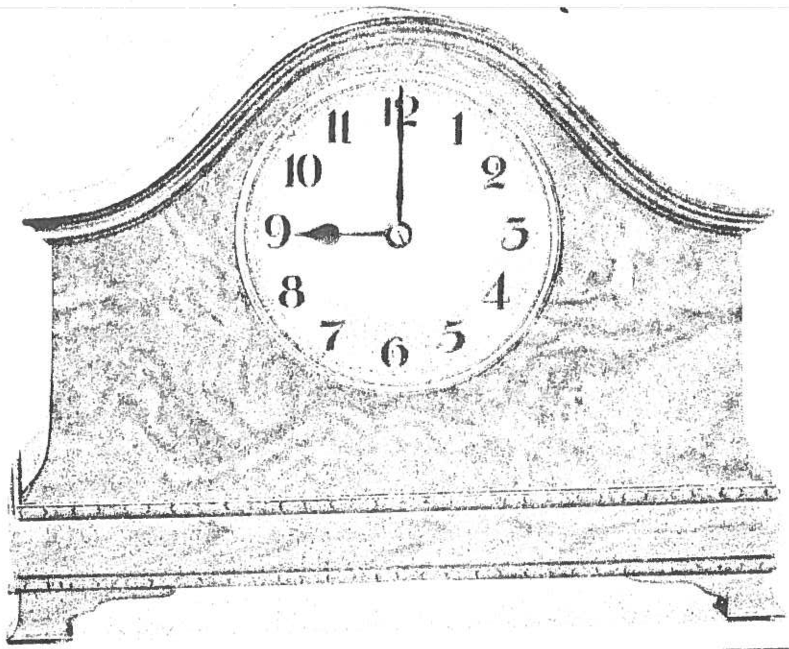
12

BULLE-CLOCK. — **Model N° 39**. Mahogany or oak, 6 in. dial.
height 10 in. width 16 in. depth 6 in.
FIXED PRICE £ **5.12.6.**



Same model 5 in. dial. £ **5.10.0.**

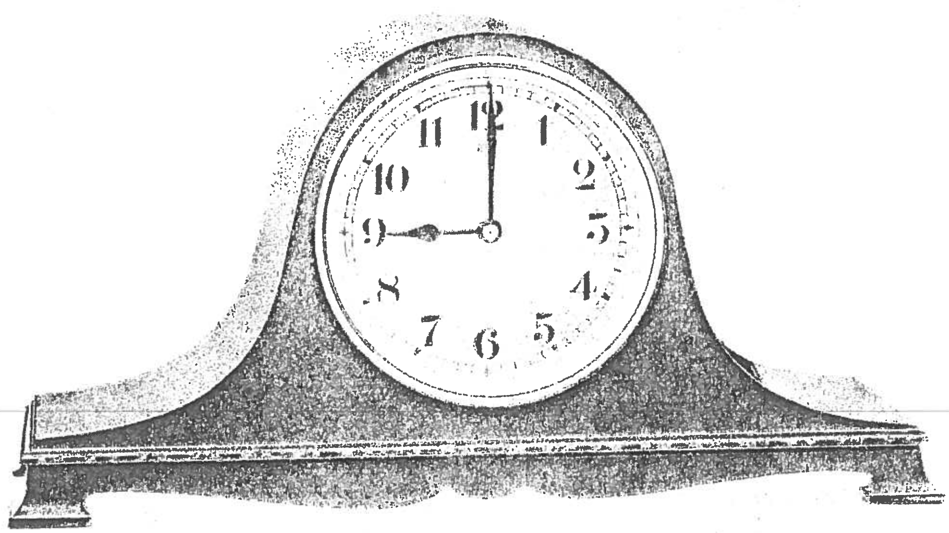
BULLE-CLOCK. — **Model N° 24.** Walnut 6 in. dial.
height 12 in. width 15 in. depth 5 in.
FIXED PRICE £ 7.10.0.



13

BULLE-CLOCK. — **Model N° 13.** Napoleon, mahogany. 6 in. dial.
height 9 in. width 17 in. depth 5 in.
FIXED PRICE £ 6.6.0.

14



To be continued.

Same model in oak £ 6.0.0. — Same model in walnut. £ 6.12 0.

Collection of about 200 electric clocks (50 master, 80 independent, 30 secondary, 20 synchronous, 10 quartz) for $35,000. Details open for discussion. The clocks are in Switzerland. Michel Viredaz, Home +41 21 784 05 38, Work +41 21 924 23 31, Fax +41 21 924 45 29,
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