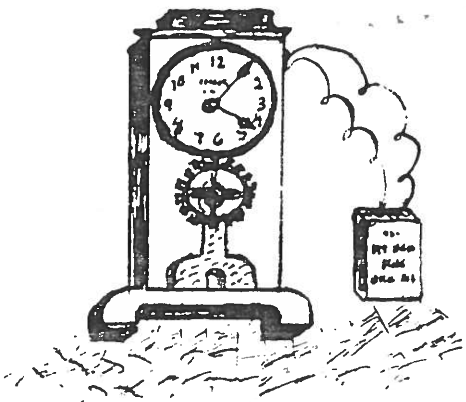
The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78



April 1978
VOLUME IV---ISSUE #2
Martin C. Feldman, Editor

Hello fellow enthusiasts:

We note with regret but not with surprise the appearance of fewer and fewer examples of electrical horology which still are available to the average specialist collector. I can easily recall just a few years back at least three or four Tiffany Never-Winds, Barrs, and Bulles being very common on Mart tables at various clock meetings. A case in point is the last New York Regional which I attended on April 7 at the Concord Hotel in Kiamesha, New York. With close to 200 exhibitors there were terribly few electrical clocks with only one double-contact Tiffany Never-Wind. The latter was the highlight of all the electrics. The few Bulles which were displayed were only exceptional because of their price tag. I feel certain this is a trend in that fewer electrics will be available in the future and prices will commensurately continue to rise. The devaluation of the dollar and the English pound has cut very heavily into buying electrics from many European countries---with the exception of those able to financially overcome the currency fluctuations and inflation. The only way to stand up to the economics of supply and demand, devaluation, and inflation, is to firmly advise the seller that a particular clock is worth what you fairly are willing to pay and to stick by your guns. If this means losing the clock for a principle ---then so be it. Living by principles in life is never easy but nevertheless one must, and they extend to the horological world as well.

In this issue we are featuring two patents. The S. Fischer patent has been requested by many members. This clock movement is featured photographically as well. It was produced in unknown, but apparently very moderate numbers, by the New York Standard Watch Co. operating out of New York. These are Hipp contact clocks and can usually be depended upon for a good rate. A striking feature of the clock is the three in-tandem semi-lunar plates which support the train. The workmanship is usually of excellent quality with some models having gilt plates. The second patent is one of the earliest American patents I have been able to come across and is being reprinted for that reason. Whether such a clock was ever extant is debatable, but wouldn't it be absolutely delightful to find one! Lastly, we are reprinting with kind permission an article by George E. Lloyd-Jones, The Bulle Clock. It is an excellent article which should be appreciated by those who don't read French (La Bulle Clock - by H. Belmont) since it is written in English describing the mechanism and basic repair hints which are important in servicing these very sensitive clocks.

Enjoy this issue.

Electromagnetically yours,

Martin C. Feldman, FNAWCC

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***** MART *****

WANTED: Stromberg Masters--Write details.
Joseph Bourell, 4213 No. Milwaukee Ave., Chicago, Ill. 60641

WANTED: Electrical Horological Literature---any type. Highest prices paid.
Hamilton-Sangamo clocks--write details.
Martin C. Feldman, 620 Reiss Place, Bronx, NY 10467

WANTED: Unusual Electrical Clocks (including Warren Mystery Battery Cl.).
Also unusual foreign pieces.
A. Marx, 105 Bayeau Rd. New Rochelle, NY 10804

FOR SALE: Master clock, platinum contact one minute signal, jeweled Waltham mvt., approximately 5" case, excellent timekeeper---------------------$60.00
Sangamo Electric, time only, center seconds disc, beehive case, GRO--$57.00
Martin C. Feldman, 620 Reiss Place, Bronx, NY 10467

WANTED: Self-Winding Clock Co. (NY)--Master clock movement or Jeweler's Regulator movement (Style A). I have lots of SWCC parts and many style F movements, but need the above two movements for an SWCC book I am completing.
Dr. B.E. Honning (#39029), P.O.Box 7704, Long Beach, CA 90807 (213)427-8001

FOR SALE: Zenith (hot-wire) CALORA wooden-cased wall clock. Needs work. Extremely rare---possibly experimental (approx. 16" x 21").------------$175.00

Wallace Square wooden-cased office clock. Electrical pin-wheel mvt. Complete---$125.00
A. Marx, 105 Bayeau Rd. New Rochelle, NY 10804

FOR SALE: ORIGINAL BULLE PARTS: Silk suspensions--$4.00; all springs (isochronism, silver, spiral)--$3.50; magnets--$10 & $12; coils--$12 & $16.50; hardware-25¢ ea. All postpaid. M. Feldman

MEETING NOTICE: Sunday, May 21, 1978 at 2:30 P.M. Directions: Hutchinson River Pkway.--exit Webster Ave. (New Rochelle) and make any left to North Ave. Take right onto North Ave. and continue to Paine Ave. make left and go four blocks to Bayeau Rd. make left to #105.
Home of: Alan Marx (914) 632-5986

The Bulle clock

by George E Lloyd-Jones ATD FBHI

SINCE the early 19th century, inventors have tried to use the magnetic effects of electricity to provide power for clocks, and devices by Alexander Bain, Ritchie, Wheatstone and other early pioneers may be seen to advantage in the Science Museum in Kensington.

While the work of these pioneers is unlikely to be other than of academic interest to most horologists, one rather more recent electro-magnetic clock, the Bulle, was produced in some numbers, and might possibly come into the hands of the repairer. One did, in fact, come my way some while ago, and the following notes on its construction and repair may, I feel, be of interest to others.

THE Bulle clock was invented by Professor Marcel Moulin and M Favre-Bulle about 1920, and the description which follows will be readily understood by reference to the illustrations. The pendulum bob consists of a coil of wire, which moves over a curved magnet with consequent poles – north in the middle and south at each end. A cell in the base provides current to the coil during alternate swings, producing a magnetic field, and the interaction between this and the fixed magnet supplies the impulse necessary to keep the pendulum in motion.

Unlike other electro-magnetically maintained pendulum clocks, the Bulle pendulum, on receiving an impulse, has the properties both of a dynamo and a motor, and consequently very little current is needed from the cell. Moreover, the movement of the coil through the field of the magnet produces an electromotive force *(E)* opposite to that of the cell, and the larger the arc of the pendulum and the greater its speed at the midpoint, the less current is drawn from the cell. The inventors claimed that this novel form of propulsion would enable one cell to operate the clock for ten years.

A pin near the top of the pendulum rod engages with a forked lever carried on an arbor, which has at its other end a pivoted pawl system. The forked lever is itself insulated from the arbor, but one horn carries a silver contact which does connect to the arbor. The movement of the pendulum causes the pin to touch the contact on alternate swings, completing the circuit which provides the impulse. At the same time, the oscillation of the pawls at the other end of the arbor drives a contrate ratchet wheel, which, through a worm reduction, turns the hands.

The circuit is shown diagrammatically in fig 1. A lead from the cell, which is contained in the base, is connected to the insulated conductor at the top of the main frame. A spiral wire connects the conductor to the pendulum rod, which is insulated from the frame by a special non-conducting suspension. One end of the coil is connected to the rod, and the other end to the striker pin, which is insulated from the rod. The silver contact on the fork leads via the frame to the lead back to the other connection on the cell. Thus,

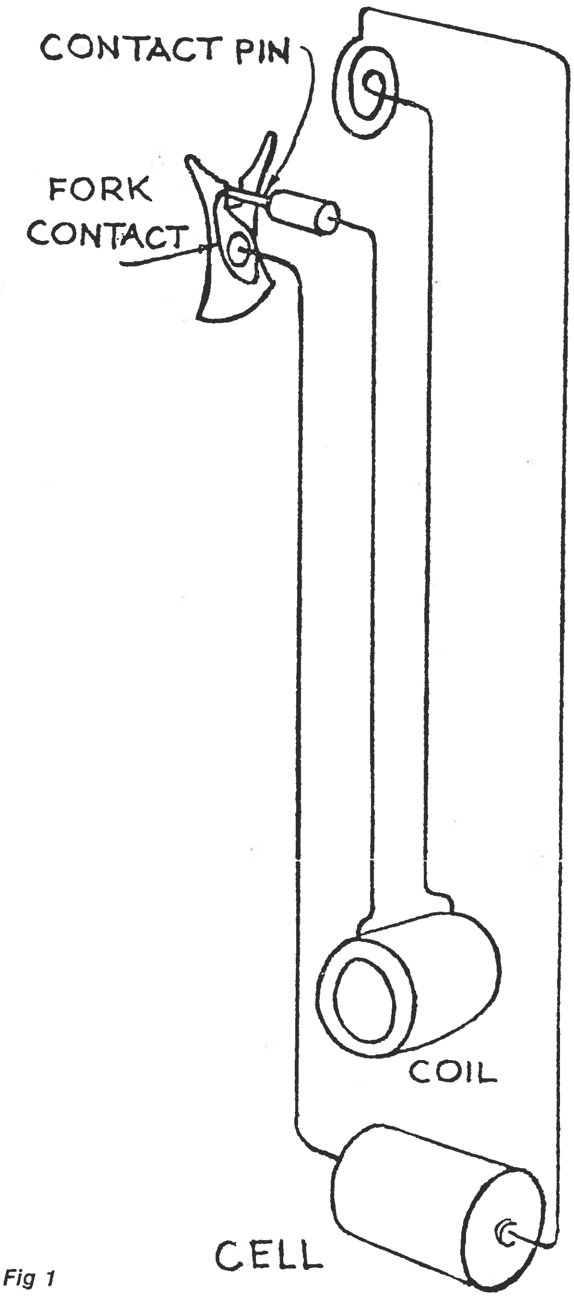


Fig 1

Reprinted with kind permission from THE HOROLOGICAL JOURNAL, VOL.119, No. 11, May 1977. (Brant Wright Associates LTD,P.O.Box 1305,LIC,NY 11101)

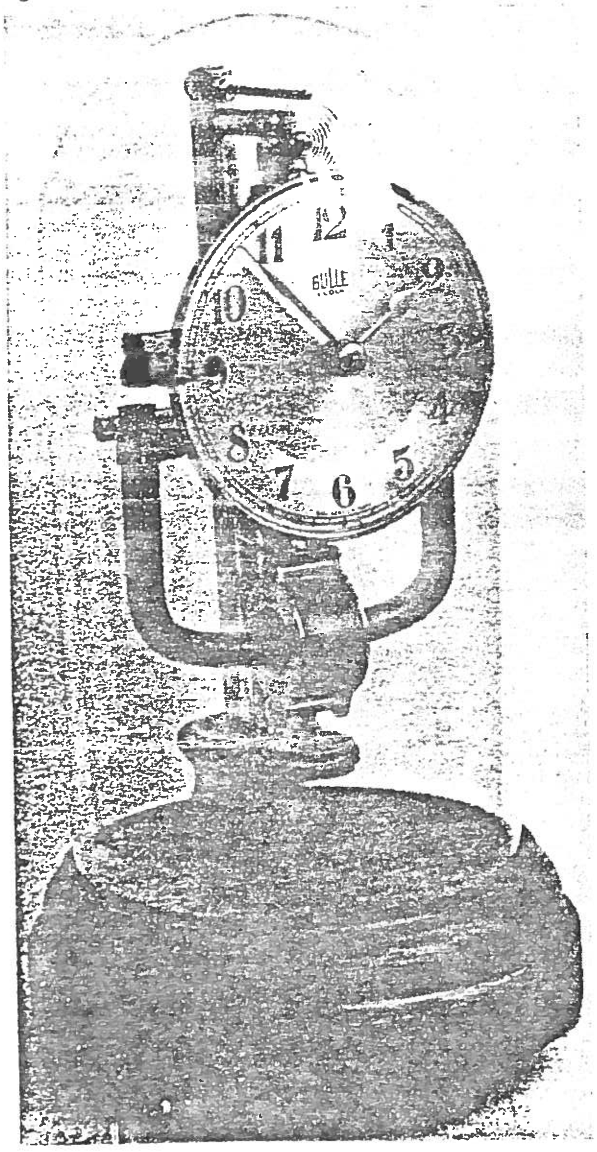
the circuit is complete only when the striker pin touches the contact on the fork, and an impulse is given, therefore, on alternate swings.

The clock shown in fig 4 arrived as a collection of corroded and damaged bits, without the shade and base and several of the more easily detached parts. None of the textbooks I consulted was very helpful, and as I had to proceed mainly by reasoning and observation, the following notes may save time and trouble for anyone who has to deal with a similar machine.

The coil can be tested for continuity with a test meter, as can any other part of the circuit which is suspect. The resistance of approximately 1400 ohms is too high for a simple lamp and battery check.

The pendulum rod assembly (shown in fig 5) conducts current to the coil, and must therefore be insulated from (a) the striker pin (b) the check spring attachment and (c) the frame at the suspension. Insulation at (a) and (b) is achieved by sheet fibre packing, the set screws bearing on small steel plates. At (c) the suspension is silk ribbon between chops, and is still obtainable from material dealers.

Fig 4



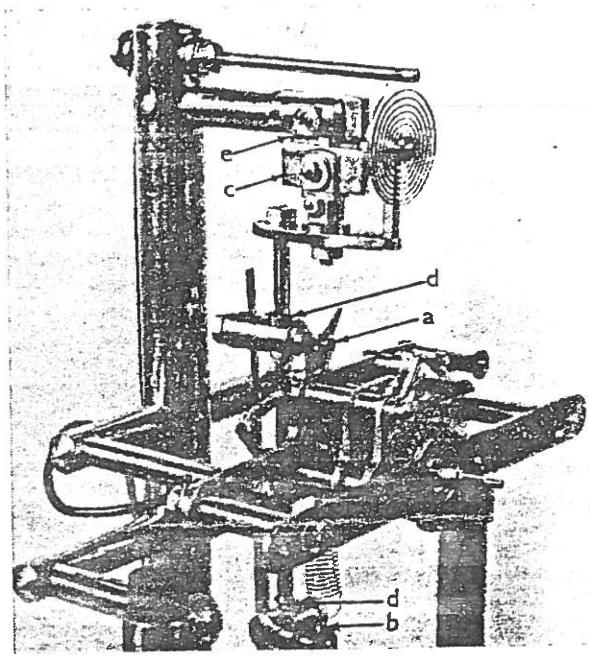


Fig 5

The magnet can be tested in practice with a needle on other small iron or steel indicator. The magnetic strength will affect the degree of arc, and, if very weak, remagnetisation will be necessary, remembering to put a north pole in the middle and a south at each end.

The magnet should be clamped in the frame so that the coil passes centrally over it in a vertical plane. In the horizontal plane, some adjustment can be made on the feet of the base to bring the coil concentric with the magnet.

The connecting wire. I used a small clock balance spring. If the centre of this coincides with the centre of suspension, it should move only about its centre. Some models used a flexible loop of wire here, but the spiral spring seems a prettier solution.

The striker pin adjustment will be obvious to everyone familiar with the lever escapement. It is possible here to adjust slightly the degree of movement of the fork – a deeper engagement providing a greater angle of movement. The points of contact should be clean and bright.

The pawl system. The brass shroud, which carries the pawl pivots, is fitted to a taper on the arbor and locked by a 10 BA nut. The adjustment should not have to be disturbed, but if for any reason it becomes necessary (the arbor was badly worn in my example, and I turned a new one slightly oversize, and broached pivot holes true to fit), the following points should help.

→ *page 30*

The Bulle clock

The pawl action should be enough to move the contrate wheel very slightly more than one tooth, and the back stop pawl should fall with perceptible clearance behind the tooth. This action is affected by three factors:

(a) The degree of arc of the pendulum
(b) The depth of the striker pin in the fork
(c) The position of the pawl pivots, when the fork is neutral, with reference to a line through the centre of the arbor, at right angles to the direction of motion of the pawls.

The first two factors need no further explanation but the geometry of the third may not be immediately apparent.

In fig 2 and 3, X Y represents a centre line at right angles to the direction of motion of the pawls. The fork is neutral, and for the sake of clarity one pawl only is considered. In fig 2 the pawl pivot falls on the line X Y, and the possible movement at right angles to X Y is at a maximum (A) per degree of rotation. In fig 3 the pawl pivot is at its greatest remove from X Y and the possible movement now at its minimum (B) per degree of rotation.

Constructional factors do not permit this full range of adjustment, but if the principle is borne in mind, it is not difficult to achieve a good action. Excessive action will cause two teeth to be gathered, while insufficient action will not gather at all, and there will be no drive to the hands.

Check spring. This is fitted, partly to eliminate circular error and also to control the arc of vibration. This spring was badly damaged in my clock, and I had to find a replacement, which did not prove easy. I set it to be just in tension with the pendulum at rest, to give the maximum arc.

Lubrication appears to be a moot point. An almost identical clock, belonging to a colleague of mine, has a setting-up label in the base which says at one point "the clock should not be oiled". This is presumably to prevent an unenlightened owner from oiling the striking pin and fork, which would prevent good electrical contact, but I can see no harm in oiling the pivots in the train, including the fork arbor bearings. Current is passed from the frame to the fork contact by a very small tension spring, the end of which loops around a little silver knob on the end of the arbor; this spring also acts as a friction check on the fork action. Without this connection, the current would have to pass from the frame through the arbor, and oil at the bearings would give bad conduction. To test this, I tried my clock out 'dry', but the fork arbor bearings are large, and after a few weeks were making unpleasant noises. I cleaned and oiled them, and there has been no trouble since.

I turned a new base from Iroko wood, first turning the hollow on the underside, which holds the dry cell, and then reversing on the face plate to turn the face and the groove for the glass. The brass feet have screws to provide adjustment for the level of the clock. A skeleton dial or open chapter ring would be a practical possibility, as the attachments are at the edge, and would enable more of the working to be seen. The glass is standard, and readily available from material dealers.

The clock should run on a single 1.5 volt cell: if, after starting the pendulum, it comes rapidly to a stop, reverse the leads, when it should quickly build up a good arc. If the arc is low, the bar magnet may be a little weak, and an increase in voltage to three will give a greatly increased arc, which can then be regulated by the check spring. The electro-magnetic interference with the free swing of the pendulum is contrary to good horological theory, but, in fact, with careful adjustment a very good rate is obtainable.

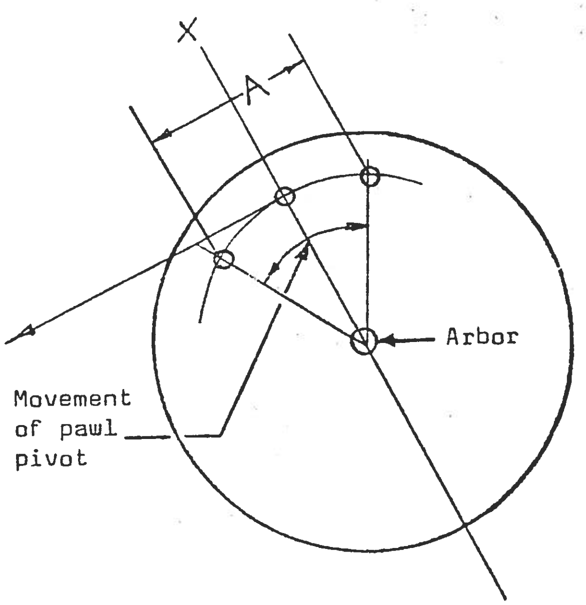


Fig 2

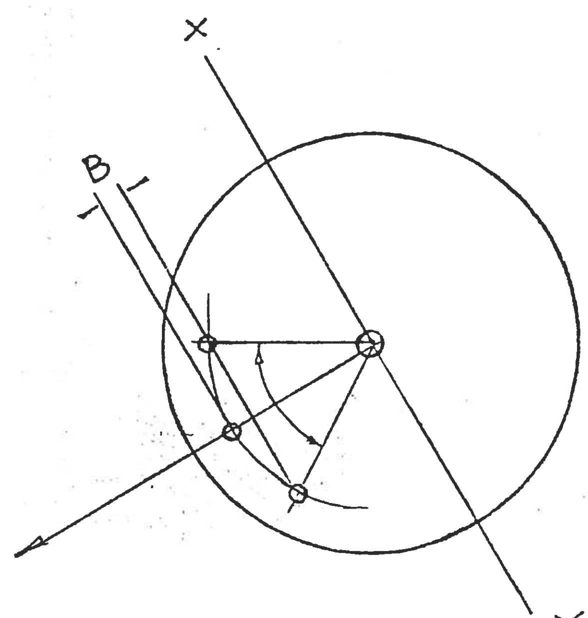


Fig 3

-270-

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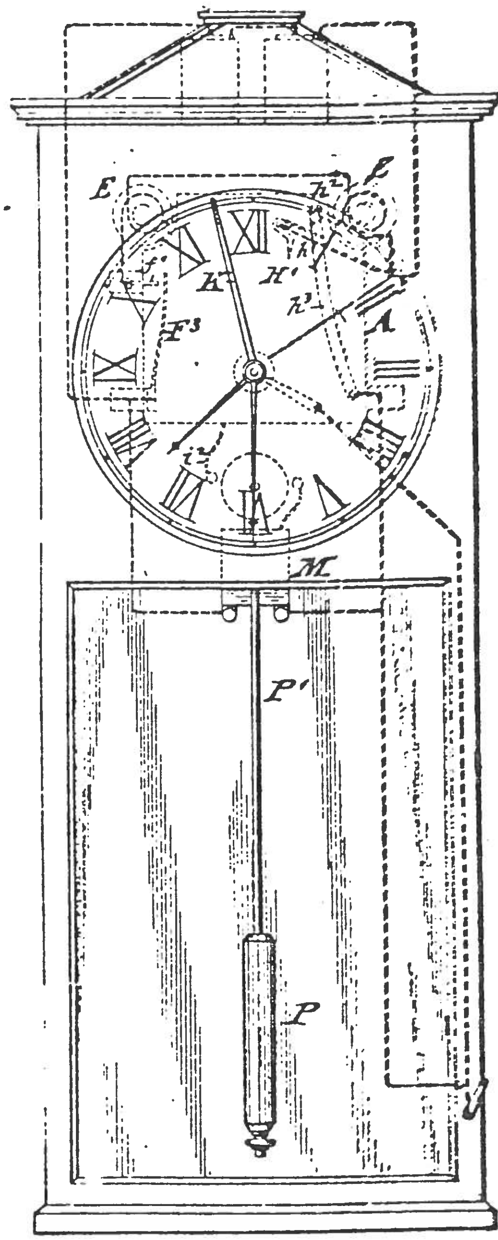
S. FISCHER.

ELECTRIC CLOCK.

No. 555,313. Patented Feb. 25, 1896.

Fig: 1.



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ATTORNEYS.

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S. FISCHER.
ELECTRIC CLOCK.

No. 555,313. Patented Feb. 25, 1896.

Fig: 2.

Fig: 3.

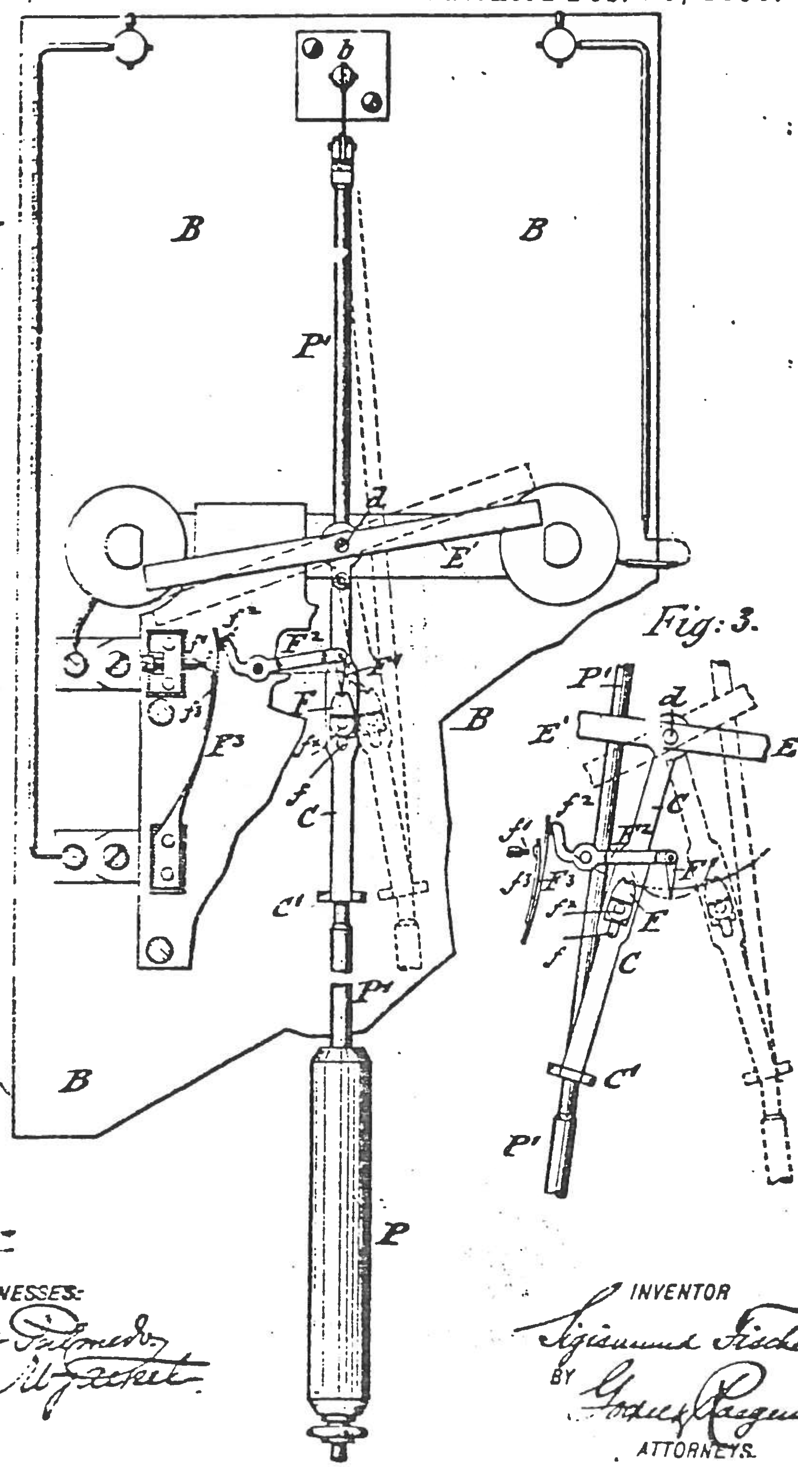

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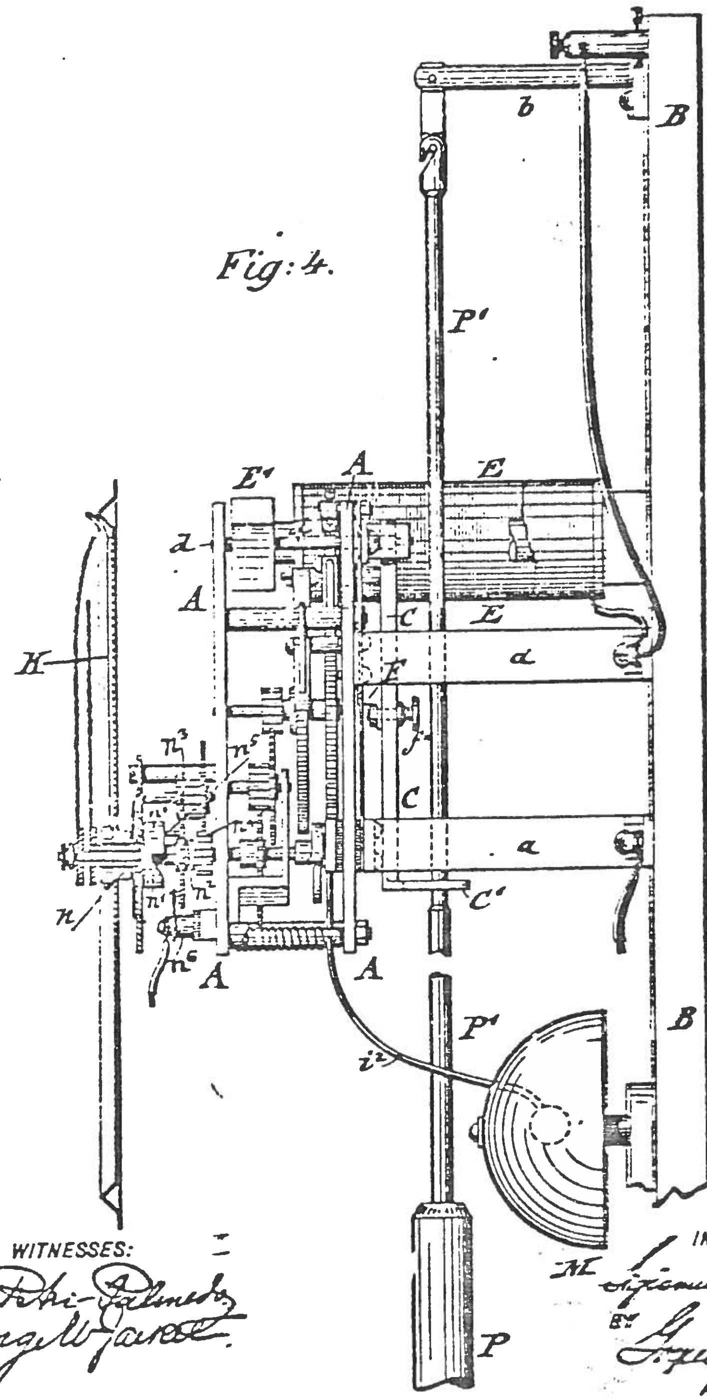
Fig: 4.



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S. FISCHER.

ELECTRIC CLOCK.

No. 555,31[illegible]. Patented Feb. 25, 1896.

Fig: 6.

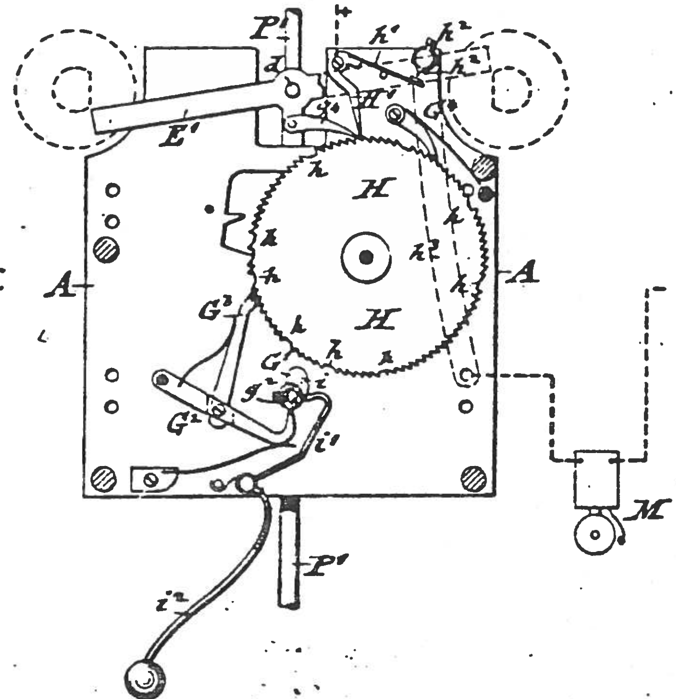
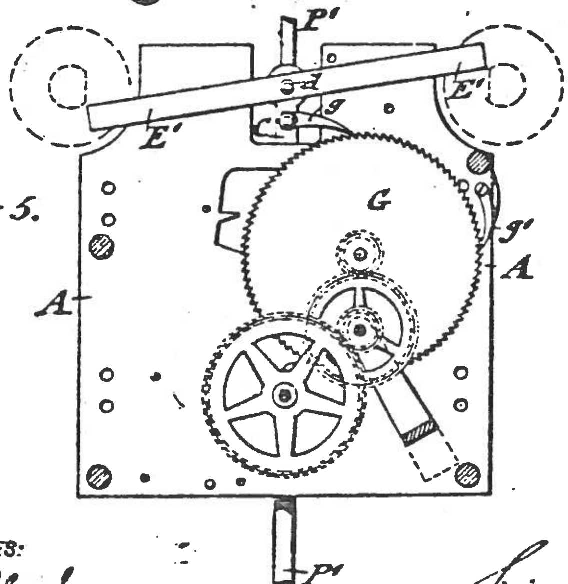


Fig: 5.



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UNITED STATES PATENT OFFICE.

SIGISMUND FISCHER, OF BROOKLYN, ASSIGNOR OF ONE-TENTH TO VICTOR D. BRENNER, OF NEW YORK, N. Y.

ELECTRIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 555,313, dated February 25, 1896.

Application filed May 10, 1895. Serial No. 548,820. (No model.)

To all whom it may concern:

Be it known that I, SIGISMUND FISCHER, a subject of the Czar of Russia, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Electric Clocks, of which the following is a specification.

This invention has reference to certain improvements in electric clocks which are driven by electric impulses imparted intermittently to the pendulum of the clock; and the invention consists of an electric clock in which the pendulum is driven by electric impulses imparted to it, as from a primary battery, so as to operate a going-train and a striking-train. A recessed block on the crutch of the pendulum is engaged by a pendant pivoted to a fulcrumed lever, said pendant engaging the recess of the block when the beats of the pendulum are gradually becoming shorter, so that the lever actuates a circuit-closing device, closes the circuit and energizes an electromagnet which attracts an armature attached to the crutch and imparts an impulse to the pendulum. The going-train operates the minute and hour hands, while the teeth on the main wheel of the striking-train serve to close the circuit of an electric bell, so as to strike the full hours. The half-hour-striking mechanism is operated by a separate clapper in connection with an eccentric on the arbor of the hour-hand.

The invention consists further of an alarm device arranged in connection with the electric clock, said alarm device closing the circuit of the alarm-bell at the proper time, as will be fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a front elevation of my improved electric clock, showing the arrangement of the circuits for the going-train, the striking-train, and the alarm device. Fig. 2 is a front elevation drawn on a larger scale and showing the mechanism by which the electric impulses are imparted to the pendulum. Fig. 3 is a front elevation of parts of Fig. 2, showing the pendulum when at full beat. Fig. 4 is a side elevation, partly in section, of my improved electric clock, also drawn on a larger scale; and Figs. 5 and 6 are detail sectional views showing, respectively, the going and the striking train of my improved clock.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the frame of my improved electric clock, which is attached by brackets *a* to an upright insulating-plate B, of slate or other suitable material. From a horizontal post *b* at the upper part of the plate B is suspended the pendulum P in the usual manner. The pendulum-rod P' is engaged by the lower forked end C' of a crutch C, which is attached at its upper end to a spindle *d*, that turns in bearings of the supporting-frame A.

On the front part of the spindle *d* is mounted the armature E' of an electromagnet E that is attached to the supporting-plate B. The ends of the armature E', as well as the pole-faces of the cores of the electromagnet, are made concentric to the axis of the spindle *d*, so that the ends of the armature can pass closely to said pole-faces as the armature is oscillated by the beats of the pendulum. On the crutch C is arranged a block F, which is capable of adjustment in a slot *f* of the crutch C by a clamping-screw $f^{\times}$, as shown in Figs. 2 and 4. The block F is provided with a V-shaped recess in its upper end, said recess being engaged at certain intervals of time by a wedge-shaped pendant F', which is pivoted to the inner end of a fulcrumed contact-lever F^2, the outer end of which is provided with an agate heel f^2 that presses on a spring F^3 provided with a contact-spring f^3, which latter is placed in contact with a contact-screw *f'*. The spring F^3, as well as the contact-pin *f'*, are insulated from the frame A of the clock, the screw *f'* being connected with one pole and the spring F^3 with the other of a primary battery which is located in any suitable position relatively to the clock. Whenever the contact-spring f^3 is pressed by the agate heel f^2 of the fulcrumed lever F^2 against the contact-screw *f'*, the current from the battery will pass from one pole of the same to the contact-spring F^3, over the spring f^3 to the contact-screw *f'*, from the same through the coils of the electromagnet E and back to the other pole of the battery, as shown in dotted lines in Fig. 1 and in full lines in

Fig. 2. As soon as the circuit is closed, the current energizes the electromagnet, so that the poles of the same attract the armature E' and impart a turning motion to the same on its spindle. When the pendulum P swings a full beat, the block F on the crutch of the pendulum clears the point of the pendant F', as shown in dotted lines in Fig. 3; but when the beats of the pendulum get gradually smaller the block will not be able to swing clear of the pendant F', but will be engaged by the point of the latter, which drops in the V-shaped recess in the upper end of the block, as shown in Fig. 2, so that when the crutch arrives in its vertical position the contact-lever F^2 is oscillated on its fulcrum, as shown in Fig. 2, and thereby the contact-spring f^2 is placed in contact with the contact-screw f', so that the circuit of the battery is closed, the electromagnet energized, the armature oscillated, and an impulse imparted to the pendulum. As long as the battery-current is of considerable strength, the closing of the circuit takes place at greater intervals of time as stronger impulses are imparted to the pendulum, while when the battery has been running for some time its electromotive force is diminished, the closing of the circuit of the battery takes place at shorter intervals of time and the impulses imparted to the pendulum are of less strength, so that thereby a certain compensation between the gradual losing of the strength of the battery and the increasing frequency of impulses imparted to the pendulum is produced which secures the regular running of the clock.

To the upper part of the crutch C of the pendulum P is applied a pivoted pawl g that engages the main spur-wheel G of the going-train. A check-pawl g' prevents the spur-wheel G from turning in the opposite direction. At each right-hand beat of the pendulum the pawl g engages one tooth of the spur-wheel G and turns it thereby on its axis, so as to impart by an intermediate train of gear-wheels motion to the minute-hand and from the same, by the usual transmitting mechanism, to the arbor of the hour-hand, as shown in Figs. 4 and 5.

The mechanism so far described forms an electrically-operated clock which receives all its impulses from a primary battery and which is of comparatively simple construction, so that it can be furnished at a small expense. When the clock is desired to strike hours and half-hours and give in addition thereto at certain predetermined intervals of time an alarm, then it is necessary to add a striking-train for striking full hours, a mechanism for striking the half-hours, and an alarm device which utilizes the bell of the striking mechanism. The striking-train is operated from the arbor g^2 of the hour-arbor, on which is mounted an eccentric G' that rotates with the arbor of the hour-arbor once every hour and actuates a pivoted and spring-actuated lever G^2 having a hook-shaped end, which latter is engaged by the eccentric G'. The lever G^2 is provided with a pivoted and spring-actuated pawl G^3 having a double tooth at its end which engages the teeth at the circumference of the striking gear-wheel H. The circumference of the striking-wheel H is divided into a number of groups of teeth corresponding to the number of strokes of the clock from one to twelve, said groups of teeth consisting of one, two and so on up to twelve teeth, each group being separated from the adjacent groups by a recess h, formed by removing a tooth, so that when the striking-wheel H is turned entirely around on its axis, which takes place once in every twelve hours, all the hours have been struck by the striking mechanism. Besides the actuating-pawl G^3, the striking-wheel H is engaged by a spring check-pawl G^4, which is also provided with two teeth, and by a single pawl g^4 on which rests a fulcrumed lever H' that carries a contact-spring h', which forms contact with a contact-screw h^2 that is insulated from the frame of the clock and connected by a metallic conducting-strip h^3 with the electromagnet of an electric bell M on the frame of the clock placed in the battery-circuit, as shown clearly in Figs. 1, 4 and 6. When the eccentric G' arrives gradually at its lowermost position, the lever G^2 is pressed against the tension of its spring in downward direction and the spring-actuated pawl G^3 moved so as to engage one of the teeth on the circumference of the striking-wheel H, the double-toothed end of the pawl G^3 securing the reliable action of the same with the teeth of the striking-wheel, even if it should pass into one of the recesses h.

During the motion of the eccentric toward its uppermost position the pawl G^3 is gradually lifted by the spring of the lever G^2 and the striking-wheel H moved for the distance of one tooth, so that the pawl g^4 on the crutch C is moved out of one of the recesses h between the groups of teeth on the circumference of the striking-wheel H and into engagement with the first tooth of the next following group. In passing over said tooth the fulcrumed lever H' is raised and electric contact formed between its contact-spring h' and the screw h^2, so that the electric bell is sounded. At the next beat of the pendulum the pawl g^4 engages the next adjacent tooth of the group and makes the contact h' h^2, so as to again sound the electric bell, and so on until all the strokes of the respective hours have been sounded and the pawl g^4 arrives in the next recess, separating the group of teeth just actuated from the next adjacent group. As long as the pawl g^4 is in the recess its point will be moved forward and back in said recess, following the oscillations of the pendulum, without producing the actuating of the electric bell for striking a full hour. As soon as, however, a full rotation of the eccentric G' is completed and the striking-wheel H has been moved by the pawl G^3

for the distance of one tooth, the pawl g^4 on the crutch of the pendulum is moved out of the recess h into engagement with the first tooth of the next group of teeth on the circumference of the striking-wheel, whereby the next hour is struck, and so on. The battery by which the electric impulses are imparted to the pendulum and the going-train of the clock is also employed for causing the striking of the full hours, but in such a manner that the electric current is supplied always for the impulses of the pendulum when the latter is moving toward the left, while the current is supplied to the going and striking mechanisms when the pendulum is moving toward the right. When the circuit of the striking mechanism is closed by the contacts h' h^2, the current flows from one pole of the battery to the electromagnet of the bell, through the coils of the same and the metallic connecting-strip h^3 to the insulated contact-screw h^2, then over the contact-spring h' of the fulcrumed lever H' and the frame of the clock to a binding-post on said frame, and then to the opposite pole of the battery, as shown in Figs. 1 and 6.

When it is desired to strike besides the full hours also half-hours, a second clapper i^3 of the bell M is actuated by the eccentric G', which for this purpose is provided with a pin i that engages the curved end of an upwardly-extending arm i' on the fulcrumed and spring-actuated clapper i^3, so that one stroke is given to the bell at every hour, but alternatingly with the full-hour strokes, which are imparted by the striking mechanism. This is accomplished by locating the pin i in such a manner on the eccentric G' that it engages the arm i' of the clapper once every hour, but midway between the full hours, so as to strike thereby one stroke entirely by mechanical means, which indicates the half-hour.

When the clock is to be provided with an alarm so as to start the bell in a similar manner as in alarm-clocks, the usual alarm-hand K is provided on the dial of the clock, which is to set the hour at which the alarm is to be sounded. The alarm-hand K is applied in the usual manner with a sleeve n, which is placed on the arbor of the hour-wheel and provided with a notched collar n'. The arbor of the hour-hand is actuated by a helical spring n^2, which is interposed between a gear-wheel n^3 on the arbor of the hour-hand and a pinion n^4 on the arbor of the minute-hand, as shown in Fig. 2, the tubular arbor of the hour-wheel being adapted to slide on the arbor of the minute-hand. A pin n^5 is applied to the gear-wheel n^3 on the arbor of the hour-hand and is moved over the face of the notched collar n' until the pin n^5 arrives on the notch of the collar and permits the forward motion of the arbor of the hour-hand in the spring n^2, so that the pin n^5 is moved into the notch of the collar n. Simultaneously therewith the gear-wheel n^3 forms contact with an insulated contact-plate n^6, that is shown in Figs. 1 and 4. The contact-plate n^6 is insulated from the supporting-frame A of the clock and connected with a switch S, which is set into a closed position whenever the alarm is to be used. As soon as the pin n^5 of the gear-wheel n^3 on the arbor of the hour-hand arrives at the notch of the collar n' on the sleeve of the alarm-hand the contact between the gear-wheel n^3 and the contact-plate n^6 is made, whereby the circuit is closed and the current conducted from one pole of the battery to the electromagnet of the bell M, then to the switch S, from the latter to the contact-plate n^6 and gear-wheel n^3, and then through the frame of the clock back to the opposite pole of the battery, as shown in Figs. 1 and 4. The bell is sounded until the switch S is disconnected, or until the pin i of the hour-wheel has gradually moved past the notch in the collar of the alarm-hand. As the latter takes a considerable length of time, during which it is unnecessary that the bell should be sounded, it is preferable to disconnect the switch and discontinue the ringing of the bell.

By the construction described an electric clock is obtained which is actuated by intermittent electric impulses from a primary electric battery and which is to some extent independent of the gradual weakening or running down of the battery, as with the running down of the battery the intervals of time at which the impulses are imparted are shortened, and correct and reliable time indicated by the clock independently of the greater or smaller electromotive force of the battery.

The striking of the half and full hours renders the clock more acceptable to persons who prefer a clock with a striking mechanism, while the alarm device is of advantage to persons who have to get up at a certain time, so that the electric clock combines thereby the advantages of a good timekeeper with an alarm-clock.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination with a swinging pendulum and its crutch, of a recessed block on said crutch, a fulcrumed circuit-closing lever, a gravity-pendant pivoted to one end of said lever adjacent to said block, and a circuit-closing device operated by the opposite end of the circuit-closing lever when the pendant is engaged by the recessed block.

2. The combination of a swinging pendulum, a crutch for said pendulum, a block on said crutch provided with a recess at its upper end, a fulcrumed circuit-closing lever, a gravity-pendant pivoted to said lever, spring-contacts operated by said lever when the pendant is engaged by the block, an armature mounted on the spindle of said crutch, and an electromagnet adapted to impart oscillating motion to said armature and an impulse to the pendulum when the circuit is closed by

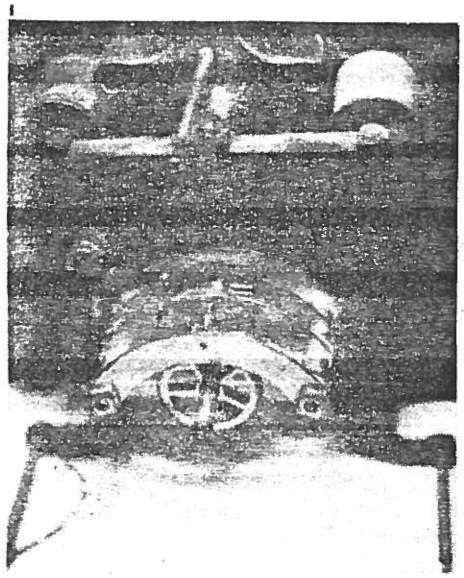
the periodical engagement of the block with the pendant, substantially as set forth.

3. The combination with a pendulum and its crutch, said crutch [illegible] operated by electric impulses imparted to the same, of a striking-train, the main wheel of which is provided in its circumference with groups of teeth for striking the hours, intermediate recesses between said groups of teeth, an eccentric on the arbor of the hour-hand, a spring-pawl engaged by said eccentric and adapted to turn the main wheel of the striking mechanism for one tooth at each rotation, a circuit-closing device operated by a pawl on the crutch, and an electric bell in said circuit so as to strike the full hours at each full rotation of the hour-wheel, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

SIGISMUND FISCHER.

Witnesses:
PAUL GOEPEL,
GEORGE W. JAEKEL.

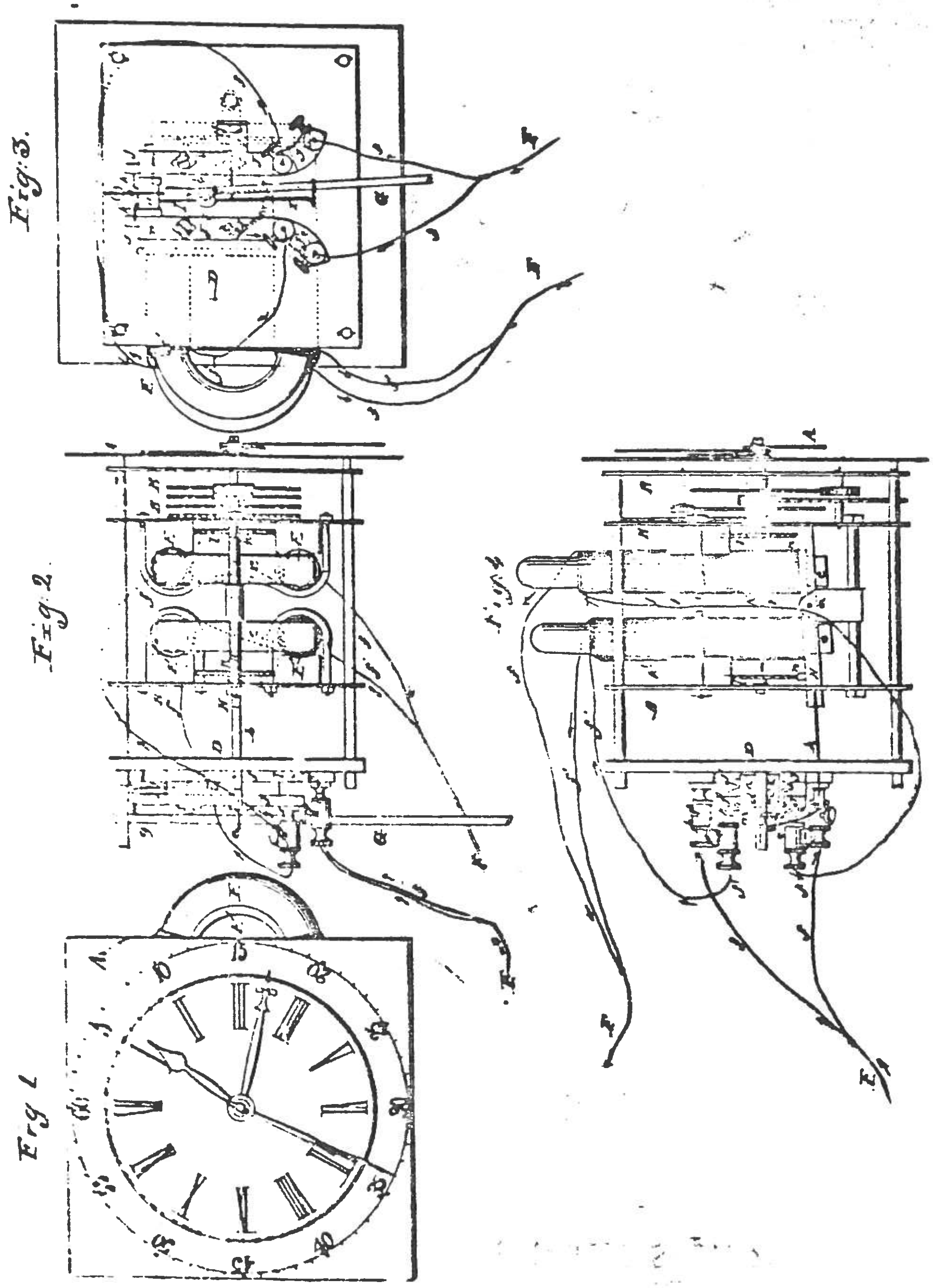


New York Standard Watch Co.
master clock movement

A. HALL.

ELECTRIC CLOCK.

No. 11,723. Patented Sept. 26, 1854.



UNITED STATES PATENT OFFICE.

ALEXANDER HALL, OF LOYDSVILLE, OHIO.

IMPROVEMENT IN ELECTRIC CLOCKS.

Specification forming part of Letters Patent No. 11,723, dated September 26, 1854.

To all whom it may concern:

Be it known that I, ALEXANDER HALL, of Loydsville, in the county of Belmont and State of Ohio, have invented certain new and useful Improvements in Electric Clocks; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front view of an electric clock constructed according to my invention. Fig. 2 is a side view of the same. Fig. 3 is a back view, and Fig. 4 a top view.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates, first, to certain mechanism which is employed for the purpose of transmitting to the pendulum the motion which is obtained by the alternate attraction of the armatures of two electro-magnets, as an electric current from a battery is caused to flow through them in alternate succession.

It relates, secondly, to certain means of closing the circuit as it is changed from one electro-magnet to the other to give motion to the pendulum.

It relates, thirdly, to a certain arrangement of permanent magnets for the purpose of securing and holding the connection by which the circuit is closed until the direction of the circuit requires to be changed.

To enable those skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A is the dial of the clock, B B are plates, and C C posts, which form the frame, all being of metal.

D is the back, which is formed of wood.

G is the pendulum-rod, suspended by a spring, *g*, from a post standing out from the back D.

E E′ are two electro-magnets placed side by side in a horizontal position. Each of these magnets is coiled round with one of two wires, *f f′*, which branch off from and again unite in the wire F, which is supposed to be connected at opposite ends with a battery. The two branches *f f′* of the wire F are for the purpose of making an electric current pass through one and the other of the magnets alternately by breaking the circuit through one branch and closing it through the other.

H is a beam capable of vibrating on a fixed center, *a*, and having attached to it at equal distances from the center the armatures *e e′* of the two magnets E E′, and being so arranged that by a slight vibrating motion one of the armatures will be brought in contact and the other out of contact with the poles of its magnet.

To the rear end of the beam H is rigidly attached a thin, straight, flat steel spring, *b*, which possesses sufficient strength to transmit the necessary amount of maintaining-power from the beam to the pendulum, and is connected to the upper part of the pendulum-rod by a light wire, *c*. The pendulum as it vibrates gives motion to a light lever, I, of the first order, which vibrates on a fixed stud, *h*. This lever is formed of wire and forked at the bottom to receive the pendulum-rod, and the rod is allowed some play in the fork. At its top end it carries a small wooden block, *d*, on either side of which is secured a piece of soft iron, *m*, and on the top are two pieces of silver wire, *k k′*, which are bent toward opposite sides and made of wedge form at their extremities.

On one side of the lever I a pair of permanent magnets, J J, are secured to the back D of the clock, and on the opposite side a similar pair, J′ J′. The magnets of each pair are separated by a piece of wood between them. The pair J J is intended to form part of the circuit through the branch wire *f*, and the pair J′ J′ part of the circuit through the branch wire *f′*, and hence the wires are connected with their lower ends. The upper ends are not connected, in order that the circuits may be broken, but each pair has two small pieces of brass, *j j*, soldered to the upper poles in such a position that the wedge-points of the wires *k k′* will be carried between and away from them alternately by the vibrations of the pendulum, and thus close the circuit through one branch wire and break the circuit through the other in alternate succession. When the point of either wire is between and in contact with the pieces *j j* the piece of soft iron *m* on the same side is in contact with or near enough to the poles of the magnets to be sufficiently under the influences of their attraction to hold the point in its place, and thus keep the circuit closed until the proper time for breaking it.

The manner in which the change of the direction of the current from one branch wire is effected is as follows: Suppose the pendulum to be in motion and to have just completed its stroke to the right, as shown in Fig. 3. The lower end of the lever I has been moved to the right side, and the upper end toward the left, and the point of the wire k' has just arrived between the brass pieces $j\,j$ on the top of the magnets J′ J′, as shown in Fig. 4. The circuit through the branch f' of the wire is just closed and about to follow the direction of the black arrows in the several figures of the drawings through the electro-magnet E′. The beam H, which occupies the position shown in Fig. 4, with the armature e in contact with the magnet E, which is now inoperative, is just about to move under the influence of the magnet E′ on the armature e'. The movements of the beam and of the pendulum take place, and the movement of the latter, just before it terminates, causes the point of the wire k' to be withdrawn from between the brass pieces $j\,j$ on the magnets J′ J′ and the points of the wire k to be brought between the brass pieces $j\,j$ on the magnets J J, and thus the circuit through the wire f' is broken and a circuit is formed through the wire f, following the direction of the red arrow. The magnet E now attracts the armature e, and the beam and pendulum reassume the position shown in Fig. 4. By a repetition of this operation the beam receives a continuous vibratory motion and gives motion to the clock-movement, and at the same time furnishes the maintaining-power to keep up the motion of the pendulum.

The main arbor K of the clock-movement receives motion from the beam by means of two click-teeth, $n\,n$, at equal distances from the center of the beam, which act upon two ratchet-wheels, $l\,l$, on the arbor as the beam vibrates. These ratchets have thirty teeth and are arranged upon the shaft with the teeth of one opposite the centers of the spaces between the teeth of the other. One click falls into a space at every vibration of the beam, and thus causes the ratchets to move half a tooth, requiring sixty vibrations of the beam to cause one revolution of the arbor.

The arbor has the second-hand of the clock fast upon it, and the pendulum is of the proper length to vibrate once in a second, and thus the second-hand is caused to make one revolution in a minute.

Motion is transmitted from the arbor K to the minute and hour hands by a suitable train of wheel-work, which it is not necessary here to describe.

This clock is believed to possess advantages over all electric clocks hitherto used. One advantage is believed to consist in the application of the power to the pendulum near the axis of oscillation, as in the common clock driven by springs or weights, instead of near the pendulum-weight; for when applied there any variation in the strength of the current from the battery will not affect the movements of the pendulum as when applied below. Another advantage consists in the method of applying the power by means of the walking-beam and spring, the spring having the effect of preventing shocks and any deviations of the pendulum from a uniform isochronal movement which might otherwise be caused by a variation in the strength of the battery or by atmospheric influences.

The method of closing the circuits through the two electro-magnets and the arrangement for securing the connection by which the circuits are closed are such as to insure perfect operation.

It is scarcely necessary to add that this clock is capable of communicating motion to a number of other clocks, and for this purpose it is more particularly intended. The motion may be given to the other clocks in various ways; but the simplest way is to furnish each of the other clocks with a single electro-magnet and carry one of the wires $f\,f$ round the whole series of magnets before re-uniting it with the wire F. A beam with the armature of the magnet attached to one end and with a light spring at the other, applied in such a way as to throw the armature away from the magnet when the circuit through the wire is broken, will serve to give motion to the main arbor of each clock in the same manner as the beam H gives motion to the arbor K.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. Giving motion to the clock-movement and to the pendulum by means of a beam, H, and spring b, said beam carrying and deriving its motion from the armatures of two electro-magnets, E E, through which electric circuits are alternately closed and broken, and transmitting motion to the clock-movement by means of clicks and ratchets or their equivalents, and to the pendulum by means of the spring b, which serves to maintain its isochronous vibration without regard to the strength of the current, and thereby make the clock keep perfect time and serve to regulate a number of electric clocks, substantially as herein described.

2. The manner of closing and breaking the circuit of the battery so as to make it pass through one and the other of the electro-magnets alternately by means of wedge-shaped points $k\,k'$, of silver or other metal, which are caused to vibrate by the movements of the pendulum and pass between small posts $j\,j$ of suitable metal attached to permanent magnets or other conductors which form parts of the separate circuits through the two electro-magnets, as herein described.

3. Securing the connections which close the separate circuits, when they are made by means of two pieces of soft iron, $e\,e$, which vibrate in connection with the wedge-shaped pieces $k\,k'$, or other equivalent means of closing the circuit, and are brought, when the circuit is closed, into contact, or nearly into contact, with permanent magnets J J, as herein fully set forth.

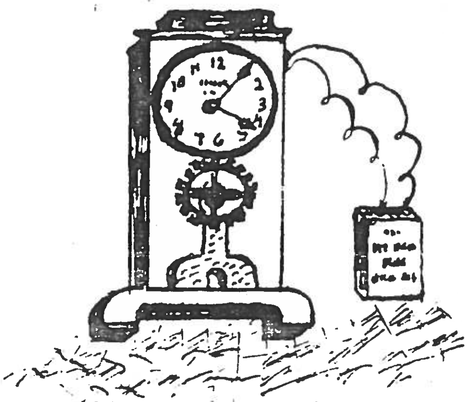
ALEX. HALL.

Witnesses:

S. H. WALES,

JNO. W. HAMILTON.

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY Chapter No 78



June 1978
VOLUME IV---ISSUE #3
Martin C. Feldman, Editor

Hello fellow enthusiasts:

The invention of the synchronous motor which we all take for granted in the common electric clock has had, as we learn in this month's issue, a most interesting history while being developed. Henry E. Warren, the acknowledged "father" of the synchronous motor discusses his role in the development of the common synchronous motor for electric clocks in a paper which he read to the Boston Clock Club on February 6, 1937. While some members of our Society may suggest that we are straying from our basic interests in early electrical clocks by publishing material dealing with A.C. clocks and electronic timepieces, few can deny that the year 1916 is early or at least midway between the present and the first introduction of commercial electrical timepieces. I would be interested in publishing photos, perhaps in the next Journal, of the Warren Telechron Clock (please send in labeled B & W photos if you have them; thanks.). Mr. Warren modestly bypasses his role in the invention and production of a very interesting battery clock which he produced in fairly sizable numbers from about 1909 through 1915. In two issues of our own Journal, we have published material which discussed his battery clock. This particular clock is avidly sort by collectors as it has become quite rare. In conjunction with his invention of his battery clock, Mr. Warren invented the mercury switch, which he patented and received a very handsome income over many years. While the Henry Warren story remains to be told, basically he went into production of A.C. electric clocks under the name of the Warren Electric Co. which was changed through a merger to Warren Telechron. Eventually the name Warren was dropped leaving Telechron, to be followed by the name General Electric which has remained for many years. Mr. Warren was an engineer, inventor, clock enthusiast, and from all accounts a very fine gentlemen.

On May 21, our V.P. Alan Marx and his lovely wife opened their home to the members of the Electrical Horology Society for one of our, what has become, quarterly meetings here on the northeast coast. Ten members attended including your President and both Vice-Presidents. A short business meeting was held. We voted to contribute $50 towards the NAWCC Building Fund, as this amount is consistent with our present treasury. We hope to be able to duplicate, if not surpass this amount during 1979. Our membership stands slightly below 100 remaining relatively constant, and dues-reminder-cards will be sent out shortly. We have been offered a room at the National Convention during 1980 to be used for meetings, exhibits, etc. which should prove to be quite useful in getting our widespread membership together in one room for a general meeting. The next northeast meeting will be held in the home of Charles Roth during September--more to follow in the August Journal.

continued-Pg.9

MODERN ELECTRIC CLOCKS
By
Henry E. Warren

A paper read at a meeting of the Clock Club held at the Old State House, Boston, on February 6, 1937

The work of any individual is quite likely to have a different appearance when examined from the perspective of centuries after his death. For example, when Columbus was voyaging across the trackless ocean, then only searching for a passage to India, the discovery of a new world was not in his picture at all. To-day we only think of Columbus as having discovered a new world. Likewise this Clock Club, in giving consideration as it does to the work of the early American clock makers, is perhaps more greatly interested in certain features of their product, such for example, as the artistic appearance and the slow evolution of the same case and dial, than in the technical problems which in all probability occupied most of the original artizan's thoughts and activities. I doubt very much whether the Willards worried half as much about the shape and appearance of the cases which they made as they did about the movements that went into these cases, and yet to-day the cases are of paramount interest. My story will probably appear less exciting to you than that of the early clock makers. In fact my tale would probably appeal more strongly to a group of engineers who are especially interested in science and technique. It may well be that one or two centuries from now some other aspect of this work will be more interesting and perhaps seem more important.

Let me recall in the beginning that there are two distinct functions of clocks. One is to measure time as accurately as possible and the other is to tell time with the greatest possible convenience. The work which I have done has a great deal more to do with the second function than with the first, for I must plead at the start that I am innocent of having made any advance in the accuracy of measuring time. My work has been wholly concerned with providing devices which would tell the time with the very greatest convenience and with a high degree of accuracy wherever other modern conveniences of civilization are found. Centuries ago the very early clock makers recognized the desirability of telling the time over as wide an area as possible, and therefore, their timekeepers were provided with bells which rang out the hours. It was from the French name for bells that the word clock came. That method of telling time, although it represented a great advance, is wholly inadequate for modern civilization. We now need to know the minutes as well as the hours, and so striking clocks are no longer dominant. Our modern clocks must tell the minutes and even the seconds with precision, if we are to keep abreast with the procession.

Prior to 1916 when the work which I will describe to you began, the only timekeepers which were used on a very extensive scale consisted of separate clocks, each one of which was constructed to measure time independently. Mr. Brown's clock had no connection with Mr.Jones' clock and either one of them had only that degree of accuracy which was imparted by the design and construction of the movement, aided or hindered by skill or lack of skill in regulating by Mr. Brown or Mr. Jones. The result, as you know, was that the average clocks were frail reeds as regards accuracy of time measurement. It was necessary to set them at rather frequent intervals if the owners expected to keep engagements and make train connections. Moreover all of these separate clocks had one particularly annoying feature which was that they would stop running unless wound up at regular intervals of a day or a week.

For a hundred years, more or less, inventors yearning for mental exercise have concerned themselves with the problem of using electricity to drive clocks. Springs and weights, although reasonably satisfactory for that purpose, can supply only a very limited amount of energy, but electric batteries and generators are not limited in this respect. A multitude of ways were discovered whereby electric energy could be used to keep a clock train running. From time to time many forms of electrically driven clocks have appeared on the market, but they have only been sold in small quantities and each particular variety has folded up after a while and passed into oblivion. The reasons have been, first, that all these various electric clocks were more costly, usually more delicate, more likely to get out of order, and generally speaking, no better time-keepers than the common variety. They had the advantage that no winding was necessary, but this was offset by the fact that the batteries were somewhat uncertain in durability. For public buildings, however, battery-driven systems of clocks with time-telling units scattered throughout a given building, all of the units being energized and synchronized from a central master clock, were coming into wide general use by the beginning of this century. Such clock systems eliminated the burdensome labor of winding numerous units and more important still they insured uniformity in the time-telling function of the various clocks. Moreover these clocks minimized the cost of measuring time accurately, because only a single unit was used for this function. The obvious weakness of these electric clock systems was the necessity for separate sets of wires to carry energy and synchronizing impulses from the master clock. Such a system was practically out of the question for wide-spread use in a community, although the Western Union Telegraph Company established limited systems of this kind in our great cities where people were willing to pay a substantial rental charge per month for time service. The Western Union systems were substantially the same in principle as the building installations. They utilized a single master clock at a central point with wire connections to various stores and offices throughout a city where the service was under contract.

Like most of the other electric clock inventors I had dreams of various methods whereby electricity from batteries could be used to drive clocks. As far back as 1908 I filed a patent application on a rather crude form of electrically driven clock which represented the result of several years of desultory experimenting during my spare time. This work until then and for several years later was simply a hobby which gave me the same kind of pleasure as collecting stamps or playing bridge does to other people. However, as is often the case, the habit grew stronger and developed into a compelling urge.

Eventually I engaged assistance and organized a small independent company for the purpose of making further developments in electric clocks which were still of the battery type. This was done without severing my regular job of superintending the work of a manufacturing company. In 1916 the inadequacy of the battery clocks which I had been able to design and build impressed me so forcibly that I began exploring other possibilities in the art of telling time. The need of some simple mechanism which would have universal application made me think, as a few people had done in the preceding decades, of the possibility of utilizing the existing communication systems for the distribution of time.

The two great networks which were then available were the telephone system, then reaching a very large portion of the houses and offices of the well-to-do people, and the electric light and power lines which covered a still more extensive territory. Of these two systems of communication, the one which appealed to me more strongly was the electric light system, because this carried abundant power for the purpose of driving clocks and, far more important, it contained the germ of a system for measuring time. In 1916 more than 90% of all electric light, heat and power was distributed in the form of so called alternating current. The alternations of this current might conceivably be used to measure time intervals provided they could be properly controlled. The other 10% of electric power was distributed in the form of so called direct or constant current which flowed smoothly in one direction like the current from a battery, and there was nothing about this current itself which could be used to measure time. At least three or four other people in various parts of the world had thought of the possibility of using alternating current for time-telling purposes, as was afterwards discovered by a thorough investigation. However, none of these individuals had taken any effective action towards the dream into reality and consequently there was not anywhere in the world twenty years ago a place where alternating current was being used to operate clocks. Unfortunately we have not in this ancient room a regular supply of alternating current because the older cities were, in the beginning, provided with direct current systems by the original power companies. The cost of these systems, which require immense amounts of copper to be buried under the streets was so great that even after the use of alternating current became almost universal many of the older networks like the one in the center of Boston were still continued in use. Consequently, in this district where only direct current is available, modern electric clocks cannot be used.

For the purpose of this lecture, however, I have brought a small alternating current generator which is capable of developing a supply of alternating current suitable for demonstration and I can now show you how alternating current differs from direct current. You will notice that the rapidly revolving Neon lamp of the demonstration device appears, when supplied with direct current, as a smooth ring of light, which means that the brightness of the lamp remains practically constant as it revolves rapidly in the circle. When, however, the same revolving lamp is supplied with alternating current you will see that the circle of light becomes a chain resembling separate links of light. Each one of these links of light is caused by an electric wave or impulse in the wire through which the current flows. The fact that some of the links are on the outside and an equal number on the inside means that these impulses which flow in the wire are first in one direction and then in the other direction, which explains the designation "alternating". If you will take the trouble to count the separate links of light in the whole circle you will find that there are six in the outer row and six in the inner row or twelve altogether. When I tell you that the lamp is revolving ten times every second you will see that there are 120 of these separate alternations of electricity in the wire every second.

For convenience the alternating current is characterized by the number of pairs of these alternations, each pair being called a cycle so that this particular current has 60 cycles a second. Now in the demonstration device the number of these cycles every second is not exactly sixty but only approximately that value and that was the situation in 1916 when I dreamed of utilizing this alternating current for time-telling purposes. It seemed to me possible that the number of these cycles or pairs of alternations per second could be made equal to exactly 60 on the average, if I could only persuade the operators of the power stations to adopt a different method of regulating the speed of the generators, which alone determined the rate of alternations. Before this could be done it was necessary to provide some means whereby the time characteristics of these alternations could be used to drive the hands of a clock. You can readily understand I think that if each of these flashes of light which you see so clearly could be used to move a gear wheel having a very large number of teeth, by the space of a single tooth, this imaginary gear wheel might be connected to the hands of a clock so that this hand would creep along the same small distance on the dial for each alternation and thus behave exactly the same as any ordinary clock hand. You will recall that an escapement serves precisely the same function since it permits the hands of a clock to move a small distance for each swing of the pendulum and if you can imagine these flashes of light serving in place of the oscillations of a pendulum with some kind of an escapement which would form a connecting link between the flashes of light and the hands of a clock you may visualize exactly what I had in mind.

When alternating current was first used to distribute light and heat in 1886 there were no satisfactory motors which could be used for power purposes. The great advantage of the alternating current over the direct current lay in the fact that, through what is called magnetic induction, current could be distributed at a high voltage and then transformed by means of motionless magnetic devices called transformers to low voltage which would be safe for household use. It was not possible to use these transformers with direct current and consequently such current could not be transmitted economically for great distances from the power station. However, the motors which had been successfully developed to convert direct current into power would not perform even reasonably well when supplied with alternating current. The problem of building a successful alternating current motor was not solved until Nikola Tesla and Eli Thompson discovered how to produce a so-called rotating magnetic field in a stationary iron structure when supplied with alternating current. Then it became feasible to build alternating current motors which were rather crude at first, but have now been developed to a point where, for many purposes, they are equal to or better than direct current motors.

I have here a simple apparatus designed to demonstrate the production of a rotating magnetic field in a stationary structure and the effect of such a field in causing the rotation of a movable member. In order that you may appreciate the rotation of the field I have a commutating device which can supply current from a battery into one of four soft iron pole pieces arranged around the circumference of a circle. Any one of these four pole pieces is thus magnetized by current passing through a coil of wire similar to that which is used in an electric bell. The commutator can be turned by hand as slowly as desired and there is a small electric lamp located on each pole piece so that you can see which one is magnetized at any instant. Inside the circle of these pole pieces is a thin smooth hardened steel disc which, like all hardened steel, has the power of becoming permanently magnetized and when so magnetized it has the properties of a needle of a compass. That is to say one end of the magnetic axis tends to point toward the north pole. When the demonstration device was first put in service the hardened steel disc had not been magnetized so that it did not have a magnetic axis tending to point in any definite direction. The instant, however, I turn on the current from the battery and thus set up a north magnetic pole in the position indicated by the little electric lamp and, by the way, the structure is so arranged that a south magnetic pole is always set up diametrically opposite, the magnetic force passing through the hardened disc immediately magnetizes the disc in the diametrical direction of this force. Now the disc has become a permanent magnet like a compass needle and this means that if the north pole is shifted by means of the commutator, either to the right or to the left of its present position, the disc will tend to follow, as you can see by the motion of the arrow which has been painted upon its surface. From this time you will see that the white arrow follows the lighted lamp, however fast I turn the commutator, so that I now have a motor in which there is a rotating part capable of delivering power moving inside a perfectly stationary structure. The intangible thing which is rotating and dragging this steel disc around is the magnetic field which is following exactly the rotation of my hand. I am in fact sending alternating current impulses into the field.

Now a commercial alternating current motor is not quite as simple as this demonstration device. In the first place the alternations are so rapid that the eye could not possibly follow such a field, if it were set up in this particular structure, and in the second place there is no cummutator in most alternating current motors. However, the fundamental thing, namely, the rotating field does exist in all alternating current motors. This rotating field may be very easily produced in magnetic structures by several methods, but the simplest of these methods is by the use of what are called shading coils mounted on magnetic poles. Most ordinary alternating current motors do not have rotating parts which follow the rotating magnetic field with the exactness of this demonstrating device. Usually the tendency is for the rotor to run almost but not quite as fast as the field. The difference between the field speed and the rotor speed is called slip and the amount of slip depends upon the load. In small commercial motors the rotor may slip as much as 10% behind the field. This means that if the field is revolving 3600 times per minute, the rotor would revolve when loaded less than 3300 times per minute; although when the motor is carrying a very light load its speed would be nearly 3600 turns per minute. You will observe that in alternating current motors of this kind there is a very strong tendency for the speed of the motor to be dependent upon the number of alternations of the current and not upon its strength or voltage. In order to use the alternating current for accurate time-telling purpose I was compelled to devise a small reliable alternating current motor in which the rotor would follow the alternations of the current with extreme accuracy. There could be no slip between the rotor and the rotating field, otherwise my clocks would be unreliable. A motor having these characteristics was long ago designated as "synchronous" from two Greek words meaning "equal time".

In 1916 very few synchronous motors were used for power purposes none of them were in any respect adaptable for driving common clocks. By utilizing the same principle which is illustrated in this demonstrating device, namely, a rotor of hardened steel which could be permanently magnetized and then made to revolve synchronously in a rotating field there was created a device admirably suited to drive even small clocks. As you can readily see, this device is one that may be made very small and inexpensive, while because of its simplicity and the very light weight of the moving parts durability may be readily secured. Motors of this type are not well adapted to develop power, nor are they efficient when compared with commercial motors, but the work of driving hands of a clock is so light that these little motors, of which I will hand you samples for inspection, are very suitable. The power output of the first motors which I made for driving clocks was in the neighborhood of one millionth of a horse-power, but minute as this seems it still represents very much more power than is delivered by an ordinary spring clock movement. This is illustrated by the weight lifting capacity of this demonstrating apparatus. You can see that a very strong spring clock movement is able to lift on a drum mounted on its second hand arbor, which turns one revolution per minute, a small weight amounting to 1/4 oz. Along-side is a Telechron clock motor which has a shaft revolving one revolution per minute and this motor will easily lift through a drum of the same diameter a weight of 35 oz. Moreover I would point out that the spring clock movement even when tightly wound has its rate very considerably affected by lifting the tiny weight, while the Telechron motor does not change its rate to the smallest degree with a load 140 times as great.

As soon as a satisfactory motor which could be used to drive the hands of a clock became available, in the early summer of 1916, the next problem which I faced was to bring about in some manner the accurate regulation of the alternating current impulses which were being sent in all directions over the wires so that these impulses in connection with the newly designed motor might be used to supply power companies' customers with a dependable time-telling device. For the solution of this problem two things were necessary, first, an instrument that could conveniently be used by power station attendants for the purpose of regulating the frequency of the alternations, and, second, creation of a state of mind among the power company managers that would justify them in giving this extraordinary new service to the public. The second part of the problem was, on the whole, more difficult than the first. It took only a few months to design and build a thoroughly satisfactory master clock which could be used at power stations so as to indicate errors in the average frequency, which were hundreds of times smaller than could be measured with the instruments then in use.

Several years elapsed, however, before resistance on the part of some of the managers of the electric light companies was overcome to a point where they would give this new service. This was because some of them felt that the added responsibility might be serious and many of them believed that the new service would be of no financial advantage to their companies on account of the very small power consumption of the clock motors. However, most of the managers were public spirited and progressive and they could see a real opportunity which eventually became evident to all. At that time the meters for measuring electricity were scarcely sensitive enough to register the current consumed by a single clock on any customer's premises so that the company might get no returns, but better meters soon became available and in the course of a few years power companies found the revenue received from current used by these tiny motors was really an important matter. The value of current used by a single clock during a year will vary anywhere from $.50 to $1.50, depending upon the rate. If $.75 per year be taken as a fair average, you will see that a company having 100,000 of these clocks on its lines would receive a return of $75,000 a year from the current used. As a matter of fact this income is mostly extra profit, because the motors run 24 hours a day and the load is absolutely steady. For 100,000 clocks a generator with a capacity of 300 k.w. is adequate. Modern generators range from 25,000 to more than 100,000 k.w. capacity. Consequently this represents a very trifling portion of the output of one large generator. This means of course that the money invested in generating equipment, transmission lines, etc., to operate these 100,000 clocks is really small compared with $75,000 per year return. There is no other electrical device which yields as large a return on the investment to the power companies. Furthermore there are a good many power companies that have several times 100,000 clocks on their lines. It is estimated that the number of electric clocks now running in the United States is above ten million. As a result these clocks have become of considerable economic importance to power companies, which explains their eagerness in stimulating sales.

The growth in the sale of these modern electric clocks was very gradual after the first system became available in 1916. Only a few thousand were sold each year for the next three or four years. By 1921, however, the success of those in use and the publicity which followed stimulated sales to a point where manufacturers of other kinds of clocks began to take notice, but it was not until 1927, ten years after the system first became available, that forms of synchronous electric clocks other than the ones which I have described to you began to appear on the market. Then a group of rival manufacturers began to grow and within a few years there were over hundred different concerns which were selling synchronous electric clocks intended for use on systems that had been established quite generally throughout the country. Nearly all of these new forms of clocks differed from the original type in that they possessed no starting power, that is to say, it was necessary to start them manually and whenever there was an interruption in the power supply they would stop and not run until they had again been started by hand. While they were running they kept just as good time as the original type of self-starting synchronous clocks, but most of them were defective in some respect or other so that within another period of a few years they began to disappear from the market. Most of them were noisy, nearly all were short-lived, and the universal habit of stopping after every interruption proved to be a nuisance in many cases.

You will notice that the Telechron clocks of which there is a display in this room are provided with an indicating device so as to give a signal after an interruption. Such interruptions, of course, make an error in the time indicated by the clock equal to that of the interruption. Generally speaking interruptions are short so that the warning signal is sufficient for most purposes to take care of the usual interruptions in the current. When it becomes very necessary to eliminate the effect of interruptions, as in public building installations and some other places, Telechron clocks are built either with sustaining mechanisms which keep the hands in motion during an interruption or with resetting apparatus which automatically measures the length of an interruption and then after the current returns moves the hands forward to make correction.

On account of the relatively great power of this little synchronous motor as compared with spring clock movements many new uses have been found for this kind of time-keeping device. Prior to 1916 there were a number of recorders on the market which depended on spring clocks to drive charts or perform other services that had a time function, but the performance of these devices was limited by the relatively weak power of the spring clock movements. When Telechron motors became available for power which was a hundred times greater than that of the spring clock movements, the instrument makers began to redesign their mechanisms so as to be of greater service to their customers. Many kinds of new devices making use of these synchronous motors were also developed. Consequently a large part of the output of Telechron motors each year is used in instruments and devices that cannot be considered as ordinary clocks. In fact hundreds of thousands of motors are used annually for such purposes. Another field of usefulness for these new time-keeping motors is apparent for the very large dials such as are used in tower clocks. Instead of requiring a very heavy weight, a long pendulum and an expensive movement a tower clock with a dial several feet in diameter can be perfectly operated by means of one of these tiny motors which I hold in my hand. The use of large clocks especially those having Neon illumination has spread into the advertising field and wherever you go now-a-days you will find frequent outdoor signs which are seeking the good-will of observers by showing the time of day on very large clock dials.

In the modern electric clocks, as I have already intimated, the function of measuring time is separate from the function of telling time. Two devices are necessary, first a single very reliable and accurate master clock located at some central point on a power system, and second an unlimited number of synchronous motor clocks located wherever convenient on the distribution system of the power company. The same generators, wires, and tranformers which carry light, heat and power to all the company's customers also carry without any extra charge accurate time impulses to these modern electric clocks. The only thing that is necessary for the electric clock to do is to translate the alternating current impulses into time indications. Therefore, they serve to tell the time which is accurately measured by another device. As a result of this arrangement the mechanical construction of the electric clock is of a very different nature from that of the ordinary spring and weight-driven clock. In the latter conservation of power is of the utmost importance. Only a slight amoun of energy is available in a tightly wound spring or a lifted weight and this naturally must be used in the most miserly way if the delicate time-measuring escapement device is to perform accurately. Therefore, we find that in the ordinary clocks and watches the gear wheels are made very light, the teeth are made very perfect and the bearings are made as nearly frictionless as possible so as to reduce to the minimum the power needed to drive the escapement and all other moving parts.

In the electric clock, however, it is not difficult to provide an abundance of power which can be used for the simple task of keeping the clock hands in motion. There is no escapement to bother about. Consequently the gear train which connects the spinning rotor with the clock hands may be of relatively coarse construction, with bearings that might be considered crude in the former type of clocks. The two important conditions which must be met are that the gear train from rotor to hands is durable and capable of running for a long time without attention and that in operation the moving parts are very quiet. It is really immaterial whether the teeth of the slower moving members of the train are cut or stamped or whether the gear wheels are solid or spoked, the bearings coarse or delicate. The most difficult problem is to make sure that the faster moving members of the train are well lubricated and will remain so for a period of years and that there is not anywhere in the device a troublesome source of noise.

People have become accustomed to the ticking of ordinary clocks, but in twenty years they have not become accustomed to the much fainter buzzing or humming sound which is emitted by some of the electric clocks on the market. The modern electric clock is required for public acceptance to be practically silent. Such a result is not easy to obtain because wherever alternating current is used to set up a magnetic field, there is a tendency to generate a humming sound. Motion which cannot be seen by the eye is ample to make a very disagreeable sound. Consequently while the manufacturer of modern electric clocks escapes naturally some of the very difficult manufacturing problems which are connected with other kinds of clocks, he is obliged to solve this new problem of noise, if he is to make a success of his product.

Synchronous motor clocks may be readily substituted for practically all forms of ordinary clocks and their field of usefulness may be extended far beyond that of spring and weight-driven clocks. The electric movements are small and compact so that they may be mounted in any ordinary form of case. The dial may be readily illuminated by using a trifling amount of the energy which is available inside the case itself. They have already become the most popular form of alarm clock. They may be arranged to show the time of day by moving numerals in place of moving hands. They may be arranged to switch electric current on and off at predetermined times or to give signals according to a regular program. In fact there seems to be no limit to the field of usefulness of these new time-keepers.

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continued from Page 1

Members brought to this meeting interesting clocks, including a fine Hipp-type wall clock completely designed and constructed by Al Ettinger which he plans to exhibit at the National Convention in San Antonio. An excellent repast was served by Mrs. Marx which rounded out a fine afternoon. A vote of thanks was offered by your President in the usual manner.

In closing, I wish to again ask for original articles for publication. If you have material you wish to submit for publication, please do so now so that the summer will not interfere with your plans to send this out. In any event, until we meet again in the August Journal, on behalf of the officers and myself--<u>HAVE A HAPPY AND HEALTHY SUMMER</u>!

Electromagnetically yours,

Marty Feldman

Martin C. Feldman, FNAWCC

**** MART ****

FOR SALE: Self Winding CC, N.Y. 22" Sq. wood case $175.00, metal case 14" dial w/o glass $140.00; same, gold plated w/glass & sweep hand $190. Bulle elec. clock, Paris, dome missing, $225.00; Poole elect.w/dome $225.00. Prices incl. packing, ins. FOB dest. USA.
L.O'Briant,3516 Swift Dr.,Raleigh,NC 27606

FOR SALE: Master clock, platinum contact one minute signal, jeweled Waltham mvt., approximately 5" case, excellent timekeeper --------------------$60.00
Sangamo Electric, time only, center seconds disc. beehive case,GRO-$57.00
Martin C. Feldman,620 Reiss Place,Bx.NY 10467

ORIGINAL BULLE PARTS: Silk suspensions--$4.00; all springs (isochronism, silver, spiral)--$3.50; magnets--$10 & $12; coils--$12 & $16.50; hardware--25¢ ea. All postpaid. Martin C.Feldman

WANTED: Howard Slave Dial center hole only (edge holes O.K.) 11½ dial, 9½ chapter ring. Jerry Frank, 15-86 -208th St.Bayside,NY 11360 (212)423-0674

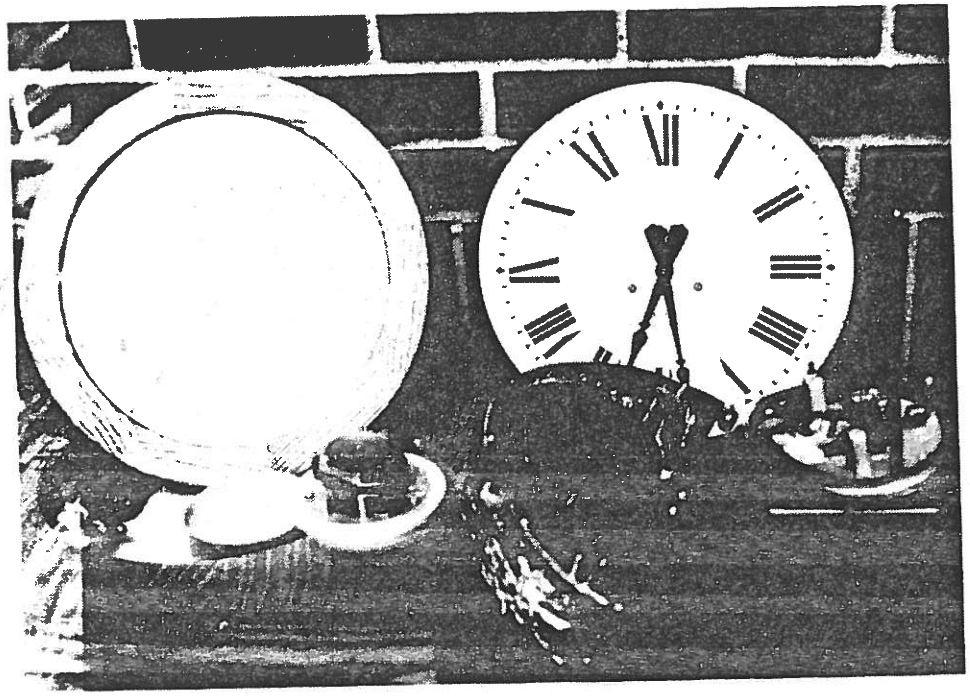
WANTED: Stromberg Masters--Write details.
Joseph Bourell,4213 No.Milwaukee Ave.,Chicago,Ill. 60641

WANTED: Electrical Horological Literature--any type. Highest prices paid. Hamilton-Sangamo clocks--write details.
Martin C. Feldman, 620 Reiss Place, Bx.NY 10467

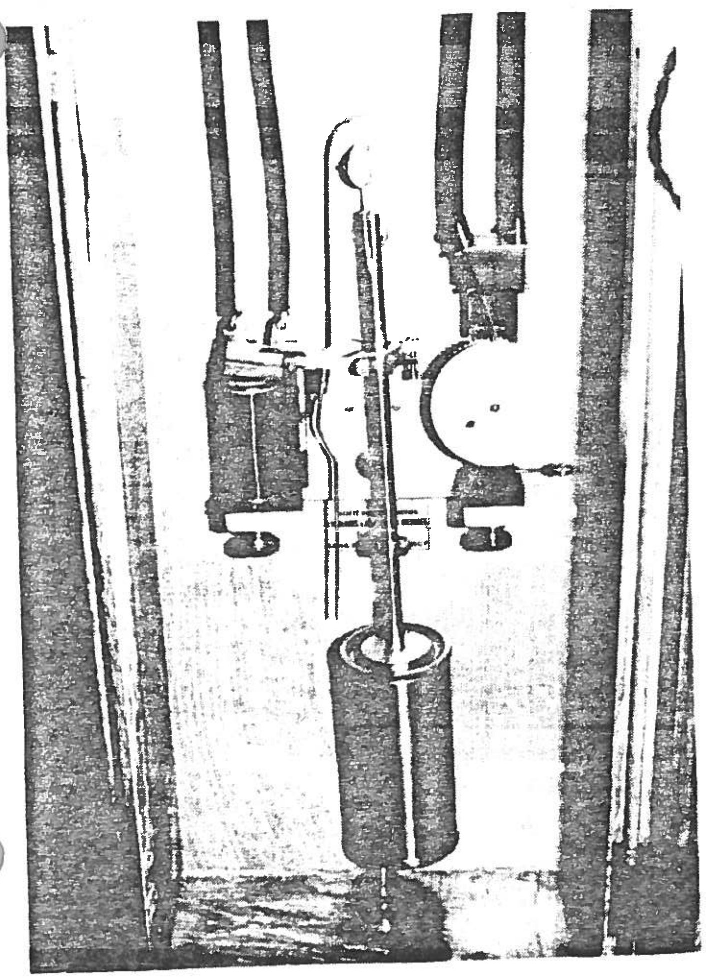
WANTED: Unusual Electrical Clocks (including Warren Mystery Battery Cl.). Also unusual foreign pieces. A.Marx,105 Bayeau Rd. New Rochelle,NY 10804

WANTED: Self-Winding Clock Co. (NY)--Master clock movement or Jeweler's Regulator movement (Style A). I have lots of SWCC parts and many style F movements, but need the above two movements for an SWCC book I am completing.
Dr. B.E. Honning (39029), P.O. Box 7704, Long Beach, CA 90807 (213)427-8001

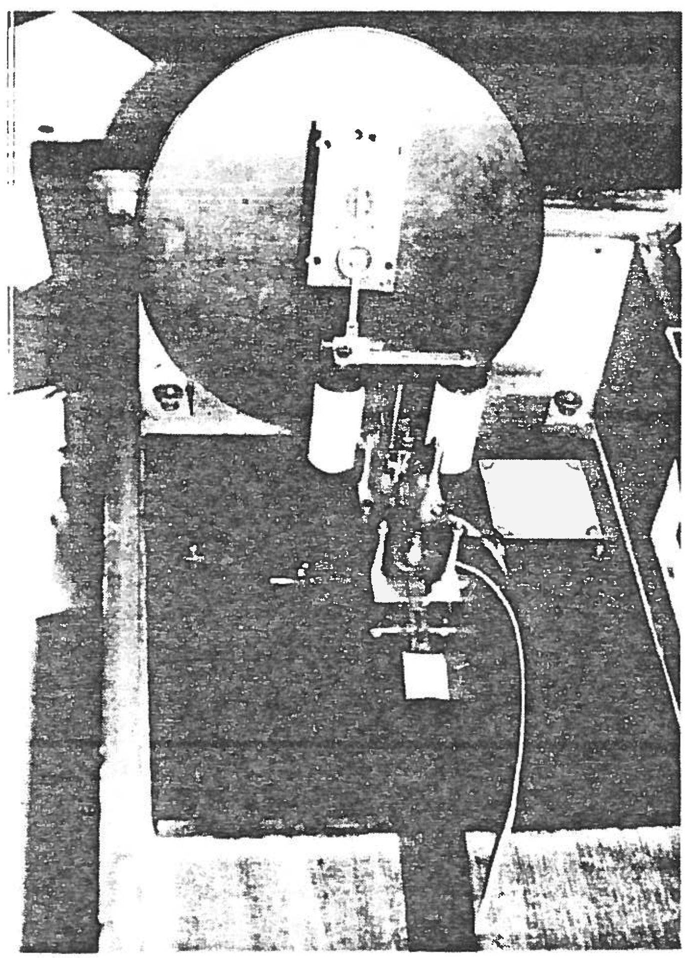
CLOCKS EXHIBITED AT THE LAST EHS MEETING



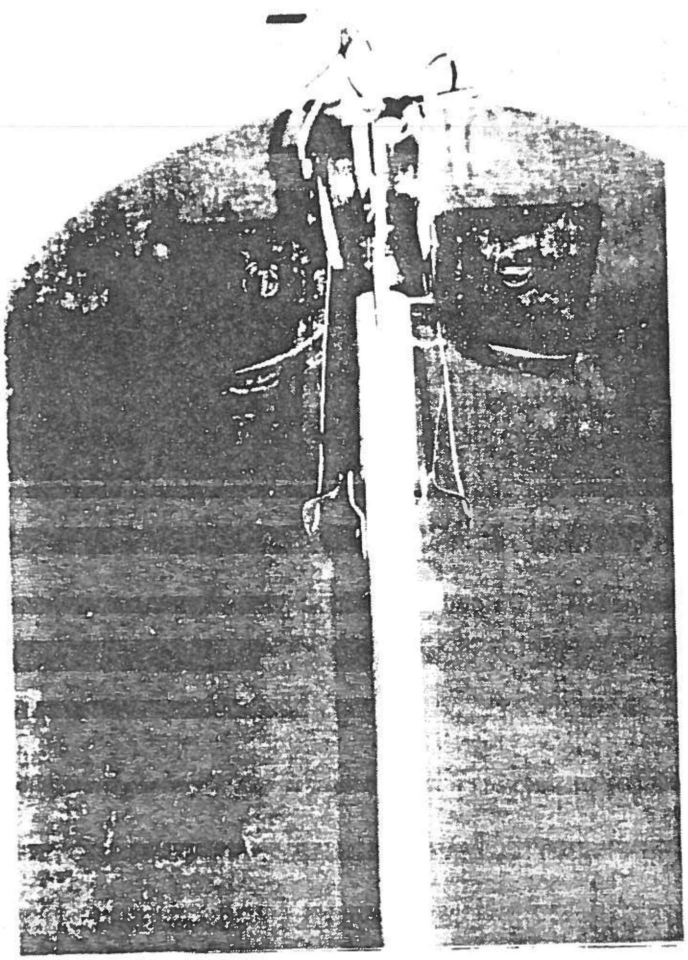
TWO SLAVE CLOCKS, A BULLE, AND AN A.C. MVT.



CAMPICHE MASTER CLOCK



SEIMENS-HALSKE ELECTRICALLY WOUND
REMONTOIRE MASTER CLOCK

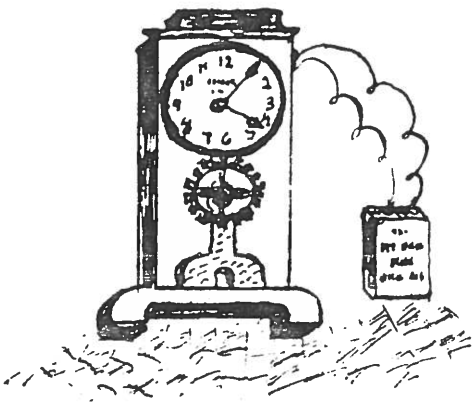


CONTACT SYSTEM FROM RITCHIE CLOCK

UNKNOWN FINELY MADE FRENCH SLAVE CLOCK

H. Curtis and M. Feldman with a Sangamo Electric. Taken March 4, 1978 at Mid-Hudson Chapter Meeting when I spoke on <u>EARLY BATTERY CLOCKS</u>.

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY Chapter No 78



August 1978
VOLUME IV---ISSUE #4
Martin C. Feldman, Editor

Hello fellow enthusiasts:

Now that we are all half way through the long hot summer, I hope that everyone has been able to get away from the daily routine and has found time to do something enjoyable in the way of recreation. As usual our Journal must be published and work has continued, albeit on a less frenetic level, in trying to bring you interesting and substantial information dealing with early electrical timepieces. This Journal completes the translation dealing with the Favarger Clock which was published as Part #1 in the December 1977 Issue of the JEHS. In addition W.M. Davis's patent is reprinted as it shows an interesting electrically driven double pendulum clock, which unfortunately has its motion work propelled by the pendulum. In addition, another curious oddity is included for your amusement. We have sent off our $50 donation to the Building Fund and I also have copied 19 patents (about 90 pages) of early electrical clocks which I donated on behalf of the Chapter to the Reference Section of the NAWCC library.

As our furry-skinned rodent, who is anxiously looking at his pocket watch, seems to imply your editor is quite concerned about the lack of original articles from the membership, a generally plateaued membership roster and non-payment of dues from many members who certainly would hate to lose their membership. If any members can help us in the latter three areas, it would be sincerely appreciated.

The drawing on the left depicts your editor busily consulting (or is it consorting?) with five French language experts who seem to be well equipped for the job. Never let it be said that we do not go to great lengths to provide you with a fine Journal. The translators have indicated they are willing to travel to help the research endeavors of other EHS members in good standing!

Enjoy this issue.

Electromagnetically yours,

Martin C. Feldman, FNAWCC

NATIONAL ASSOCIATION of WATCH and CLOCK COLLECTORS, Inc.

OFFICE — MUSEUM — LIBRARY

P. O. Box 33 514 Poplar Street Columbia, PA 17512

gratefully acknowledges receipt of
photocopies of 19 patents on electrical clocks, 1870-1890

from

Electrical Horology Society--NAWCC Ch. 78
c/o Martin C. Feldman FNAWCC #14172
620 Reiss Place, #7-E
The Bronx, NY 10467

as a (donation) ~~XXXXX~~ to the NAWCC Museum and Library

July 14, 1978

Association Representative

From: A. Favarger, L'ÉLECTRICITÉ ET SES APPLICATIONS À LA CHRONOMÉTRIE, Neuchatel, 1924, pp. 354-360.
Translated by: Martin C. Feldman,FNAWCC

Large Capacity Master Clocks With Hipp Contacts

When in one of the two two types of master clocks described above which is fitted with a 1/2 second pendulum one eliminates the time-switch, the hands, the face and the entire minute contact apparatus and only saves the mechanism of the electrically oscillating pendulum, the latter is able, all alone, to be utilized as a master clock capable of impulsing a certain number of slave electrochronometers having the Hipp impulsing system. It is adequate for these slaves to be arranged to beat, not minutes, nor even seconds, but only 1/2 seconds; an objective easily realized by a simple adaptation of their gearing to their time-switch. It is necessary, besides, to fit the suspension of the oscillating clock with a contact reverser identical in principal to the one with Hipp contact blades described on pages 239 and others. At each prime oscillation of the pendulum all the hands of the slave clocks which rely on this contact system will advance by a jump and will beat 1/2 seconds; to beat absolute seconds the slaves rely on an intermediary contact (page 239) with a pendulum oscillating at the rate of one second per half period.

But, the distribution of the electrically unified hour, by means of slaves beating half seconds and seconds only finds usefulness in observatories, scientific laboratories, and certain special industries. For distribution of the time (civil), which regulates the general activity of the public, the minute (in exceptional cases the 1/2 minute) is sufficient for all needs.

In the last case the possibility that one eliminates from the mechanism of a Hipp Master Clock all the parts which are not absolutely necessary to maintain the oscillations of the pendulum and, as much as the remaining clock is a master clock as it impulses slaves each minute, this simplified converted clock has a great capacity for slave clock control and we shall describe it further. One is easily assured, in examining figure 251, that the adaptation of the relatively complicated mechanism with the addition of a contact mechanism such as is seen in figure 254 is only possible as long as the number of the group interrupters does not surpass a certain number, which experience has taught to be best at about six and not more than eight. This number is, in effect, limited by the presence of different other sub-sections such as the time-switch wheel, the current reverser, etc. which already encumbers the mechanism. In the elimination of these sub-sections, all which can be eliminated, in reducing the space occupied by those which are necessary and remain, one is able to bring to 20 the number of group interrupters which can close successively at one-second intervals in the interval of one and the same minute. Thus, one is able to obtain a capacity of 500+ clocks (slaves).

(continued from VOLUME III---ISSUE #6, Dec.1977)

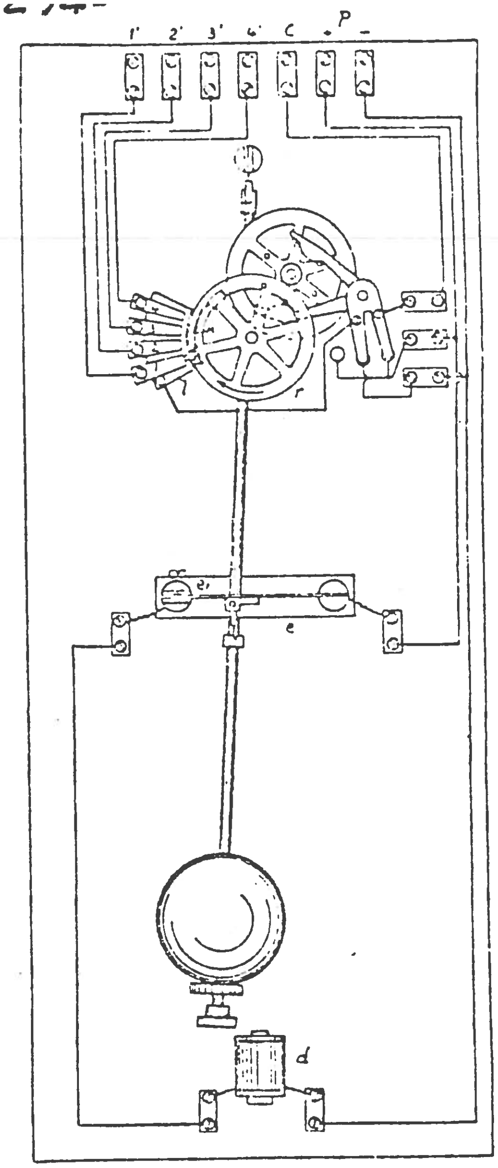
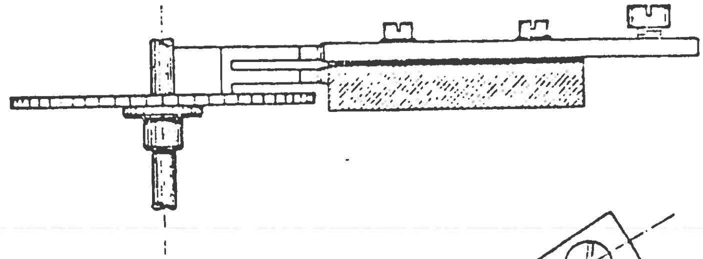


Fig. 251



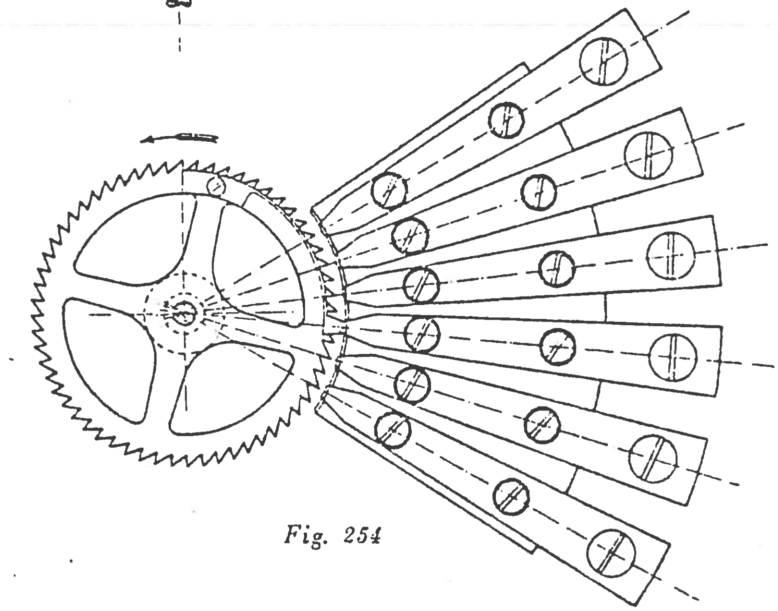


Fig. 254

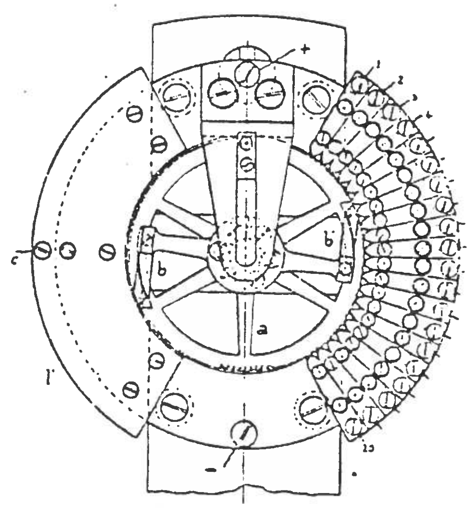


Fig. 255

Figure 255, showing a front view represents such a 1/2 second master clock. "a" is the escape wheel which is made to advance by one tooth at each double oscillation of the pendulum.

This wheel makes one revolution, not in one minute, but in two minutes; permits the elimination of the current reverser in fig.251, and its replacement by the following less encumbering device.

The wheel "a" (Figs.255, 256) carries two insulated contact springs "b" and "b'" which come each in their turn to successively touch the 20 insulated points 1,2,3, etc., 20, connecting to the 20 groups 1', 2', 3', etc. 20' the minute slaves and thus causes their hands to jump (in 20 seconds), one on the even minutes and the other, at the half-revolution following "a", on the uneven minutes. The two springs "b" and "b'" are connected with the two poles (+) and (-) of the current source "P" through the intermediary of two other flat springs "e" and "f" (fig.257) which are continually in metallic contact with the tips of two pivots of the horizontal shaft carrying the escape wheel "a".

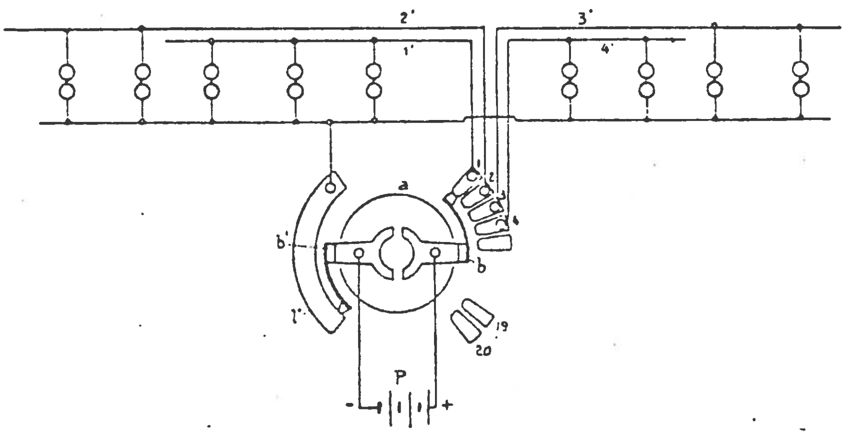


Fig. 256

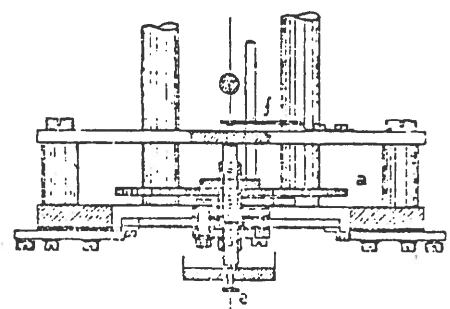


Fig. 257

This shaft is in two parts, one insulated from the other as seen in Fig.257. From then on, if one of the two contact springs, "b" for example, should be the one which is in contact with "P+", touching successively all the insulated contact fingers 1, 2, 3, etc., 20, the other, "b'" which is in contact with "P-" touches at all times the arc "1'" which itself is connected to the slave clock common current return wire, and thus the closed circuit which begins traveling from the emission point of positive current is:

> "P+"--"b"-- successively 1, 2, 3,...20 -- the groups 1', 2', 3'.. ..20' (from which it leaves through the base), the arc "1'"-- "b'"--"P-".

But, this position of "b" and "b'" occurs during one of the two half-revolutions of wheel "a" and its two part shaft. For the other half-revolution, it is the spring "b'", contacting "P-" which contacts the arc "l'" with "P+", and thus the positive current travels through the closed circuit:

"P+"--"b"--"l'"-- successively the groups 1', 2', 3'...20' (from which it leaves through the top), then 1, 2, 3,...20--arc "l'"--"b'"--"P'".

Thus, this emission is the part of the circuit which contains the slave clock electromagnets, is the inverse of that which had passed through them during the preceding half-revolution of "a".

It goes without saying that the arrangement of the contact apparatus which has come to be described as suitable to one-half-second Hipp contact pendulum clocks is applicable as such to the same pendulum clocks beating seconds, and thus the master clock corresponds, at least exteriorly, to the one represented by fig. 258.

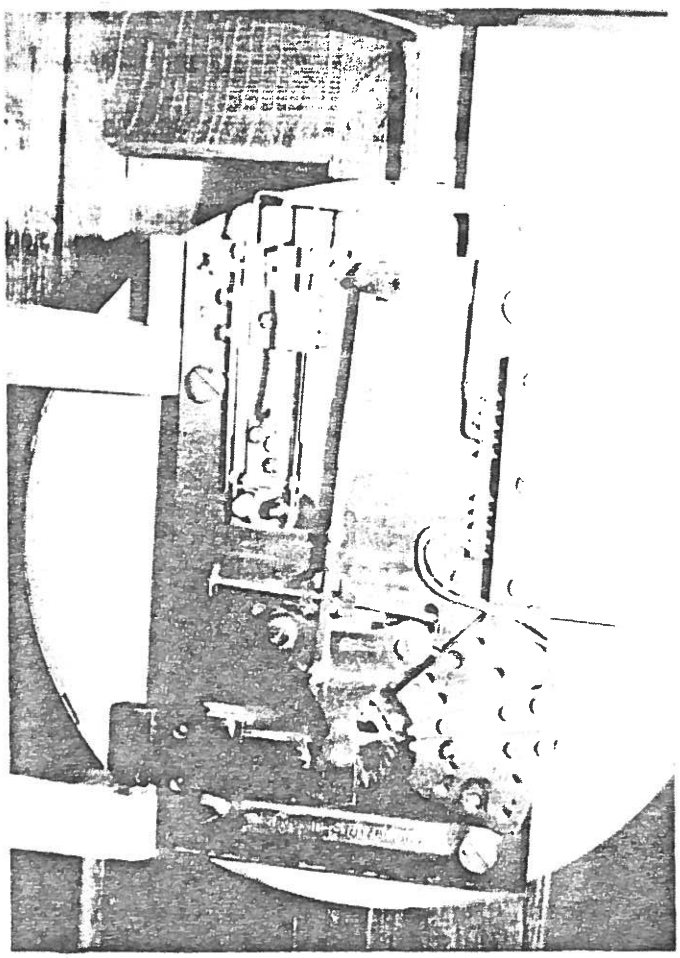


Photo #1--backplate of Master Clock showing two contact fingers in the lower right, escape wheel in center and additional contacts in the upper left.

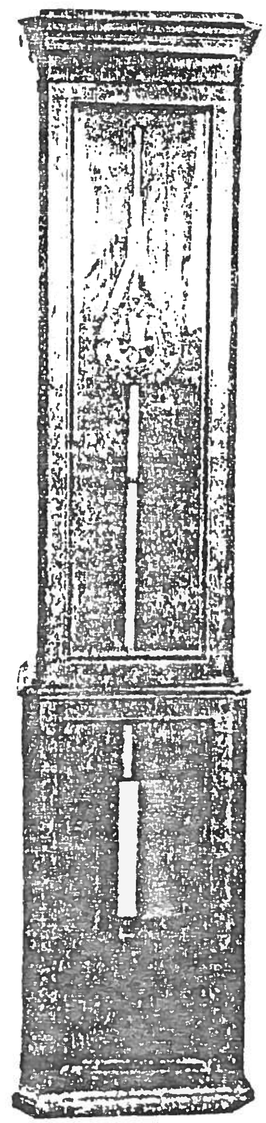
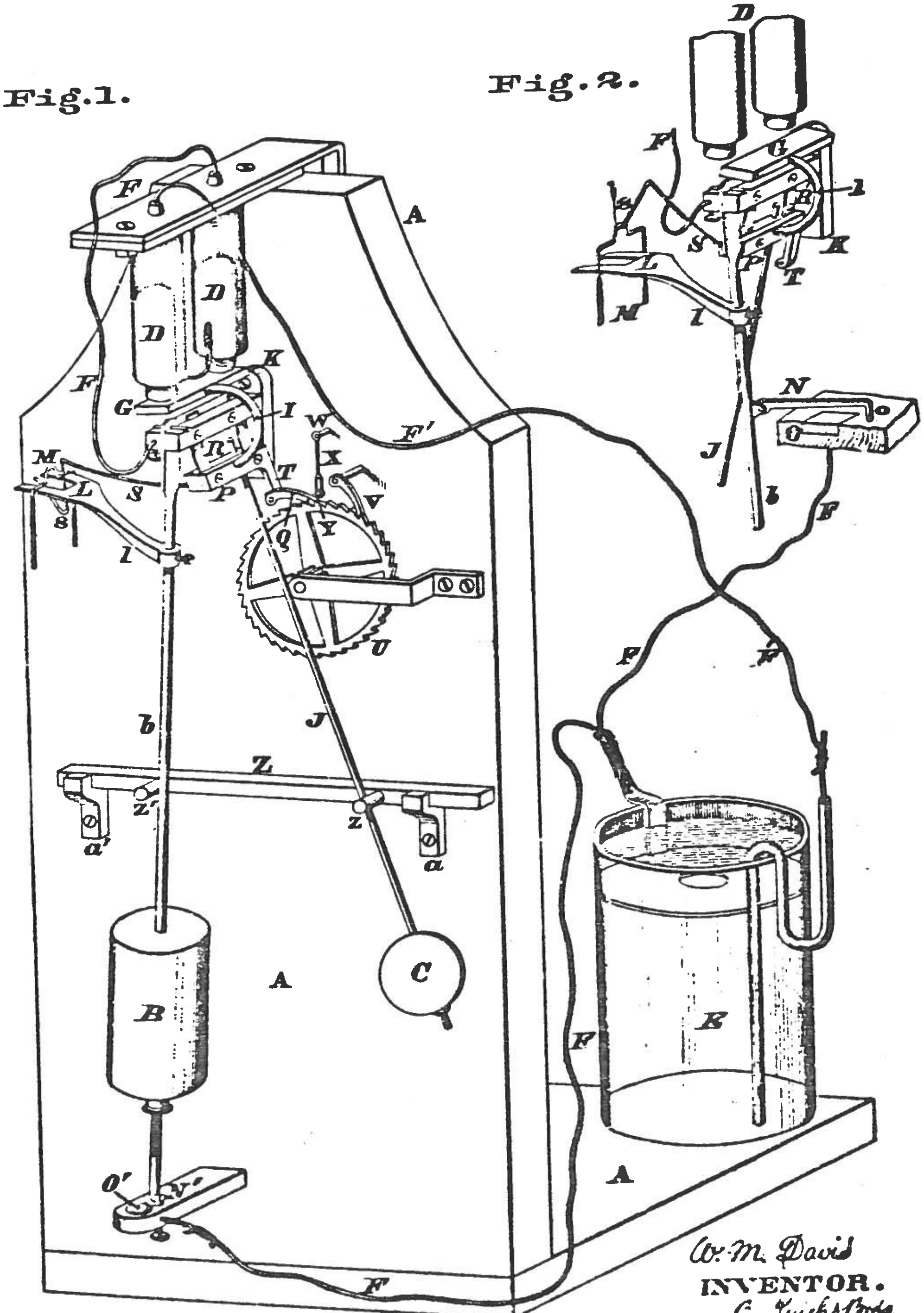


Fig. 258

W. M. DAVIS.
ELECTRIC CLOCK.

No. 120,185. Patented Oct. 24, 1871.

Fig.1. Fig.2.



Attest.
Jas. H. Layman.
John G. Col.

W. M. Davis
INVENTOR.
by Knight Bros.
Attys.

UNITED STATES PATENT OFFICE.

WILLIAM M. DAVIS, OF CINCINNATI, OHIO.

IMPROVEMENT IN ELECTRIC CLOCKS.

Specification forming part of Letters Patent No. 120,185, dated October 24, 1871.

To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, of Cincinnati, Hamilton county, Ohio, have invented a new and useful Electro-Magnetic Clock, of which the following is a specification:

This clock, as its name implies, is kept in motion by an electric current, and the regulating part is composed essentially of two pendulums and an electro-magnet. These pendulums, with their peculiar attachments, are called, respectively, the regulating and impelling-pendulum, and are connected with a train of wheels and corresponding dials, such as enter into the composition of a common clock, from which, however, my device differs in this: that the pendulum, by the aid of the electric current, impels the machinery instead of being impelled by it. This combination may be made directly between the impelling-pendulum and the clock-work; but in most applications of my device, as where a distant clock or number of clocks are to be driven, the communication will be made through the instrumentality of one or more supplementary impelling-pendulums interposed between the regulating-pendulum and the clock or clocks to be driven.

Figure 1 is a perspective view of an apparatus which embodies the essential features of my invention, the impelling-pendulum being at the right extremity of its beat and the armature at its nearest proximity to the magnet. Fig. 2 represents portions of the same parts when the impelling-pendulum is at the left extremity of its beat, and the armature at its furthest removal from the magnet.

A represents the face of a stand to which the operative parts are attached. B is a pendulum, which I call the regulating-pendulum because it regulates the motions of all the others, the number of which may be, as before stated, one or many. C is a pendulum with an attached armature, which may be called the impelling-pendulum because by the force it receives from a magnet, D, it impels the regulating-pendulum; and, when the clock is attached directly to this combination, it impels the clock also. The motions of these two pendulums, when moving in combination as a regulator, must be isochronous, but not simultaneous. In order that this isochronism may with certainty be kept up while thus moving, they must previously have been so adjusted as to have their normal periods of vibration as nearly equal as possible. E is a battery, and F F' are wires which, including the rod *b* of the regulating-pendulum B, lead from the magnet to different poles of the battery. G is the armature of the magnet D, and is connected by a rigid attachment, I, to the pendulum-rod, J. K is the cock which supports the pendulums, being firmly secured to the stand for that purpose. Projecting from the pendulum-rod *b*, near its upper end, is an arm, *l*, which terminates in a fork, L. This fork is designed to receive the impulse-weight M, (hereafter to be described,) which is dropped upon it at the properly-recurring moments to keep the pendulum B in motion. To enable the fork L to perform its functions to the best possible advantage the arm *l* is curved upward so that the fork L, when the pendulum is at rest, shall be on a level with the center of motion of the pendulum. The bifurcated form of the arm L *l* allows the hook S *s* to play freely up and down between the prongs without touching them. M is a small weight, which may be called a detached gravity impulse, as it is designed to keep the pendulum B in motion by pressing on the fork L during a greater portion of its descending than of its ascending motion. It may be made in any suitable form; in this case it is a piece of fine wire nearly in the form of the letter U. N is a circuit-breaker attached to the pendulum-rod *b*, Fig. 2, and so adjusted as to draw its point *o* onto the metallic plate O by the swinging of the pendulum B. The plate O is a part of the electric circuit F, and is surrounded by a non-conducting material so that by the return swing of B the point *o* of the circuit-breaker N is pushed from the plate O and the circuit is broken. The pendulum-rod J is supported by a cross-bar, P, at its upper end, which cross-bar is connected with the cock K by two flexible supports, R R'. Into this cross-bar is inserted a lifting-arm, S, on the outer end of which is a fork, *s*, which is designed, during its upward stroke, to lift the weight M from the fork L. The pendulum-rod *b* is hung in the plane of the magnet in order that the disturbing effects of the latter on the motions of the pendulum B may be reduced to a minimum.

The pendulum B is put in motion so as to draw the point *o* of the circuit-breaker N into the metallic plate O, which closes the electric circuit, and causes the magnet D to attract the armature G. This draws the pendulum C aside, (to the right in the drawing,) and drops the weight M onto the fork L, (see Fig. 1,) thus giving an impulse to the pendulum B *b*. As N is pushed from the plate O by the return swing of B *b*, the circuit is broken and the armature, released from magnetic attraction, allows C to swing to the left, thus lifting the weight M from the fork L, as represented in Fig. 2. The above-described movements will be constantly repeated so long as the battery-power is sufficient to keep the pendulum C in motion, for the pendulum B receives a constant supply of moving force from C through the medium of the weight M, while C receives a constant supply from the magnet, which in turn receives it from the battery through the circuit-making function of B. Any irregularity in the motion of C arising from varying force in the battery power will not affect the motion of B, for the impulses which the latter receives from the weight M will be sensibly constant within certain wide limits in the variation of the battery force. These limits are, on the one hand, when the battery power becomes too weak to keep the pendulum C in motion; and on the other hand, when it becomes so forcible as to derange the whole apparatus. To prevent the occurrence of this last catastrophe as far as practicable a check-bar, Z, is placed in front of the pendulum-rod J, so that the rod shall come in contact with the studs *z z'* of this check-bar, and thus limit the swing of the pendulum within the proper bounds. This check-bar is supported by two brackets, *a a'*, and is free to slide endwise in either direction as the rod J may push it. This will remedy the evil effect of too much battery power unless this force is exceedingly great, which will rarely, if ever, occur. Such a check-bar is to be applied to all the driving-pendulums in the circuit.

We come now to a description of the connection between the regulating-pendulum B *b* and the clock movements. Anywhere in the electric circuit may be placed one or more pendulums, called supplementary pendulums, precisely similar to C, which pendulums are connected with electro-magnets similar to D. These supplementary pendulums will be operated upon by the action of B *b* in making and breaking the electric circuit in the same manner and at the same time as the impelling-pendulum C is. Each one of these supplementary pendulums becomes an intermediate link between the regulating-pendulum and the clock movement with which it is connected; and it now remains to show how this connection is made. From the cross-piece P on the rod J there extends downward a small lug, T, to which is attached by a delicate joint the feed-hand Q. At each alternate swing of the pendulum C this feed-hand Q moves forward the notched time-wheel U of the clock, which is provided with a catch-pawl, V, to prevent a retrograde movement of the wheel U as Q is withdrawn by the return swing of C. As the pendulum C may be subjected to various lengths of swing by the varying power of the battery, a provision has been made to prevent it from moving the time-wheel more than one tooth at each forward swing of the pendulum. This provision is shown at W, where a pin projects from the stand A and holds at its outer end by a suitable joint a bridle, *x*, of slender wire. This bridle embraces a small wrist, Y, that projects from the side of the feed-hand Q very near its point. This wrist slips quite freely up and down to a certain extent within the loop of the bridle, as shown in Fig. 1. The length of this bridle and its point of support are so adjusted that the feed-hand shall be lifted above the point of the tooth which it is at the time feeding forward, just at the moment the catch-pawl T falls into the notch next to the one it last occupied. In the return swing of the pendulum C the feed-hand is again lifted by the bridle above every tooth except that one which is next to the tooth it last moved forward.

While selecting for illustration the form here presented, because practically tested by me, I reserve the right to employ any obvious modification of the operative parts. For example, instead of using the detached gravity impulse M an attached gravity impulse may be used. This form of the gravity impulse may be represented by a small bar of metal or other material, with one end secured to some part of the stand by a delicate or flexible joint, the other end pressing on the impulse arm L, being raised from it at the proper moment by the same mechanism which lifts the detached impulse M; or the force of a spring may be used to give motion to the regulating-pendulum, and have its pressure withdrawn at the proper moments by the same mechanism, or its equivalent, which relieves the pendulum from the gravitative force of M.

Instead of using the combination of the time-wheel U and the feed-hand Q to communicate motion to the clock-train, I may use other forms of mechanism—such, for example, as that described by Edmund Beckett Denison, M. A., at pp. 132 and 133 in his "Rudimentary Treatise on Clock and Watch-Making: London, 1850." According to this author the object may be effected simply by reversing the escape-wheel and pallets of an ordinary recoil-escapement, and causing the pendulum to drive the machinery instead of being driven by it. In the form in which the escape-wheel is now usually made this plan will not allow of so wide a swing of the driving-pendulum as the one used by me without deranging the operative parts.

In the drawing two circuit-breakers are represented, one of which has already been described. The other is represented at N' O' at the lower end of the pendulum-rod *b*. N' is a knife-edge of platinum or other suitable metal, secured to the lower end of the rod *b*. O' is a globule of mercury held in a metallic cup, which is represented forming part of the electric circuit. As the pendulum B *b* swings back and forth the knife-edge N' enters and leaves the mercury O', and the circuit is alternately made and broken. Other forms may still be suggested. A platinum or other suitable metallic point may be caused to dip vertically into a vessel of mercury instead of a knife-edge; or a metallic spring attached to the rod *b*, and allowed by the swing of the pendulum to fall on a metallic plate, which is connected with the other pole of the battery, may be used to discharge these functions.

Among the many advantages of this clock the following may be mentioned: As the regulating part is moved by electric force alone there is no necessity of having frequent access to it; therefore it may be inclosed in an air-tight case, thus reducing the atmospheric resistance to a constant quantity. Being thus inclosed, it may be placed in a cellar or vault specially prepared for it, and by that means removed from all thermic changes, a very important desideratum for all accurate time-keepers.

It will be seen, when the mechanism is well considered, that the force which impels the regulating-pendulum must be sensibly constant, notwithstanding there may be a great variation in the battery power. This, combined with the slight variable resistance it has to overcome, viz.: making and breaking the electric circuit, seems to give ample assurance of uniform motion.

I claim as my invention—

1. The combination of the regulating-pendulum B and its impulse power M with the impelling-pendulum C and its moving power—the electric magnet D.

2. The combination of the lifting-arm S on the pendulum-rod J and the impulse power M, whether that be the force of gravity or of a spring, with the arm L *l*, or its equivalent, on the rod *b*.

3. The combination of the regulating-pendulum B and an electric circuit with impelling-pendulum or pendulums C, whether near or distant.

4. The combination of the pendulum B having an impulse-arm, L *l*, and the circuit-breaker N O, with the impelling-pendulum C having a lifting-arm, S *s*, and weight M, and the attached armature G and magnet D, or the essential equivalents of these separate parts, operating in unison, substantially as and for the purpose described.

5. The combination of the check-bar Z and the impelling-pendulum C, for the purpose described.

6. The described combination of the elements G, C, D, J, L, M, and S with an electric circuit, so as to telegraph time from the regulating-pendulum B to any number of clock-dials, whether near or distant.

7. The combination of the impelling-pendulum C, as above described, with the feed-hand Q and bridle X, or its equivalent, and the wheels of an ordinary clock movement, for the purpose of indicating time.

8. The method of communicating motion to and of controlling the motions of an impelling-pendulum, C, whether near or distant, by means of an attached armature actuated by an electro-magnet which is charged at isochronous intervals by a regulating-pendulum, B.

In testimony of which invention I hereunto set my hand.

WILLIAM M. DAVIS.

Witnesses:

GEO. H. KNIGHT,

JAMES H. LAYMAN.

(50)

*** MART ***

FOR SALE: Self Winding CC, N.Y. 22" Sq. wood case $175.00, metal case 14" dial w/o glass $140.00; same, gold plated w/glass & sweep hand $190. Bulle elec. clock, Paris, dome missing, $225.00; Poole elect.w/dome $225.00. Prices incl. packing, ins. FOB dest. USA.
L. O'Briant, 3516 Swift Dr., Raleigh, NC 27606

FOR SALE: Master clock, platinum contact one minute signal, jeweled Waltham mvt., approximately 5" case, excellent timekeeper------------------$60.00
Sangamo Electric, time only, center seconds disc.beehive case, GRO-$57.00
Martin C. Feldman, 620 Reiss Place,Bx. NY 10467

ORIGINAL BULLE PARTS: Silk suspensions-$4.00; all springs (isochronism, silver, spiral)--$3.50; magnets--$10 & $12; coils--$12 & $16.50; hardware--25¢ ea. All postpaid. Martin C. Feldman

WANTED: Electrical Horological Literature--any type. Highest prices paid. Hamilton-Sangamo clocks--write details.
Martin C. Feldman, 620 Reiss Place, Bx.NY 10467

WANTED: Howard Slave Dial center hole only (edge holes O.K.) 11½ dial, 9½ chapter ring. Jerry Frank, 15-86 -208 St. Bayside, NY 11360 (212)423-0674

WANTED: Stromberg Masters--Write details.
Joseph Bourell, 4213 No.Milwaukee Ave.Chicago,Ill.60641

WANTED: Unusual Electrical Clocks (including Warren Mystery Battery Cl.). Also unusual foreign pieces. A. Marx,105 Bayeau Rd.New Rochelle,NY 10804

WANTED: Self-Winding Clock Co. (NY)--Master clock movement or Jeweler's Regulator movement (Style A). I have lots of SWCC parts and many style F movements, but need the above two movements for an SWCC book I am completing.
Dr. B.E. Honning (39029), P.O.Box 7704, Long Beach, CA 90807 (213) 427-8001

MEETING NOTICE

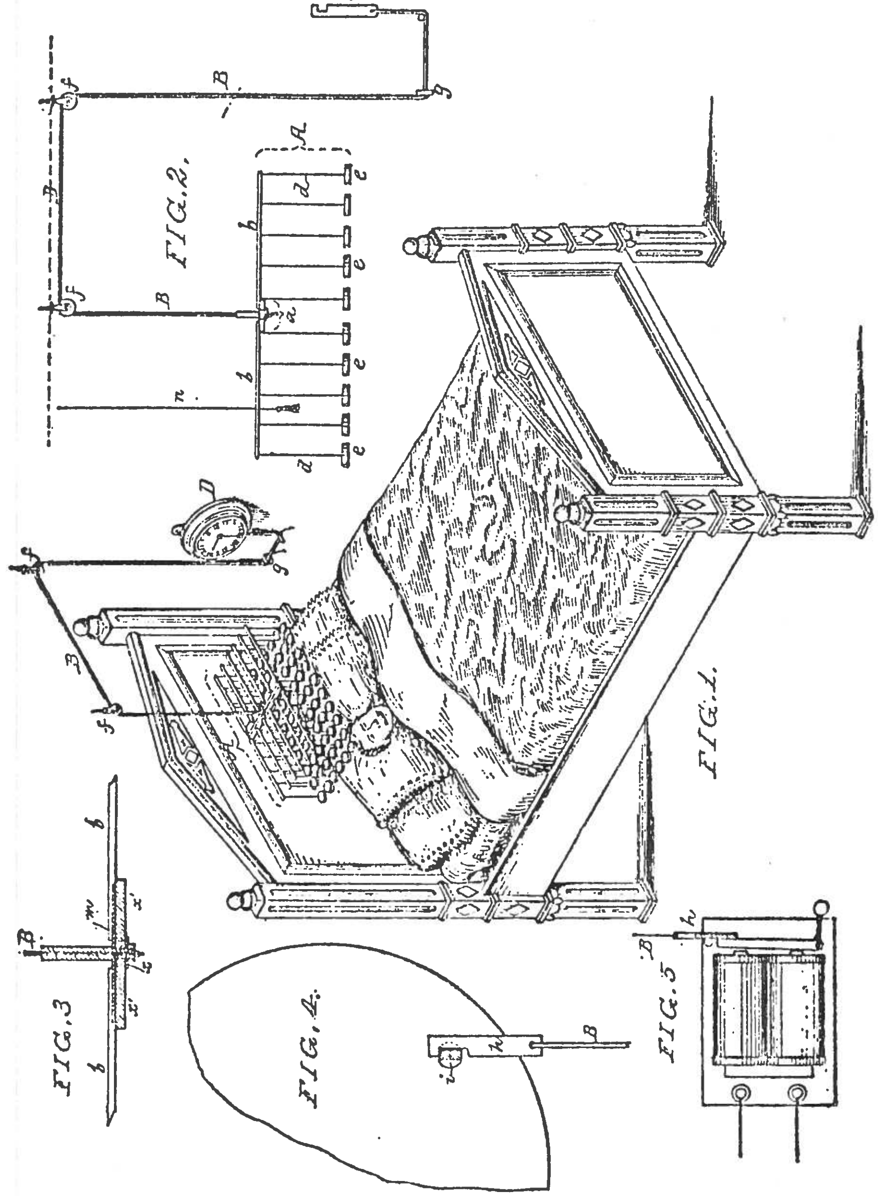
Sunday-Oct. ~~1st~~ 8th - 2:00 p.m. @ Charles Roth's home
2 Circle Lane Roslyn Hts., N.Y.
Please call for directions and reservations 516 621-4540

-302-

(No Model.)

DEVICE FOR WAKING PERSONS FROM SLEEP.

No. 256,265. Patented Apr. 11, 1882.



Tactile Alarm Clock

UNITED STATES PATENT OFFICE

DEVICE FOR WAKING PERSONS FROM SLEEP

Specification forming part of Letters Patent No. 256,265, dated April 11, 1882
Application filed December 14, 1881. (No model)

. . . The object of my invention is to construct a simple and effective device for waking persons from sleep at any time which may have previously been determined upon, the device being also adapted for use in connection with an electric or other burglar-alarm apparatus, in place of the usual gong-alarms. . . .

Ordinary bell or rattle alarms are not at all times effective for their intended purpose, as a person in time becomes so accustomed to the noise that sleep is not disturbed when the alarm is sounded.

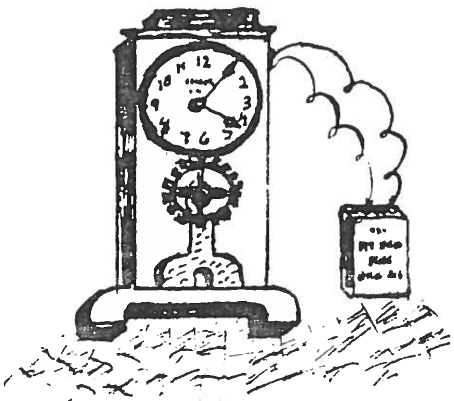
The main aim of my invention is to provide a device which will not be liable to this objection.

In carrying out my invention I suspend a light frame in such a position that it will hang directly over the head of the sleeper, the suspending-cord being combined with automatic releasing devices, whereby the frame is at the proper time permitted to fall into the sleeper's face.

In the drawings, A represents the frame, which consists of a central bar, *a*, having on each side a number of projecting arms, *b*, the whole being made as light as is consistent with proper strength. From each of the arms *b* hang a number of cords, *d*, and to the lower end of each of these cords is secured a small block, *e*, of light wood, preferably cork . . . the only necessity to be observed in constructing the frame being that when it falls it will strike a light blow, sufficient to awaken the sleeper, but not heavy enough to cause pain. . . .

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78



OCTOBER 1978
VOLUME IV---ISSUE #5
Martin C. Feldman, Editor

Hello fellow enthusiasts:

The interest in electrical horology has been steadily increasing while, unfortunately for new members, the availability of electrical clocks has sharply declined. The exquisite early examples of the art are virtually no longer extant as far as the current market is concerned. In addition, the current continuing devaluation of a dollar makes purchasing of clocks most attractive here in our own country. Examples of the more mass-produced electrical clocks still can be found and it is a good idea to buy now if you can.

The literature dealing with our specialty is also extremely difficult to come by. Except for the fine sporadic publication of the Electrical Horology Group in England our Journal remains the only continuing source of information dealing with early electrical horology. Our Journal is being collected and stored in the reference section of the NAWCC library for future use by interested members. In order for us to continue we must have a source of new articles as well as the support of our membership. Therefore since dues for the 1979 year will be coming up, why don't you make our Treasurer's job easier and send the $7.00 in early to, Mr. Charles Roth, 2 Circle Lane, Roslyn, NY 11577! In addition, recruitment of new members would be gratefully appreciated.

This month our Journal features an article dealing with the Howard Self-Winding Master Clock--Model 89 and an interesting article reprinted from the Horological Journal describing a free pendulum clock with liquid escapement.

Enjoy this issue.

Electromagnetically yours,

Marty Feldman

Martin C. Feldman, FNAWCC

THE E. HOWARD MODEL 89 SELF-WINDING MASTER CLOCK

By: Martin C. Feldman, FNAWCC

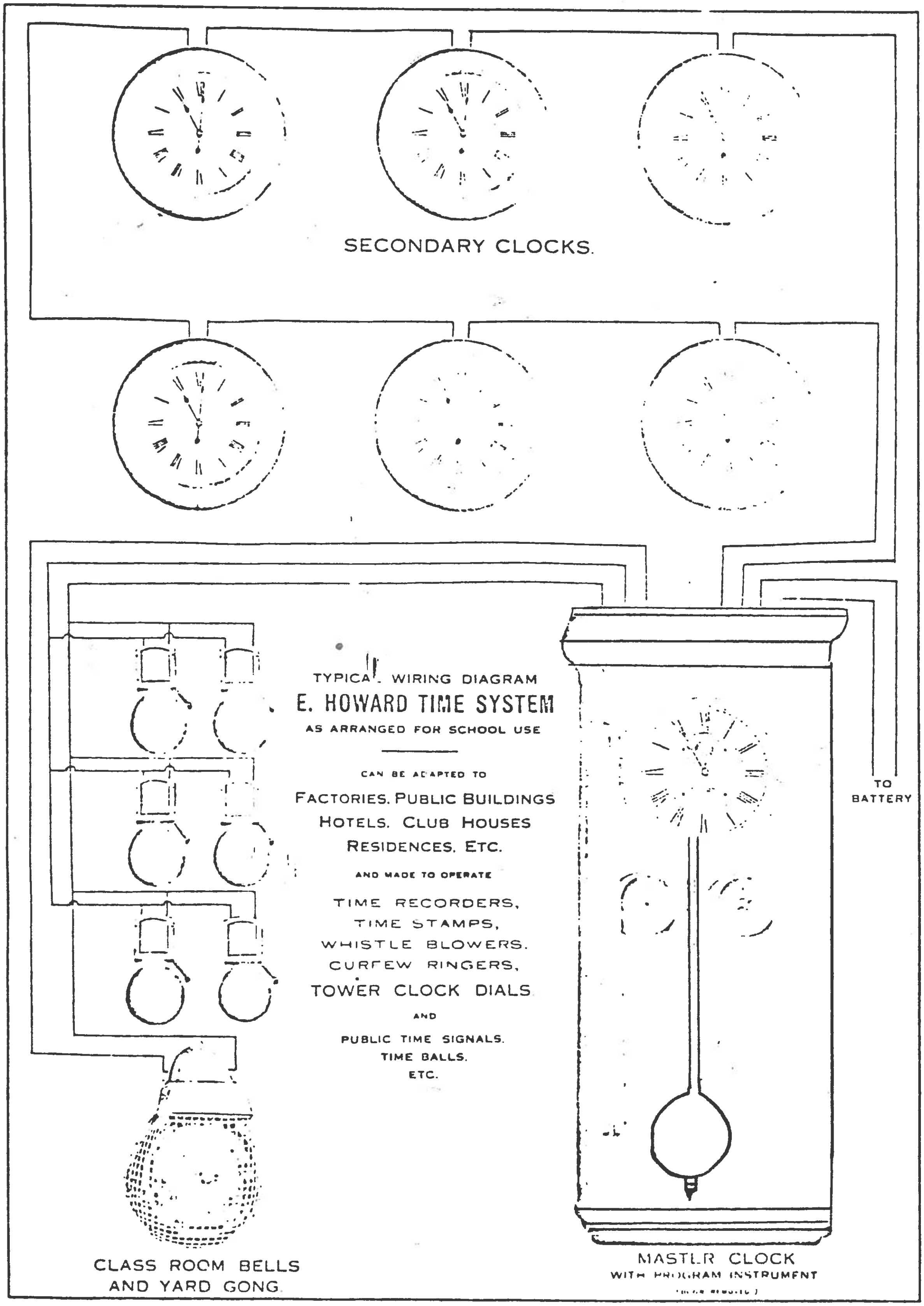
When electricity was being touted as the new energy source which would revolutionize machines and eliminate much of the manual labor associated with the functioning of the machines---both to keep them operating and to guide them in their operation--electricity was wedded to many clock mechanisms, as we all well know. As with many marriages the results expected can be either for better or for worse. Unfortunately, we see significant numbers of clocks where the combination of electricity and a horological mechanism gave birth to what can best be described as a miscarriage. One of the main reasons for the failures was that the inventors generally did not understand fundamental horological principles and therefore compromised the accuracy of their clocks--all in an effort to utilize electricity. There are examples of electrical clocks which do offer a fine rate such as the Lowne, Bulle, and Shortt clocks among others. The American master clocks which combined a weight-driven movement with a self-winding feature were among those clocks which proved highly reliable rate-wise as well as having a generally trouble-free lifetime. In addition, if one opted for a mercurially compensated pendulum plus an electromechanical synchronization device, an extremely fine rate was the expected as well as the proven result.

The earliest self-winding master clocks were produced by the Self-Winding Clock Co. of Brooklyn, New York beginning operations during the first part of the 1880's utilizing a movement by Seth Thomas and a rotary motor of their own manufacture. They later built the entire clock themselves and went on to supply the Western Union Telegraph Co. with clocks. Western Union, in turn, provided standardized time to its customers as they were also in the business of selling time. As business improved for the Self-Winding Clock Co., other companies such as Seth Thomas, E. Howard, Standard Electric, Stromberg, Landis, etc. began to produce their own master clocks which generally worked on the same principles of Self-Winding's Clocks, but differed in some points of engineering, size, style and cost.

E. Howard produced many fine regulators, and then at about 1900 began producing self-winding clocks. This production continued roughly until 1930. Originally the company produced weight-driven clocks with minute or half-minute electrical contacts. As competition from the other companies became more keen and as it was also to their financial benefit to produce self-winding clocks, they did extend their production to this type.

Mechanically the clocks were built on the solid Howard regulator design with the addition of a solenoid to wind the clock once per minute thus ensuring a virtual constant torque of the mainspring and eliminating errors due to run-down of the latter. In addition, many clocks were fitted with a mercurially compensated pendulum enabling the user to regulate the clock to within one or two seconds per week. The clocks, through the use of suitable contacts and relays were capable of operating numerous slaves. The slave numbers were only limited by the size of the institution or building they were to be in and, by the power supply. Each slave had a coil of 6-1/2 ohms drawing about one volt. They were usually connected in series, with the larger systems having the series system connected in parallel. The master clock itself used 24V DC for rewinding the spring. Battery or accumulator systems in conjunction with recharging apparatus was the most desirable although not the most common. During 1915, a clock with all the "extras" would probably have sold for $400-500. The photos accompanying this article show model #89, in running condition but unrestored. The additional literature was put out by Howard for promotional purposes and the wiring diagram shows a typical installation. Specific variations based on need and design were of course illustrated separately.

The E. Howard Self-Winding Clock was a fine example of the electrical/horological marriage and remains a desirable collector's item today.


SECONDARY CLOCKS.
TYPICAL WIRING DIAGRAM
E. HOWARD TIME SYSTEM
AS ARRANGED FOR SCHOOL USE
CAN BE ADAPTED TO
FACTORIES. PUBLIC BUILDINGS
HOTELS. CLUB HOUSES
RESIDENCES. ETC.
AND MADE TO OPERATE
TIME RECORDERS,
TIME STAMPS,
WHISTLE BLOWERS,
CURFEW RINGERS,
TOWER CLOCK DIALS
AND
PUBLIC TIME SIGNALS.
TIME BALLS.
ETC.
TO BATTERY
CLASS ROOM BELLS
AND YARD GONG.
MASTER CLOCK
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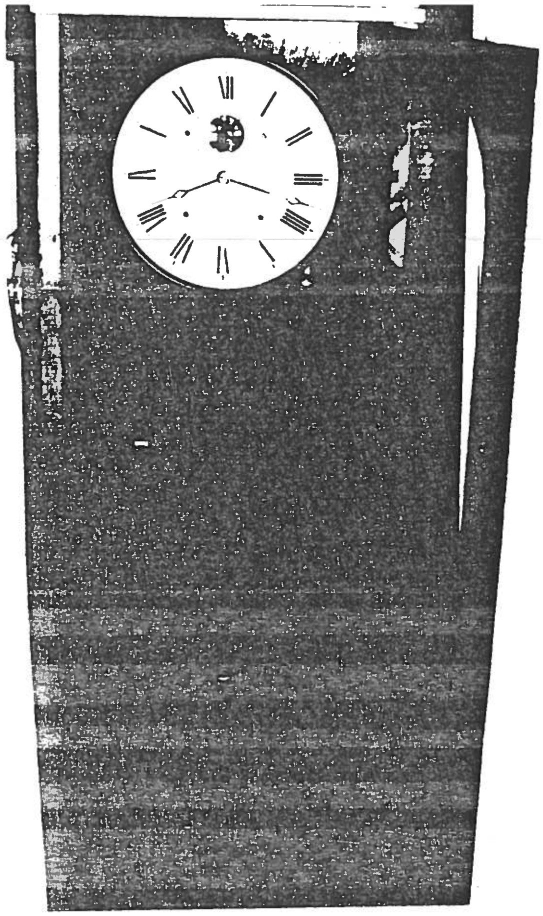
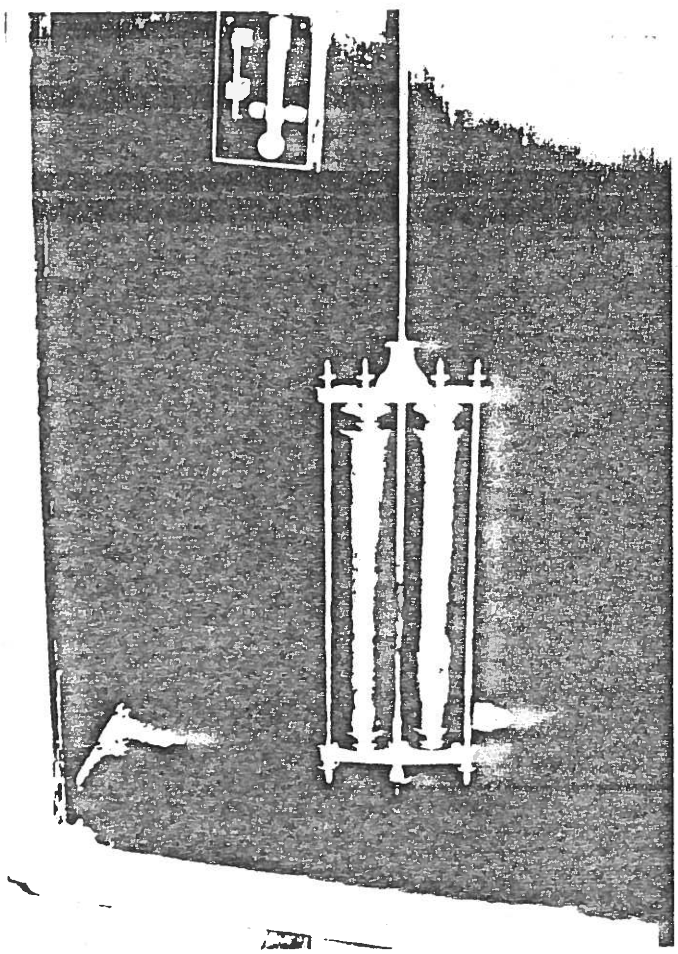
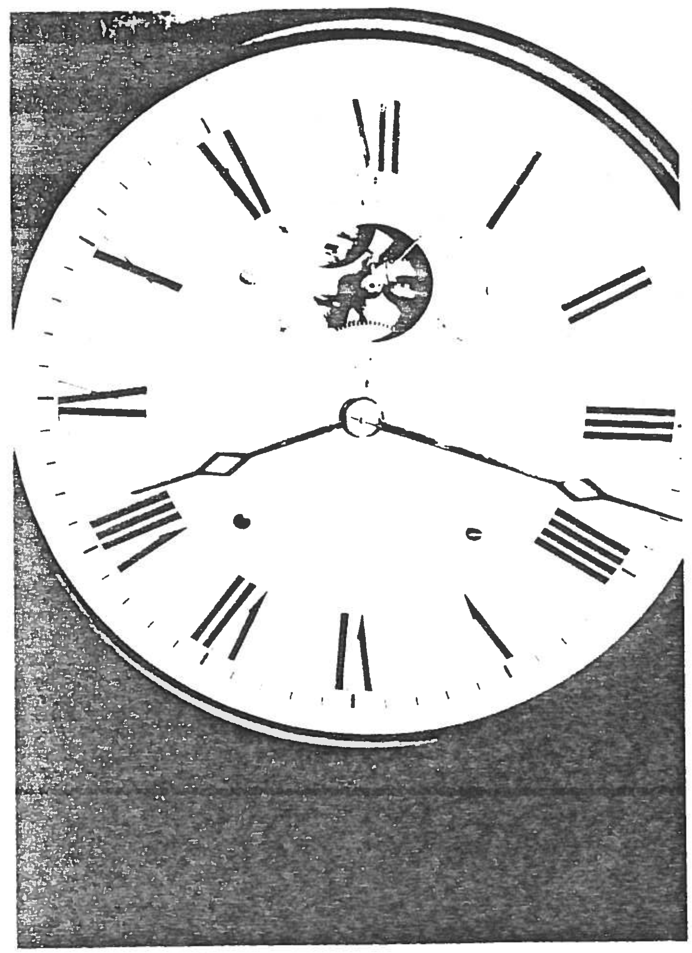


. [illegible] MODEL 89 [illegible] CLOCK



MERCURY PENDULUM & WIND SWITCH



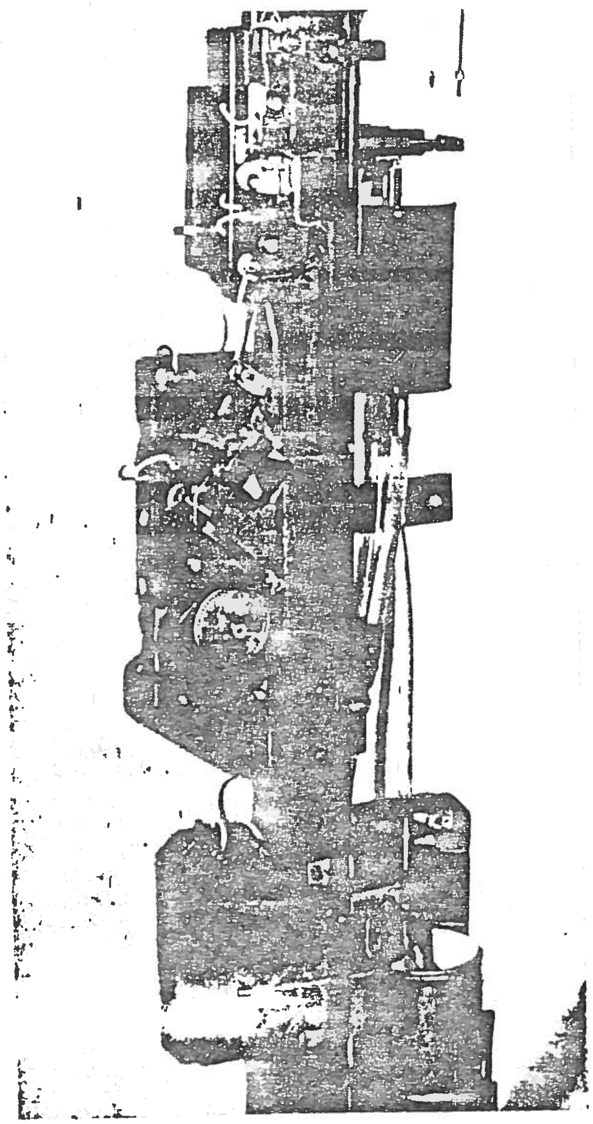
CLOCK FACE

OUR No. 89 Regulator represents without question, the best regulator value on the market. It is used extensively by jewelers, watchmakers, and in train despatchers' offices of the leading railroads. The movement is well made throughout. The wheels are carefully and accurately cut from hard rolled clock brass; the pinions and arbors are cut from solid bar steel, tempered and highly polished. The movement plates are specially heavy, affording good bearings for all pivots. The escapement is the Graham dead beat. The pendulum is hung from the front of the movement, when the cherry rod is used, or when the mercurial compensated pendulum is used, it is mounted on a special bracket fastened to the back of the case, and is entirely independent of the movement. The dial is 12 inches in diameter, and is usually enameled on zinc, but can be silvered if desired. This regulator is furnished with 8-day or self-winding movement. It can be used for operating any number of secondary clocks. As an example of the excellence of the general performance we call attention to ten of these regulators furnished the Buffalo B. & S. W., and Niagara Falls division of the New York, Lake Erie and Western Railroad for the month of August, 1889. The average variation from mean time during the month was 8.9 seconds. The greatest individual variation of any one of these regulators was 24 seconds. In the Wabash Station, Moberly, Mo., an 89 ran for 18 days with no variation, and for 30 days with an extreme variation of 3 seconds. In the Union Depot at Cleveland, Ohio, an 89 ran for 16 weeks with an extreme variation of 3 seconds in any one week. These records are from official reports of railroad Superintendents and Inspectors, and are not the result of accident. A Watchmaker wanting a low-price regulator cannot find the equal of this style clock for the money. (See page 26).

Free pendulum clock, with liquid escapement

by John F Wright

AMONG those who are interested or concerned with precision pendulum clocks will be some who object to any pendulum being described as *free*, but I will justify my use of this word by explaining that I have based my values, mainly, on those expounded by Hope Jones – particularly in his book *Electrical Timekeeping*, and I set out with the prime intention of designing and making a pendulum clock with those standards in mind. My clock, Patent no 1442669, which I will now describe in a general way, has, I hope you will agree, an original and simple escapement, the basis of which is a stream of liquid from a constant level reservoir, arranged to fall upon an angled pallet fixed to the pendulum. This gives the pendulum an impulse, and at the same time, has the instant effect of diverting the liquid stream. It is this deflected stream which is used as a means of obtaining a signal, or command, from the pendulum; thus, in the one operation of receiving an impulse, the pendulum also transmits a message.



It will be seen from the following descriptions of my liquid escapement how the deflected liquid stream is used to control a slave clock and also the frequency of impulses to the master, or free pendulum.

The liquid I have used is water, but any suitable fluid could, of course, be used. The sump at the base of the clock contains three pints of water, and a submerged mini pump raises the water to the higher constant level reservoir.

Not an updated clepsydra

At the mention of water in relation to a clock, some people, perhaps, would conjure up visions of clepsydras, the Chinese water wheel, or some other antique time-piece. But, on the contrary, my clock is quite new because it is the first time, as far as I know, that "fluidics" has been applied to a pendulum. This comparatively new science of fluid control, (which has been described as the mechanical equivalent of electronics) is, I think, particularly applicable to a pendulum. In fact, in the context of precision timekeeping, I submit that had I filed this patent at the relevant time, my liquid escapement (perhaps as seen in fig 3), with controlled temperature and pressure conditions etc, would have had certain advantages over other free pendulum clocks. However, analysing free pendulum clocks is a lofty topic and I would not like to labour the point. In any case, it is purely academic, because of course, the free pendulum clock has long since been superseded as a time standard. But I would just like to say that applying "fluidics", I think, has enabled the pendulum impulse to be given more accurately; it has also enabled the master pendulum to control it's slave clock without any further disturbance other than in receiving it's own impulse.

I would conclude this introduction by saying that I think my clock – as outlined – with reference to fig 1, has an original and attractive escapement. I hope that others will see it as such and that it will be sought after as an interesting and novel, time-piece.

There follows an explanation of the movements, in detail and I will begin with reference to fig 1

The pendulum (P) and a support (A1) attached to this pendulum which holds the angled pallet (A) can be seen. The pallet (A) is positioned so that it is under

• page 8

Reprinted with permission from the Horological Journal, November, 1977.

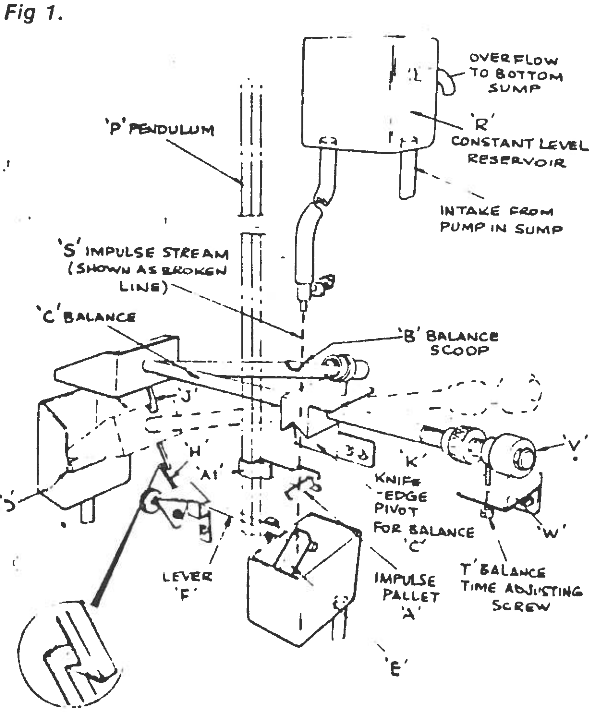
Free pendulum clock

the impulse stream of liquid (S), shown as a broken line coming from the constant level reservoir (R). You will see from the angle of the pallet (A) that the pendulum will receive an impulse only when the pallet (A) travels through the impulse stream from *right to left;* the pendulum is not allowed to go through the stream from *left to right* for the following reasons.

Between the pallet (A) and the outlet of the impulse stream (S) is positioned a scoop (B). This scoop is rigidly attached to the tipping balance (C) which is supported on a knife edge (K); you will see that scoop (B) extends outwards to intercept the impulse stream and divert it into the balance pan (C). When the weight of liquid is sufficient, the balance will tip and rest at the stop (D) (the balance is shown in broken lines in its tipped position). You will see also how the balance (C), once having tipped to the stop (D), is held in that position by means of the catches (J) and (H) as follows:– When the scoop (B) (which is part of the balance (C)) moves out of the line of the impulse stream (S) (when the balance tips) the impulse stream falls upon the projection (E) which is attached to the lever (F) (projection (E) extends into the line of the impulse stream). The lever (F) is moved downwards by the force of the impulse stream (S) and so catch (J) which is attached to the balance (C) is held by the catch (H) on the end of the lever (F) with the result that the balance is held fast in it's tipped position; the liquid, of course, empties from the balance pan in this position. It is essential that the balance and pendulum are synchronised, in order that the balance tips only when the pendulum is in it's extreme position to the right, and the pallet (A) on the pendulum can then travel through the stream of liquid to receive an impulse. As well as receiving an impulse, the pallet (A) also performs a very important function by diverting the impulse stream of liquid (S) away from lever (F), which then lifts and releases the tipped balance in order that it can resume it's original position, with it's scoop (B) under the impulse stream (S). The pendulum can now swing unimpeded until the balance (C) is again tipped by the weight of the liquid, now once more entering the balance pan.

The time that it takes for the balance to tip depends upon adjustment. You will see that at one end of the balance (C) is a permanent magnet (V). By adjusting the screw (T) the magnet (V) is brought nearer to, or further from, an adjacent armature (W). Obviously, when the magnet is nearer to the armature, more liquid is required to tip the balance and vice-versa. There is a wide range of adjustment possible; for instance, with a one second pendulum the minimum time required for the balance to tip is 1½ seconds – that is, every time the pendulum is in its extreme position to the right, so that the pendulum receives an impulse every two seconds. In this form, the balance simply prevents an impulse being given on the return swing of the pendulum. However, by adjustment, the balance can be made to tip, say, every 9½ seconds so that the pendulum receives an impulse every 10 seconds. It can be seen, therefore, that the balance (C) measures the time between pendulum impulses (long or short); for this reason, I call the balance, a slave clock, and it is under the direct control of the pendulum.

Fig 1.



A more elegant clock

Although I made an escapement similar to the one just described which worked in a very satisfactory way, the materials used made its appearance very inelegant so that, once having proved to myself that it worked, I concentrated on other designs, using this liquid escapement principle. I am now, however, in the process of making what I hope will be, a more acceptable clock with the tipping balance.

At this point, may I say that I apologise if the continual explanations and references might be tedious, but I find it difficult to describe my clock, effectively, without resorting to this method. If I could re-write my explanations and give them the appeal of *Wind in the Willows*, or, perhaps, even *Gone with the Wind*, I most certainly would; but, things being what they are, I ask you to bear with me and turn to fig 2. One particular controlling factor with the fore-going escapement is the force of the impulse stream; it is necessary that it should be strong enough to operate the release lever (F) and, although the angle of the pallet (A) on the pendulum can be adjusted so that the pendulum impulse is controlled, nevertheless this impulse stream in some cases, could be more than is required. To overcome this problem, I would now like to describe the application of 'fluidics' to this liquid escapement. If you look at fig 2 you will see the basic changes that are necessary. Instead of the impulse stream being required to *depress* lever (F) – in order to hold the balance – now, because when the balance falls it automatically *holds* itself on the re-designed catch at (J) and (H), the re-designed lever (F) has to be depressed in order to *release* the balance.

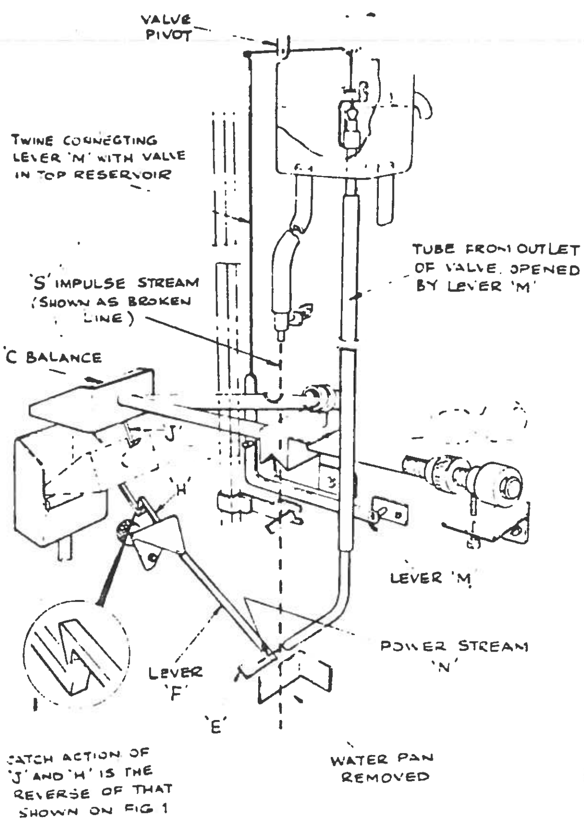


Fig 2.

The necessary force to depress lever (F) is now supplied by a secondary stream of liquid (N) which is directed towards the lever (F), as shown. This power stream of liquid (N) is turned on and off by a lever (M) which is operated by the liquid balance (C) when it falls. The lever (M) is connected by leverage, or twine, to a valve as shown, which is in the line of the power stream (N). When the balance (C) falls on the lever (M), it results in the valve being opened, and so the power stream (N) starts flowing.

It will be seen from fig 2 that the power stream (N) would impinge on the projection (E) of lever (F) if not interrupted, but as the power stream (N) is turned on (as a result of the balance (C) tipping), so – at the same time – the pendulum impulse stream (S) is uncovered and thereby allowed to fall into the path of the power stream (N), thus deflecting it and reducing its power (fluidics). When the pendulum interrupts the impulse stream, in receiving its impulse, the power stream (N) is allowed to operate the lever (F), depress it, and so release the balance.

The pendulum, therefore, by the application of 'fluidics', controls the exact time cycle of the liquid balance.

It has always been very difficult, but necessary with a free pendulum, to arrange the exact moment – to within a fraction of a swing – that the impulse should be given, bearing in mind that two separate timing devices are being synchronised. With my design, the two timing elements are, of course, the tipping balance and the 1 second pendulum, and they achieve precision of synchronisation because of the liquid impulse. It behaves as a continuously falling gravity arm and the exact moment that it begins to flow is unimportant; the pendulum will always begin to receive its impulse at the same relative moment of time in its swing.

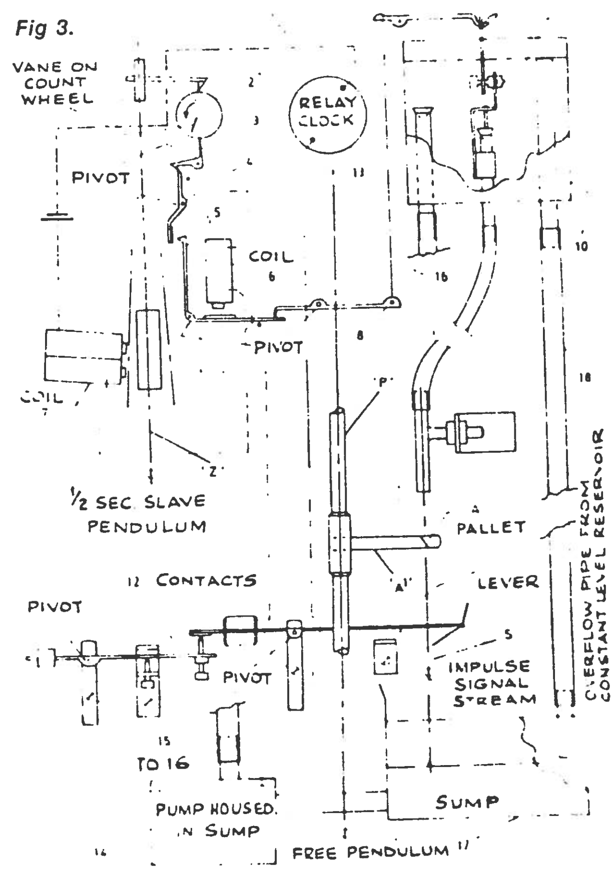
I should explain here that the impulse stream is supplied from a constant level reservoir (R), and the liquid is re-circulated by means of a pump; I have used a submerged mini pump which has proved to be very quiet and reliable.

The continual overflow from the reservoir (R) ensures a constant level of liquid, and therefore a constant pressure. The small cross-sectional area of the impulse stream would, I think, make any variation in density or viscosity of the liquid, due to temperature variation, a correspondingly small amount.

I mentioned earlier that I made a balance to tip every 9½ seconds. It synchronised with the pendulum for as long as I had it running, which was a few weeks, over a wide range of temperatures, and yet the balance still stayed under the control of the pendulum. This seems to indicate that the variation of the fluid stream must have been small, and therefore the impulse to the pendulum, which takes only a fraction of a second, would be correspondingly stable. The main feature of my clock is that when the pendulum receives its impulse, through the medium of a stream of liquid, the stream of liquid is deflected and by this means transmits a signal through the same impulse stream. There

→ *page 10*

Fig 3.



Free pendulum clock

is no reason why one should just use a tipping balance as a slave, any other slave clock could be used. If you look at fig 3 you will see a very different arrangement. A ½ second pendulum is used as a slave, and it is held and released electrically by using the impulse stream (S) as a means of operating the electrical switch (12).

The ½ second pendulum (Z) of the slave clock rotates the count wheel (2) by means of a gathering hook, and a vane on the count wheel (once every revolution), releases the lever (4) by lifting the catch (3). A contact face on lever (4) falls upon the contact face of lever (5), closes the circuit (shown chain dotted), and energises coil (6) and (7). Coil (6) attracts the armature on lever (5) and forces lever (4) back to a stop, holding it in that position. The bob of the slave pendulum (Z) acts as an armature and is attracted to the coil (7) as it travels to the left, and is held there. Lever (8) is actuated by lever (5) and lifts the liquid valve (9), housed in the constant level reservoir (10). The lifting of liquid valve (9) allows the impulse signal stream (S) to flow.

If the count wheel (2) has 30 teeth, then, with a ½ second pendulum, one revolution of (2) would take 30 seconds.

However, the slave clock pendulum is given a gaining rate and so completes one revolution of the count wheel (2) in 29.5 seconds approximately. If the slave and free pendulum are synchronised, then the free one second pendulum will be in its extreme position to the right, when the impulse signal stream (S) starts to flow. When the pallet (A) on the free pendulum travels through the liquid stream, the pendulum receives an impulse, and the pallet also deflects the liquid towards a projection on lever (11), depressing the lever, and the circuit is broken when the contacts (12) are opened. When the circuit is broken, coil (6) is deenergised and, consequently, the liquid stream is shut off. Lever (4) is replaced under catch (3) and coil (7) releases the slave pendulum, enabling it to measure the next 29.5 seconds. A relay clock (13) in the circuit records the time. The water is recirculated by a pump as previously explained.

It will be seen how lever (11) is actuated by the impulse stream being deflected onto it, as opposed to the method shown in fig 1, where the liquid stream is deflected away from the lever. But either way, the liquid stream is used to transmit a signal.

Liquid escapement

At this point I would like to say something about the name *liquid escapement* which I have used in various places in this article – as well as in the title. It is a name I have given to describe the system whereby a pallet, attached to a timing element, is impulsed by a stream of liquid, and transmits at the same time a command, or signal, through that same liquid stream.

Although I may be running short of space, I would like briefly to mention a clock I have made similar to the one just described, the major difference being the slave clock.

Instead of the ½ second pendulum slave (Z), as shown in fig 3, I have adapted a synchronous motor to act as a slave. It has a geared spindle speed of 4 r/min; on this spindle is mounted a spring loaded 2 in diameter disc, which acts as a slipping clutch. Formed on the circumference of this clutch are two indents diametrically opposed; also a gravity arm is arranged to rest on the circumference so that every 7½ seconds it falls into one of the indents. In so doing it closes the circuit, similarly to the one shown in broken lines in fig 3; an energised coil in this circuit holds the gravity arm in the indent, and so the disc is restrained and slips on the synchronous motor spindle. The circuit is broken by the pendulum (P) when it operates the switch lever (11) while receiving its impulse. The gravity arm is consequently released – the slipping disc is allowed to rotate again, and begins to measure the next 7½ seconds; the pendulum, in this way, receives an impulse every 8 seconds. I would just mention that because of evaporation, the three pints of water used in this clock needs to be topped up with ½ pint of water every two weeks; I think covers could be used to reduce this amount of evaporation.

Although it has been running for about nine months, this clock is not in a good position, (in my workshop) to gauge its time performance, I have had to disturb it many times to do other work. However, I do know that it has, at least on one occasion, stayed within the time pips for a month approximately.

I hope soon to establish this clock in a permanent position, when I might get more realistic records.

We wish to thank friend and fellow member R. L. O'Briant for his help in making available the issues of the Horological Journal from which we reprint these excellent articles.--Ed.

MART

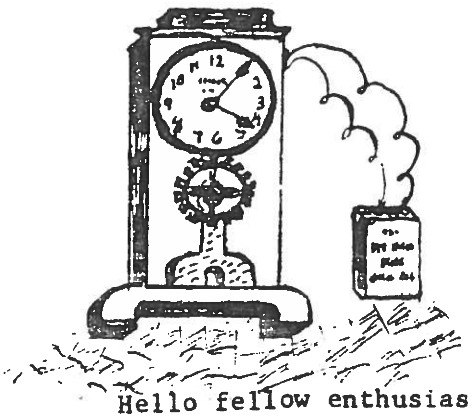
FOR SALE: Self Winding CC, N.Y. 22" Sq.wood case $175.00,metal case 14" dial w/o glass $140.00; same, gold plated w/glass & sweep hand $190. Bulle elec. clock,Paris,dome missing, $225.00; Poole elect.w/dome $225.00. Prices incl. packing, ins. FOB dest. USA.
L.O'Briant, 3516 Swift Dr.,Raleigh,NC 27606

FOR SALE: ORIGINAL BULLE PARTS: Silk suspensions-$4.00; all springs (isochronism, silver, spiral)---$3.50; magnets--$10 & $12; coils---$12 & $16.50; hardware---25¢ ea. All postpaid. Martin C. Feldman

WANTED: Electrical Horological Literature--any type. Highest prices paid. Hamilton-Sangamo clocks--write details.
Martin C. Feldman,620 Reiss Place, Bronx,NY 10467

WANTED: Unusual Electrical Clocks (including Warren Mystery Battery Cl.). Also unusual foreign pieces.
A. Marx, 105 Bayeau Rd.New Rochelle, NY 10804

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY Chapter No 78



December 1978
VOLUME IV--ISSUE #VI
Martin C. Feldman, Editor

Hello fellow enthusiasts:

As the holidays approach we are all once again busily preparing for the festive season. Some members have bought clocks over the summer and have been waiting for the cold winter months to finally get down to work in the restorative phase of their collecting activities. Others have not bought much and probably will be busy puttering around their existing clocks trying in one way or another to increase their accuracy and beauty. I feel a bit envious of those who have the time to restore their own clocks as I am kept quite busy restoring early battery clocks for others. It is rare that I have time to get to my own, although I keep making New Year resolutions to that end. Now that there are reprints on the market of the Hope-Jones's books, I trust that members will avail themselves of the opportunity to purchase these excellent tomes. While they are written with a slant towards the "Synchronome" clock, they nevertheless do contain much valuable historical and practical information for the electrical horologist. They also would make nice Christmas gifts, either to be received or given.

This month we feature the fine original work compiled by Mr. Arthur Mitchell of the Electrical Horology Group in England. The Eureka Clock Survey was under preparation for quite a long time as material had to be collected from various sources scattered all over the world. The final result is an interesting article offering new information heretofore unpublished. The second article from the HOROGICAL JOURNAL of August 1978 deals with various battery testers on the market. While most of us are not concerned with testing watch batteries, which this article specifically describes, we are concerned with batteries in general. The article is valuable in that it addresses itself to the questions of testing batteries and how different types function. Specifics such as measurement under load, temperature of cells, and ionic concentration are discussed.

The Officers of the EHS and myself would like to take this opportunity to wish you all a festive Holiday Season and a Happy and Healthy New Year.

Enjoy this Issue!

Electromagnetically yours,

Martin C. Feldman, FNAWCC

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THE ANTIQUARIAN HOROLOGICAL SOCIETY

Electrical Horology Group

Eureka Clock Survey

Introduction

The survey has been a continuing activity over a period of about six years with information still being received albeit now rather slowly. Requests for information were made in both trade and collectors journals as well as to individual collectors. Replies have been received from America, Australia, Canada and Holland. The number of replies received is only about 2% of the estimated number of clocks made and may reflect the fact that the majority of those still extant are in the ownership of other than clock collectors.

Fortunately, the clocks reported are spread throughout the total 10,000 believed to have been made enabling a reasonably clear picture to be examined. The clocks may be divided initially into two main groups, viz:-

Group A Those having a short movement, i.e. with the balance wheel wholly behind the dial.

Group B Those having a tall movement, i.e. with the balance wheel situated below an elevated dial.

Patent No. 14614 was granted in 1906 and the clocks were announced to the public in June, 1909 with the trade journals carrying a line diagram and description of the tall movement. One recorded clock with a tall movement No. 7129 carries a presentation plate dated September, 1910. The Junior Army & Navy Stores Ltd. Catalogue for 1912 carried illustrations of both short and tall movement clocks.

Few additional styles to those originally detailed on the survey sheet have come to light. In the main these have been variations in elaboration of a break arch case. Nothing significant in the way of special features beyond those listed on the survey sheet have been noted. Very few clocks are recorded with numbered cases and probably because of the limited information no logical sequence is apparent.

An analysis of the recorded clocks is given below which it is hoped will provide the overall picture as it stands at present.

Serial Numbers

The total number of clocks reported to date is 201. Some of these are without cases and others have been reported without details of style or features being given.

Fig. 1 shows the distribution throughout the believed total production. The lowest and highest serial numbers recorded and the total numbers within each block are given.

Group A clocks have recorded serial numbers 13 to 5565
Group B clocks have recorded serial numbers 7054 to 9950.

The dials are found in three distinct types:-

Type 1 Full enamel dial with the inscription "1000 day Electric Clock" in addition to the makers name.

Type 2 Annular enamel dial allowing movement to be partly seen.

Type 3 Full enamel dial with makers name inscription only.

The Type 1 dial is found on the vast majority of the clocks up to about serial No. 3000. Type 2 dial was introduced at about serial No. 3000 and Type 3 is found on the clocks with serial numbers above 7000. Both Arabic and Roman numerals are found throughout.

The three ball bearing is seen to occur both in the 3000 and 7000 series. This may well have been an experiment as it appears its use was short lived and the two ball bearing was continued to the end. The occurrence runs from Nos. 3118 to 3808 and Nos. 7124 to 7456 of the clocks recorded but there are as many two ball as three ball bearings recorded within these blocks of numbers.

A "second" hand was fitted on some clocks throughout the 7000 series but this did not record seconds. It was useful as an indication that the motion work was being driven by positive action of the pawl on the ratchet wheel which could not easily be seen behind the full dial. Most movements have the extended arbor for fitting the "second" hand but the dials are not pierced. The "second" hand is recorded on clocks between serial No. 7054 to 7911 but there is nearly double the number recorded without the "second" hand as with in this block of numbers.

Only one clock fitted with striking work has been recorded although another example, now in America, has been rumoured.

Conclusions

In a survey such as this one hopes the questionnaire will cover every aspect simply and clearly but it is inevitable that minor points of detail will crop up which leaves some doubts. If all the clocks could have been examined and these minor details compared it would probably have led one into more positive conclusions on some of the major aspects of the production run.

It is considered that firm conclusions should not be drawn from such a small sample. However, the recorded clocks are spread over the full range of serial numbers allowing some suggestions to be made:-

1. Movement manufacture was in two phases which followed one another

   Phase 1 clocks up to about serial number 3000 (short movement)

   Phase 2 clocks from about No. 3000 up to 7000 (short movement with annular dial) and from 7000 up to 10,000 (tall movement) were made in parallel.

2. The Phase 2 clocks introduced a new and wider range of styles to the purchaser.

3. A considerable stock of movements had been made before being launched on the market.

Whilst the serial numbers recorded are randomly placed throughout the 10,000, Fig. 1 reveals whole blocks of numbers missing, e.g. in round figures 700 to 1500 and 5600 to 7000.

Although it was found that clocks with consecutive serial numbers had been recorded or groups with serial numbers within a band of ten figures generally each clock is a different style.

It is interesting to note the numbers of clocks recorded in the 3000 and 7000 series are almost double those of any others.

Styles

The upper half of Fig. 2 shows the distribution of the main styles together with the total numbers of each style recorded.

One important style which was omitted from the original classification was the break arch case. This has been reported with varying amounts of elaboration from the simplest moulding to the extensively layered mouldings including integral side pillars. These have been divided into Styles 1a and 1b.

The glass dome clock (Style 6) came in several base variations. The lower numbered clo ks have rectangular wooden or round brass bases. From serial No. 3000 either round or rectangular brass bases were used. The metal bases are by far the more common. Where rectangular bases were fitted the glass dome also had rectangular mouths.

The Rectangular clock (Style 8) has a flat topped wooden case with a glazed full door to the front and a solid full door to the back.

Under the general term Four Glass (Style 10) have been included clocks with brass framed glass cases of the very large carriage clock type as well as those with wooden framed glass lift-off covers.

Three styles predominate and have serial numbers over the whole range. Two of these are the glass dome version and the four glass version. Not unexpectedly the popularity of having the movement wholly visible was as high then as it is today. It is not surprising that the traditional break arch bracket clock case in its various forms shares the popularity of styles.

The two earliest clocks reported are both of the break arch style although not identical. The next earliest is the glass dome style followed by the four glass with wooden framed lift-off cover.

Features

The lower half of Fig. 2 shows the distribution of the important features.

In the Group B clocks a few movements were made with the balance wheel completely below the dial whereas in the majority of movements in this Group the dial slightly overlaps the rim of the balance when viewed from directly in front.

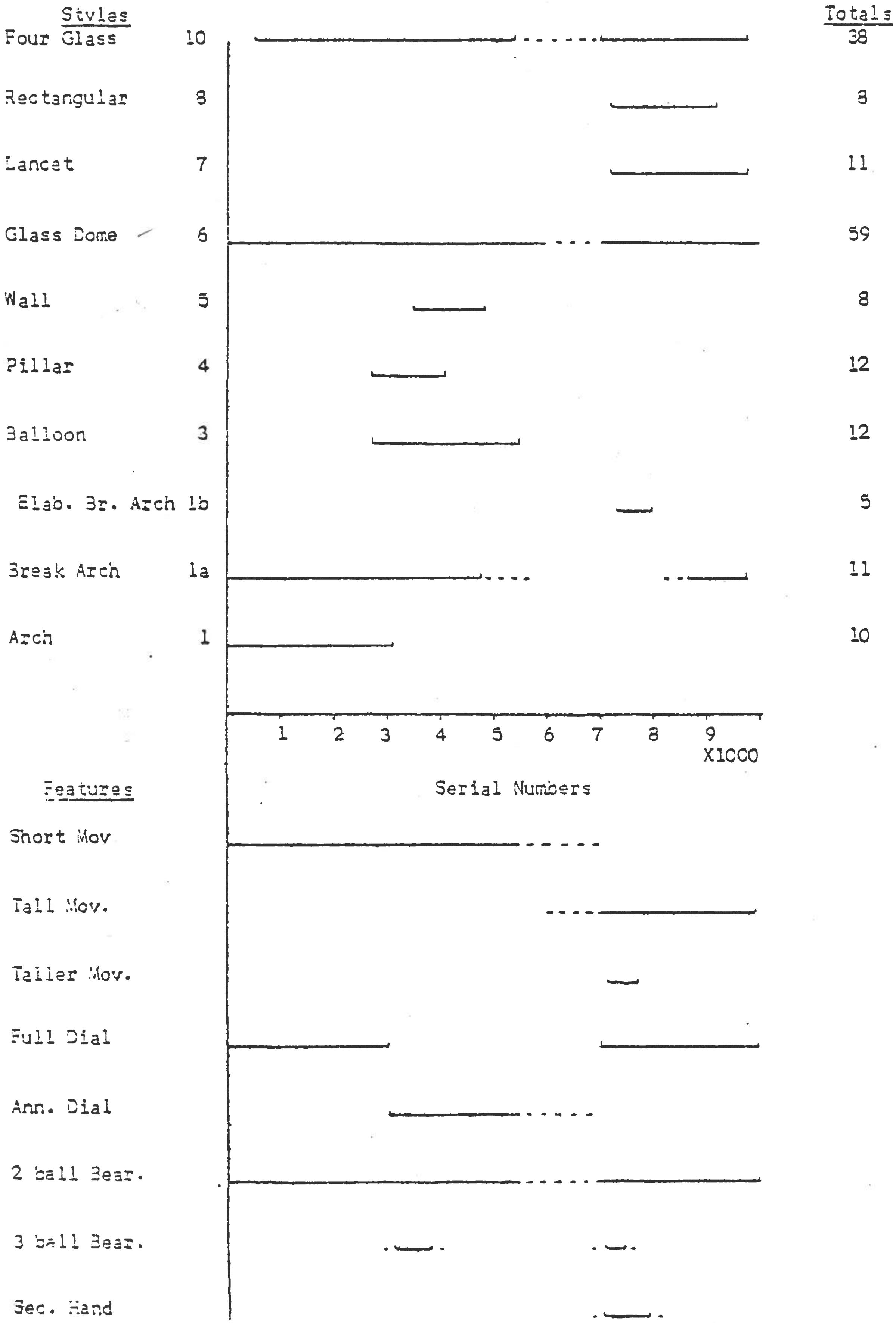


Fig. 2 DISTRIBUTION OF MAIN STYLES & FEATURES

4. Both short and tall movement clocks were offered at the same time starting soon after the announcement to the public.

5. The existence of clocks in the 6000 series can only become more doubtful in the continuing absence of a report of one. There is the possibility, however, that this whole block were exported to the Continent from where only two reports have been received but neither were in the 6000 block.

6. The three ball bearing was an experiment which proved to have no significant advantage over the two ball bearing.

7. The "second" hand was introduced in th first of the tall movements, probably considered necessary because of the new design for the dial drive actuating lever and the pawl and ratchet being hidden behind the full dial. Common parts were used in all movements hence the extended arbor for the "second" hand is found in the short movement with annual dial.

8. A standard range of models was offered which was varied from time to time. In addition more elaborate models were either made to order or as specials.

9. The most popular model is the glass dome type followed by the four glass which is followed by the break arch case.

10. Apart from perhaps a few showroom display models, movements were assembled into the cases against specific orders.

Several clocks have been recorded with serial numbers higher than 10,000 viz. 12072, 14066, 14094, 14111, and 14154. All have short movements, two of which are numbered in the 4000 series, and housed in large cases. The dials are painted and much larger than the normal Eureka enamel dial. The serial number, maker's name and "1000 day Electric Clock" are painted on the dial and all have an aperature through which a key may be inserted to adjust the regulator.

The explanation for these examples can only be speculative at the present time, two alternatives are suggested:-

a. These clocks were assembled in parallel with Group B possibly to meet a special demand for a larger clock suitable for libraries, boardrooms or other very large rooms.

b. These clocks were assembled from the remaining stocks of movements or parts as the Company went out of buisness. The dials and cases being only those obtainable at the time.

Since these clocks are distinctly different from the established Eureka styles it could be that new blocks of numbers were considered necessary and perhaps the 12 and 14 denote the year of manufacture.

The opinions expressed in this article are those of the author and readers are invited to offer their views on any aspect discussed.

A. Mitchell,

Hon. Secretary,
Electrical Horology Group

Sept., 1977

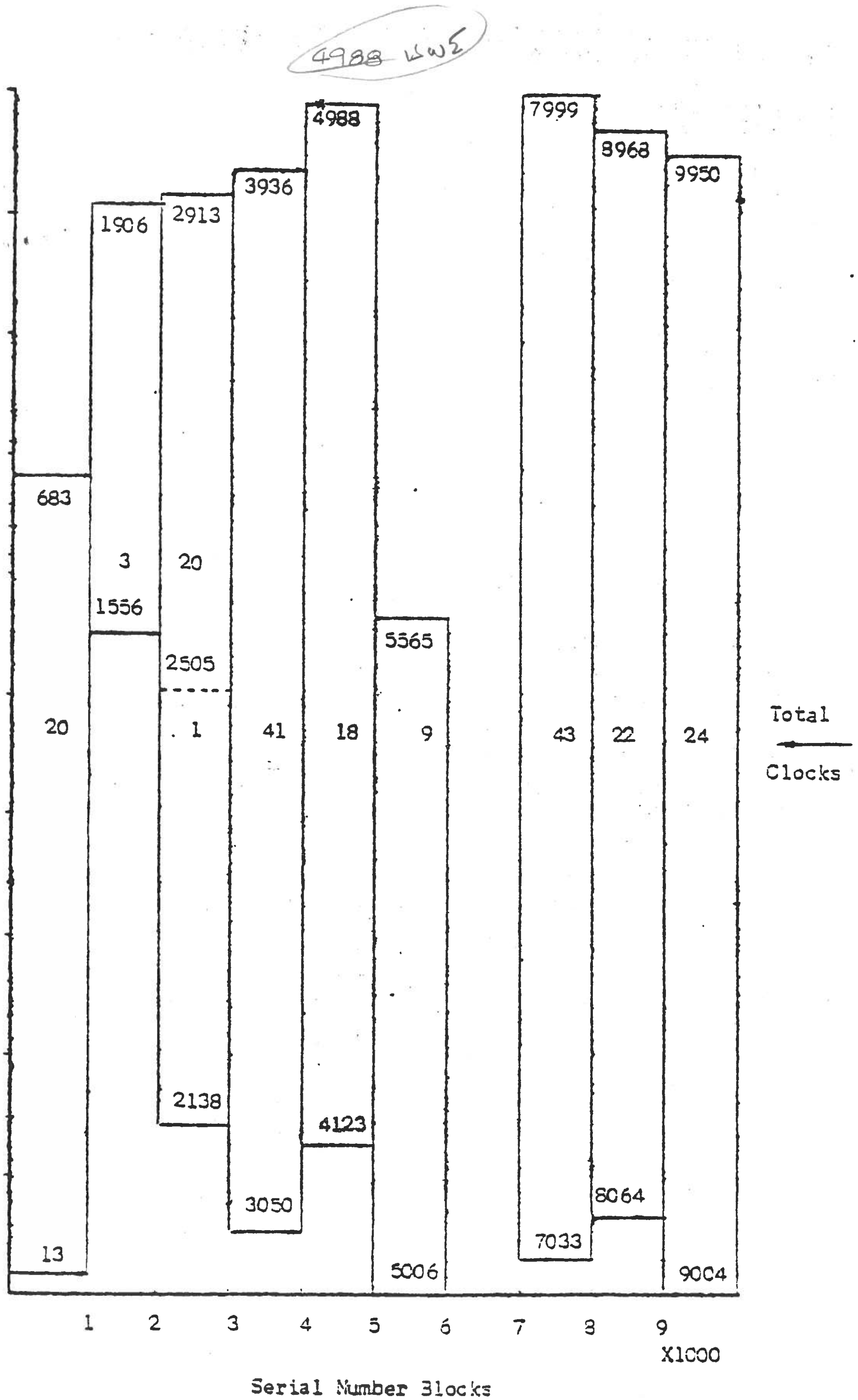
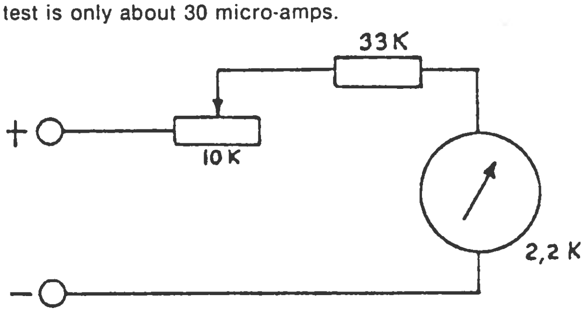


Fig. 1 DISTRIBUTION OF RECORDED CLOCKS

Some battery testers on the market

Bulova Model 320

THE circuit shown in fig 1 is a simple voltmeter with a green zone on the scale between 1.26 and 1.46 volt. The internal resistance of the instrument is quite high and the current to be delivered by the battery under test is only about 30 micro-amps.



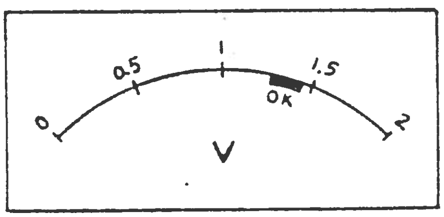


Fig 1

Advantages: – Simple, clear scale

Drawbacks:
- No load being applied, a battery at 99% run down is given as good.
- The scale is not intended for silver cells, but the value of 1.5 volt is within the scale.
- No diode is included, so that the needle goes out of scale on the left side if the polarity is reversed.

A*F Battery tester Nr 9350

Corresponding to the circuit in fig 2. It is effectively a ammeter in series with a diode. The forward voltage of the diode being approximately 0.6 volt, this value is subtracted from the battery voltage, the remaining being loaded by about 1400 ohms. This results in an expanded scale.

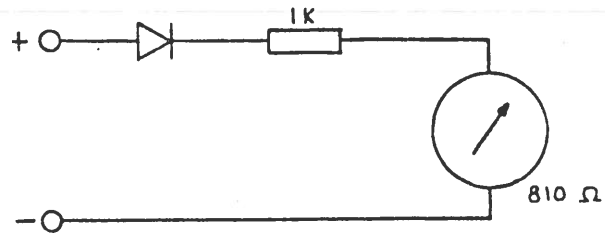
The current drawn from the battery is 0.4 mA for mercury and 0.5 mA for silver cells.

Advantages:
- Simple, two scales for 1.35 and 1.5 cells.
- Expanded scale

Drawbacks: – Makes no difference, between high and low drain cells.

Delrix battery tester

The circuit (fig 3) shows an ammeter with two diodes.



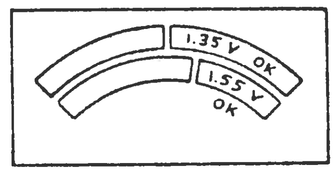
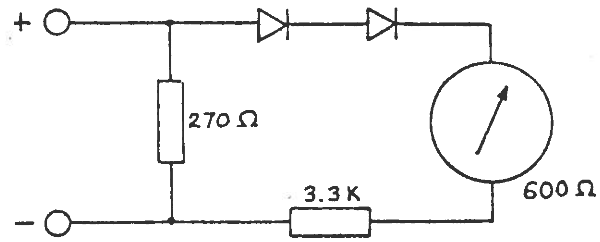
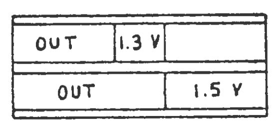


Fig 2 (above) fig 3 (below).





The total resistance being 270 ohms, the current is relatively high; 5 mA at 1.35 V and 5.5 mA at 1.5 V. This is too high for small low drain batteries having an internal resistance of perhaps 100 ohms or more, the voltage drop reaching 0.5 volt.

Advantages: – Simple; two scales for 1.35 and 1.5 volts

Drawbacks:
- The load is too high for small low drain cells that are systematically indicated as bad.
- The battery fixture is not very convenient for small batteries that are difficult to remove.

→ page 14

Favorite battery tester Nr 20.031

This tester is somewhere between the Bulova and the Delrix and has two scales, one for LED and the other for LCD or analogue watch batteries (fig 4).

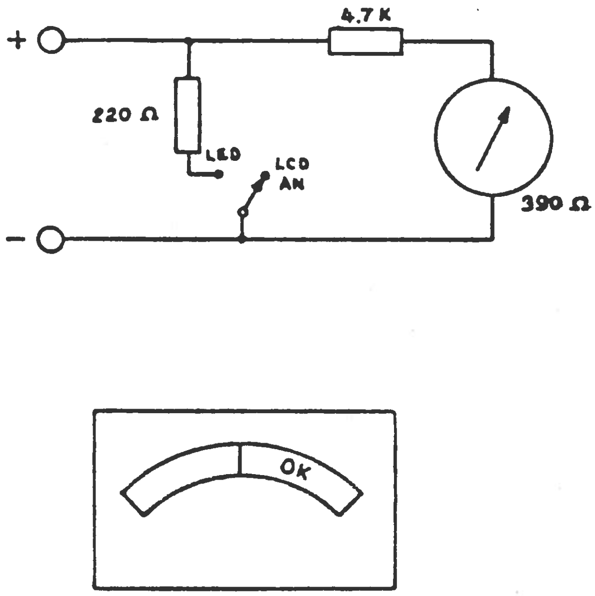


Fig 4

The limit for the voltage to be considered as good is 0.85 V. The load being relatively low; 0.2 mA for low drain and 4 mA for high drain, almost any battery will be given as good unless it is totally empty.

Advantages: – Simple
– Separate scales for low and high drain

Drawbacks: – No difference between mercury and silver cells
– The load is too light and only "dead" batteries are detected.

UCAR battery tester model W 100

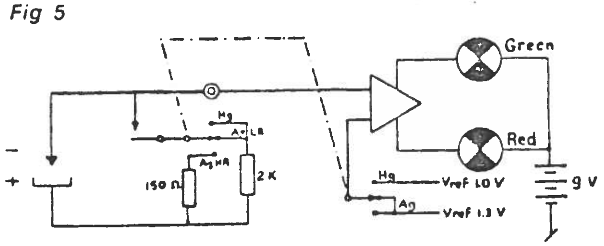
Here, the result is displayed by two LED lamps in a go/no-go way.

The instrument has three measuring ranges:
- Mercury low rate
- Silver low rate
- Silver high rate

The tester has an internal supply using a 9 V battery; the condition of this battery being indicated by a flashing lamp.

Although this instrument has a good appearance, it is again a simple voltmeter measuring the voltage under load (fig 5).

Fig 5



The load is 2000 ohms for low drain and 150 ohms for high drain cells, resulting in currents of 0.5 mA for mercury batteries, 0.65 for silver low rate and 8.5 mA for high rate batteries.

The voltage at which the green light appears is 1 volt for mercury and 1.3 V for silver cells, thus, the allowed internal resistance for mercury cells is about 700 ohms. As most analogue watches use a motor consuming current peaks of 0.5 to 1 mA, a battery accepted by the tester may not work because, during the motor pulse, the supply voltage of the circuit is too low.

Advantages: – A simple go/no-go indication
– Three ranges for mercury, silver low rate and silver high rate

Drawbacks: – The test location chart only concerns UCAR batteries
– The load for low rate mercury batteries is too low for detecting batteries with an excessive internal resistance.
– It is not easy to remove a small battery from the measuring jig.

Ray-O-Vac battery tester

An improvement over the previously described testers is that the measurement can be made on six different load conditions:

– Silver	Low rate	Small	diameter	Load	4.4 mA
– ,,	,, ,,	Large	,,	,,	8
– ,,	High rate	Small	,,	,,	17.6
– ,,	,, ,,	Large	,,	,,	36.4
– Mercury	Small	diameter		,,	0.55
– ,,	Large	,,		,,	1.2

The tester automatically starts when a battery is put on the measuring head (fig 6).

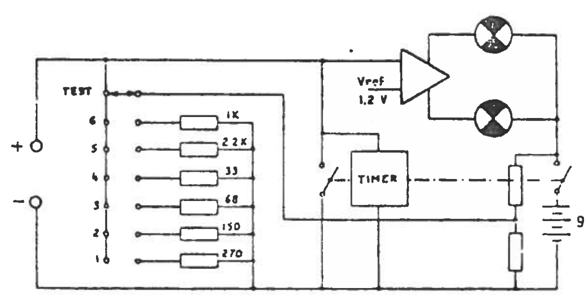


Fig 6

The cycle is as follows:
- The battery is short-circuited from 1 to 2 seconds
- The load is applied for 2 seconds
- The voltage is checked and the battery is accepted (green light) if it remains above 1.2 volt.
- The result is displayed for 2 seconds.

Advantages: – The six measuring ranges allow the test conditions to be adapted to most of the usual batteries.
– The delay between loading and measure allows polarisation effects to be taken into account.

Drawbacks: – The short-circuiting of the battery before testing may be dangerous for high rate cells.
– The choice between small and large

diameter is not a good criteria for the internal resistance.
- The measuring head is not convenient for small batteries.

ETIC "Compu-Test"

As the UCAR or the Ray-O-Vac testers, the Compu-Test has a green-red LED display of the result. But the measuring principle is quite different (fig 7).

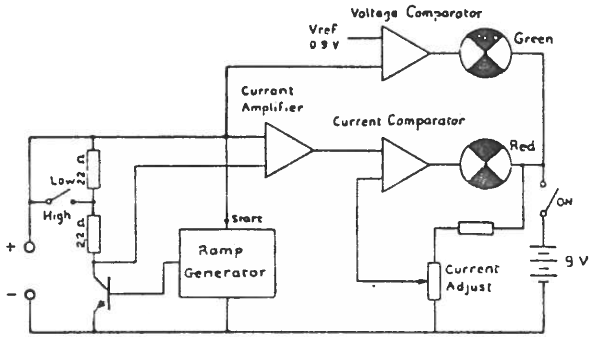


Fig 7

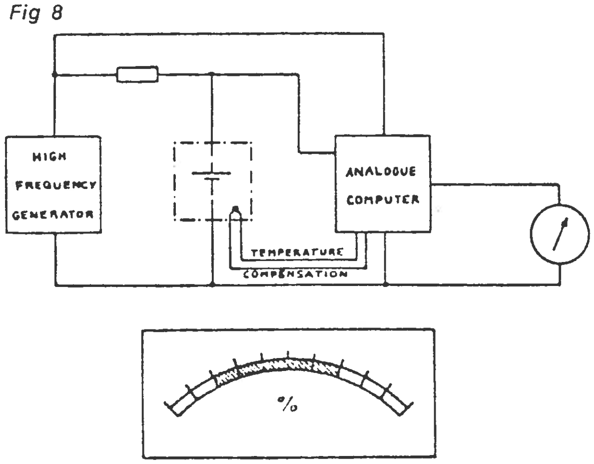
- The positioning of the battery starts the loading by an increasing current starting at zero until a value depending of the battery type is reached.
- If the voltage remains above 0.9 volt until the maximum current is obtained, the battery is considered as good.

With this system, it is possible to consider the chemical time constant of the battery, which is related to the degree of use of the cell. At the same time, the maximum internal resistance is shown.

Advantages:
- Considers both the capacity and internal resistance
- Two different ranges of current rise speed
- Continuously adjustable current limit allowing any type of battery to be measured; the range and the current value are given in a setting table where most types of the main manufacturers are given.

Drawbacks:
- The time required for measurement is between 5 and 13 seconds.

Fig 8



Elma "Proficheck"

This instrument is not yet available on the market, but a prototype was shown at the Basle Fair. It makes use of a new principle consisting of a measurement of the high frequency internal resistance of the battery to be tested (fig 8).

In an electrolyte, the condition is made by ions instead of electrons. The mobility of ions, ie the speed at which electrical charges are moving is much lower in the case of an ionic conduction and depends on the concentration of ions in the solution. This concentration, in a battery, is related to the remaining capacity. As the ionic current is temperature dependant, the battery temperature is first measured and this effect compensated. Then, the internal resistance is measured at a frequency of a few hundred kHz and the component due to the ac current is extracted. The display is made on a panel meter graduated in % of the nominal capacity. The scale is adjusted for each individual battery type by a dial and a setting table.

Advantages.
- True measurement of the remaining capacity in % of the rated value

Drawbacks:
- No indication of the dc internal resistance.
- 10 to 15 seconds required for temperature stabilisation and compensation.
- Relatively expensive.

Comparison of the different battery testers

The eight battery testers discussed may be classified by the type of measurement they make:
- The first five: Bulova – A*F – Delrix – Favorite – UCAR measure the battery voltage under a given load. As a battery has a constant voltage over its whole life if the current drawn is very small, these testers effectively measure the internal resistance of the cell. This is this criteria and no other that will be used to decide if a battery is good or not.
- The Ray-O-Vac tester does the same, the only differences being that the cell is measured two seconds after the load has been applied.

If the test duration is not considered, the voltage at which the threshold is fixed is not really important: a voltage drop of 0.2 volt at 2 mA or 0.4 volt at 4 mA corresponds to an internal resistance of 100 ohms in both cases.

Thus, we can classify these testers by the maximum internal resistance they show between the different types of batteries.

	Maximum allowed internal resistance					
	Silver				*Mercury*	
Tester	*High rate*		*Low rate*		*Low rate*	
	Large	*Small*	*Large*	*Small*	*Large*	*Small*
Ray-O-Vac	8.2	17	38	68	125	273
UCAR	23		308		700	
Favorite	163		3800		3000	
Delrix	53		53		79	
A*F	385		385		500	
Bulova					2900	

Compared with the internal resistance values given by the battery manufacturers:

→ page 16

FOR SALE: Self Winding CC, N.Y. 22" Sq. wood case $175.00, metal case 14" dial w/o glass $140.00; same, gold plated w/glass & sweep hand $190. Bulle elec. clock, Paris, dome missing, $225.00; Poole elect. w/dome $225.00. Prices incl. packing, ins. FOB dest.USA.
L. O'Briant, 3516 Swift Dr., Raleigh, NC 27606

FOR SALE: ORIGINAL BULLE PARTS: Silk suspensions-$4.00; all springs (isochronism, silver, spiral)--$3.50; magnets--$10 & $12; coils--$12 & $16.50; hardware--25¢ ea. All postpaid.
Martin C. Feldman, 620 Reiss Place, Bx.NY 10467

REPAIRS: Battery clocks expertly repaired. Write needs.
Martin C. Feldman, 620 Reiss Place, Bx.NY 10467

WANTED: Electrical Horological Literature--any type. Highest prices paid. Hamilton-Sangamo clocks--write details.
Martin C. Feldman, 620 Reiss Place, BX.NY 10467

WANTED: Unusual Electrical Clocks (including Warren Mystery Battery Cl.). Also unusual foreign pieces.
A. Marx, 105 Bayeau Rd. New Rochelle, NY 10804

WANTED: Self-Winding Clock Co. (NY) --Master clock movement or Jeweler's Regulator movement (Style A). I have lots of SWCC parts and many style F movements, but need the above two movements for an SWCC book I am completing.
Dr.B.E.Honning (39029), P.O.Box 7704, Long Beach, CA 90807 (213)427-8001

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SPECIAL ANNOUNCEMENT

Your editor has been invited to speak at the Sunday, January 21, 1979 New York Chapter Meeting of the NAWCC. The topic will be concerned with early electrical clocks. An exhibit table will be set up and members who wish to exhibit interesting electrical clocks and related apparatus are invited to do so. Members who are not in the New York Chapter may also attend as guests and should contact me for reservation information. I cordially invite everyone to this meeting as I believe I have planned an interesting slide-illustrated talk with new slides hitherto not shown before. Hope to see you there!

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For those who have not already sent in their 1979 dues, please do so immediately so that you will be insured your journals for next year. Many thanks to those who have already sent in their 79 dues. Charles W Roth

Typical or maximum internal resistance						
Tester	*Silver* *High rate*		*Silver* *Low rate*		*Mercury* *Low rate*	
	Large	*Small*	*Large*	*Small*	*Large*	*Small*
Ray-O-Vac (maximum)	4-10	10-20	25-50	50-100	25	50
UCAR (maximum)	23	23	300	300	700	700
Varta (typical)	6-8	12	15-30	30-60	60	90
Renata (maximum)	10-12	20	50	30-60	–	–

The first conclusion is that the specifications widely vary from one manufacturer to another and it is illusory to speak about equivalence so far as the internal resistance is concerned Thus, batteries of the same size, same voltage and same rate but from different manufacturers must not be tested under the same conditions.

The second conclusion is that the group of six testers mentioned show such a wide range of allowed resistance (for example anything between 79 and 3000 ohms for mercury cells) that no consistent result can be obtained on the degree of drain of a battery, with the exception of the UCAR for UCAR batteries and of the Ray-O-Vac for Ray-O-Vac batteries.

That is not to say that the other testers are useless, but they only indicate if a battery is dead or not.

If the meter needle is slightly in the red zone, it may be because the cell is loaded too much.

Conversely, a "good" indicator doesn't tell anything about the possible remaining life.

The situation is quite different for the last two testers.

If a load is applied at a slowly increasing rate, the internal resistance will change during the measurement and this, in a different manner for a fresh or an old battery. This principle is used in the ETIC Compu-Test which not only measures the internal resistance, but the condition of the chemical reaction inside of the cell. Owing to the differences in the manufacturing process, the speed at which the current rises and the current to be reached by a good battery before a given voltage drop occurs must be chosen from a setting table supplied with the tester.

This is not a true capacity measurement, but a test allowing one to know if a battery will work satisfactorily in a watch or not.

For example, it may happen that a battery stored over a long period still has over 90% of its rated capacity, but the increase of the internal resistance is so high that, if used in an analogue watch, the voltage during the motor pulse will not be sufficient to drive the motor correctly or even, that the dividers don't work correctly during the motor pulse, thus making the watch lose a few seconds per hour. Such batteries must be discarded.

On the contrary, the ELMA Proficheck achieves a true capacity measurement. This instrument is still under test, and the first results seems to be very encouraging.

A test was made on six batteries type UCAR 325 having a rated capacity of 50 mAh. They were first measured on the Proficheck, then put in continuous discharge until the voltage dropped below 1 volt. The results were:

Battery Nr	*Elma result mAh*	*Discharge mAh*	*Internal resistance*
1	40	47	325
2	40	53	260
3	50	48	225
4	38	34	470
5	50	50	315
6	48	43	420

It must be said that these batteries were stored for about 18 months. This is probably the reason why the internal resistance measured before the discharge test was so high. Batteries Nr 1, 4 and 6 were rejected by the Compu-Test.

All these batteries would be accepted by the Bulova and Favorite, all would be rejected by the Delrix!

Conclusions

The measurement of watch batteries is not simple. One has to chose between two attitudes:–

- test the battery according to manufacturer's specifications
- make sure that the tested battery will ensure correct working of the watch.

These two decisions are not always compatible.

The best way is to understand how a battery works and how it is used. Then the results given by any battery tester can be interpreted for a specific use.

The choice of a battery tester depends on its application:

- For a watch manufacturer, it is of prime importance to know the life expectancy of the watch. Knowing the current consumption, the peak current demand and the minimum voltage at which all elements of the watch are still working, the battery will be chosen in terms of capacity and internal resistance. These parameters must not only be met by a new cell, but also after one or two years of storage.
- For the watch repairer, the battery test should show if this is responsible for the failure, and if the replacement battery will ensure normal life.

In the first case, sophisticated instruments are needed and destructive tests are necessary to know if a battery will satisfy the working conditions.

In the second case, a simple voltage measurement will not allow a diagnosis. It simply shows if the battery is totally empty or not. A new battery should only be fitted after the consumption of the watch has been measured, as well as the parameters of the new battery in order to be sure that the watch will not stop after a few weeks.

It would also be helpful if battery manufacturers gave more information on the internal resistance after a given storage time and on what happens to batteries subjected to pulsed current.

From the watch manufacturer, one should know the minimum voltage required for the circuitry, the motor, the display, the lamp.

With this information the repairer will be able to choose the right battery, and not just the equivalent that is perhaps only approximate.