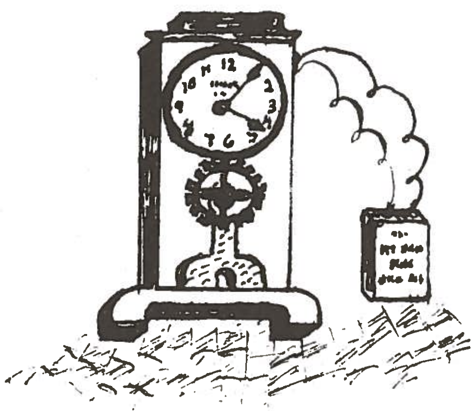
The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78



VOLUME 1---ISSUE #2

February 18, 1975

Hello fellow enthusiasts:

The editorial this month will primarily concern itself with the current status of our Chapter. A great many inquiries have been made requesting information describing our Chapter's goals and how one may join. Our cover letter with application form attached has been sent to at least 40 people within the last six weeks. Approximately 32 members have been newly admitted to Chapter membership and now we can boast of 120 members. Having a large number of members is not the be all end all of our organization. We would like to stress the need for contributions to our Journal by all members and even perhaps by non-members. This leads me to the next topic I should like to discuss; that is, the lack of material for publication from our membership. Very little has been sent in with the main reasons being---lack of time; lack of material; and an inability to write in general. All three of these reasons are invalid. Time can be made, material is always present, and virtually anyone can write. Your Editor would be most pleased to receive contributions which need some polishing--this will be done at Journal Headquarters with full credit given to the author. Once again I must complain about the lack of use of our Mart. Where can you advertise for so little to so select a group as ours who are interested in purchasing your electrical horological items? Only in our Journal, to my knowledge, can this be accomplished! Another topic which has been of some considerable annoyance is the lack of dues sent in by the membership. Approximately 40 people, many of whom are Charter members, have not sent in dues to date. Without beating a dead horse as to the importance of dues, especially to our organization, I shall only say that the $7.00 yearly dues were to be paid during the month of October 1974 for the 1975 fiscal year. They are to be sent to: Mr. Charles Roth, 2 Circle Lane, Roslyn, N.Y. 11577. Mr. Roth who is our Secretary-Treasurer will be forced to drop all members not paying their dues after sending out this Newsletter. To be reinstated, of course back dues and present dues will have to be made up, but unfortunately we do not over-print many Journals and if you are collecting a complete set you may find yourself missing one or two editions. Regrettably, this cannot be helped. Our Journal is published every second month with a total of six per year.

In general very few electrical clocks have been turning up here in the New York-New Jersey area and those that have are quite expensive. I understand this situation is true in the rest of this country as well as in the United Kingdom, but sometimes one gets lucky and finds a decent specimen at a fair price.

I have been honored in having been asked to speak to the N.Y. Chapter of the NAWCC on April 6, 1975. My subject will be Early Battery Clocks and at this point I am soliciting from any of you who have 35 mm slides of electrical timepieces to please let me borrow them through April 6th as I should like to include as many different clocks as possible in my talk. Your kindness in this regard would be most appreciated.

This month we have permission from Mr. C.L. Stong to reprint an article from The Amateur Scientist section of the Scientific American, Sept. 1974. This article was written by Mr. Lawrence M. Leeds and should prove of interest to those of us wishing to convert an early weight driven regulator to one of high precision using electronics to regulate its timekeeping. This article will be in two parts, part two to be published during April 1975. Also in April 1975 a copy of the patent for the Tiffany Never-Wind clock will be published as well as articles received from the membership.

Lastly, our second meeting will be held in the home of Mr. Charles Roth on April 27, 1975 at 2:00pm. You must call Mr. Roth as soon as possible to reserve your place as there is a limited number of members Mr. Roth's home can accommodate; Tel. #516-MA 1-4540. Each member should be prepared to bring an example of anything dealing with electrical horology being either a clock, manuscript, book or the like.

****

MART

FOR SALE: slave clocks--International Time Recorder and Cincinnati, Send for List. Monroe Postman, 10 Yerba Buena Ave., Los Altos Ca. 94022

****

WANTED: Bulle movement for parts. Send particulars to: Mr. Gene Zepp, P.O.Box 693, Stony Brook, N.Y. 11790

****

WANTED: Electrical Horological Literature--books, pamphlets, articles, diagrams, manuals and the like. ANY CONDITION--ORIGINAL or XEROX. Send particulars to: Martin C. Feldman,1545 Rhinelander, Bronx, N.Y.10461

****

WANTED: Unusual electrical timepieces---to buy or trade. Write: Alan Marx, 105 Bayeau Rd. New Rochelle, N.Y. 10804

****

FOR SALE: Limited quantities of original Bulle parts--suspensions, springs, coils, magnets (some parts for large and small Bulles). M.C.Feldman (address above)

****

IMPORTANT REQUEST TO ALL MEMBERS

We are in the process of negotiating for membership identification cards. Through a minor snafu we do not have all the numbers of the Charter Members as issued on their certificates of membership. To all members to whom this request applies, PLEASE send me your number as soon as possible. Until all numbers are at Chapter headquarters we CANNOT issue membership cards as we do not wish to duplicate numbers. Thank you for your help.

Marty Feldman

****

THE AMATEUR SCIENTIST

A venerable clock is made highly accurate by equipping it with quartz-crystal works

Conducted by C. L. Stong

Technological advances have relegated pendulum clocks to the status of charming but unreliable antiques. One such instrument, however, has been modernized by its enthusiastic owner, Laurance M. Leeds (10232 El Dorado Drive, Sun City, Ariz. 85351). Leeds coupled his 80-year-old Seth Thomas wall clock to a quartz-crystal oscillator. The clock now ticks off the time to an accuracy of about one second per year.

"As a clock fancier," Leeds writes, "I have long enjoyed the operation of pendulum wall clocks. I have also often wished that I could somehow make one run with high accuracy. Eventually it occurred to me that perhaps I could synchronize the beat of the pendulum to a submultiple of the fixed frequency of a quartz-crystal oscillator. The experiment worked. Week after week the old pendulum now 'notches up' the 60th second of every minute in almost exact coincidence with the signals of radio station WWV, on which the National Bureau of Standards broadcasts accurate time and frequency data.

"For my Seth Thomas clock I designed the system of electronic synchronization to control the rate of the pendulum through any tendency it might develop to vary within a maximum range of about 30 seconds per day. In other words, the pendulum remains locked to a submultiple of the frequency of the crystal even though the clock experiences forces that would cause an uncontrolled pendulum to speed up or slow down by as much as 15 seconds per day. This hold-in-range capability is considerably more than adequate because without controls the clock kept time to within a few seconds per day for many years in spite of variations in temperature and barometric pressure and the degradation of the oil in the bearings of the clock.

"The heart of the timekeeping system is the quartz-crystal oscillator. The quality and the cost of this apparatus can vary widely. The devices are available commercially and can also be made at home.

"The best commercial oscillators have a short-term stability of better than .0001 second per day, or roughly one part in a billion. Their cost, however, may be beyond the reach of most amateurs. Moreover, to realize the full potential of the best oscillators the experimenter must have access to equally costly accessories for calibrating the crystal periodically. The performance of quartz crystals changes with age.

"Experimenters who are modestly well equipped to construct electronic devices can make relatively simple crystal oscillators by dispensing with precise temperature controls and the other refinements of the best oscillators. Although these simplifications reduce the timekeeping accuracy of the oscillator by several orders of magnitude, the resulting performance is still impressive. For example, a quartz crystal of the 'AT-Cut' family that has been ground to vibrate at a selected frequency of from one to five megahertz will, when it has been properly compensated by a tuning capacitor of negative temperature coefficient, maintain an accuracy of one part in 10 million through a temperature variation of 15 degrees Fahrenheit. (Incidentally, experimenters who rely on the transmissions of WWV as the calibration standard must bear in mind that a single calibration cannot be assumed to be better than one or two parts in 10 million. The station's signals reach most receivers after one or more reflections from the ionosphere, which is rarely at rest. The Doppler shift and vagaries in electromagnetic propagation therefore degrade the accuracy randomly.)

"I made my oscillator with a crystal bought from the International Crystal Manufacturing Company (10 North Lee, Oklahoma City, Okla. 73102). When I ordered the crystal, I specified the frequency and mode of its operation, the value of the tuning capacitance and the type of holder in which the crystal was to be mounted. I also informed the manufacturer that the crystal was for a horological application in which a minimum variation in frequency was essential; that the operation was to be at room temperature within the limits of 20 and 28.5 degrees Celsius; that within this range the frequency must not increase with temperature, and that the rate at which the frequency changed within the specified range of temperature must be within limits sufficiently narrow to be nullified by the use of a Type N750 capacitor for a portion of the tuning capacitance. The N750 is a special ceramic capacitor that has a negative coefficient of temperature of about 750×10^{-6} per degree Celsius [*see top illustration on page 194*].

"Before making an exact measurement of the temperature characteristic of the crystal I operated it continuously in an oscillator circuit for a period in excess of three months. I find that this 'aging' is necessary for the short-term stability of the crystal to settle down to a few parts in 100 million. After this procedure I put the crystal and its oscillator circuit in a housing fitted with controls for maintaining any desired temperature within the specified range of operation.

"The influence of temperature on the rate at which the crystal vibrated was then measured and tabulated as I altered the proportion of Type N750 capacitance in the tuning capacitor. Proper temperature compensation requires the accuracy of these measurements to be one or two parts per 100 million. The measurements are made by beating the unknown frequency against a secondary-standard crystal oscillator of known stability. Piano tuners employ the same principle when they beat the sound emitted by a string against that of a tuning fork.

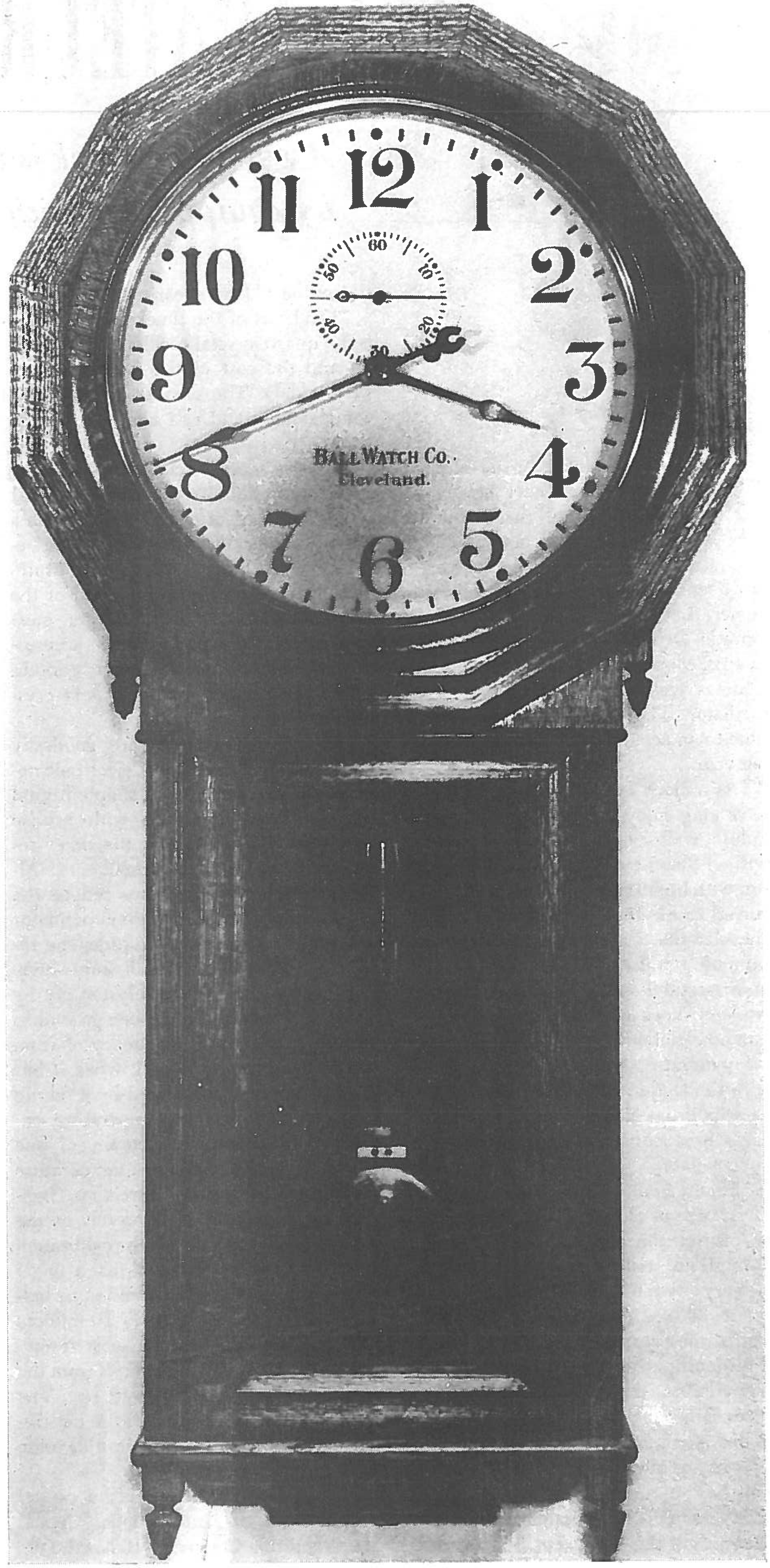
"From graphs of the tabulated measurements it is simple to determine the proportion of the tuning capacitance that should consist of negative-coefficient capacitance to achieve optimum stability through the specified range of temperature. In designing with series and parallel combinations of capacitors that have zero and negative temperature coefficients the capacitor with the negative temperature coefficient can be regarded as having the formula $N(1 - 750 \times 10^{-6}/°C) = N(1 - D)$. For example, it will be found that a capacitor of 10 picofarads (negative temperature coefficient) connected in series with one of 10 picofarads (zero temperature coefficient) performs as though the combination were a single five-picofarad capacitor with a negative temperature coefficient of $D/2$.

"The frequency of the alternating current generated by the oscillator is divided by a digital counting circuit. The resulting quotient has the form of direct-current pulses at a frequency that corresponds to the precise period of the pendulum clock when it is keeping exact time. These low-frequency pulses of current energize a solenoid that is rigidly mounted inside the case of the clock adjacent to one limit of the pendulum's swing. The solenoid develops pulses of magnetism that correspond to the pulses of current.

"The magnetic pulses periodically interact with the field of a small permanent magnet that projects from a slender rod mounted on the pendulum. The magnet was made with pieces of barium ferrite cut from the plastic-housed magnet of a cabinet latch. The correct direction of current in the coil to attract the magnet to its center was determined by suspending the magnet partway into the solenoid by a thread, applying current and observing the movement of the magnet. The electrically generated pulses of mechanical force speed up the clock just enough to compensate for the intrinsic slow rate to which the pendulum was adjusted and for unavoidable variations of rate caused by changes in temperature or pressure.

"The choice of the frequency of the oscillator and the details of the digital counting circuit depend on the rate at which the pendulum is designed to swing. My Seth Thomas was designed to beat 72 times per minute when keeping exact time. (The horologist's beat corresponds to the number of a pendulum's half-periods.) I selected a crystal that was ground to oscillate at three megahertz, or 180 million vibrations per minute. To obtain 36 pulses per minute, a rate that corresponds to the period of the pendulum, divide 180 million by five million.

"To make the division I selected the relatively new family of complementary-symmetry metal oxide semiconductor (COS/MOS) devices. This choice was dictated primarily by the low power con-



Wall clock, of Seth Thomas manufacture, modified by Laurance M. Leeds

EHS PAID UP MEMBERSHIP

Akers,Robert L., N.Y.
Bailey,Frances J.,Sr., N.J.
Becker, James W., N.Y.
Berger, Steven, Ill.
Blumenstock, Duane, Michigan
Bourquin, John L., L.I.
Bradley, William H., Georgia
Campbell, L.A., Calif.
Clifford, Robert F. N.Y.
Clough, Jack Jr., N.Y.
Cobb, Wesley R., Md.
Cohen, George, N.Y.
Cramer, Henry R. Indiana
De Angelo, Peter, N.J.
Denney, K.C., Okla.
Dennis, Olin, Mo.
Doloff, Bert, Penna.
Farrow, J.W., Calif.
Fast, Jerry, Illinois
Feiertag, Robert H., Ohio
Feinstein, George, Bklyn,N.Y.
Feldman, Martin C., N.Y.
Finley, John H. Ohio
Fisher, Elowin, N.Y.
Fox, Harry, Ill.
Goodwin, Louis W., Conn.
Gould, Howard, S., Mich.
Graham, George A., N.J.
Green, Thomas D., Conn.
Fried, Henry, L.I.
Hagans, Orville, R. Colo.
Hamilton, David., Michigan
Hanff, E.A., Pa.
Hawkins, Delbert R., Kansas
Heldman, Alan W., Ala.
Hendry, Allen, Pa.
Highfill, Paul, Ca.
Hills, R.C. Louisiana
Hines, E.W. Calif.
Holmberg, Roger, Ca.
Jaroslaw, Leo, A., Mass.
Kepner, George L., Calif.
King, Maurice L., Texas
Kopia, Stan, Va.
Levy, Bruce,M.D. N.Y.
Lyle, Walter, Pa.
Marcus, Ben. N.Y.
Marsh, Glen, Calif.
Marx, Alan, N.Y.
McGinness, Robert, N.Y.
Miller, Jack, Pa.
Molloy, William H., Calif.
Nelson, Carl, Wisconsin
O'Neil, Charles, J. Conn.
Payne, J.F., Fla.
Perry, Manuel A., R.I.
Pogue, Irvin A., Ill.
Postman, Monroe H., Calif.
Quill, Walter, Ill.
Roach, W.D., Ore.
Robertson, C.S. Texas
Robertson, Robert J., Ontario
Roth, Charles, N.Y.
Schaefer, R.M., Iowa
Scolnik, William, N.J.
Sellors, John Jr., Ohio
Singer, Joseph, Ohio
Stephens, J.A., Pa.
Trainello, Jerry, N.Y.
Vogel, R.H. Ind.
~~Vogel, R.H. Ind.~~
Wacek, Ben, N.Y.
Warburton, Richard, Wash.
Winch, John L., Maine
Worth, Walter, Mass.
Zlobin, George,N.Y.
Knauff, Harry A., M.D. Missouri
Crispin William, Belleville,Ill.
Faine Harold H., Calion,Ohio
Mausteller J.W., Evans City,Pa.
Scholz Ronal E.Sr., Wickliffe, Ohio
Wood Stacy B.C., Lancaster, Pa.

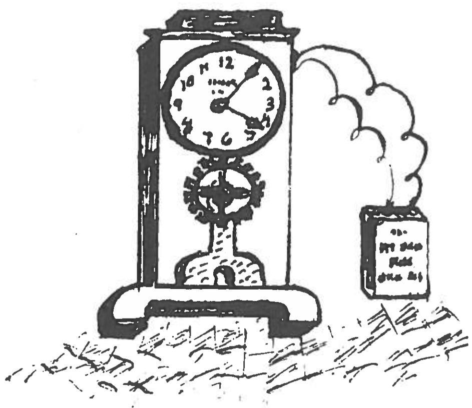
If you do not find your name on this sheet this means that you are now considered an inactive member of Chapter 78. To rectify this please send $7.00 dues to:

Mr. Charles Roth
2 Circle Lane
Roslyn,N.Y. 11577

within two weeks.

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY Chapter No 78

VOLUME 1---ISSUE #3
April 14, 1975



Hello fellow enthusiasts:

Our Chapter continues to grow and happily we now are receiving articles and suggestions from many members. This is to be expected, of course, as the mathematical probability of such receipt increases with the addition of new members. At last count we have 120 members in good standing. The enthusiasm that our members show regarding the formation and continuation of Chapter 78 is heart-warming indeed. At this time we are also in the process of providing the library of National at Columbia, Pa. with a full set of our publications. To those members who have requested back issues, very few are available. If the demand is sufficient we shall make arrangements to reprint all the publications from issue #1 through the present to be sold on a first come first served demand basis. The minimum we can reprint would be 100.

This month the article from the Scientific American, September 1974 is concluded. A reprint of an article describing the Warren clock and another describing the electrical clock made by the New York Standard Watch Co. of New York is included. Of course, our regular features are to be found in this issue too. Space does not permit the inclusion of the Tiffany Never-Wind clock patent in this issue.

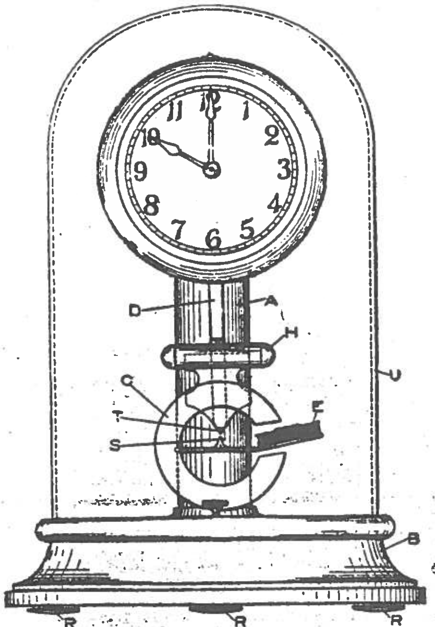
Your articles and comments are always welcome and I look forward to receiving them from you. Enjoy this issue.

Electromagnetically yours,

Mort Feldman

MAGNETIC CLOCK WILL RUN TWO YEARS.

THERE has recently been perfected and placed upon the market a new kind of timekeeper known as the Warren Magnetic Clock, which the manu-



Front View of the New Magnetic Clock, Said to be One of the Simplest Ever Designed and Extremely Accurate.

facturer claims embodies improvements in the mechanism, and especially the escapement, more radical than any made during the previous century.

From the base of the clock (B) there arises a column (A) which forms a support for the pendulum and the movement, and also contains the battery. The pendulum consists of a permanent magnet (C) riveted firmly to a rod (D) of "Invar," which is a metal practically unaffected by changes in temperature.

Mounted upon the column (A) and located within the gap or opening of the magnet (C) is a coil of extremely fine insulated wire (E), and the ends of this fine copper wire are firmly soldered to two brass rods at the back of the column.

Within the column (A) there is room for a special battery cell of the same diameter but somewhat longer than the cells that are commonly used in flashlights. This battery cell rests upon a strong spring and is held down by the pointed end of a brass rod which may be swung away from the battery in order to replace it.

Mounted upon the pendulum rod is a brass case (H) within which is located an electric pulsator consisting of a sealed glass tube from which air has been carefully exhausted. Inside this glass tube is an inner steel tube, protected from all atmospheric influences such as dust, moisture, or oxidation, containing (presumably) mercury, which sends electric impulses through the coil (E) at every complete swing of the pendulum. These impulses are of such a nature as to maintain the swing of the pendulum in practically the same width of arc whether the battery be new or old. If the swing of the pendulum be increased or decreased by external means, the electric pulsator (H) will quickly restore it to its normal arc.

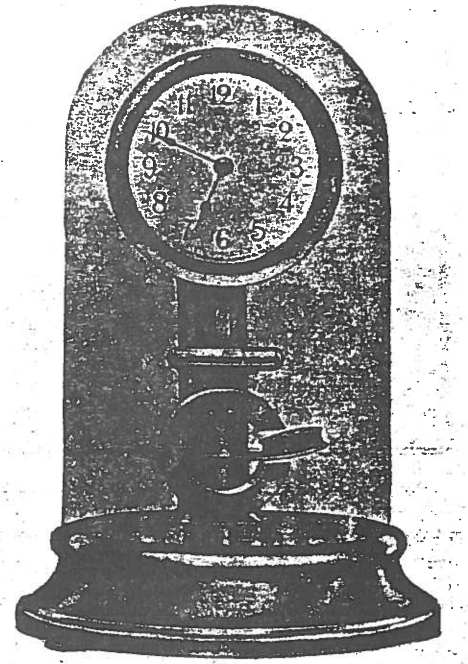
With this clock, owing to the efficiency of the electric system, the battery will last two years in service. The amount of current consumed by the clock is so small that an ordinary dry cell such as is used in ringing bells will easily run twenty-five clocks simultaneously for several months.

Motion is transmitted from the pendulum to the movement as follows: A case which is practically airtight is screwed to the back of a heavy brass plate carrying the movement. Within the case, mounted in sapphire jewels so as to revolve with the utmost freedom, is a vertical pivot made of hardened magnet steel. Upon this pivot is cut a coarse screw thread. Meshing with this screw thread but not clearly shown is a gear mounted upon a horizontal pivot. The lower end of the needle carries a curved extension projecting downward into a cup or depression at the bottom of the case. This cup is nearly filled with a fine quality of light mineral oil. Neither air nor dust can enter the case and the oil which it contains cannot possibly escape. Mounted upon the pendulum rod (D) is a little platform or bracket just below the clock dial, and concealed upon the platform are two very small permanent horseshoe magnets. The poles of the magnets strongly attract the curved extension at the lower end of the needle inside the case, through two thicknesses of metal and an air-space.

According to a new principle broadly patented the reciprocating or swinging motion of the pendulum which moves the pendulum (D) and bracket to and fro across the axis of the magnetic needle causes the latter to revolve once for every complete swing of the pendulum.

The oscillating motion of the pendulum is thus converted into a continuous motion of rotation of this needle and thus by means of a screw thread transmits motion, at a greatly reduced rate, to the first gear of the clock train. The remainder of the clock train is more or less conventional although the bearings are so designed as to run without lubrication. The entire works of the clock are protected by a dust-tight cover.

The advantages of this method of transmission from the pendulum to the clock movement are as follows:



Magnetic Clock Enclosed in Glass Case. It Will Run Continuously Two Years on One Flashlight Battery.

There is no mechanical connection between the pendulum and the movement, and consequently there is no striking or rubbing of any part by the pendulum and no friction; no manipulation is needed to connect the pendulum with the movement. There is nothing to prevent enclosing all the important parts of the clock in an air-

The mechanism for transmitting motion from the pendulum to the movement produces substantially the same drag upon the pendulum whether the clock hands are moving up or down, and consequently the rate of the pendulum and its timekeeping qualities are exceedingly good.

The important parts of the clock movement are enclosed in a tight case partially filled with a fine quality of mineral oil. No dust can possibly enter this case, and the parts cannot become rusty or sticky.

The parts move continuously in oil. No part strikes upon another as in the case of the ordinary escapement, and consequently the movement is absolutely noiseless.

To regulate the rate of the pendulum the following means are employed: A small permanent magnet is mounted beneath the hollow base of the clock so as to be moved against the resistance of a spring by means of an adjustment screw. A perfectly definite force of attraction will be maintained between the end of the regulating magnet and the bottom of the pendulum magnet (C), but the amount of this force of attraction can be varied by the adjustment screw because the force will diminish as the magnet is moved further away from (C) and vice versa.

A very important advantage of this method of regulating is that the clock need not be stopped nor the pendulum disturbed in any way for regulation.

For the purpose of setting up these clocks correctly on a mantel or other surface three leveling screws are provided beneath the base, and a pointer and indicator are on the column and pendulum rod respectively. By these means a person may easily adjust the clock to run on any surface.

This reprint is through the courtesy of Charles O'Neil. From the Electrical Experimenter, Oct.1916,Pg.405.

A BATTERY-POWERED CLOCK

by Bill Burnham

Reprinted from Bulletin of NAWCC--February 1961,Vol.1X, No.8,Whole 90
Courtesy of Richard Vogel

A great deal has been published covering a variety of clocks and watches of the mechanical type, the driving media being weights or springs, employing some form of escapement to control the speed of the going train, the escape wheel in turn giving an infinitesimal push to the pendulum or lever as the case may be. With each helping the other in this manner the mechanism will keep going until the driving power is exhausted. We also have the self-winding mechanism, such as in the wrist watch which depends on a certain amount of physical movement to keep it going without further attention by the wearer.

Today we have the synchronous electric clock, which with proper cycle control of the electrical current gives one of the most accurate timepieces devised by man. In this type of timekeeping device we have a controlled input of power to keep it running accurately, instead of an escapement control to keep some driving force from running wild. Yet, when the current fails the clock stops, and how much better off are we than with a precision made mechanical clock that requires only periodic attention of the owner to keep it properly wound?

This article will deal entirely with a timekeeping device which employs two batteries (commonly referred to as telephone batteries) that occasionally give an electrical impulse to keep the pendulum swinging. The swing of the pendulum drives the going train. As in the well-known mechanical clock, the length of the pendulum controls the accuracy of the timekeeper.

Figure 1 shows the assembled clock hanging on the wall; this clock is 48 inches high. The top is 20 inches wide by 7 3/4 inches deep, and the box is 16 inches wide by 5 1/4 inches deep. Figure 2 shows the movement removed from the case for a closer observation.

Let us now study the operation of this mechanism and compare it with conventional pendulum clocks.

The bob of this clock is rather heavy and is in two pieces, held together with a star-headed bolt, which may be seen in the center of the bob. The mechanism has a true 80-beat pendulum with a small hand that makes one revolution per minute.

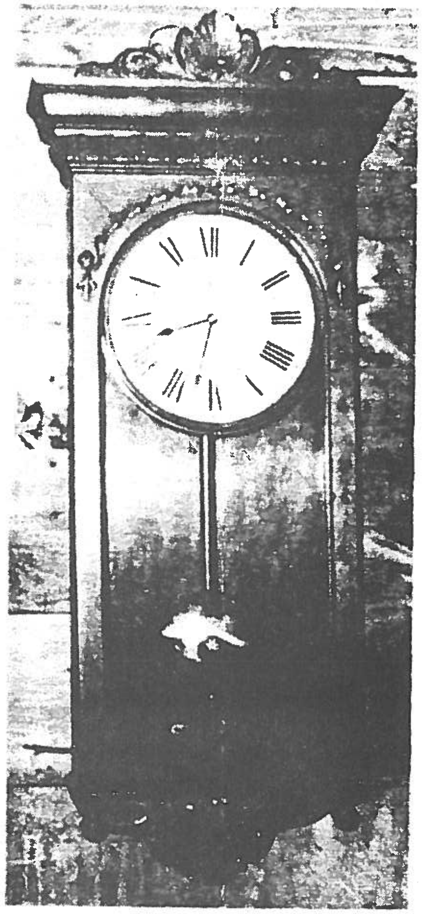


Fig. 1

This small hand cannot be properly called a seconds hand, inasmuch as each complete swing of the pendulum moves the hand 1 1/2 seconds. The reason for this will be seen later as we study the mechanism more closely.

The pendulum is made of wood, with the rating nut at the bottom of the bob, and is attached to the back of the plate of the movement by a thin flat spring, as in any conventional pendulum clock. The crutch-wire is attached to a steel bar that oscillates between two electro-magnets seen at the top right and left hand sides of the movement. Fastened to this bar is a semi-circular piece which carries a pawl. This pawl advances a 40-tooth ratchet wheel one tooth for each complete cycle of the pendulum. The 40-tooth ratchet wheel makes one revolution per minute. As the small hand is attached to the ratchet wheel spindle it also makes one revolution per minute. Because a minute has 60 seconds, and the ratchet wheel has 40 teeth, we have an equation of 60 divided by 40 which gives 1 1/2 seconds for each impulse given to the small hand. The lever with the disc-shaped end seen at the left center of the movement is a locking pawl to keep the ratchet wheel from turning backward as the pendulum reverses its swing.

The ratchet wheel is geared directly to, and drives the gear train, which in turn moves the minute and hour hands to indicate the hours and minutes.

As the ratchet wheel is driven by the swing of the pendulum it cannot be classed as an escapement. Here the pendulum (like the controlled cycles of the synchronous electric clock) becomes the prime driver. Instead of regulating through an escape wheel the speed of the driving train, as in a weight or spring driven clock, the function of the pendulum is completely reversed.

At the lower left-hand corner of

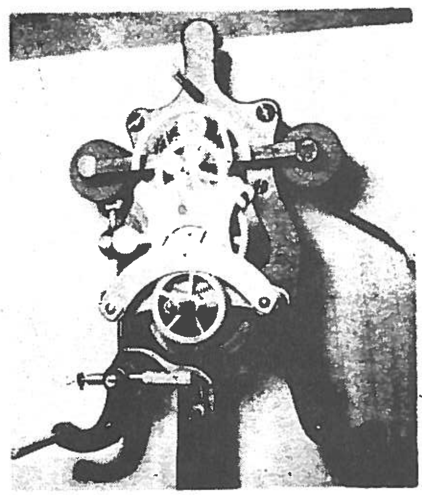


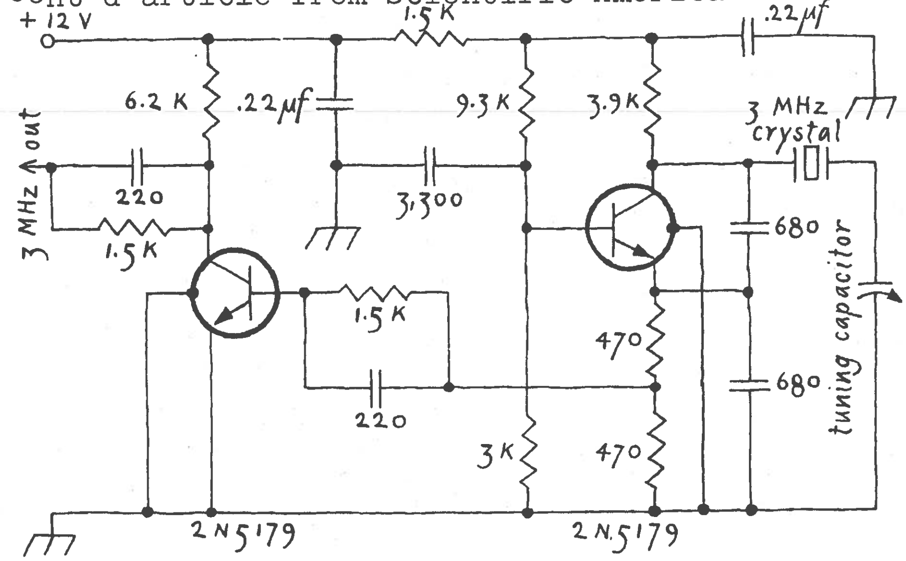
Fig. 2

the movement is seen a double curved lever pivoted within a square-ended bar which is fastened to the frame. Pivoted to the right-hand end of this lever is what I shall refer to as a "dangle bar", which has a "vee" notch in its lower end. The points of this "vee" notch point downward, with the right-hand point being longer than the left.

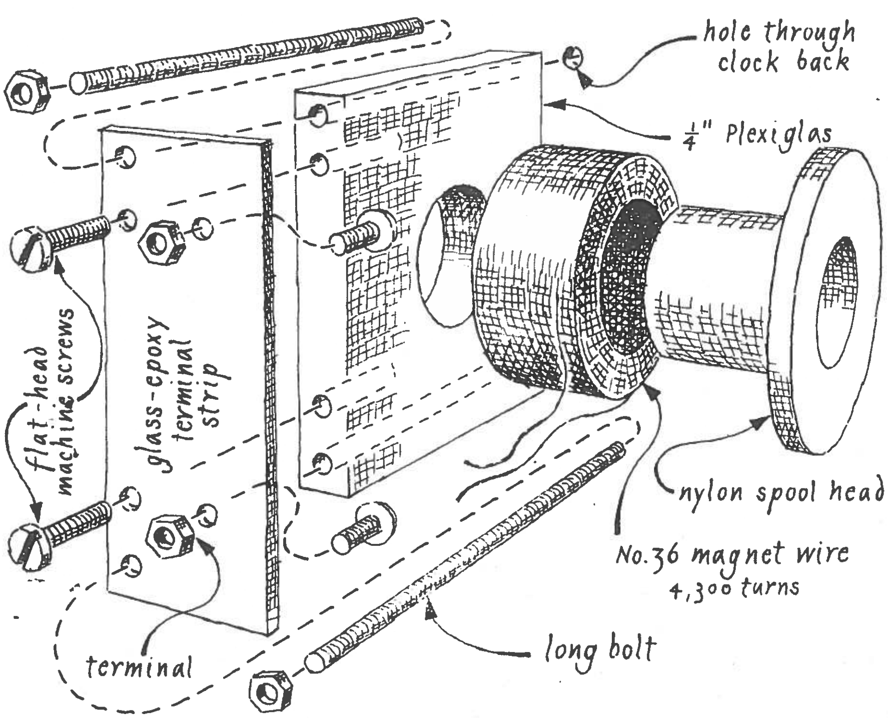
Just below this dangle bar, set into the pendulum rod is a knife-edged pin, with the knife-edge pointing upward. The function of the dangle bar and knife-edge pin will be explained later.

To the left of the double curved lever, but not in contact with it, will be seen a thin flat spring attached to a vertical bar fastened to the frame, but insulated from it. A wire from the left-hand electro-magnet is attached to the top of this vertical bar. At the right side of the movement is a coiled wire extending to the right from the right-hand electro-magnet.

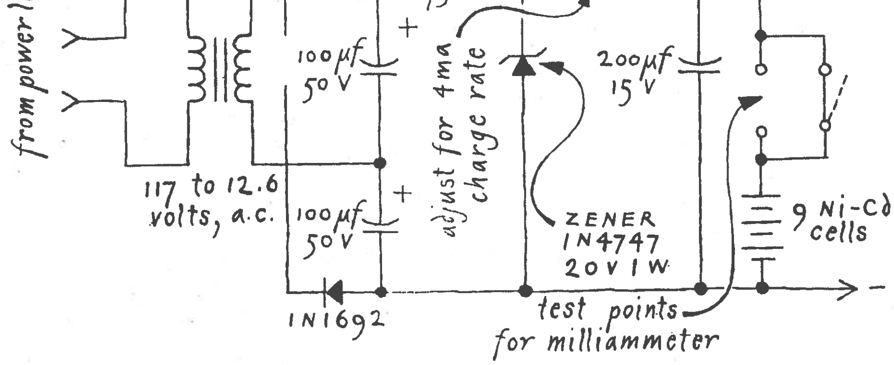
Cont'd article from Scientific American



Circuitry of the quartz-crystal oscillator



Details of the solenoid assembly



Circuitry of the power supply

sumption of the devices at low switching speeds. In my circuits the power required by the devices is in microwatts.

"The cos/MOS circuit enables the clock to operate for more than 100 hours on a storage battery of nine nickel-cadmium cells. The capacity of the battery is 750 milliampere-hours. The cells are kept on a continuous trickle charge of about four milliamperes. This scheme makes the system immune to occasional power-line interruptions. An interruption of even a fraction of a second would disorganize the operation of the digital counting circuit. For this reason I regard the battery as being essential.

"A feature of my circuit is a manual switching scheme that enables me to change the divisor from five million to either 5,000,256 or 4,999,744 and thus retard or advance the clock as desired. The shift in rate, which I refer to as 'precession,' amounts to about 4.4 seconds per day. If after a month or so of unattended operation I observe that the clock does not indicate the beginning of the 60th second of each minute in exact coincidence with the time signal of WWV but is, say, a fraction of a second fast or slow, I flip the switches to alter the rate as necessary. After the error has been corrected I restore the divisor to five million. Precession has no effect on the rate at which the crystal vibrates. It merely alters the frequency of the magnetic pulses.

"Except for attaching the solenoid to the case and adding the small magnet to the pendulum, I made no significant changes in the mechanism of the clock. The driving weight continues to operate the hands through the unaltered train of gears and to supply some of the driving energy to the pendulum through the Graham deadbeat escapement. The maximum arc through which the pendulum can swing is limited to the angle at which the pallets of the escapement mechanism make contact with the roots of the teeth of the escapement wheel. In my clock the maximum swing is limited to about 3½ degrees of semiarc. A minimum semiarc of one degree is required for the pallets to sequentially release the teeth of the escapement wheel. Hence the synchronization scheme must be effective within a total excursion of not more than 2½ degrees of semiarc.

"The natural period of a pendulum is fixed primarily by its effective length and by the restoring force that results from gravitation. The effective length is determined by the distribution of the several masses of the pendulum with respect to the point from which the assembly swings. This length cannot be readily altered to change the period and thus synchronize the pendulum to the oscillator. The restoring force can, however, be increased easily by combining magnetic attraction with gravitation. The addition to gravitation of any force that tends to restore the pendulum to dead center will increase the beat, whether the added force is continuous or impulsive or whether it acts with or against the motion of the pendulum. In my arrangement pulses of magnetic attraction, which act on the pendulum tangentially between the solenoid and the magnet, are applied for .028 second once during each period.

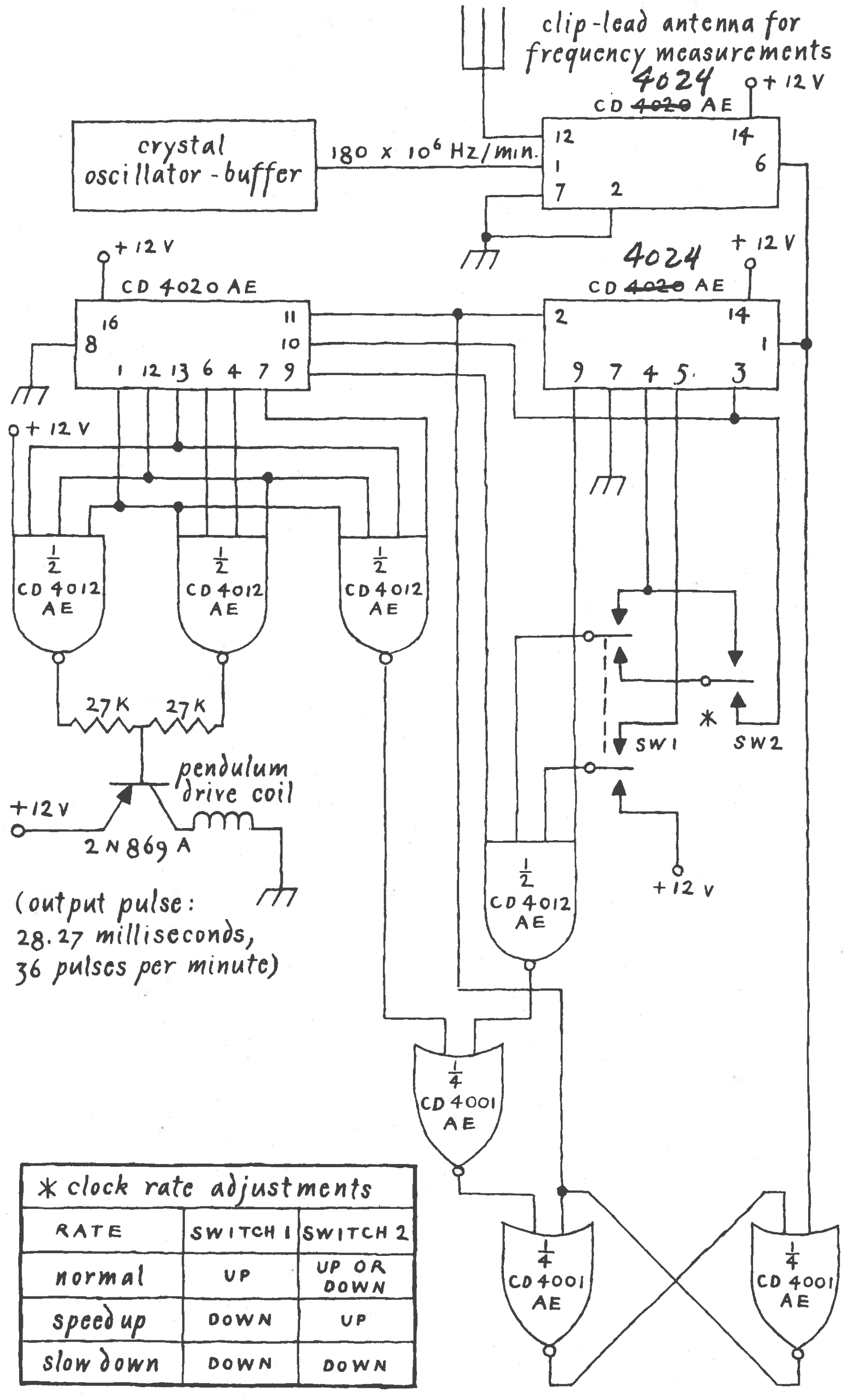
"The pulses begin as the pendulum approaches one limit of its excursion and continue through the initial portion of its departure in the opposite direction. During the interval of the pulse the position of the magnet is always beyond the magnetic center of the solenoid. For this reason the force of the entire pulse tends to speed up the clock. The intrinsic rate of the pendulum is preset slow by approximately half of the hold-in-range.

"Pendulums that traverse a circular arc, as is usually the case, have a period that increases slightly with increases in the length of the arc. This effect is known to horologists as circular error. In my clock the length of the arc changes somewhat less than 2½ degrees, depending on variations of interaction of the solenoid and the magnet. The variations compensate for random forces that would otherwise cause the clock to fall out of step with the oscillator. It turns out that the circular error of a few seconds per day induced by this variation in arc augments the system's hold-in-range.

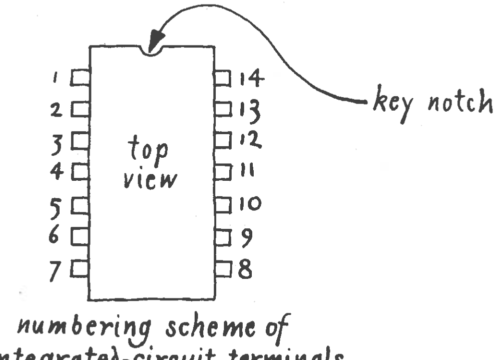
"I make no claim that the system is the best one that could be devised. It works. The clock has not lost synchrony during the two years it has been following the crystal.

"A theory of operation that seems to explain the system's ability to converge to stable synchronization, with a very tight phase lock, has been formulated. An important aspect of the interaction is the relative phase of the pulse and the pendulum in the vicinity of one limit of the pendulum's excursion. This is the region where the pendulum slows to a stop and reverses its direction.

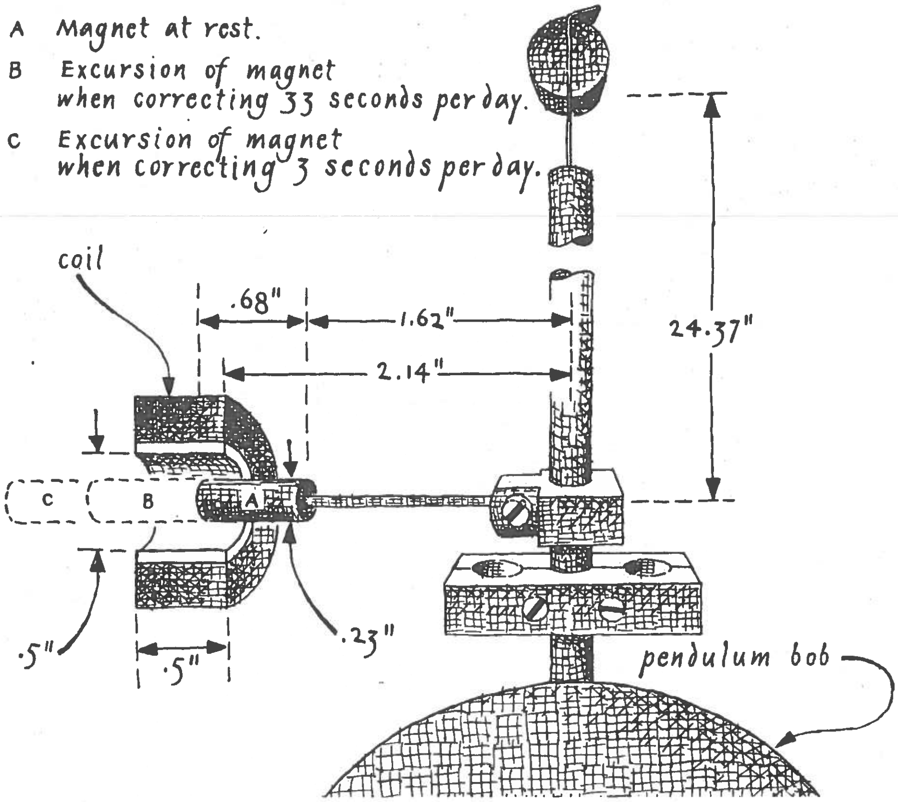
"Consider the duration of the pulse to consist of three contiguous parts [*see bottom illustration on next page*]. Assume that the clock is operating synchronously with the oscillator at about the center of the hold-in-range. The pulse begins as the pendulum approaches the limit of its excursion on the left side. The first part of the pulse is the



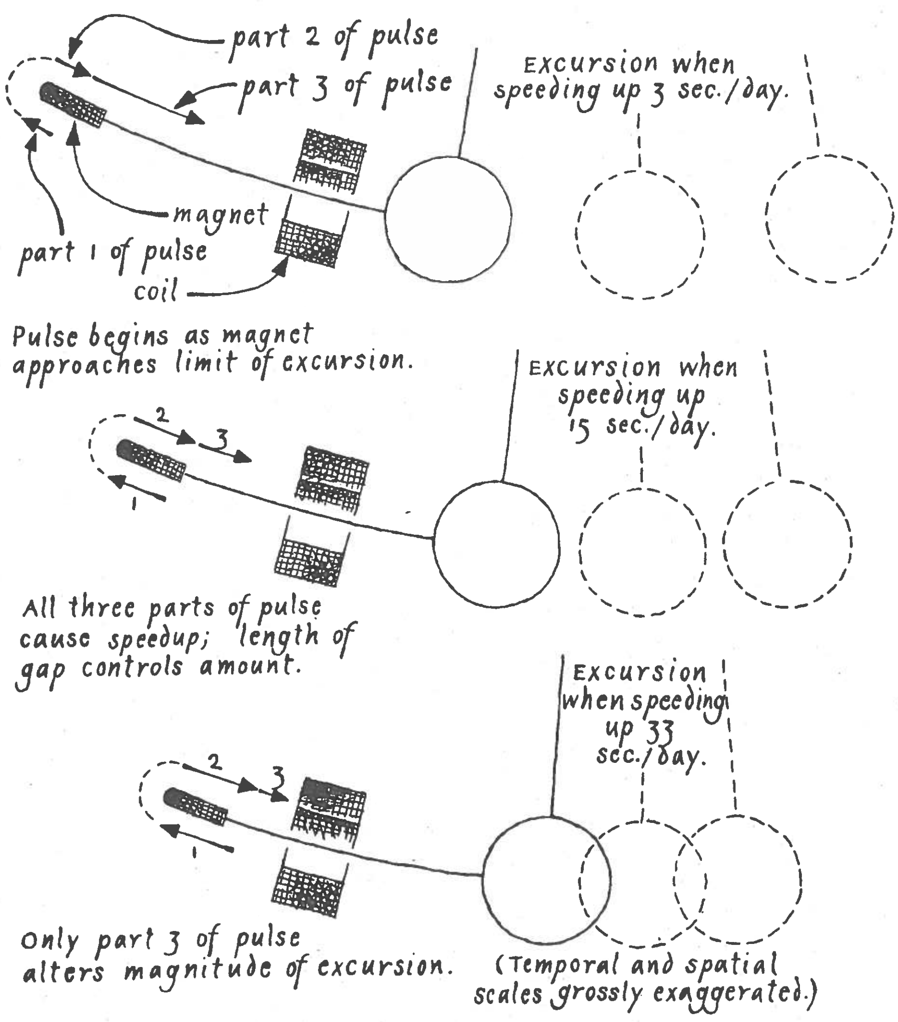
* clock rate adjustments		
RATE	SWITCH 1	SWITCH 2
normal	UP	UP OR DOWN
speed up	DOWN	UP
slow down	DOWN	DOWN



Arrangement of the digital counting circuit



Details of the pendulum assembly



Representation of the synchronizing forces

portion that extends from the onset to the instant when the pendulum comes to rest.

"The first part of the pulse would typically span about nine milliseconds. The second part begins at the instant the pendulum begins to move on its return beat and always persists for exactly the same interval as the first part. The third part is the remainder of the pulse, about 10 milliseconds. In the illustration the heads of the arrows indicate the direction of the pendulum's motion; the shafts of the arrows depict increments of the pulse. The total force of all three parts causes the pendulum to speed up, but only the third part tends to increase the length of the arc because, with respect to the arc, the forces of the first and second parts cancel.

"Assume now that the absolute phase between the pulse and the pendulum is such that the first and second parts constitute most of the pulse. The third part is therefore small and the arc will be only slightly longer than it would be if the clock were powered by its driving weight alone. Because of the reduced arc the magnet is comparatively closer to the magnetic center of the solenoid when the pulse occurs and the relative speedup force of the total pulse will be large. That is the phase in which substantially maximum speedup is being imparted to the system. Conversely, when the phase is such that the third part is relatively large, the arc is also large, as is the distance between the magnet and the solenoid. Hence the pulse exerts a lesser tendency to speed up the pendulum, which, as I have mentioned, is deliberately adjusted to run slow.

"As an example of how the system converges to stable synchronization assume that the rate is near normal at the center of the hold-in-range and that some random force of external origin tends to speed up the clock. The pendulum would respond by arriving earlier at the limits of its excursion. Hence the magnet would be closer to the limit at the beginning of the pulse.

"The first and second parts of the pulse would be shorter than normal and the third part would be extended. This part would tend to increase the arc and therefore the distance between the magnet and the solenoid, thereby reducing the tendency of the electronic system to speed up the clock. That is precisely the action required to offset the increase in the intrinsic rate.

"Conversely, if forces of external origin tend to retard the clock, the pendulum and the magnet approach the limits of their excursion somewhat behind schedule. The first and second parts then persist through a longer interval, with a corresponding decrease in the duration of the third part. The arc decays. This result reduces the distance between the solenoid and the magnet and initiates the additional force required to speed up the pendulum. Thus the phase relation between the pulse and the pendulum causes the system to converge automatically to stable synchronization.

"The relative phase of the pendulum with respect to the pulse does not change by more than half the duration of the pulse, or 14 milliseconds. If the frequency of the oscillator is assumed to be constant and the system alters the intrinsic rate of the pendulum by 30 seconds per day, the indication of the clock does not actually depart from the exact time, as generated by the oscillator, by more than 10 or 12 milliseconds.

"In terms of feedback the scheme of synchronization is an open loop. Hence the pendulum does not automatically fall in step with the oscillator. To coax the two into the phase relation at which the pendulum pulls into synchrony I clip a pair of headphones, in series with a 100,000-ohm resistor, across the terminals of the solenoid. The pulses are heard as distinct clicks. I then pull the pendulum to one side and try to release it so that the click is heard just as the pendulum arrives at the left extreme of its excursion. The knack of initiating the swing correctly comes with practice. The magnet must pass to the left through the magnetic center of the solenoid before the click is heard. If this condition is satisfied, the system will pull into synchrony within an hour or so.

"During this interval it may be necessary to control the magnitude of the arc manually. I do so by judiciously stroking the bottom tip of the pendulum in the desired direction with a small camel's-hair brush. The need for this control stems directly from the theory. The beat spans 833⅓ milliseconds, whereas the pulse lasts for only 28 milliseconds. The probability of starting the pendulum by hand so that the relatively narrow pulse straddles the point in time at which the pendulum reverses its direction is exceedingly remote.

"Assume that all the pulse occurs prior to the arrival of the pendulum. The full pulse acts to reduce the arc, but an inordinate speedup of the pendulum is required before the pulse can straddle the point at which the pendulum reverses its direction. By automatically reducing the arc, however, the system indicates to the experimenter that the needed correction is pendulum speedup, which occurs when the arc is at a minimum and the distance between the magnet and the solenoid is small. Hence the experimenter should stroke the pendulum with the brush only enough to prevent the arc from falling below, say, 1½ degrees. Eventually the pendulum will be speeded up enough to lock into synchrony at the desired phase.

"Conversely, if the pulse occurs after the pendulum has departed from the extreme of its excursion, the arc will tend to become excessive. Use the brush to prevent the arc from exceeding a safe value. I have installed a stop in my clock that limits the arc to about 3½ degrees, so that no damage is done to the escapement. This synchronizing procedure presupposes that the amplitude of the pulse is reasonably adequate, but that may be unknown at the outset.

"The required amplitude of the pulse depends on several factors, such as the geometry of the system and the strength of the magnet. The amplitude must be determined experimentally and adjusted to a value that is compatible with the characteristics of the pendulum and its escapement. I proceeded as follows.

"During synchronized operation the maximum arc coincides with the minimum pendulum speedup (a correction of about three seconds per day). Hence, as the first step in determining the optimum pulse amplitude, I adjusted the intrinsic rate of the clock to be slow by three seconds per day. I then synchronized the pendulum. Next I increased the am-

RCA CD4024AE 7-STAGE COUNTER

PIN NUMBER	FUNCTION
1	CLOCK INPUT
2	RESET
3	Q7
4	Q6
5	Q5
6	Q4
7	GROUND
8	BLANK
9	Q3
10	BLANK
11	Q2
12	Q1
13	BLANK
14	VDD (+12 v)

RCA CD4020AE 14-STAGE COUNTER

PIN NUMBER	FUNCTION
1	Q12
2	Q13
3	Q14
4	Q6
5	Q5
6	Q7
7	Q4
8	GROUND
9	Q1
10	CLOCK INPUT
11	RESET
12	Q9
13	Q8
14	Q10
15	Q11
16	VDD (+12 v)

RCA CD4001AE QUAD 2-INPUT NOR

PIN NUMBER	FUNCTION
1	INPUT, GATE 1
2	INPUT, GATE 1
3	OUTPUT, GATE 1
4	OUTPUT, GATE 2
5	INPUT, GATE 2
6	INPUT, GATE 2
7	GROUND
8	INPUT, GATE 3
9	INPUT, GATE 3
10	OUTPUT, GATE 3
11	OUTPUT, GATE 4
12	INPUT, GATE 4
13	INPUT, GATE 4
14	VDD (+12 v)

RCA CD4012 DUAL 4-INPUT NAND

PIN NUMBER	FUNCTION
1	OUTPUT, GATE 1
2	INPUT, GATE 1
3	INPUT, GATE 1
4	INPUT, GATE 1
5	INPUT, GATE 1
6	BLANK
7	GROUND
8	BLANK
9	INPUT, GATE 2
10	INPUT, GATE 2
11	INPUT, GATE 2
12	INPUT, GATE 2
13	OUTPUT, GATE 2
14	VDD (+12 v)

DIVISOR EXPRESSED IN BINARY NOTATION

DIVISOR	Q12 … Q1 (CD4020AE)	Q7 … Q1 (CD4024AE)	Q4 … Q1 (CD4024AE)	SWITCH POSITION
5,000,000 =	1 0 0 1 1 0 0 0 1 0 0 1	0 1 1 0 1 0 0	0 0 0 0	NORMAL
5,000,256 =	1 0 0 1 1 0 0 0 1 0 0 1	1 0 0 0 1 0 0	0 0 0 0	SLOW DOWN
4,999,744 =	1 0 0 1 1 0 0 0 1 0 0 1	0 1 0 0 1 0 0	0 0 0 0	SPEED UP

(ON COUNTING TO THE DIVISOR, THE CIRCUIT GENERATES AN OUTPUT PULSE AND RESETS TO 0.)

Layout of pins and circuit-division scheme plitude of the pulse gradually during a period of several hours until the pendulum reached a steady-state arc of maximum allowable excursion.

"With the arc so established, I determined the hold-in-range by adjusting the pendulum to swing at progressively lower intrinsic rates, resynchronizing and noting the resulting arc after it had settled into the steady state. In my clock pulses of the desired amplitude result in a semiarc of three degrees when the system is correcting at the rate of three seconds per day. The semiarc reduces to 2⅜ degrees when the system is correcting 15 seconds per day and 1⅞ degrees when the correction is 33 seconds per day. The lower limit of 1⅞ degrees was dictated by the fact that the driving weight acting alone causes an arc of about 1⅜ degrees.

"The clock selected for this project should demonstrate, when it is under mechanical operation, a stability or rate adequate for synchronized service. It should have a deadbeat escapement, and the second hand should make one revolution per minute. (Many European wall clocks have second hands that make one revolution in 45 seconds.)

"People who do this project but who have not worked with cos/mos devices should keep in mind the very low power requirements of the apparatus. Since the devices operate on microwatts or less, they can be destroyed by an electrostatic discharge from the experimenter's finger. Keep them packed in their conductive plastic cases or conductive foam until they are used. Ground your body when you handle them. Avoid touching the terminals. Build the circuits with sockets that fit the devices. Switch the power off before putting the devices in the sockets or removing them.

"The terminal pins are numbered sequentially in the counterclockwise direction as viewed from the top, beginning at the notch or the equivalent mark at one end of the dual-in-line package. The accompanying table [*preceding page*] lists the terminal layout, according to function, of the CD4020AE and CD4024AE devices. All cos/mos devices and compatible sockets are available from distributors such as KA Electronic Sales (1220 Majesty Drive, Dallas, Tex. 75247).

"One can also modify a pendulum clock that runs at a rate of 60 or 80 beats per minute. Make or obtain a quartz-crystal oscillator of appropriate frequency and synchronize the clock to it. On receipt of a stamped, self-addressed envelope I shall send circuit diagrams for generating the required pulses of current."

← Scientific American, Sept. 1974

A Battery-Powered Clock, cont'd.

The two batteries referred to earlier are set into the top of the case, and are wired in series, giving an electrical current of three volts. One wire from the batteries is attached to the coiled wire at the right-hand side of the movement, and the other wire is attached to the horizontal bar carrying the double curved lever.

To start the clock the pendulum is swung to the right far enough to clear the dangle bar. As the pendulum is released and allowed to swing freely it will kick the dangle bar from right to left, and left to right, alternately until such time as the pendulum swings to the right just far enough so that the knife-edged pin in the pendulum rod engages the "vee" notch in the dangle bar. Now, as the pendulum swings to the left, the knife-edged pin lifts the double curved lever causing the left end of this lever to make contact, in its downward swing, with the thin flat spring. This closes the electrical circuit, thereby giving a push to the pendulum, through the crutch wire, which carries the pendulum far enough to the right to again clear the dangle bar, and another cycle is started. It takes approximately 52 seconds for the pendulum arc to become short enough to engage the dangle bar again and start each new cycle.

It is obvious that such an arrangement as this will keep on operating until the batteries become so weak that they will no longer provide the necessary power to push the pendulum far enough to the right to engage the dangle bar. When this happens the pendulum will gradually slow down and come to a halt.

I do not know at this writing how long the batteries will last. The clock has been running 10 months on the batteries presently in the clock, with no apparent loss of energy. Because the batteries will eventually lose their power, and all moving parts will wear, we cannot claim perpetual motion for this mechanism. However, it is not subject to failure because the lights go out. It does not need the daily, weekly, or monthly attention to keep it wound. And it can be regulated to rival the accuracy of the synchronous electrical clock.

This clock was made by the New York Standard Watch Company. It was patented February 25, 1896. Patent No. 555,313 was issued to Sigismund Fischer, a subject of the Czar of Russia, residing in Brooklyn, New York.

Although this clock is time only, the patent papers outline a striking mechanism, also electrically operated. It may be arranged to strike the hours only, or the hours and half-hours. When an hour is being struck each swing of the striking hammer is actuated by an electrical impulse, the frequency of the strike being controlled by the swing of the pendulum. When the half-hour strike is added, a cam rotating at the same speed as the minute hand raises and releases the hammer mechanically once for every hour on the half hour.

Provision is also outlined for adding an electrically operated alarm when desired. • • •

WANTED:

Literature concerning maintenance and repair for International Time Recording Co. Master Regulator Model No. 263. Irvin A. Pogue
212 N. Wm. Drive,Chillicothe, Illinois 61523

****

FOR SALE:

Synchronome Master Clock, Mahogany case, mint,works; ca. 1925.

WANTED:

Electrical horological literature--any type.
Hamilton-Sangamo clocks--write details.

Martin C. Feldman,1545 Rhinelander Ave.Bx.10461

****

FOR SALE:

Synchronome clock, good condition, excellent throughout, fine timekeeper.

Alan Marx,105 Bayeau Rd.New Rochelle,N.Y. 10804

****

FOR SALE:

Barr clock complete but not running---------$85.00 or trade.

Jerry Fast,14 W.Oak St.Algonquin,Ill. 60102

****

MART CHARGES: $2.00 PER 4 TYPEWRITTEN LINES.

****

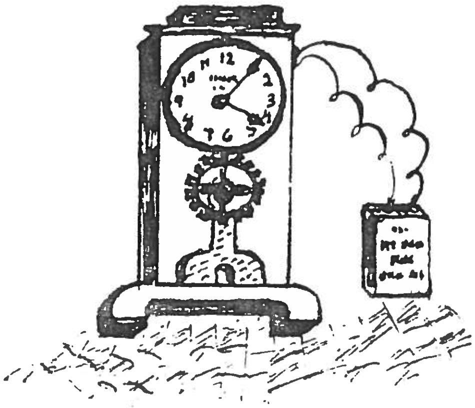
TECHNICAL QUESTIONS AND ANSWERS

From Mr. John Winch, Jr.:

"I came across a new clock that was used in the Electrical Dept. of the City of Portland back in 1917. This was the last date it was used. The name of the maker is: THE HOLTZER MAGNETO CLOCK CO., Boston and Chicago. It must have been some kind of a watchman's clock as it has a hole in the magneto box for a crank to wind same. Perhaps someone has seen one like it? Any information would be helpful. Thank you."

PLEASE SEND REPLYS TO ME AND I WILL FORWARD THEM TO JOHN AS WELL AS PRINT THE INFORMATION IN THE JUNE JOURNAL-----Marty Feldman

The
JOURNAL
OF THE
ELECTRICAL HOROLOGY SOCIETY
Chapter No 78



VOLUME 1---ISSUE #3
April 14, 1975

Hello fellow enthusiasts:

Our Chapter continues to grow and happily we now are receiving articles and suggestions from many members. This is to be expected, of course, as the mathematical probability of such receipt increases with the addition of new members. At last count we have 120 members in good standing. The enthusiasm that our members show regarding the formation and continuation of Chapter 78 is heart-warming indeed. At this time we are also in the process of providing the library of National at Columbia, Pa. with a full set of our publications. To those members who have requested back issues, very few are available. If the demand is sufficient we shall make arrangements to reprint all the publications from issue #1 through the present to be sold on a first come first served demand basis. The minimum we can reprint would be 100.

This month the article from the Scientific American, September 1974 is concluded. A reprint of an article describing the Warren clock and another describing the electrical clock made by the New York Standard Watch Co. of New York is included. Of course, our regular features are to be found in this issue too. Space does not permit the inclusion of the Tiffany Never-Wind clock patent in this issue.

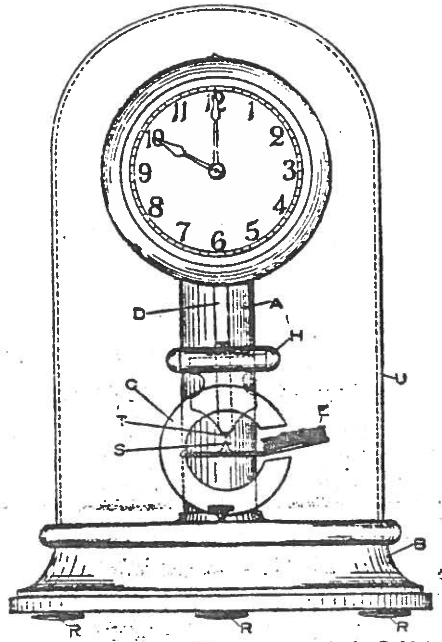
Your articles and comments are always welcome and I look forward to receiving them from you. Enjoy this issue.

Electromagnetically yours,

Morty Feldman

MAGNETIC CLOCK WILL RUN TWO YEARS.

THERE has recently been perfected and placed upon the market a new kind of timekeeper known as the Warren Magnetic Clock, which the manufacturer claims embodies improvements in the mechanism, and especially the escapement, more radical than any made during the previous century.



Front View of the New Magnetic Clock, Said to be One of the Simplest Ever Designed and Extremely Accurate.

From the base of the clock (B) there arises a column (A) which forms a support for the pendulum and the movement, and also contains the battery. The pendulum consists of a permanent magnet (C) riveted firmly to a rod (D) of "Invar," which is a metal practically unaffected by changes in temperature.

Mounted upon the column (A) and located within the gap or opening of the magnet (C) is a coil of extremely fine insulated wire (E), and the ends of this fine copper wire are firmly soldered to two brass rods at the back of the column.

Within the column (A) there is room for a special battery cell of the same diameter but somewhat longer than the cells that are commonly used in flashlights. This battery cell rests upon a strong spring and is held down by the pointed end of a brass rod which may be swung away from the battery in order to replace it.

Mounted upon the pendulum rod is a brass case (H) within which is located an electric pulsator consisting of a sealed glass tube from which air has been carefully exhausted. Inside this glass tube is an inner steel tube, protected from all atmospheric influences such as dust, moisture, or oxidation, containing (presumably) mercury, which sends electric impulses through the coil (E) at every complete swing of the pendulum. These impulses are of such a nature as to maintain the swing of the pendulum in practically the same width of arc whether the battery be new or old. If the swing of the pendulum be increased or decreased by external means, the electric pulsator (H) will quickly restore it to its normal arc.

With this clock, owing to the efficiency of the electric system, the battery will last two years in service. The amount of current consumed by the clock is so small that an ordinary dry cell such as is used in ringing bells will easily run twenty-five clocks simultaneously for several months.

Motion is transmitted from the pendulum to the movement as follows: A case which is practically airtight is screwed to the back of a heavy brass plate carrying the movement. Within the case, mounted in sapphire jewels so as to revolve with the utmost freedom, is a vertical pivot made of hardened magnet steel. Upon this pivot is cut a coarse screw thread. Meshing with this screw thread but not clearly shown is a gear mounted upon a horizontal pivot. The lower end of the needle carries a curved extension projecting downward into a cup or depression at the bottom of the case. This cup is nearly filled with a fine quality of light mineral oil. Neither air nor dust can enter the case and the oil which it contains cannot possibly escape. Mounted upon the pendulum rod (D) is a little platform or bracket just below the clock dial, and concealed upon the platform are two very small permanent horseshoe magnets. The poles of the magnets strongly attract the curved extension at the lower end of the needle inside the case, through two thicknesses of metal and an air-space.

According to a new principle broadly patented the reciprocating or swinging motion of the pendulum which moves the pendulum (D) and bracket to and fro across the axis of the magnetic needle causes the latter to revolve once for every complete swing of the pendulum.

The oscillating motion of the pendulum is thus converted into a continuous motion of rotation of this needle and thus by means of a screw thread transmits motion, at a greatly reduced rate, to the first gear of the clock train. The remainder of the clock train is more or less conventional although the bearings are so designed as to run without lubrication. The entire works of the clock are protected by a dust-tight cover.

The advantages of this method of transmission from the pendulum to the clock movement are as follows:

Magnetic Clock Enclosed in Glass Case. It Will Run Continuously Two Years on One Flashlight Battery.

There is no mechanical connection between the pendulum and the movement, and consequently there is no striking or rubbing of any part by the pendulum and no friction; no manipulation is needed to connect the pendulum with the movement. There is nothing to prevent enclosing all the important parts of the clock in an air-tight case.

The mechanism for transmitting motion from the pendulum to the movement produces substantially the same drag upon the pendulum whether the clock hands are moving up or down, and consequently the rate of the pendulum and its timekeeping qualities are exceedingly good.

The important parts of the clock movement are enclosed in a tight case partially filled with a fine quality of mineral oil. No dust can possibly enter this case, and the parts cannot become rusty or sticky.

The parts move continuously in oil. No part strikes upon another as in the case of the ordinary escapement, and consequently the movement is absolutely noiseless.

To regulate the rate of the pendulum the following means are employed: A small permanent magnet is mounted beneath the hollow base of the clock so as to be moved against the resistance of a spring by means of an adjustment screw. A perfectly definite force of attraction will be maintained between the end of the regulating magnet and the bottom of the pendulum magnet (C), but the amount of this force of attraction can be varied by the adjustment screw because the force will diminish as the magnet is moved further away from (C) and vice versa.

A very important advantage of this method of regulating is that the clock need not be stopped nor the pendulum disturbed in any way for regulation.

For the purpose of setting up these clocks correctly on a mantel or other surface three leveling screws are provided beneath the base, and a pointer and indicator are on the column and pendulum rod respectively. By these means a person may easily adjust the clock to run on any surface.

This reprint is through the courtesy of Charles O'Neil. From the Electrical Experimenter, Oct.1916, Pg.405.

A BATTERY-POWERED CLOCK

by Bill Burnham

Reprinted from Bulletin of NAWCC--February 1961,Vol.1X, No.8,Whole 90
Courtesy of Richard Vogel

A great deal has been published :overing a variety of clocks and vatches of the mechanical type, the lriving media being weights or ·prings, employing some form of es- :apement to control the speed of the :oing train, the escape wheel in turn :iving an infinitcsimal push to the)endulum or lever as the case may)e. With each helping the other n this manner the mechanism will :eep going until the driving power ; exhausted. We also have the self- vinding mechanism, such as in the vrist watch which depends on a cer- ain amount of physical movement o keep it going without further ıttention by the wearer.

Today we have the synchronous ·lectric clock, which with proper :ycle control of the electrical cur- ·ent gives one of the most accurate imepieces devised by man. In this ype of timekeeping device we have ı controlled input of power to keep t running accurately, instead of an ·scapement control to keep some lriving force from running wild. 'et, when the current fails the clock tops, and how much better off are ve than with a precision made iechanical clock that requires only :riodic attention of the owner ›p it properly wound?

This article will deal entirely with . timekeeping device which employs wo batteries (commonly referred to ; telephone batteries) that oc- asionally give an electrical impulse ı keep the pendulum swinging. The wing of the pendulum drives the ›ing train. As in the well-known iechanical clock, the length of the endulum controls the accuracy of 1e timekeeper.

Figure 1 shows the assembled clock anging on the wall; this clock is 3 inches high. The top is 20 inches ide by 7 3/4 inches deep, and the box is 16 inches wide by 5 1/4 inches deep. Figure 2 shows the movement removed from the case for a closer observation.

Let us now study the operation of this mechanism and compare it with conventional pendulum clocks.

The bob of this clock is rather heavy and is in two pieces, held together with a star-headed bolt, which may be seen in the center of the bob. The mechanism has a true 80-beat pendulum with a small hand t›akes one revolution per minute.

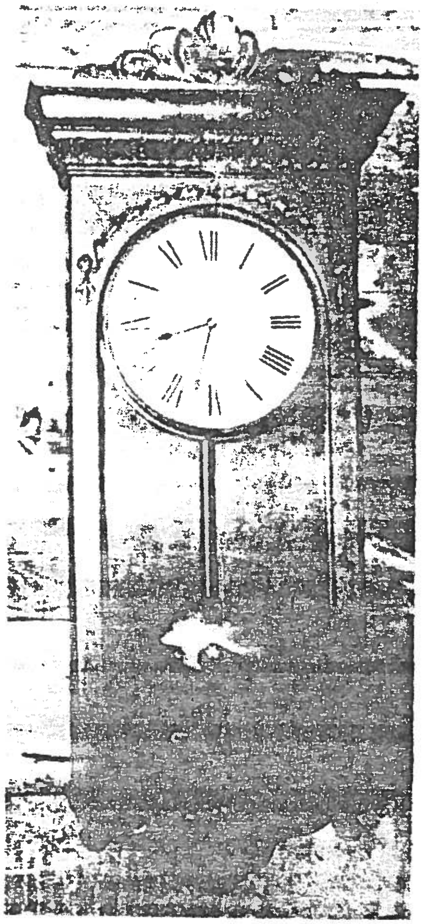


Fig. 1

This small hand cannot be properly called a seconds hand, inasmuch as each complete swing of the pendulum moves the hand 1 1/2 seconds. The reason for this will be seen later as we study the mechanism more closely.

The pendulum is made of wood, with the rating nut at the bottom of the bob, and is attached to the back of the plate of the movement by a thin flat spring, as in any conventional pendulum clock. The crutch-wire is attached to a steel bar that oscillates between two electro-magnets seen at the top right and left hand sides of the movement. Fastened to this bar is a semi-circular piece which carries a pawl. This pawl advances a 40-tooth ratchet wheel one tooth for each complete cycle of the pendulum. The 40-tooth ratchet wheel makes one revolution per minute. As the small hand is attached to the ratchet wheel spindle it also makes one revolution per minute. Because a minute has 60 seconds, and the ratchet wheel has 40 teeth, we have an equation of 60 divided by 40 which gives 1 1/2 seconds for each impulse given to the small hand. The lever with the disc-shaped end seen at the left center of the movement is a locking pawl to keep the ratchet wheel from turning backward as the pendulum reverses its swing.

The ratchet wheel is geared directly to, and drives the gear train, which in turn moves the minute and hour hands to indicate the hours and minutes.

As the ratchet wheel is driven by the swing of the pendulum it cannot be classed as an escapement. Here the pendulum (like the controlled cycles of the synchronous electric clock) becomes the prime driver. Instead of regulating through an escape wheel the speed of the driving train, as in a weight or spring driven clock, the function of the pendulum is completely reversed.

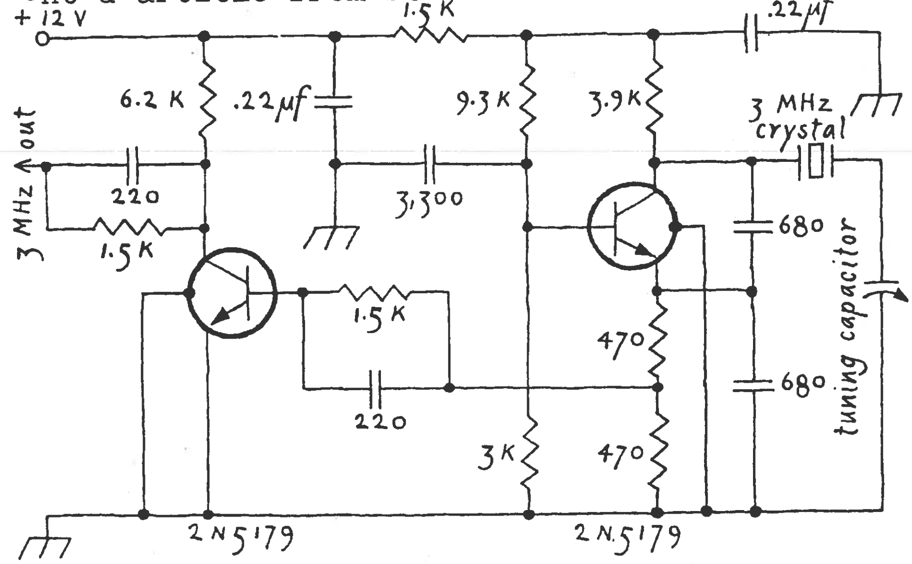
At the lower left-hand corner of the movement is seen a double curved lever pivoted within a square-ended bar which is fastened to the frame. Pivoted to the right-hand end of this lever is what I shall refer to as a "dangle bar", which has a "vee" notch in its lower end. The points of this "vee" notch point downward, with the right-hand point being longer than the left.

Fig. 2

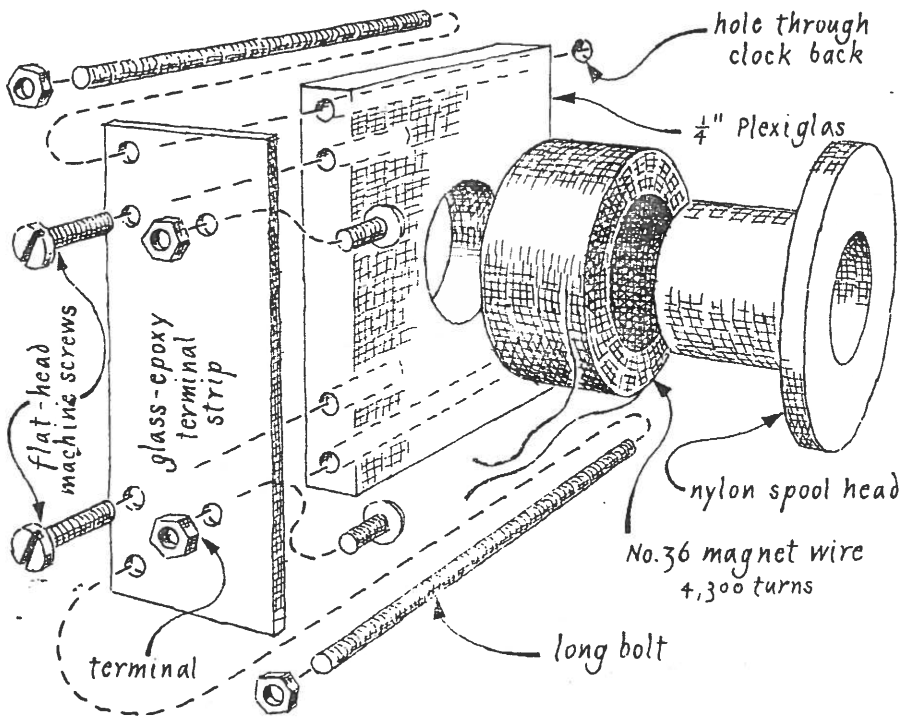
Just below this dangle bar, set into the pendulum rod is a knife-edged pin, with the knife-edge pointing upward. The function of the dangle bar and knife-edge pin will be explained later.

To the left of the double curved lever, but not in contact with it, will be seen a thin flat spring attached to a vertical bar fastened to the frame, but insulated from it. A wire from the left-hand electro-magnet is attached to the top of this vertical bar. At the right side of the movement is a coiled wire extending to the right from the right-hand electro-magnet.

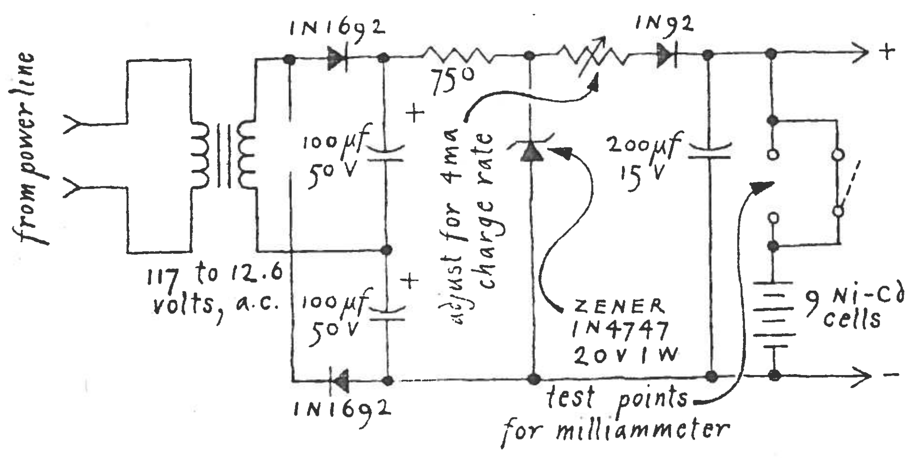
Cont'd article from Scientific American



Circuitry of the quartz-crystal oscillator



Details of the solenoid assembly



Circuitry of the power supply

sumption of the devices at low switching speeds. In my circuits the power required by the devices is in microwatts.

"The COS/MOS circuit enables the clock to operate for more than 100 hours on a storage battery of nine nickel-cadmium cells. The capacity of the battery is 750 milliampere-hours. The cells are kept on a continuous trickle charge of about four milliamperes. This scheme makes the system immune to occasional power-line interruptions. An interruption of even a fraction of a second would disorganize the operation of the digital counting circuit. For this reason I regard the battery as being essential.

"A feature of my circuit is a manual switching scheme that enables me to change the divisor from five million to either 5,000,256 or 4,999,744 and thus retard or advance the clock as desired. The shift in rate, which I refer to as 'precession,' amounts to about 4.4 seconds per day. If after a month or so of unattended operation I observe that the clock does not indicate the beginning of the 60th second of each minute in exact coincidence with the time signal of WWV but is, say, a fraction of a second fast or slow, I flip the switches to alter the rate as necessary. After the error has been corrected I restore the divisor to five million. Precession has no effect on the rate at which the crystal vibrates. It merely alters the frequency of the magnetic pulses.

"Except for attaching the solenoid to the case and adding the small magnet to the pendulum, I made no significant changes in the mechanism of the clock. The driving weight continues to operate the hands through the unaltered train of gears and to supply some of the driving energy to the pendulum through the Graham deadbeat escapement. The maximum arc through which the pendulum can swing is limited to the angle at which the pallets of the escapement mechanism make contact with the roots of the teeth of the escapement wheel. In my clock the maximum swing is limited to about 3½ degrees of semiarc. A minimum semiarc of one degree is required for the pallets to sequentially release the teeth of the escapement wheel. Hence the synchronization scheme must be effective within a total excursion of not more than 2½ degrees of semiarc.

"The natural period of a pendulum is fixed primarily by its effective length and by the restoring force that results from gravitation. The effective length is determined by the distribution of the several masses of the pendulum with respect to the point from which the assembly swings. This length cannot be readily synchronize the pendulum to the oscillator. The restoring force can, however, be increased easily by combining magnetic attraction with gravitation. The addition to gravitation of any force that tends to restore the pendulum to dead center will increase the beat, whether the added force is continuous or impulsive or whether it acts with or against the motion of the pendulum. In my arrangement pulses of magnetic attraction, which act on the pendulum tangentially between the solenoid and the magnet, are applied for .028 second once during each period.

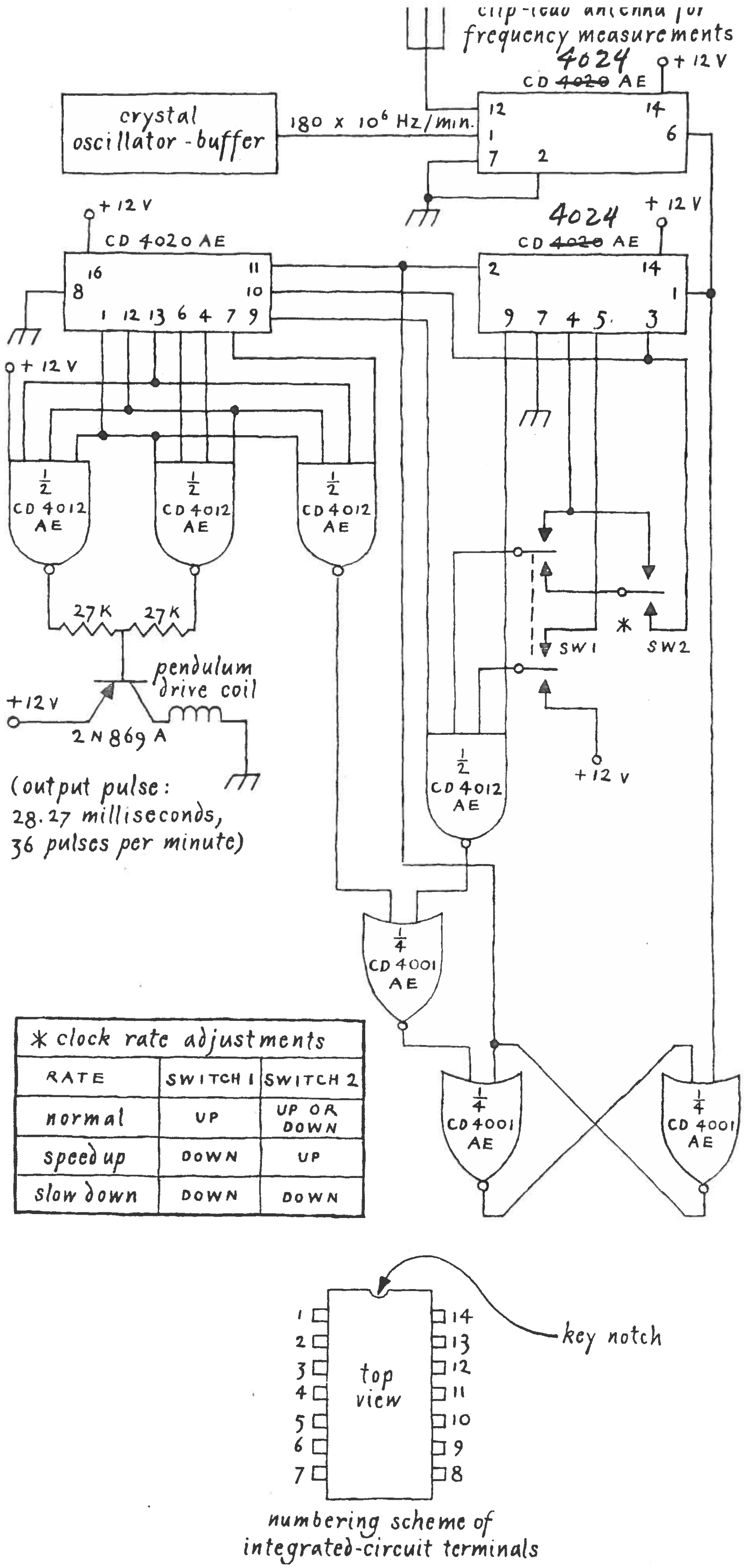
"The pulses begin as the pendulum approaches one limit of its excursion and continue through the initial portion of its departure in the opposite direction. During the interval of the pulse the position of the magnet is always beyond the magnetic center of the solenoid. For this reason the force of the entire pulse tends to speed up the clock. The intrinsic rate of the pendulum is preset slow by approximately half of the hold-in-range.

"Pendulums that traverse a circular arc, as is usually the case, have a period that increases slightly with increases in the length of the arc. This effect is known to horologists as circular error. In my clock the length of the arc changes somewhat less than 2½ degrees, depending on variations of interaction of the solenoid and the magnet. The variations compensate for random forces that would otherwise cause the clock to fall out of step with the oscillator. It turns out that the circular error of a few seconds per day induced by this variation in arc augments the system's hold-in-range.

"I make no claim that the system is the best one that could be devised. It works. The clock has not lost synchrony during the two years it has been following the crystal.

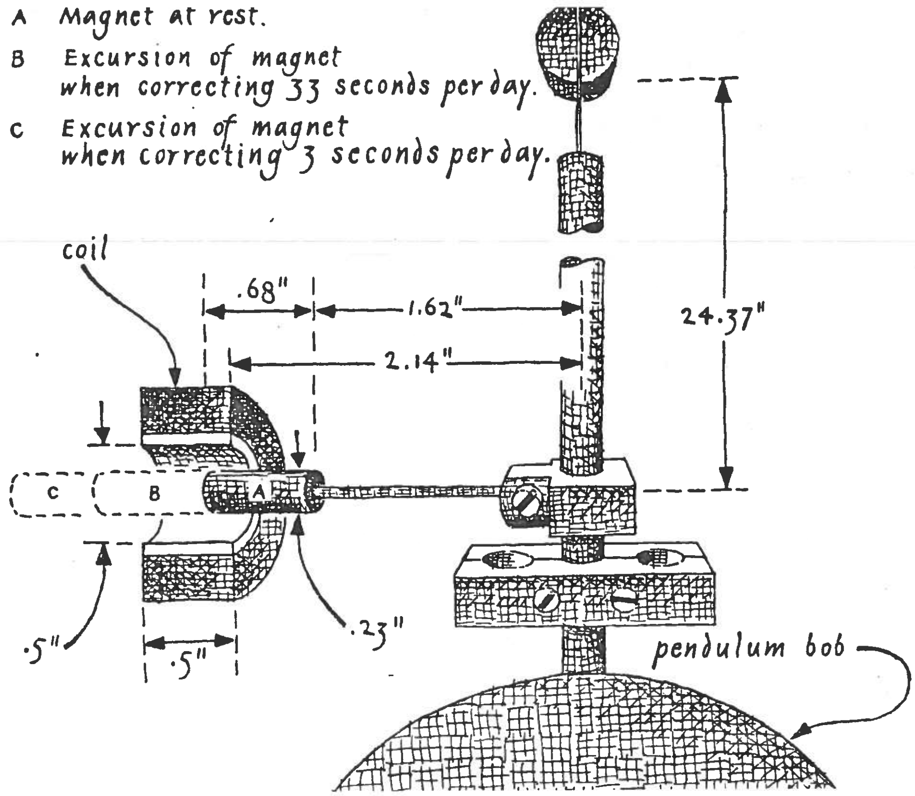
"A theory of operation that seems to explain the system's ability to converge to stable synchronization, with a very tight phase lock, has been formulated. An important aspect of the interaction is the relative phase of the pulse and the pendulum in the vicinity of one limit of the pendulum's excursion. This is the region where the pendulum slows to a stop and reverses its direction.

"Consider the duration of the pulse to consist of three contiguous parts [*see bottom illustration on next page*]. Assume that the clock is operating synchronously with the oscillator at about the center of the hold-in-range. The pulse begins as the pendulum approaches the limit of its excursion on the left side. The first part of the pulse is the

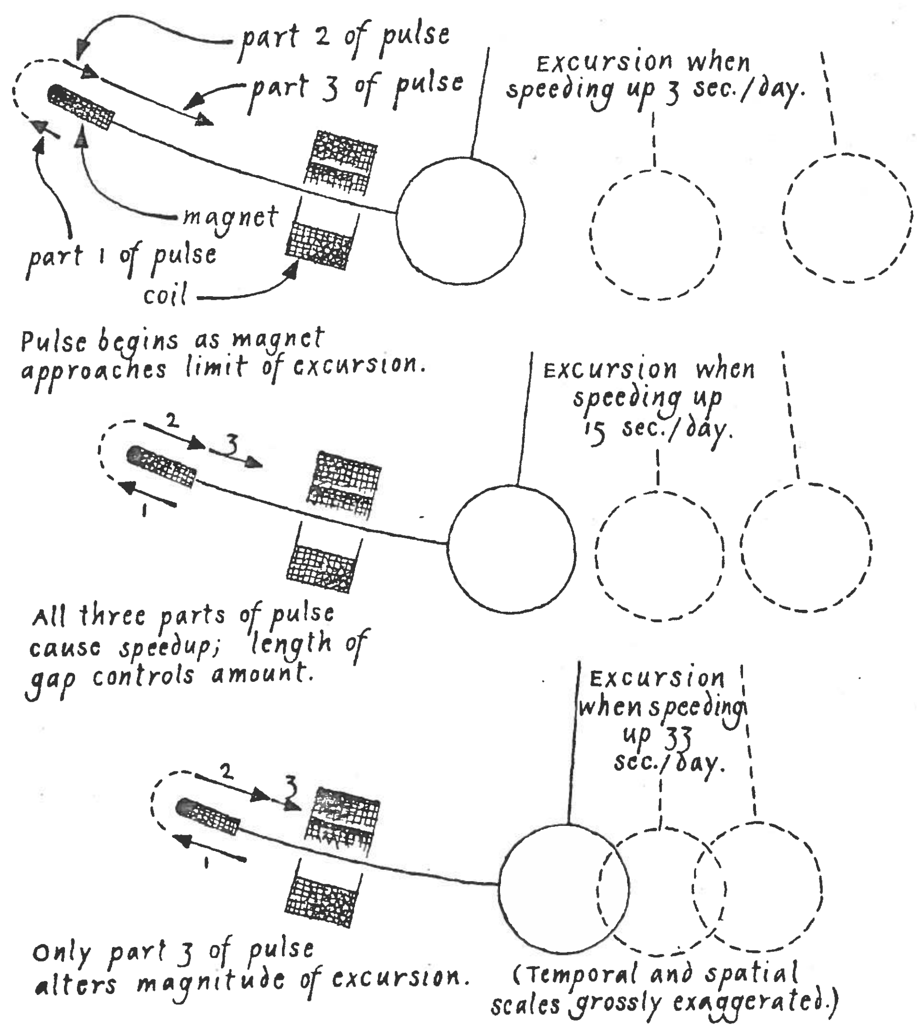


* clock rate adjustments		
RATE	SWITCH 1	SWITCH 2
normal	UP	UP OR DOWN
speed up	DOWN	UP
slow down	DOWN	DOWN

Arrangement of the digital counting circuit



Details of the pendulum assembly



Representation of the synchronizing forces

the instant when the pendulum comes to rest.

"The first part of the pulse would typically span about nine milliseconds. The second part begins at the instant the pendulum begins to move on its return beat and always persists for exactly the same interval as the first part. The third part is the remainder of the pulse, about 10 milliseconds. In the illustration the heads of the arrows indicate the direction of the pendulum's motion; the shafts of the arrows depict increments of the pulse. The total force of all three parts causes the pendulum to speed up, but only the third part tends to increase the length of the arc because, with respect to the arc, the forces of the first and second parts cancel.

"Assume now that the absolute phase between the pulse and the pendulum is such that the first and second parts constitute most of the pulse. The third part is therefore small and the arc will be only slightly longer than it would be if the clock were powered by its driving weight alone. Because of the reduced arc the magnet is comparatively closer to the magnetic center of the solenoid when the pulse occurs and the relative speedup force of the total pulse will be large. That is the phase in which substantially maximum speedup is being imparted to the system. Conversely, when the phase is such that the third part is relatively large, the arc is also large, as is the distance between the magnet and the solenoid. Hence the pulse exerts a lesser tendency to speed up the pendulum, which, as I have mentioned, is deliberately adjusted to run slow.

"As an example of how the system converges to stable synchronization assume that the rate is near normal at the center of the hold-in-range and that some random force of external origin tends to speed up the clock. The pendulum would respond by arriving earlier at the limits of its excursion. Hence the magnet would be closer to the limit at the beginning of the pulse.

"The first and second parts of the pulse would be shorter than normal and the third part would be extended. This part would tend to increase the arc and therefore the distance between the magnet and the solenoid, thereby reducing the tendency of the electronic system to speed up the clock. That is precisely the action required to offset the increase in the intrinsic rate.

"Conversely, if forces of external origin tend to retard the clock, the pendulum and the magnet approach the limits of their excursion somewhat behind schedule. The first and second parts then persist through a longer interval, with a corresponding decrease in the duration of the third part. The arc decays. This result reduces the distance between the solenoid and the magnet and initiates the additional force required to speed up the pendulum. Thus the phase relation between the pulse and the pendulum causes the system to converge automatically to stable synchronization.

"The relative phase of the pendulum with respect to the pulse does not change by more than half the duration of the pulse, or 14 milliseconds. If the frequency of the oscillator is assumed to be constant and the system alters the intrinsic rate of the pendulum by 30 seconds per day, the indication of the clock does not actually depart from the exact time, as generated by the oscillator, by more than 10 or 12 milliseconds.

"In terms of feedback the scheme of synchronization is an open loop. Hence the pendulum does not automatically fall in step with the oscillator. To coax the two into the phase relation at which the pendulum pulls into synchrony I clip a pair of headphones, in series with a 100,000-ohm resistor, across the terminals of the solenoid. The pulses are heard as distinct clicks. I then pull the pendulum to one side and try to release it so that the click is heard just as the pendulum arrives at the left extreme of its excursion. The knack of initiating the swing correctly comes with practice. The magnet must pass to the left through the magnetic center of the solenoid before the click is heard. If this condition is satisfied, the system will pull into synchrony within an hour or so.

"During this interval it may be necessary to control the magnitude of the arc manually. I do so by judiciously stroking the bottom tip of the pendulum in the desired direction with a small camel's-hair brush. The need for this control stems directly from the theory. The beat spans 833⅓ milliseconds, whereas the pulse lasts for only 28 milliseconds. The probability of starting the pendulum by hand so that the relatively narrow pulse straddles the point in time at which the pendulum reverses its direction is exceedingly remote.

"Assume that all the pulse occurs prior to the arrival of the pendulum. The full pulse acts to reduce the arc, but an inordinate speedup of the pendulum is required before the pulse can straddle the point at which the pendulum reverses its direction. By automatically reducing the arc, however, the system indicates to the experimenter that the needed correction is pendulum speedup, which occurs when the arc is at a minimum and the distance between the magnet and the solenoid is small. Hence the experimenter should stroke the pendulum with the brush only enough to prevent the arc from falling below, say, 1½ degrees. Eventually the pendulum will be speeded up enough to lock into synchrony at the desired phase.

"Conversely, if the pulse occurs after the pendulum has departed from the extreme of its excursion, the arc will tend to become excessive. Use the brush to prevent the arc from exceeding a safe value. I have installed a stop in my clock that limits the arc to about 3½ degrees, so that no damage is done to the escapement. This synchronizing procedure presupposes that the amplitude of the pulse is reasonably adequate, but that may be unknown at the outset.

"The required amplitude of the pulse depends on several factors, such as the geometry of the system and the strength of the magnet. The amplitude must be determined experimentally and adjusted to a value that is compatible with the characteristics of the pendulum and its escapement. I proceeded as follows.

"During synchronized operation the maximum arc coincides with the minimum pendulum speedup (a correction of about three seconds per day). Hence, as the first step in determining the optimum pulse amplitude, I adjusted the intrinsic rate of the clock to be slow by three seconds per day. I then synchronized the pendulum. Next I increased the am-

RCA CD4024AE 7-STAGE COUNTER

PIN NUMBER	FUNCTION
1	CLOCK INPUT
2	RESET
3	Q7
4	Q6
5	Q5
6	Q4
7	GROUND
8	BLANK
9	Q3
10	BLANK
11	Q2
12	Q1
13	BLANK
14	VDD (+12 v)

RCA CD4020AE 14-STAGE COUNTER

PIN NUMBER	FUNCTION
1	Q12
2	Q13
3	Q14
4	Q6
5	Q5
6	Q7
7	Q4
8	GROUND
9	Q1
10	CLOCK INPUT
11	RESET
12	Q9
13	Q8
14	Q10
15	Q11
16	VDD (+12 v)

RCA CD4001AE QUAD 2-INPUT NOR

PIN NUMBER	FUNCTION
1	INPUT, GATE 1
2	INPUT, GATE 1
3	OUTPUT, GATE 1
4	OUTPUT, GATE 2
5	INPUT, GATE 2
6	INPUT, GATE 2
7	GROUND
8	INPUT, GATE 3
9	INPUT, GATE 3
10	OUTPUT, GATE 3
11	OUTPUT, GATE 4
12	INPUT, GATE 4
13	INPUT, GATE 4
14	VDD (+12 v)

RCA CD4012 DUAL 4-INPUT NAND

PIN NUMBER	FUNCTION
1	OUTPUT, GATE 1
2	INPUT, GATE 1
3	INPUT, GATE 1
4	INPUT, GATE 1
5	INPUT, GATE 1
6	BLANK
7	GROUND
8	BLANK
9	INPUT, GATE 2
10	INPUT, GATE 2
11	INPUT, GATE 2
12	INPUT, GATE 2
13	OUTPUT, GATE 2
14	VDD (+12 v)

DIVISOR EXPRESSED IN BINARY NOTATION

DIVISOR	Q12 ↓ … Q1 ↓	Q7 ↓ … Q1 ↓	Q4 ↓ … Q1 ↓	SWITCH POSITION
5,000,000 =	1 0 0 1 1 0 0 0 1 0 0 1	0 1 1 0 1 0 0	0 0 0 0	NORMAL
5,000,256 =	1 0 0 1 1 0 0 0 1 0 0 1	1 0 0 0 1 0 0	0 0 0 0	SLOW DOWN
4,999,744 =	1 0 0 1 1 0 0 0 1 0 0 1	0 1 0 0 1 0 0	0 0 0 0	SPEED UP
	(CD4020AE)	(CD4024AE)	(CD4024AE)	

(ON COUNTING TO THE DIVISOR, THE CIRCUIT GENERATES AN OUTPUT PULSE AND RESETS TO 0.)

Layout of pins and circuit-division scheme period of several hours until the pendulum reached a steady-state arc of maximum allowable excursion.

"With the arc so established, I determined the hold-in-range by adjusting the pendulum to swing at progressively lower intrinsic rates, resynchronizing and noting the resulting arc after it had settled into the steady state. In my clock pulses of the desired amplitude result in a semiarc of three degrees when the system is correcting at the rate of three seconds per day. The semiarc reduces to 2⅜ degrees when the system is correcting 15 seconds per day and 1¾ degrees when the correction is 33 seconds per day. The lower limit of 1¾ degrees was dictated by the fact that the driving weight acting alone causes an arc of about 1⅜ degrees.

"The clock selected for this project should demonstrate, when it is under mechanical operation, a stability or rate adequate for synchronized service. It should have a deadbeat escapement, and the second hand should make one revolution per minute. (Many European wall clocks have second hands that make one revolution in 45 seconds.)

"People who do this project but who have not worked with cos/MOS devices should keep in mind the very low power requirements of the apparatus. Since the devices operate on microwatts or less, they can be destroyed by an electrostatic discharge from the experimenter's finger. Keep them packed in their conductive plastic cases or conductive foam until they are used. Ground your body when you handle them. Avoid touching the terminals. Build the circuits with sockets that fit the devices. Switch the power off before putting the devices in the sockets or removing them.

"The terminal pins are numbered sequentially in the counterclockwise direction as viewed from the top, beginning at the notch or the equivalent mark at one end of the dual-in-line package. The accompanying table [*preceding page*] lists the terminal layout, according to function, of the CD4020AE and CD4024AE devices. All cos/MOS devices and compatible sockets are available from distributors such as KA Electronic Sales (1220 Majesty Drive, Dallas, Tex. 75247).

"One can also modify a pendulum clock that runs at a rate of 60 or 80 beats per minute. Make or obtain a quartz-crystal oscillator of appropriate frequency and synchronize the clock to it. On receipt of a stamped, self-addressed envelope I shall send circuit diagrams for generating the required pulses of current."

A Battery-Powered Clock, cont'd.

The two batteries referred to earlier are set into the top of the case, and are wired in series, giving an electrical current of three volts. One wire from the batteries is attached to the coiled wire at the right-hand side of the movement, and the other wire is attached to the horizontal bar carrying the double curved lever.

To start the clock the pendulum is swung to the right far enough to clear the dangle bar. As the pendulum is released and allowed to swing freely it will kick the dangle bar from right to left, and left to right, alternately until such time as the pendulum swings to the right just far enough so that the knife-edged pin in the pendulum rod engages the "vee" notch in the dangle bar. Now, as the pendulum swings to the left, the knife-edged pin lifts the double curved lever causing the left end of this lever to make contact, in its downward swing, with the thin flat spring. This closes the electrical circuit, thereby giving a push to the pendulum, through the crutch wire, which carries the pendulum far enough to the right to again clear the dangle bar, and another cycle is started. It takes approximately 52 seconds for the pendulum arc to become short enough to engage the dangle bar again and start each new cycle.

It is obvious that such an arrangement as this will keep on operating until the batteries become so weak that they will no longer provide the necessary power to push the pendulum far enough to the right to engage the dangle bar. When this happens the pendulum will gradually slow down and come to a halt.

I do not know at this writing how long the batteries will last. The clock has been running 10 months on the batteries presently in the clock, with no apparent loss of energy. Because the batteries will eventually lose their power, and all moving parts will wear, we cannot claim perpetual motion for this mechanism. However, it is not subject to failure because the lights go out. It does not need the daily, weekly, or monthly attention to keep it wound. And it can be regulated to rival the accuracy of the synchronous electrical clock.

This clock was made by the New York Standard Watch Company. It was patented February 25, 1896. Patent No. 555,313 was issued to Sigismund Fischer, a subject of the Czar of Russia, residing in Brooklyn, New York.

Although this clock is time only, the patent papers outline a striking mechanism, also electrically operated. It may be arranged to strike the hours only, or the hours and half-hours. When an hour is being struck each swing of the striking hammer is actuated by an electrical impulse, the frequency of the strike being controlled by the swing of the pendulum. When the half-hour strike is added, a cam rotating at the same speed as the minute hand raises and releases the hammer mechanically once for every hour on the half hour.

Provision is also outlined for adding an electrically operated alarm when desired. • • •

WANTED:

Literature concerning maintenance and repair for International Time Recording Co. Master Regulator Model No. 263. Irvin A. Pogue
212 N. Wm. Drive, Chillicothe, Illinois 61523

****

FOR SALE:

Synchronome Master Clock, Mahogany case, mint, works; ca. 1925.

WANTED:

Electrical horological literature--any type.
Hamilton-Sangamo clocks--write details.

Martin C. Feldman, 1545 Rhinelander Ave. Bx. 10461

****

FOR SALE:

Synchronome clock, good condition, excellent throughout, fine timekeeper.

Alan Marx, 105 Bayeau Rd. New Rochelle, N.Y. 10804

****

FOR SALE:

Barr clock complete but not running---------$85.00 or trade.

Jerry Fast, 14 W.Oak St. Algonquin, Ill. 60102

****

MART CHARGES: $2.00 PER 4 TYPEWRITTEN LINES.

****

TECHNICAL QUESTIONS AND ANSWERS

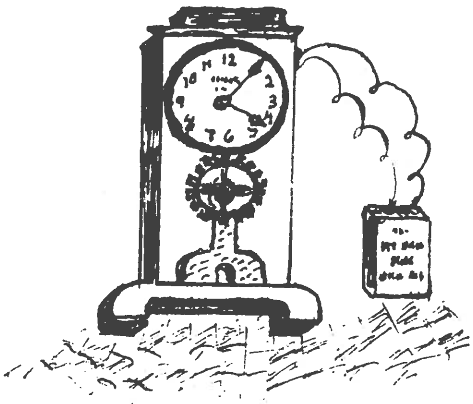
From Mr. John Winch, Jr.:

"I came across a new clock that was used in the Electrical Dept. of the City of Portland back in 1917. This was the last date it was used. The name of the maker is: THE HOLTZER MAGNETO CLOCK CO., Boston and Chicago. It must have been some kind of a watchman's clock as it has a hole in the magneto box for a crank to wind same. Perhaps someone has seen one like it? Any information would be helpful. Thank you."

PLEASE SEND REPLYS TO ME AND I WILL FORWARD THEM TO JOHN AS WELL AS PRINT THE INFORMATION IN THE JUNE JOURNAL-----Marty Feldman

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78



VOLUME 1---ISSUE #4
June 12, 1975

Hello fellow enthusiasts:

In this, our 4th issue of the Journal, I am once again delighted to report that our membership is increasing steadily. With the increased membership we are privileged to have among us more people who can contribute to this, our Journal.

Of interest you will find within a schematic and a small manual of Self-Winding clock movements which has been sent in by member Bill Crispin. From Great Britain once again we have received from Mr. Charles Aked, an excellent researcher of electrical horology, a translation from an Italian manuscript dated 1822 which Mr. Aked has edited. This is of great interest historically as the established date of the first electrical clock is the one made by Alexander Bain in 1840. This translation lends credence to an even earlier date for the beginning of Electrical Horology.

The Tiffany Never-Wind patents have not been included in this Journal as a full set, which I thought was available, is not. Hopefully, these patents will be included in a fall Journal.

I should like to include within this editorial a report of our second meeting at the home of our Secretary-Treasurer Mr. Charles Roth on April 27, 1975. Fourteen members attended from the N.Y.-N.J. area which is two more than twice those at our first meeting. Several interesting clocks were brought by the members with the most outstanding one being a Hipp Chronoscope. This museum piece was closely examined and one wonders how it ever turned up in this country!

A business meeting was held and after being called to order by your President the following issues were discussed:

1) Our Chapter has been asked to restore an early electrical timepiece which has been donated to our Museum in Columbia, Pa. by the widow of Mr. George Sobel in his memory. This clock was actively sought after by the Smithsonian Institute and we are fortunate to have it in our Museum. The clock,

if we accept this work, would probably be restored by the members in the N.Y.-N.J. area. Unfortunately, we did not have any photos nor any information as to what state of disrepair this particular clock was in. So, we decided to seek more information in the way of photos, patents and first hand knowledge--this last task being delegated to me.

2) Our nomination for a Recording Secretary and liaison between our Chapter and National was refused, therefore we still are in search of such a person. The work now is still being done by your President.

3) We decided, barring any terrible disagreement to our choices, to maintain the present slate of officers for at least one more year. They are as follows:

1) Martin C. Feldman, President--Editor of the JEHS
2) Alan Marx, First Vice President--legal affairs consultant
3) Bruce Levy, Second Vice President
4) Charles Roth, Secretary-Treasurer
5) __________, Recording Secretary-liaison (unfilled)

While this action may seem to some undemocratic, it was taken in the hopes that it will be approved by the rest of the membership since we did have approximately 15% of the members present with whom these affairs could be discussed. Any comments and ideas regarding the above will be given most careful study. A slide show was conducted by myself utilizing slides not used at the N.Y.Chapter meeting when I lectured on April 6, 1975. Also, slides sent by Mr. Charles Aked of various English clocks were shown and actively discussed. Following the lecture the members were treated to an excellent buffet which Mr. and Mrs. Roth had prepared for us. A vote of thanks was given to our hosts for the use of their home and excellent repast.

Unfortunately, I will not be able to attend the National Convention this year. I hope that some of the members will have gotten together to discuss with one another their mutual horological interests.

Enjoy this issue.

Electromagnetically yours,

Marty Feldman

Members at meeting #2

(L to R Top)

P. DeAngelo, E. Bennett, V.DeLuca, R. McGinness, A. Marx

(middle)

C. Roth, M.Feldman, G. Zlobin, B.Marcus

(front)

J. Bourquin, G. Cohen, E. Bauer, G.Feinstei

The Application of the Perpetual Electric Motor to Clocks

It is natural to think of adapting some of the movements described previously for the motive power of a clock, which certainly would be the most elegant use of our pile. It is really the motion of the pendulum by means of the pile, which is transmitted to a wheel, and thence to the mechanism of a clock, which is accomplished in Verona by various mechanics in various ways. Signor Streizig, Veronese clockmaker, was the first in 1814, a year before Signor Ramis of Monaco, which I have demonstrated conclusively in my letter to the Reale Academy of Science of Monaco, facsimile 32.

The device was an articulated lever fixed to the pivot of a vertical pendulum, which in oscillating moved the lever to meet the tooth of a wheel, and pushed it in a given direction, but was not able to give it a second impulse on the return of the pendulum in the opposite direction. So the wheel advances by one tooth at each oscillation.

Three years after, another mechanic, Signor Antonio Pozzi applied to the pivot of the pendulum the device, common to clocks, which carries inclined pallets which in oscillating with the pendulum causes a horizontal wheel to advance for each oscillation.

Finally in 1821 Signor Antonio Camerlengo devised another method which took advantage of the foregoing in the considerable freedom of the movement, such that it hardly needs a third of the motive force previously necessary. The motion of the clock consisted only of two wheels operating with a horizontal lever, the arm of which juts out of the dial, which is shown in Fig. 91 as "abcd." The arm bd is slightly more heavy than the other arm bd; but the entire lever however is movable, which pressing at the extremity a with a small force, depresses the arm ab, raising the other bd; and hardly has the force pressing at a ceased, when suddenly the arm bd falls back. Now the falling of the arm bd by means of a device which is fixed at c, advance the first wheel of the clock.

Imagine now the clock placed at the side of the vertical pendulum, so that, by the oscillations produced by two piles, the end f, Fig. 92, moves in the arc fa; and hence the point f, to strike the point a of the lever ab while the ring above mn touches the silver pole of the pile. It is clear, that the very thin wire gh yielding as the ring mn contacts the silver pole allows the point f striking on a to depress the arm ab, thus raising the end bd and progressing the first wheel.

133. This transmission of motion to the pendulum of the clock is the best attribute of the machine. In the previous clocks the pendulum met the resistance of the clock halfway through its path, which it had to overcome; the pendulum being (one can say) so light, that it could not move the clock; because then only the ring mn touches the silver pole when the pendulum has completed its arc of oscillation, does the point f, pressing on a, depress the lever. Whereupon the movement of the pendulum is so independent of that of the clock, that the first can continue without the other; and whatever may happen to the clock, causing it to stop, and in spite of the impulse by the point f on the point a; the pendulum does not cease to oscillate continuously. Whilst in the preceding clock, the oscillation of the pendulum and the motion of the clock was so dependent on each other, that the smallest irregularity of the clock, of necessity, also stops the pendulum.

Further, the clock of Signor Camerlengo is able to move the pendulum over a small arc; it is worth stating also, that as the force of the pile weakens, it must be placed nearer to the pendulum to make it oscillate; whilst in the other clocks the pendulum has to describe rather larger arcs; and it then demands more power in the pile. It is not to be wondered at, therefore, that the clock of Signor Camerlengo, which can be seen in the Physics Room of the Royal Classical School of Verona, continues its motion even in the heart of winter, by two piles; and the two clocks mentioned before have for some years been incapable of movement.

134. However, in spite of the advantages of the device of Signor Camerlengo, it has not been possible to measure time exactly with his and similar clocks; and is this not strictly, when all is said, the real purpose of a clock?

No certainly, if the motive power, that is the electrical potential of the pile is subject to variation due to the varying temperatures during the year, so will the motion of the pendulum vary. I say that the temperature, and not the humidity, being already proved (Chap. 11 para.1) that the variation of the humidity of the air, would not be able to cause much variation in the pile that is commonly used, contained in a glass tube and well maintained. Thus it is the different temperatures of the air which makes the potential of the pile inconstant; and the movement communicated to the mechanism, which rather than indicate the time of day, serves more as an electrical measurement of the pile and as a thermometer for air temperature.

Not forgetting, if the mechanic can find a device to maintain uniform motion with the variable driving force in spring clocks, are we to believe that it is completely impossible to obtain the same effect with other variable forces? Not if perhaps one could adapt the motion of a pendulum to wind a spring or raise the weight of a common clock. Then with such a clock receiving its motion from such a spring or weight, and not electrically, it would indicate the time as well as any other; and the electrically moved pendulum would not have any function than to rewind the mechanism. And although the operation would take place with varying time, according to the variation of the electrical force of the pile, if however the charging always takes place, before the spring or the weight has consumed it stored power, the uniform motion of the clock would never be disturbed. Signor Camerlengo has already proposed to attempt this task and I must hope for much from his courage.

135. But however, without recourse to new mechanisms, it does not seem impossible to me to reduce the same power of the electricity in the piles to a constancy sufficient for the purpose. The Rule V of Article 1 Chapter LV, already seen, that the collection of many piles in a group with corresponding poles, results in that potential and capability in winter which would have been from each pile that made up the group, the potential then of such a group in respect of level or quantity would remain the same in each season and the readiness only would increase with heat; for a pendulum set into oscillation by means of the two groups of piles, the loss of potential from each group for each stroke of the pendulum would be quickly compensated for winter and summer.

Now imagine a pile of components made up according to the rule already prescribed, has in winter three levels of potential and six in summer. Certainly it is that connecting together more piles in this manner, we will have the six levels of all the group. And if having also in winter the six levels, suddenly putting other piles to the first group, the voltage would not be able to go above the six levels, but will only increase in readiness. With the adding however of new piles to the group we will have so much capacity that the loss of potential made at each stroke of the pendulum will be restored within ten seconds. What will be the difference in the winter and summer potential of the group? Certainly not as much as six levels; but regarding rather the capacity which makes good the loss of potential for one stroke of the pendulum in eight or nine seconds, and in summer in half a second or even less.

Because the oscillating pendulum takes five seconds for each oscillation, the silver pole of each group is not touched except once every ten seconds. Therefore in winter there will be enough time between one contact and the next for the silver pole to recover the loss of potential that occurs at each contact. And in winter, as in summer, the pendulum will always touch the silver pole, which if it is charged with six full levels of potential, will maintain a constant motion.

If the experience which I have to offer from this my devising, is that electricity, the fluid so tempestuous and terrible we see in its perpetual captivity, could serve us in measuring time, it would be the highest value of our pile and the most valuable recompense of so long a study and so much toil.

Translated by R. Stachell, edited by Charles K. Aked.

19th January 1974.

Chapter IV, pages 345-351 of L'Elettromotore perpetuo. Trattato. Parte Seconda. Guiseppe Zamboni. Verona, 1822.

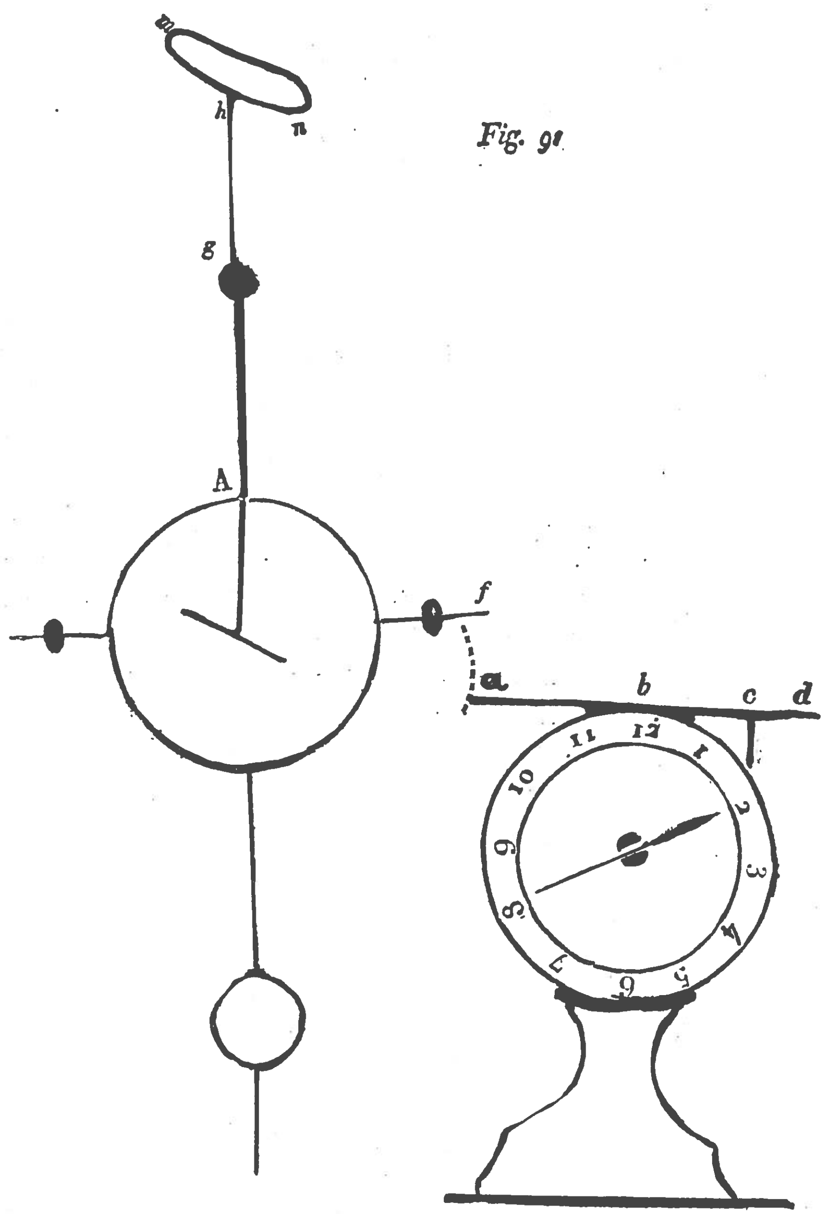
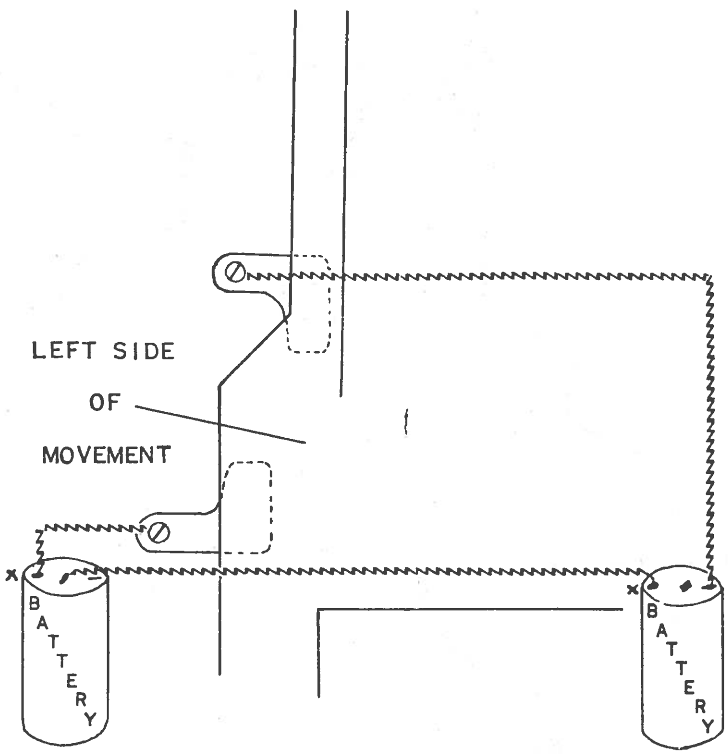


Fig. 91

WIRING DIAGRAM FOR AUTOMATIC
WINDING FROM BATTERIES

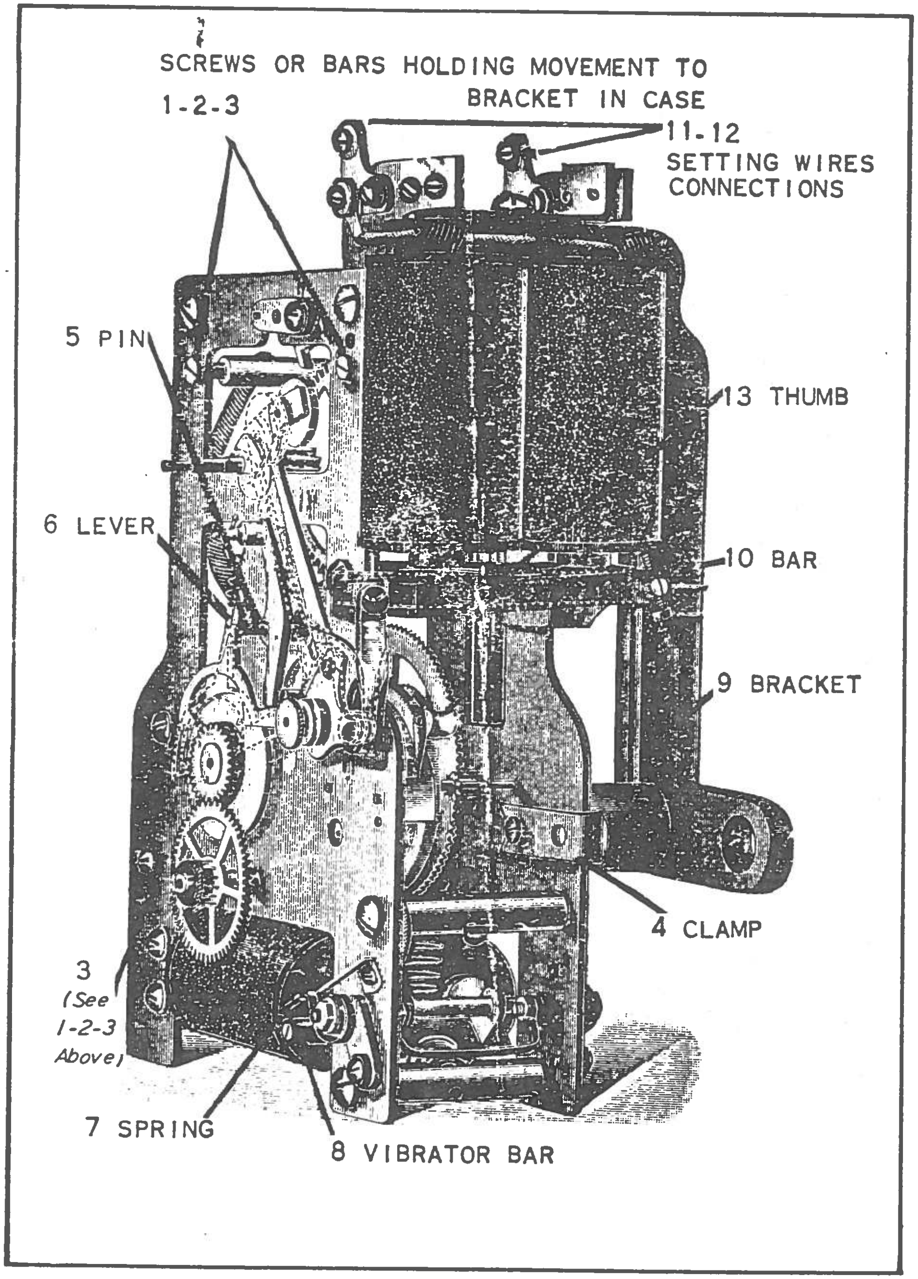


CONNECTING WIRES FOR SETTING OF CLOCK
FROM SWITCH OR PUSH BUTTON

Connect one wire to No. 11, other wire to No. 12. Either plus or minus polarity would be the same.

Connecting wires for automatic winding from two (2) No. 6 Ever Ready dry cell batteries.

DIRECTIONS
FOR REMOVING AND INSTALLING
SELF WINDING
CLOCK MOVEMENTS



DIRECTIONS FOR REMOVING AND INSTALLING SELF WINDING CLOCK MOVEMENTS

1. Do not take clock case off the wall.

2. Remove nut on center post, take off minute and hour hands.

3. Pull second hand off, being careful **not** to bend the post. **Do not remove screw in center of second hand post.**

4. Remove dial, remove battery wires from movement.

5. To remove movement, pull out clamp (4) on back, right side of movement (this may not be on movement); loosen screws or bars (1, 2 and 3), holding movement to prevent it from falling; then movement will come off bracket.

6. Do not remove bracket from case and do not remove pendulum.

7. Take replacement movement out of box same as No.5 above.

Installing Movement in Case

8. Place movement on bracket tightening screws or bars (1, 2 and 3). See that the verge wire, on back part of movement, fits into slot of pendulum rod. Do not start pendulum.

9. Take minute hand (long hand) place on center post, move slowly forward until pin (5) unlocks lever (6). Take off minute hand, being careful not to disturb position of wheels.

10. Place thumb under bar and push up sharply; this will move second hand post and minute hand post to correct positions.

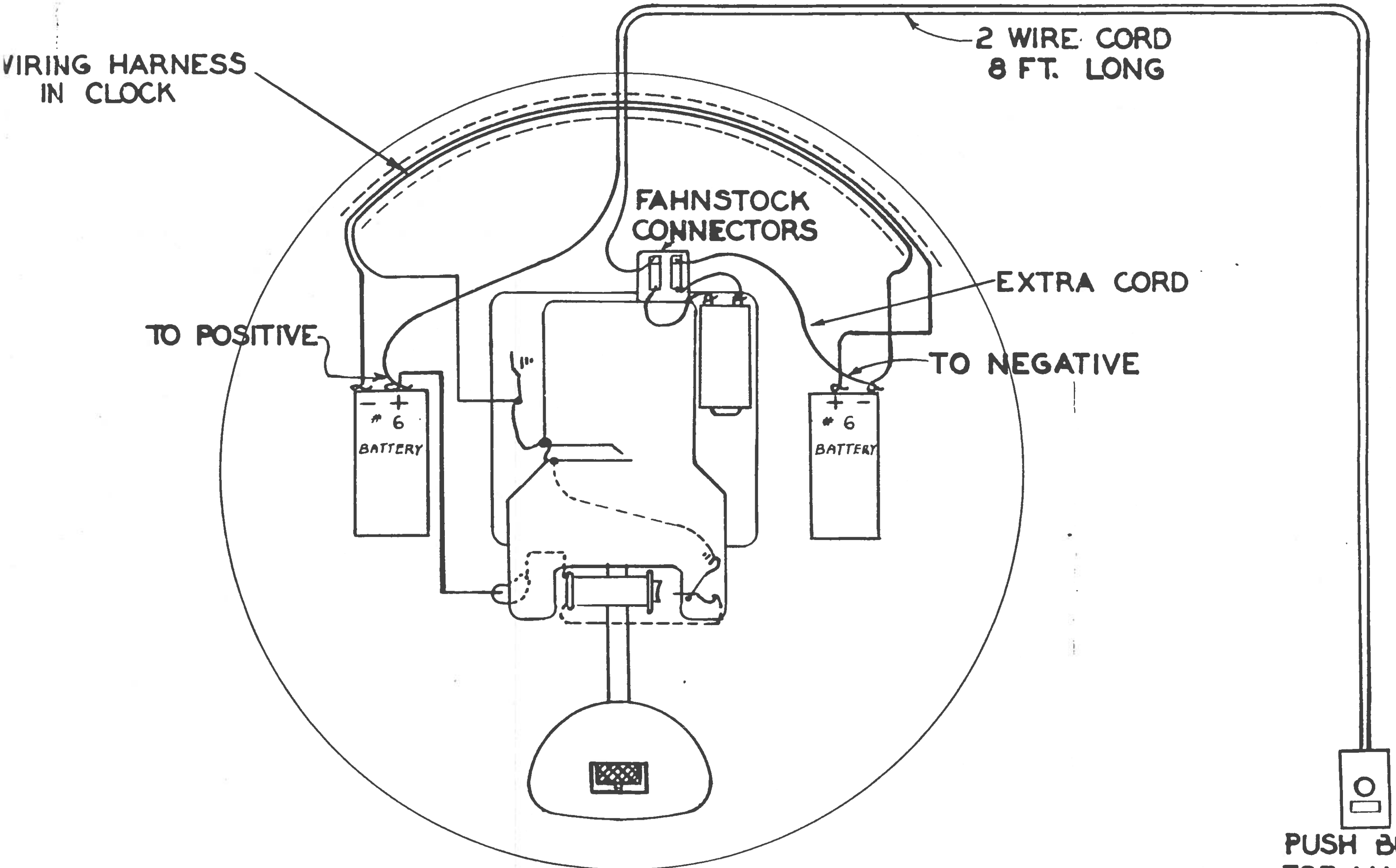
11. Connect battery wires, and setting wires exactly as removed from movement. Put on dial, then the second hand, hour hand and minute hand, all pointing to twelve. Be careful not to disturb position of wheels. Screw nut on minute hand post. Note that hands will pass.

12. Set clock to correct time, second, minute and hour; **then start pendulum**. Listen carefully to hear if clock has an even beat; if not tilt case to one side slightly until the proper sound is heard.

13. Place movement taken from case in box; fasten to bracket securely. Put the hands and instructions in an envelope in the box, and send to:

F. U. HUGUNIN INC.
1637 Railway Exchange Building
St.Louis 1, Missouri

(over)



PUSH BUTTON
FOR MANUAL
SYNCHRONIZING
USE ON HOUR ONLY

STANDARD CLOCK SHOWING MANNER

OF CONNECTING MANUAL SYNCHRONIZING UNIT

SELF WINDING CLOCK COMPANY, INC. 205-211 WILLOUGHBY AVENUE BROOKLYN, N. Y.		
DATE 10-4-46	DRAWN BY L.F.	CHECKED [signature]
SCALE	TRACED BY	APPROVED [signature]
DR. No. F-1633		

MART

FOR SALE:
Brillé Master Regulator Sweep Second hand, new battery------------$375.00
Regulator Constant Amplitude Riefler pendulum Patek Philippe Secondary---$1250.00
Ben Franklin Electric 12 inch dial Old Oak case----------------------$150.00
B.A.Wacek,165 E. 64 St. N.Y. 10021 (212) 737-0777

FOR SALE:
Synchronome Master Clock, Mahogany case, mint, works: ca.1925.

WANTED:
Electrical horological literature---any type.
Hamilton-Sangamo clocks---write details.

REPAIRS: Made: All early electrical clocks--write details.
Martin C. Feldman,1545 Rhinelander Ave.Bx.N.Y.10461

FOR SALE:
IBM Master control panel.
IBM Master clock
Both running and standing approximately 5 feet.

WANTED:
Early electrical clocks.
Alan Marx,105 Bayeau Rd.New Rochelle,N.Y. 10804

WANTED:
Needed--any parts for a Warren Battery operated timepiece; any condition--
I have the pendulum.
M.L.King, Box 135 B, Godley,Texas 76044

FOR SALE:
ATO--in brass and glass case with brown veined marble top and bottom.
Totally restored---------$250.00 plus shipping
Jean Fischer, 3920 Greenpoint Ave. Sunnyside,L.I.C.11104

MART RULES

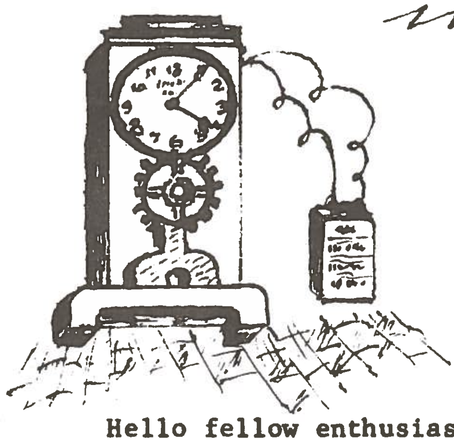
Mart information must be sent to: Martin C. Feldman, 1545 Rhinelander Avenue, Bronx, N.Y. 10461 one month prior to publication date (Sept., Nov., Jan., March, May, July -- by the first of these months).

Rates: $2.00 per 4 written lines.

NEXT DEADLINE-----------JULY 1, 1975

The
JOURNAL
OF THE
ELECTRICAL HOROLOGY SOCIETY
Chapter No 78

VOLUME 1---ISSUE #5
August 1975



Hello fellow enthusiasts:

After a not too exciting summer in the electrical clock collecting area, we once again are ready to begin our publication of electrical horological material which we hope will be of much interest to you all. Again it is worth noting that electrical clocks are becoming, as they have been during the past two years, very scarce. It has been brought to our attention that various dealers are stockpiling these clocks in the hope of raising prices even more than they are now. This is a deplorable situation and a rather sad commentary on the times we are living through. My own thoughts are that if a clock is worth buying, and the means are available, then it should be bought. But, to buy clocks for the speculative market only is not, I am happy to say, a characteristic of a true collector.

This issue is devoted to a fine techinical article by Mr. Richard Warburton who has developed a system to combine a master clock and slaves made by different companies through a main switching panel so that the adjustment of the slaves may be accomplished with a minimum of difficulty. Also, one section of the patent for the Tiffany Never-Wind clock is enclosed. We are awaiting the other sections from the U.S. Government Printing Office.

Trusting you will enjoy this issue.

Electromagnetically yours,

Harry Feldman

Those of us that have several slave clocks in our collections are from time to time confronted with trying to get them all in time with each other. Since most of us have different models, the use of the synchronization system built into most slave clocks cannot be used as the various companies have different systems. After taking my own down several times to set each one separately I have built the system shown.

The theory of operation of this distribution panel is based on the "Break-In" or "Closed Circuit" phone jack as found in the electronic stores. Most of us have seen these jacks without knowing they are the ones used on the side of the pocket radio where you plug in the ear phone. In that operation the jack has the ability to shut off the radio's loudspeaker and also, at the same time, connect the plug to the output of the radio so you may hear it in the earphone. To do this the little jack has a switch in it that is operated by the insertion of the plug. This switch turns off the speaker and the plug picks up the signal that had gone to the speaker transferring it to the earphone.

In our use of them we turn it around and we put the pulse from the Master Clock on the speaker side of the jack. There the pulse goes into the jack and comes out on the "tip" of the jack. The tip is connected to the slave clock to be controlled. With no plug inserted (see slave clock #1), the pulse from the Master goes right through the jack and on to the clock. On slave clock #2, the "red" plug has been inserted and the little switch has opened preventing the pulse from the Master clock from going on to pulse the slave. This means that clock #2 is standing still or stopped which is why we use the "red" plug. In the case of slave clock #3, we have used the "black" plug which has been shorted between the tip and the shell of the plug. This plug opens the little switch and stops the slave, but it also attaches the slave clock which is on the tip of the plug, to the shell of the plug thru the short. The shell of the jack is part of the mounting hardware and since the jacks are all mounted on a metal plate, this means that should voltage be put on the face-plate that supports all the jacks, slave clock #3 would receive that voltage and move. By using the two plugs you can move or stop any clock, or all clocks, because the pulse from the Master goes through a jack just as it does through slaves and that jack and plugs work exactly as a single slave does.

To pulse the shells of the jacks and plugs I use the circuit commonly used in broadcast stations. It is called "Making it Idiot Proof." This is done because most disc jockies are not far removed from the "Ted" on the Mary Tyler Moore Show and they will press any button around just to see what it does. So for this reason we put in two buttons. They are installed about 12 inches apart so that the human hand cannot span it. Since most "Teds" never take both hands out of their pockets at the same time you can count on this two button arrangement to keep "little fingers" from upsetting your clocks. The circuit passes the voltage from the Master clock going through both buttons to the face-plate of my panel.

We have had several power blackouts this winter and the panel has more than paid for its self in shattered nerves. My panel is made out of a "Push Plate" for a door obtainable at the hardware store. It is 4 by 12 inches and is mounted on a small frame of wood. The jacks are mounted in 1/4" holes. There are also buttons that mount in 1/4" holes if you can't drill a bigger one. Mine happen to be larger. The parts all came from Radio Shack and the numbers after the item are the stock numbers of Radio Shack. If anyone builds one and has a problem with it give me a buzz or a letter. I will be happy to try and help.

In operation the system will allow the impulse from the Master clock to go through all of the jacks and then to the slave clocks. The path of the impulse is from the relay or switch in the Master clock through the normally closed contacts in the master jack. From the master jack the impulse travels to the non-moving contact of each of the other jacks and from the moving side of each jack to the particular slave to be operated. Inserting the red plug in the Master jack will stop the impulse from the Master clock to the jacks and thus all slave clocks will be stopped. To initiate movement of the slave clocks, one inserts the black plug in the master jack and presses both buttons.

To stop or move a single slave proceed exactly as above except use the jack assigned to that slave. If you have a number of slaves by different companies this will beat taking them down off the wall one at a time to set them when you have dirty contact problems in your Master clock.

CONSTRUCTION HINTS

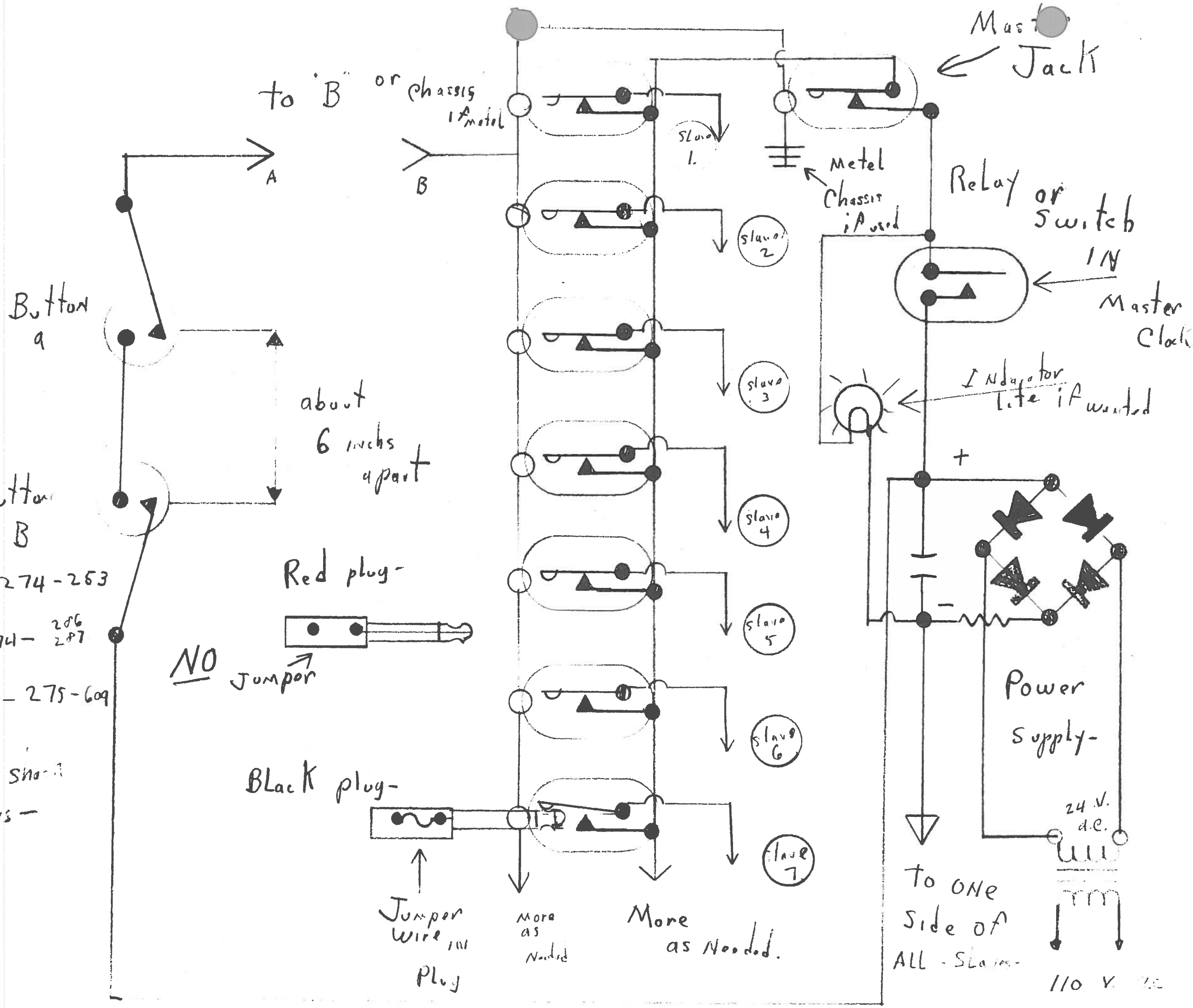
If the jacks are mounted on a metal chassis you will not need the wiring between the "ground" on the jacks. Just run the wire from button "A" to the chassis terminal on any jack and they will all be connected through the metal "ground" of the chassis. Be sure not to attach any part of the power supply to the chassis. I am assuming that the power supply is in the clock. The one I use is made from Radio Shack components:

PARTS LIST

Jacks 274-253
plugs 274-011 (I have twelve on my panel)
Push buttons 274-286 and 274-287
Transformer #273-1505
Full Wave bridge rectifier #276-1152
Filter #2721035
Resistor #271-133

See schematic for construction. Remember to observe proper polarity of components during construction.

Richard Warburton
17043- 8th N.E. Seattle,Wash. 98155



Jacks - 274-253

Plugs - 274-286 / 287

Buttons - 275-609

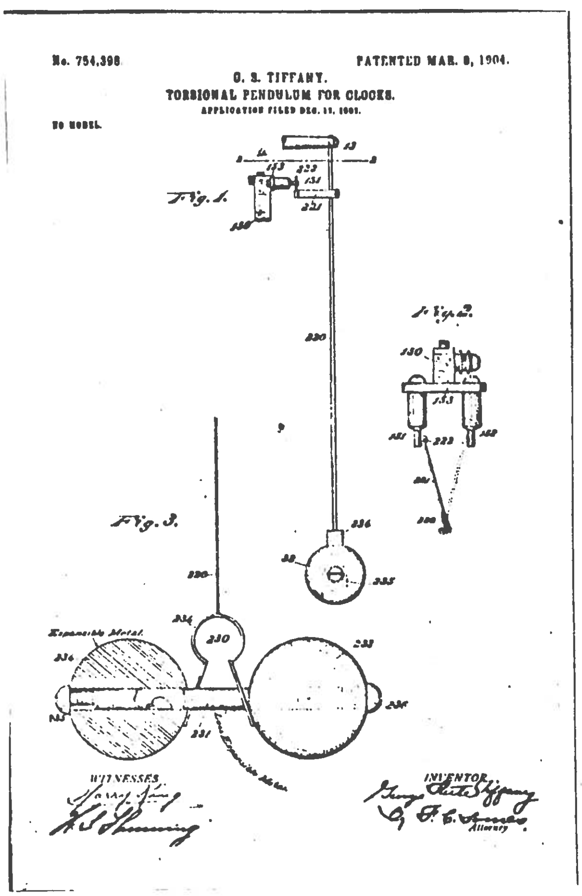
Radio Shack Numbers -

754,398. TORSIONAL PENDULUM FOR CLOCKS. George S. Tiffany, Brooklyn, N. Y., assignor of one-half to James Van Inwagen, Chicago, Ill. Original application filed Nov. 30, 1901, Serial No. 84,287. Divided and this application filed Dec. 12, 1903. Serial No. 184,921. (No model.)

To all whom it may concern:

Be it known that I, GEORGE STEELE TIFFANY, a citizen of the United States of America, and a resident of the borough of Brooklyn, in the city of New York, in the county of Kings, in the State of New York, have invented certain new and useful Improvements in Torsional Pendulums for Clocks, of which the following is a specification.

This invention relates to torsional pendulums, which are especially useful in electric clocks because the period of each beat is much longer than the beat of the ordinary swinging pendulum and less current is required to impulse them, the current being used only during a minute fraction of each beat. These pendulums are also useful in spring-actuated ›cks, tending to prolong the running thereof 'ween the windings.



The objects of the invention are to provide a torsional pendulum easily and accurately adjustable to regulate the length of the beat and self-compensating to adapt itself to variations in temperature.

The invention consists principally in a compensating pendulum comprising a torsional pendulum-rod having a lateral extension provided with a stop, preferably adjustable on the extension, a weight of solid metal on said extension, and automatic means for holding said weight in contact with said stop, the weight and extension having different expansibilities under a varying temperature, which adapt them to act automatically by expansion and contraction to shorten the radial distance between the weight and the axis of the rod as the extension expands and to increase said radial distance as the extension contracts.

The invention consists, further, in certain structural features hereinafter explained.

Figure 1 of the accompanying drawings represents a side elevation of a torsional pendulum embodying one form of this invention, together with parts of an actuating mechanism therefor. Fig. 2 represents a transverse section thereof on line 2 2 of Fig. 1 looking downward. Fig. 3 represents, on an enlarged scale, a front elevation, partly in section, of the lower portion of the torsional pendulum.

The same reference-numbers indicate corresponding parts in all of the figures.

In my application, Serial No. 84,287, filed November 30, 1901, for a patent for an improvement in electric clocks I have shown the pendulum herein described embodied in the clock set forth therein, and this case is a division of said application. The drawings hereto annexed illustrate the connection of this pendulum with the actuating mechanism of the electric clock illustrated in said original application.

In the form of embodiment herein shown a torsional pendulum support or rod 220 is designed to be suspended from the pendulum-post, as 13, of the clock to which it is applied, and a pendulum-bob 230, whose arc of oscillation is horizontal, is secured to the lower end of said torsional rod. The pendulum-rod is preferably composed of a flat elastic metallic strip of wire or strands of wire or any other material and in any other shape adapted to receive and resist a torsional force. When the pendulum is designed for use on an electric clock, the pendulum-rod has means for completing an electric circuit through its main body or otherwise, and in such a case it may be provided with a contact-arm, as 221, secured at one end to said rod and projecting at the other end between contact-studs, as 151 and 152, supported, for example, on a plate, as 153, attached to an armature, as 150. As the pendulum-rod oscillates the arm 221 touches one or the other of said contacts, preferably by means of an upright stud 222, secured to the free end thereof.

The pendulum-bob 230, suspended from the pendulum-rod, comprises a horizontal coupling-bar 231, which constitutes lateral extensions in two directions of the pendulum-rod, stops 235 and 236 on said bar, weights 232 and 233 on said bar between said stops, and a spring-clip 234, suspended from the pendulum-rod and operative to hold the weights against the stops and permit them to expand toward each other. The weights are preferably spherical in form and provided with diametrical holes in which the opposite ends of the bar enter. These weights are preferably adjustable on the coupling-bar to regulate the torsional beat of the pendulum and to compensate for variations in the elasticity of the torsional support due to changes in temperature. Any suitable means of adjustment may be employed. The means shown consist of the stops 235 and 236 in the form of adjusting-screws which engage screw-threaded holes in the end of the bar, their heads serving as the stops for the weights. These adjusting-screws render the coupling-bar extensible. The spring-clip 234 is preferably in the form of an expanding fork, which may be considered as a downward or forked extension of the pendulum-rod, serving as a means of connecting the coupling-bar therewith. The coupling-bar extends through holes in the legs of the fork and the latter bear against the weights and hold them apart from each other in contact with the stops 235 and 236. Any suitable means for this purpose may be employed. The pendulum is regulated to increase the speed of its beats by adjusting the weights nearer together and to decrease the frequency of its oscillations by moving them farther apart. This adjustment is readily effected by means of said adjusting screws or stops. To avoid variations due to changes in temperature and to secure uniform action of the pendulum, the parts of the bob are so constructed as to compensate for such differences. The coupling-bar 231 is composed of a material which expands less for a given increase in temperature than the material of which the weights are composed. For instance, the coupling-bar may be composed of steel, which has a comparatively low expansibility, and the weights of an alloy of lead, which has a comparatively high coefficient of expansion. An increase of temperature will cause an expansion of the coupling-bar and weights, and the expansion of the coupling-bar will tend to move the weights apart; but the greater expansion of the weights operating against the stops will tend to decrease the distance between them and the radial distance of each from the axis of rotation of the pendulum-rod. The relative dimensions and expansions of these elements, respectively, are such that as the coupling-bar extends outwardly the weights expand inwardly the required extent to maintain the normal relation between the weights and bar, and as the parts contract on a lowering of temperature and the weights shrink in greater ratio than the coupling-bar the spring-clip holds the weights against the stops and the weights are thereby separated from each other or moved farther from the center of oscillation. The parts of the pendulum may be so proportioned as to compensate for variations in the length or stiffness of the torsional wire due to variations in temperature.

I claim as my invention—

1. A compensating pendulum comprising a pendent torsional rod having a lateral extension provided with a stop, a weight of solid metal on said extension, the weight and extension having different expansibilities adapting them to act automatically by expansion and contraction to vary the radial distance between the weight and the axis of the rod to compensate for the contraction and expansion of the extension, and automatic means for holding said weight in contact with said stop.

2. A compensating pendulum comprising a pendent torsional rod having a lateral extension provided with an adjustable stop, a weight of solid metal on said extension, the weight and extension having different expansibilities adapting them to act automatically by expansion and contraction to vary the radial distance between the weight and the axis of the rod to compensate for the contraction and expansion of the extension, and automatic means for holding said weight in contact with said stop.

3. A compensating pendulum comprising a pendent torsional rod, a coupling-bar connected with said rod and provided with adjustable stops, weights on said coupling-bar between said stops, and resilient means operative to hold said weights in contact with said stops and permit them to expand toward each other, the weights and bar being of different solid metals and the metal of the weights being more sensitive to the changes of temperature than the metal of the bar, and adapted by expansion and contraction to compensate for the expansion and contraction of the coupling-bar.

4. A compensating pendulum comprising a pendent torsional rod, a spring-clip attached thereto, a coupling-bar supported by said spring-clip, and weights adjustable on said coupling-bar between said clip and stops.

5. A compensating pendulum comprising a pendent torsional rod, a spring-clip attached thereto, a coupling-bar supported by said spring-clip and provided with stops at its opposite ends, and weights on said coupling-bar between said clip and stops.

6. A compensating pendulum comprising a pendent torsional rod, a spring-clip attached

MART

FOR SALE:

Synchronome Master Clock, Mahogany case, mint, works: ca. 1925.

WANTED:

Electrical horological literature--any type.
Hamilton-Sangamo clocks---write details.

REPAIRS:

Made: All early electrical clocks--write details.

Martin C. Feldman, 1545 Rhinelander, Bronx, N.Y. 10461

FOR SALE:

Ulysse Nardin large size marine chronometer with log (never used) equipped with break circuit system for registering the seconds electrically; keeps Sidereal time; carrying case; $1500.00 less than 1/2 wholesale.

B.A.Wacek, 165 E. 64 Street, N.Y. 10021

FOR SALE:

1) Wallace & Tiernan Banjo Clock-pin wheel escape-unusual ---$200.00
2) Wallace & Tiernan Drop Octagon-some attention ------------$100.00
3) Stromb.Master (5') 1 sec. pend. ------------------------$425.00
4) Oak case-miniat. wall reg. - Stand. Elect.1/2 sec.pend.-mint $200.00

WANTED:

Books & interesting Elect.clocks

Alan Marx, 105 Bayeau Rd. New Rochelle, N.Y. 10804

Tif.Never-Wind Patent-continued

thereto, a coupling-bar supported by said spring-clip and provided with adjustable stops at its opposite ends, and weights adjustable on said coupling-bar between said clip and stops.

7. A compensating pendulum comprising a pendent torsional rod, a coupling-bar connected with said rod, weights adjustable on said coupling-bar between said clip and stops, and a spring means for holding said weights against said stops.

8. A compensating pendulum comprising a pendent torsional rod, a spring-clip attached thereto, a coupling-bar supported by said spring-clip and provided with stops, and weights on said coupling-bar between said clip and stops, the weights and bar being of different metals, the metal of the weights being more sensitive to changes of temperature than the metal of the bar, whereby the pendulum is self-compensating.

GEORGE STEELE TIFFANY.

Witnesses:

HENRY EDWARD DAWSON,
R. A. DE LA MATER.

<u>NEXT MEETING NOV. 9TH @ 3:00 P.M.</u>

Will be held @ Alan Marx's home
105 Bayeau Rd. New Rochelle, N.Y.

Bring Items To Show, Sell, & Swap

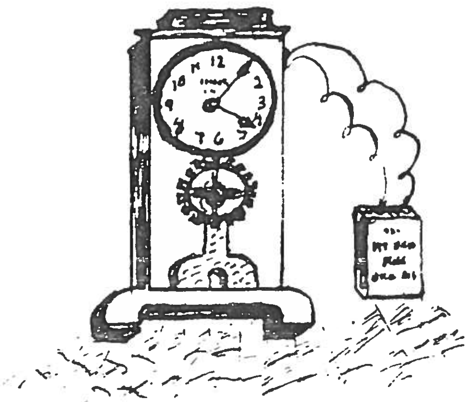
Directions:

Hutchinson River Parkway to Webster Ave. Exit, first possible left to North Ave. right on North Ave. to Paine Ave. Left on Paine. 4 blocks on Paine to Bayeau Rd. left to house.

The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY Chapter No 78

October 1975

VOLUME 1---ISSUE #6



Hello fellow enthusiasts:

This issue marks a milestone for our Society as it is the last issue of Volume 1. Volume 2 will begin with the January 1976 issue and this Volume will contain six issues for the year to be published on odd numbered months.

Our Society is prospering and at last count we have over 200 members. With the increase in membership I still hope that there will be an increase in material suitable for publication. I must, however, remind all of us that the 1976 dues of $7.00 payable to our Secretary-Treasurer, Mr. Charles Roth, 2 Circle Lane, Rosyln, N.Y., 11577, must be received no later than the end of December. Due to the high cost of printing we are unable to send out copies of Journals to members who have not met their obligations. It is also difficult, costly, and often impossible to send back issues of the Journal to inactive members who wish to become reinstated. So, please send us your dues today and it will be one less thing you have to remember at this busy holiday season.

This issue contains two translations of textbooks dealing with the Siemens Electric Master clock. While this Company still exists in West Germany all my efforts to gather any information from them have been futile as they claim that most of these clocks were destroyed along with the literature pertaining to them during World War 11. Therefore, the material in this Journal should be of historical as well as technical interest.

From the Officers of Chapter 78 and the staff of the Journal may I extend their and my own best wishes for a Happy Holiday Season and a Healthy New Year.

Enjoy this issue.

Electromagnetically yours,

NATIONAL ASSOCIATION of WATCH and CLOCK COLLECTORS, Inc.

From: R.Guye,M. Bossart, HORLOGERIE ÉLECTRIQUE, Lausanne,Switzerland,1948
Translated by: Martin C. Feldman,FNAWCC

Siemens Clock Translation

Siemens-Halske has successfully used diverse types of remontoirs for their Master Clocks. For many years they used a pendulum which was maintained through the impulse of an electromagnet based on the Hipp Principle and, a toggle switch for contact closing. This type of pendulum was subsequently abandoned and replaced by a regulator type of pendulum and a Graham deadbeat escapement. A weight powers the movement through the intermediary of a chain or cable. The cable is wound through the mechanical action of an electromagnet. This model clock has been modified after several years, particularly the remontoir mechanism, and constitutes the Master clock described below.

Figure 196 shows the remontoir assembly consisting of a: (1) electromagnet, (2) a primary contact closed each minute for 2 seconds by a five-sided cam or star-wheel (utilized both for the winding and for the impulse contact for the slave clocks), (3) a contact which is closed each second by the oscillatory action of the anchor escapement.

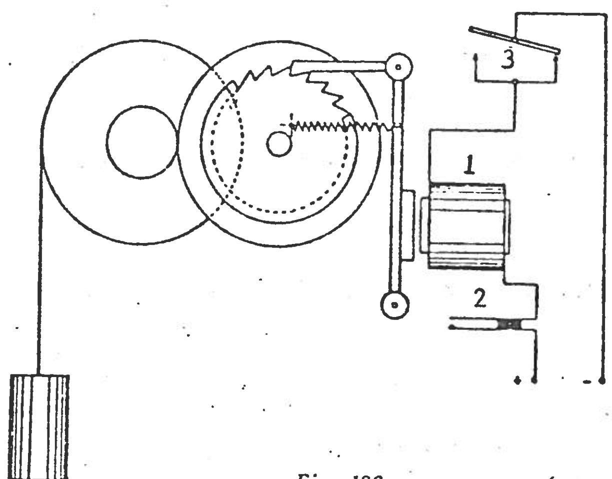


Fig. 196.

The electromagnet is thus excited successively twice each minute. Its armature, the intermediary of a ratchet mechanism and appropriate reduction gearing, causes the barrel to turn. A cable from the barrel supports the weight which is the motive force for the clock. Each minute the weight is wound and returns to its original position after having run down the previous minute in powering the timekeeping clock mechanism. The cable is long enough to give a reserve going-power of 12 hours should the current be shut off for any reason.

Represented schematically is the contact through which the power is transmitted to the slave clocks--Fig. 197. The main gear or star-wheel has five teeth; this is the same reset gear which was used to rewind the remontoir. It is fastened to one of the driving reduction gears and is activated each minute by the attraction of the armature of the remontoir electromagnet. The teeth of this star-wheel come to reset alternately on each of two groups of contact springs in such a fashion as to cause a polarity reversal of the current each minute. Besides these actions, the springs (relay contact leaves) offer an immediate ground for the current to follow after it impulses the clock so as to detour an self-induced current, or back electromotive force.

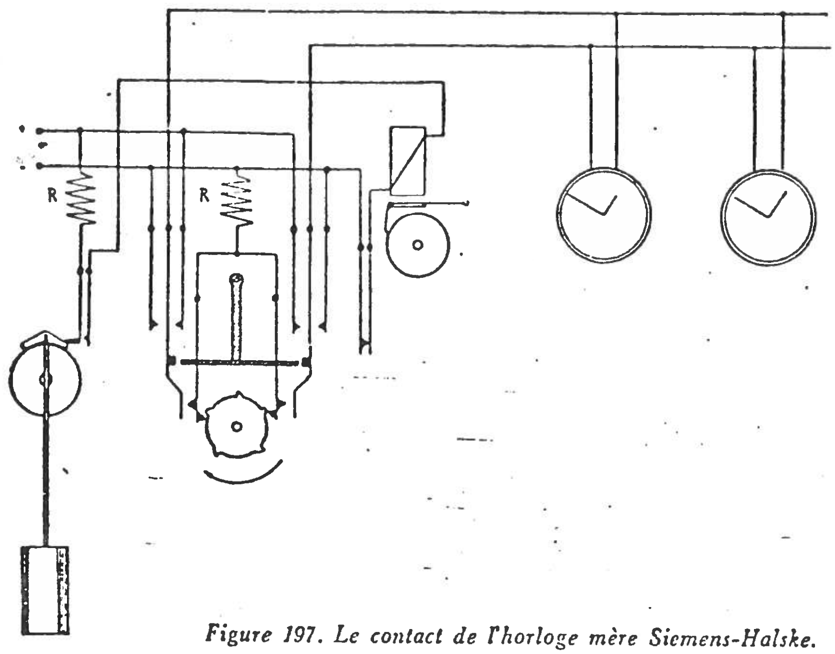


Figure 197. Le contact de l'horloge mère Siemens-Halske.

The mechanical transmission of the many functions this clock performs is represented schematically by Fig. 198 of which the following remarks pertain:

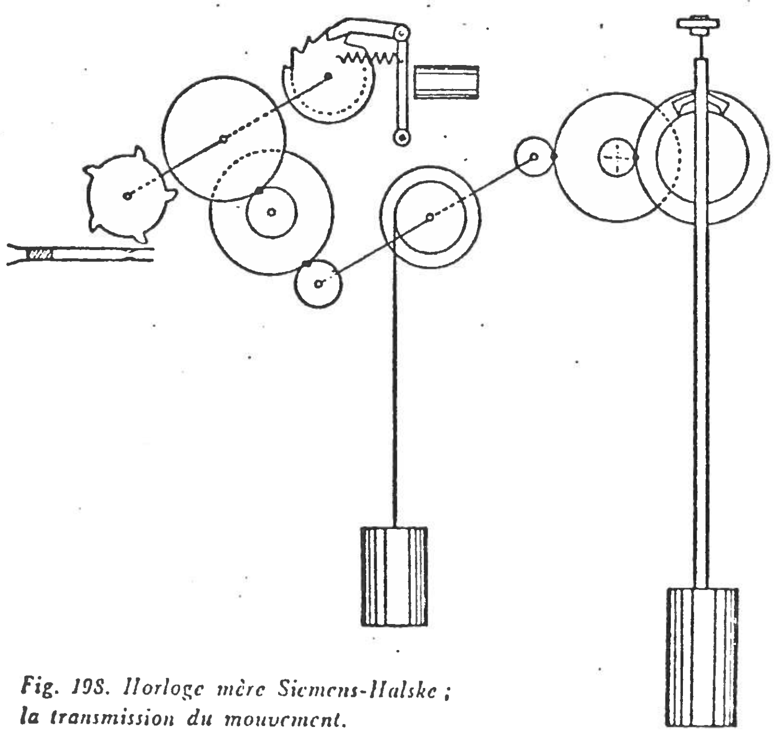


Fig. 198. Horloge mère Siemens-Halske ; la transmission du mouvement.

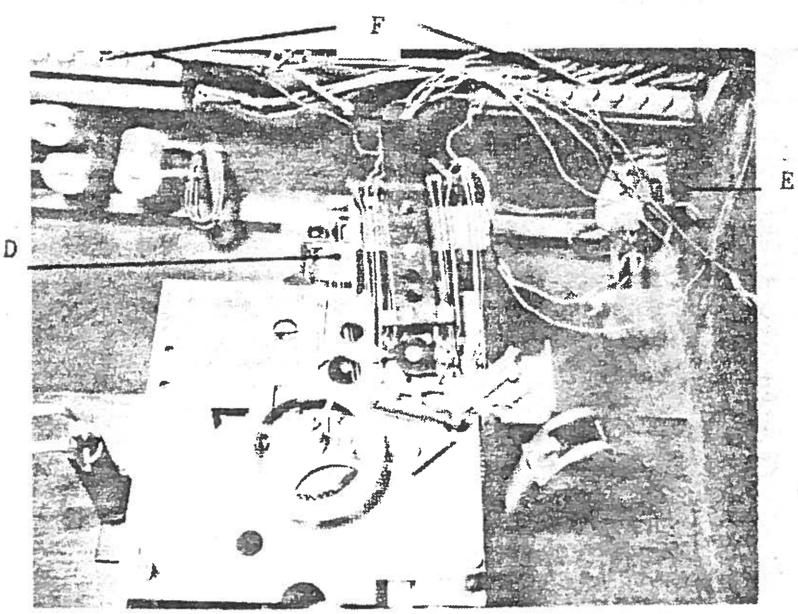
A) The minute impulse of the Master clock is initiated by the electromagnetic attraction of the armature in the remontoir mechanism and is independent of the gearing of the clockworks proper, exerting no influence on the going of the clock.

B) In case of a decrease of current due to and interruption of the current supply, the clock will continue to function mechanically until the weight has entirely wound down as opposed to the stopping of slave clock movements which become immobilized immediately following the current disruption. If the current is re-established before the expiration of the 12 hour going-reserve the electromagnet of the remontoir regains its functions; i.e. in winding the driving weight to its maximum position, and in activating the impulse current to the slaves so that synchronization takes place and the slaves show the correct time.

In other words, when there is a lapse of current the impulses are not able to be sent and are somehow accumulated by the Master clock to be re-instituted to the slaves when the current is re-established.

The mechanism which is described now is equipped with a pendulum beating 3/4 seconds (90 oscillations per minute) or, a one-second pendulum (60 oscillations per minute). The pendulum of the former type is made of mahogany wood specially treated and its bob is composed of 3 brass cylinders placed in parallel between two horizontal bars. The lowest one is supported by the regulating screw. The latter (one-second-beat pendulum) is like the Rieffler type--the rod is of Invar steel and the bob is brass in a disc form.

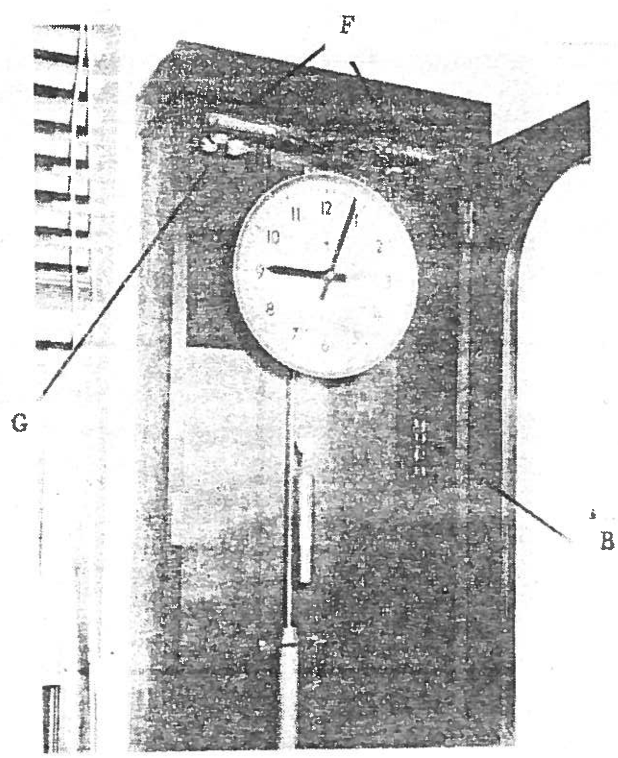
In the same way that the clocks made by Moralzeit, those of Siemens-Halske are able to perform diverse functions such as operating auxillary mechanisms, controlling seconds contacts, alarms, program devices and other signal devices of the same genre.



BEHIND FACE VIEW

(Earlier model than above)

(d)--one-second contact
(e)--fuse block
(f)--contact blocks



FRONT VIEW--DOOR OPEN

(b)--missing slave relay (?)
(f)--contact blocks
(g)--resistors

Schindler, G.,

ELEKTROUHRENTECHNIK,
Ulm (West Germany), 1968 (Translated from the German)

Edited by: Martin C. Feldman

THE REPAIR OF THE MAIN CLOCK

As the functioning of an electric clock depends first upon the main clock and its supply of current, the maintenance of these timepieces demands constant supervision and care in order to reduce disturbances to a minimum. There is special care indicated in the maintenance of the Master clock because all accurate timekeeping in the time indication is produced by the Master clock which can multiply and destroy the advantages of an electric timepiece. The disturbances in the Master clock can be either mechanical or electrical.

ELECTRICAL DISTURBANCES

These exist if the current strength diminishes. For instance, if there is a continuous closed contact (contacts stick together) this will cause the slave clocks to get out of control. When the winding magnet and the slave clocks do not respond in spite of an intact battery and the Master clock continues to operate there could be a burned out fuse. Before replacing the fuse one has to ascertain whether there is a short circuit. The power in the clock can be reduced also because the batteries are exhausted due to the fault in the charging system or oxidation of the battery contacts. The power can be reduced to such a degree that the winding magnet does not respond properly.

In Master clocks without mechanical contact works the slave clocks are no longer activated although the Master clock goes on. A very frequent disturbance is the arrest of the impulse propagation because the works are dirty or the oil has consolidated and that leads to the above mentioned permanent contact (frozen contact) which in turn produces exhaustion of the battery. Insufficient pressure at the contacts of the relay in addition to too short impulse imposes further disturbances so that the slave clocks fail to indicate proper time. Experience has taught that most disturbances occur in the mechanism of the Master clock. The relay contacts are the weak points in our main clocks. Electrical disturbances are not always easy to find. Their causes are not as evident as in the failure of mechanical parts.

MECHANICAL DISTURBANCES

These can be caused by dirt in the works and thickening of the oils which stops the clock after long operation. Before this happens there is usually a tendency for the clock to run fast. Very often there are damages to the pendulum suspension spring due to improper handling. The pendulum suspension handled in this fashion becomes distorted. The mechanism of the Master clock will come to a standstill and the weight will not descend as the cause very often is in the mutual interferance of the hands of the clock or friction of the hands against the clock face or against the front glass. An entanglement of the string after falling off the drum, or a pinching of the string very often produces a great loss of power which can stop the clock. Furthermore, disturbances in the relay assembly also can influence the works and stop the clock. Any mechanical distortion of the frame or alignment produces arrestment of the clock.

Every minute an electromagnet activates both the automatic lifting of the weight as well as the relay. The weight only powers the works. This acts as a safeguard against the depletion of the batteries, since the elevation of the weight stops before the slave clocks are stopped. (Figure #53 illustrates the principle of the impulse). The pendulum activates the pendulum contact which closes the circuit for the winding of the clock, as soon as the winding assembly is closed or activated by the works through a relay switch. The pulley system elevates the weight and activates simultaneously, via the star-wheel spring assembly, the impulsings of the slave clocks. In the next minute the polarity switch gives an impulse to a different set of relays in the opposite direction. The relays therefore, are activated ultimately which produces D.C. impulses of opposite directions and in the non-active periods the line is closed to prevent unwanted responses to outside current. Since the pulley assembly only drives the star-wheel, the works themselves is not involved in their electrical function.

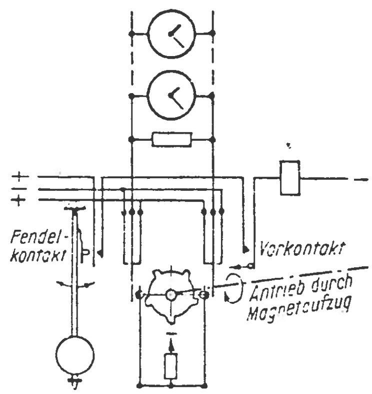


Fig. #53

****

MART

FOR SALE: 2 Standard Electric Time Co. Slave Clocks,1927 vintage. Picture available. $20.00 each, or will trade, plus cash, for Self-Winding Master Clock. Al Engel,P.O.Box 1, Canby, Minn. 56220

****

FOR SALE: Synchronome Master Clock, Mahogany case, mint, works: ca.1925.

WANTED: Electrical horological literature---any type.
Hamilton-Sangamo clocks---write details.

REPAIRS: Made: All early electrical clocks--write details.
Martin C.Feldman, 1545 Rhinelander Ave.Bx.N.Y.10461

****

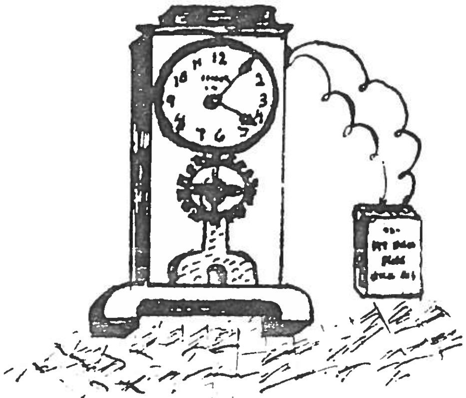
The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78

November 29, 1975

VOLUME II---ISSUE #1

Martin C. Feldman, Editor



Hello fellow enthusiasts:

This issue marks the beginning of Volume II--#1 of six issues for the year 1976. Needless to say I am very pleased with the progress our Society has made and judging from some very kind letters received from the membership, you all seem to share in my pleasure. A letter from Mr. John Mies is reproduced in this issue for your information and I hope some of our Chapter members are winners. I have suggested to Mr. Mies that another category entitled: BEST RESTORATION be included in future award ceremonies.

On November 9th a meeting of members in the NY-NJ area was held at the home of Vice-President Alan Marx --- details to be found within this issue. This issue is primarily devoted to an excellent research effort made by member Ed Hanff regarding the Rempe Mfg. Co. movement he has restored and researched. Some of you may remember his fine work dealing with the Self-Winding Clock of Champagne, Illinois which was serialized in the early editions of our publication, the EHS Newsletter.

By the time you read this I hope to be home from the hospital after some surgery and recuperating. Thus, you will see the reason for the early date of this editorial.

Enjoy this issue!

Electromagnetically yours,

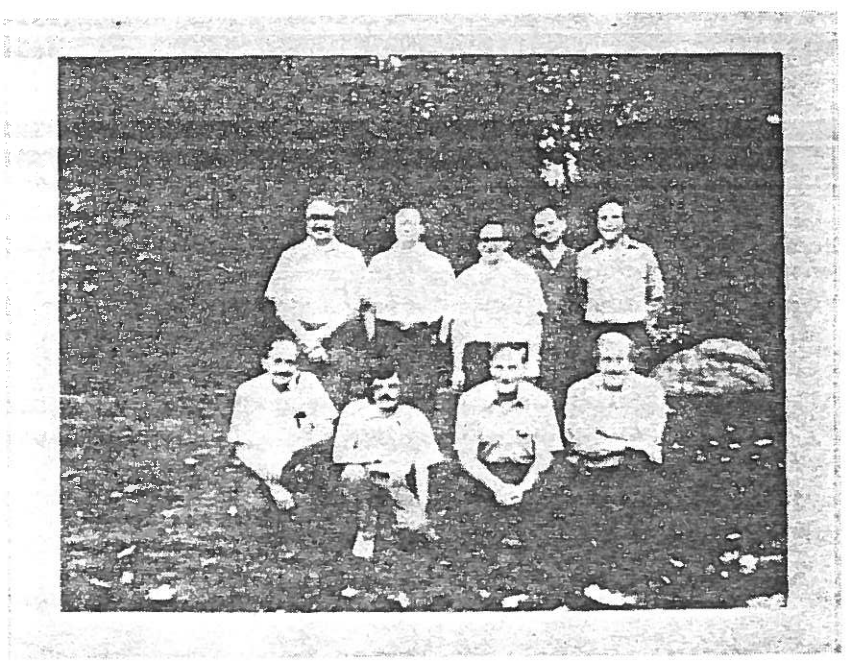
NY--NJ Meeting of the EHS.

On November 9, 1975 nine members of the EHS residing in the NY-NJ area met at the home of Vice President Alan Marx. We had a very interesting meeting and ironically 3 members who had what they thought was a one-of-a-kind clock were surprised to find that 3 out of 5 members who had arrived earlier brought this same model clock along with them! One was in working condition while two weren't but the surprise on the faces of the owners had to be seen to be appreciated.

A business meeting was held and once again the restoration of the Kennedy Electrical Clock which has been donated to the NAWCC Museum was discussed. The consensus of opinion was such that since we have a fairly large number of members of the EHS residing in this area, we might undertake the restoration of the clock only after seeing it. Your President was instructed to send a letter to National advising them of this decision. We know we shall have one problem which we may not be able to handle and that is the restoration of the wooden case. If there is any member who is capable of restoring a wooden case, please drop me a line and we shall take it from there.

A very fine buffet luncheon was prepared by Mrs. Marx for the member—guests and was enjoyed by all. A vote of thanks was heartily offered to the Marx' for opening their home to us and for their fine reception.

Members attending the above meeting--bottom row--L to R:
G.Zlobin, Pres.M.Feldman, B.McGuiness, G.Cohen.
top row--L to R:
G.Feinstein, P.D'Angelo, Vice-Pres, B.Levy, Vice-Pres. A.Marx, Sec.-Treas.C.Roth.



SUNDIAL
SOUTH VERTICAL WALL
JOHN A. MIES

Paramount
MORTUARY
8026 ALONDRA BLVD. • PARAMOUNT, CALIFORNIA 90723
(213) 633-1164

MEDALLIONS TO BE AWARDED AT NAWCC NATIONAL CONVENTION-DISNEYLAND 1976

We would like to invite your membership to bring horological items made by themselves; clocks, watches, sun dials, or other time measuring devices, to the 1976 National Convention. There will be awarded medals in gold, silver and bronze of achievement for the most outstanding horological item in each of the following four categories:

(1) EXCELLENCE IN WORKMANSHIP

(2) MOST COMPLICATED

(3) MOST UNUSUAL

(4) BEST REPRODUCTION

The above awards will be presented at the banquet.

This is a "first" for NAWCC. These awards will give just recognition for the skills, talents and creativity among our membership.

Ample space, protection and care will be provided for the creations submitted which will be prominently displayed in the 1976 National Convention exhibit section.

We ask that you invite your membership to participate in this important competition.

Thank you for your cooperation.

Further information or questions may acquired from:

JOHN A. MIES
8026 ALONDRA BLVD.
PARAMOUNT, CALIFORNIA 90723
Phone-213-633-1164

AN INTERESTING SELF-WINDING CLOCK

By: Ed Hanff

At one of our local Chapter Marts a friend of mine offered for sale a very poor looking electric clock works of unknown parentage. I acquired the works but could find no identifying marks on it and there was no pendulum or case. I consulted several clock books and NAWCC Bulletins but found nothing resembling this clock. After submitting the photograph (s) and the description that follows to Marty Feldman, he found in his files the manufacturer's name—Rempe Mfg. Co., Danville, Pa. and patent dates: 7/21/03 (#734,366) and 8/25/03 (#737,019) issued to Henry Rempe.

Basically, the clock has a conventional gear train controlled by a pendulum and recoil escapement. The clock used a two-section pendulum rod of which only the upper section was available. This section is about four inches long with a T-shaped lower end to which a lower rod section hooks on. After rough calculatinns and experiment, the total pendulum length was found to be slightly over 14 inches to operate at 99 vibrations per minute. The power drive consists of an electromagnet energized by two 1.5 volt D cells. A light-weight armature has an extended lever arm which engages a similar arm to operate a ratchet wheel on the center arbor. This arm is attached to one end of a helical spring which supplies the operating power. Another extension from the armature controls the contacts. Each operating cycle is about six minutes.

Photo 1 is a front view of the works with the contacts closed and the magnet armature about to be closed. Photo 2 is a similar view with the contacts held open and the armature starting to rise. Photo 3 is a rear view showing the short upper section of the pendulum rod.

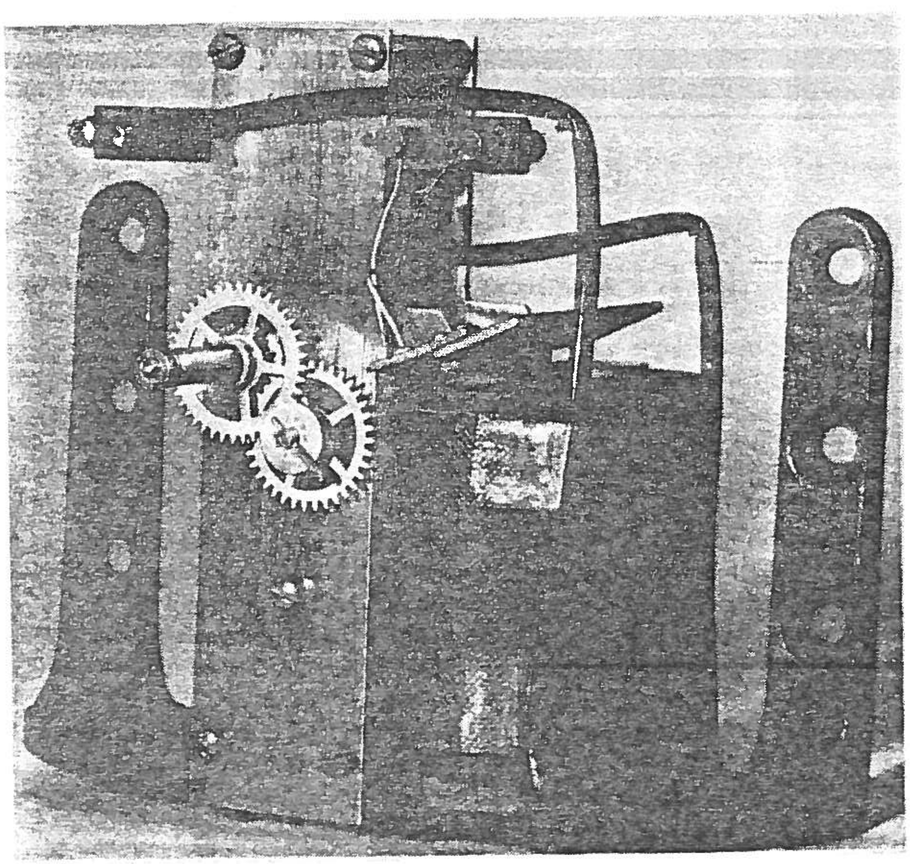


PHOTO 1.

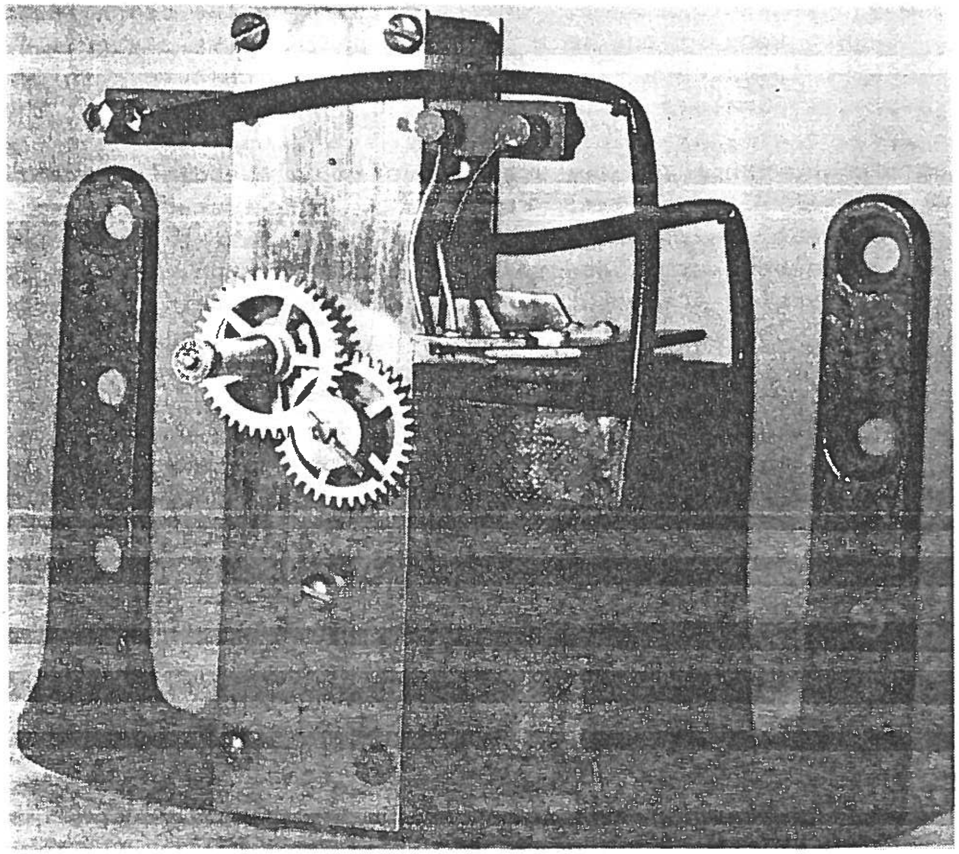


PHOTO 2.

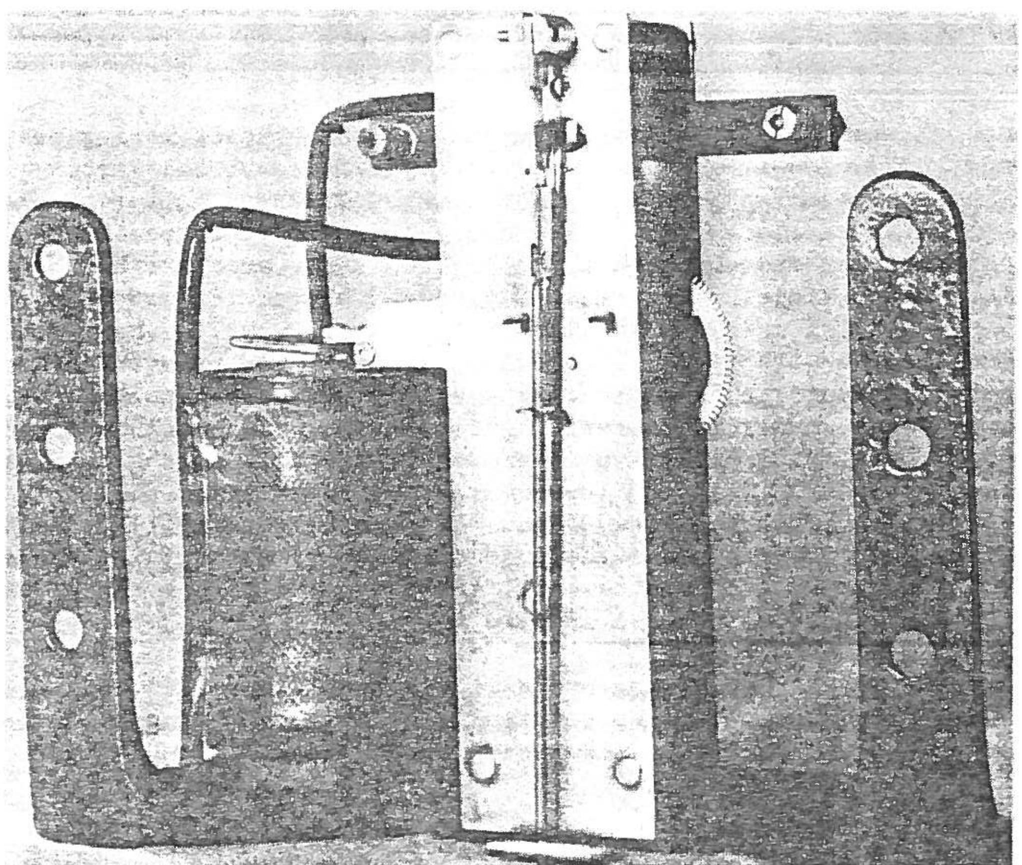


PHOTO 3.

Since the photos do not show many of the details of the clock, drawings have been made to show some of the more interesting features. Figure 1 covers the winding mechanism in which view A shows the magnet armature c in open position with contacts closed and solenoid b about to be energized. The ratchet drive arm m is made of non-magnetic brass and is an extension of the armature c. The operating arm d and ratchet wheel k are mounted on the center arbor which carries the minute hand. The helical power spring p is hooked to a small stud on arm d. In view B the armature c has been pulled against the magnet pole piece and spring p has been stretched to its maximum tension. During this action the ratchet wheel k remains stationary, backward movement being prevented by holding pawl n, while the drive pawl l moves clockwise to engage the ratchet at a new position.

There are two important points to note in this winding operation. First; the two arms d and m have curved engaging surfaces of the same radius and the relation to their pivot points is such that a true rolling action results, thus eliminating sliding friction. Second; at the start of the closing cycle when the magnetic pull on the armature is weakest, the pressure point between d and m is closest to the armature pivot and farthest from the center arbor, thus applying greater leverage to arm d. As the armature approaches the pole piece these relations are reversed.

Figure 2 covers the action of the contact mechanism in four positions A, B, C and D, and for clarity, have been drawn at twice the scale of Figure 1. Both Figures 1 and 2 are drawn as viewed from the rear, hence appear in opposite relation to the photo views. The rigid contact support f is a brass wire about 1/32" in diameter with a small silver contact q at its lower end. The flexible contact support g is of phosphor bronze 1/8" wide with a mating silver contact q at the lower end where it covers only half of the width of the support. Section XX of view D shows the lower end of support g and also shows the gap t near the end. This gap t provides clearance for the trigger r to pass from one face of support g to the other. The small trigger r is triangular in cross section and is an offset extension of its carrier arm u which is riveted to the armature c. Arm u also carries the L-shaped control arm e.

The interrelation of the various elements of the contact making mechanism is unique and in my mind is the most interesting feature of this clock. In Figure 2 view A shows the parts in mid-cycle. The armature c is rising as the power spring keeps the clock going. The contacts q are kept open as the trigger r holds back the lower end of support g. In view B the armature has reached its upper limit and trigger r has released the end of contact support g, allowing contacts q to close and energize the magnet. In view C, while the armature is drawn down toward the pole piece, the bevelled face of the trigger maintains pressure on the contacts, thus prolonging the flow of current to the magnet to prevent too rapid disconnection. During this phase of the closing sequence the upper end of control arm e applies pressure on flexible support g tending to separate the contacts q. When the lower corner of the trigger passes into gap t the contacts snap open. View D shows the armature in fully closed position while control arm e keeps the contacts open by restraining the flexible support g. This restraint continues until the trigger r passes the gap t and engages the lower end of g as shown in view A.

The complete contact operating cycle requires only a small fraction of a second and the action described can be visualized only by moving the armature slowly by hand with the battery disconnected.

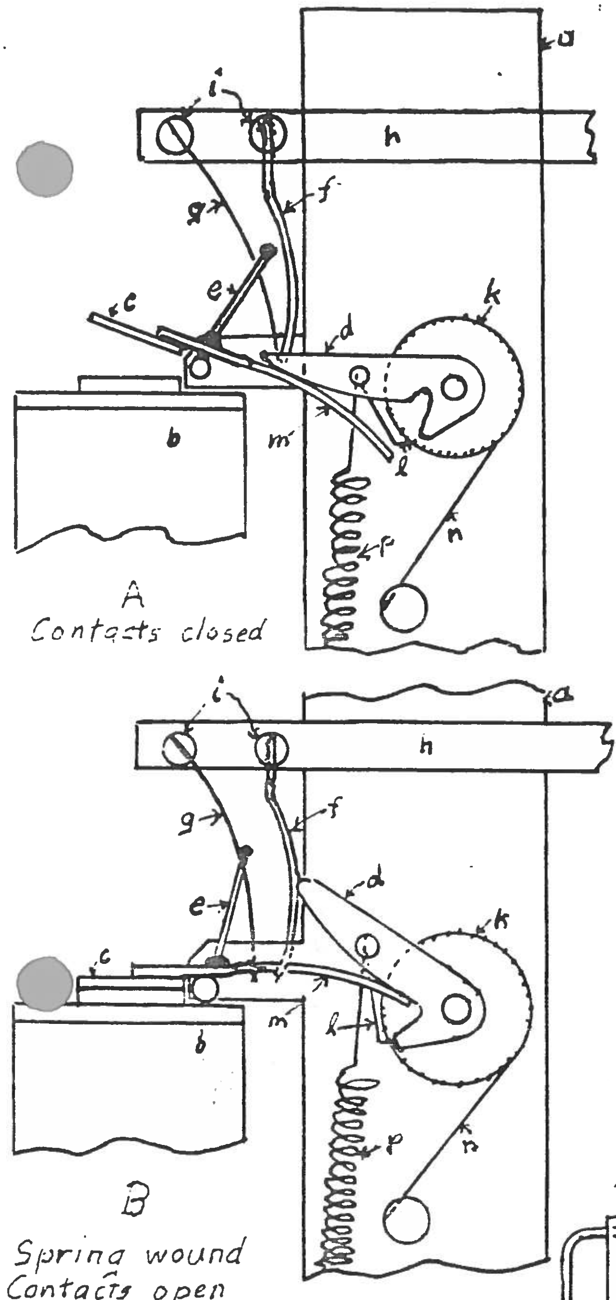


FIGURE 1 WINDING MECHANISM
Viewed from rear

0 ½" 1"
approximate scale

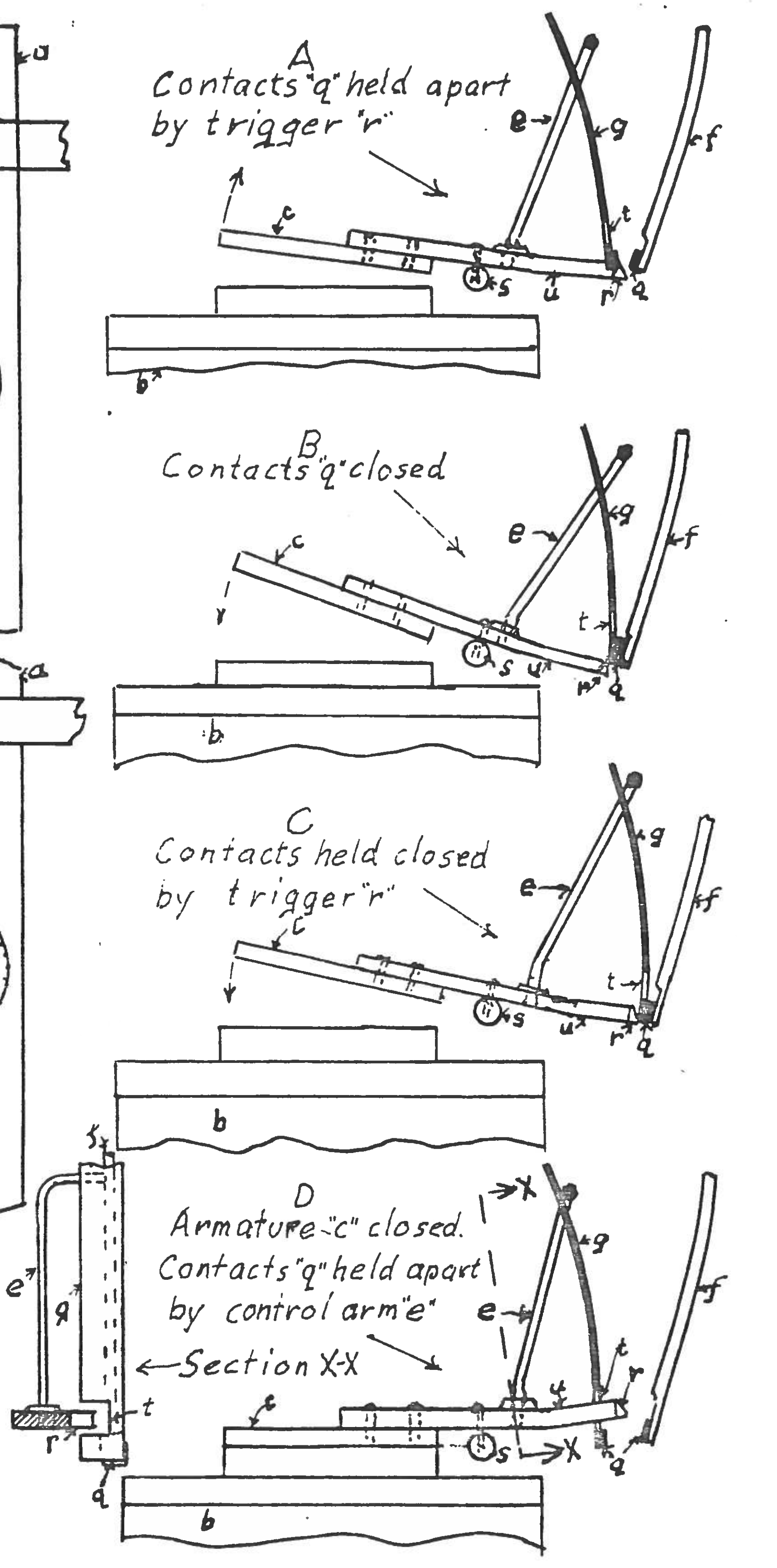


FIGURE 2. CONTACT OPERATION

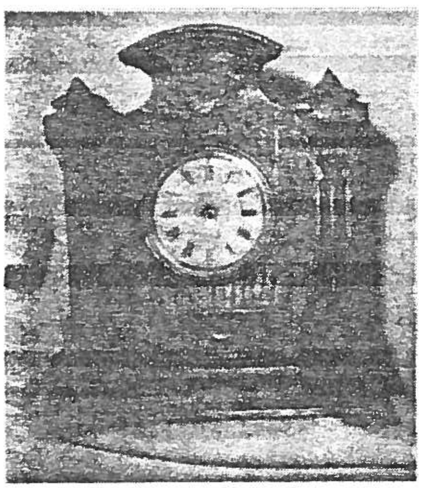
0 ½" 1"
approximate scale

DETAILS OF SELF-WINDING CLOCK

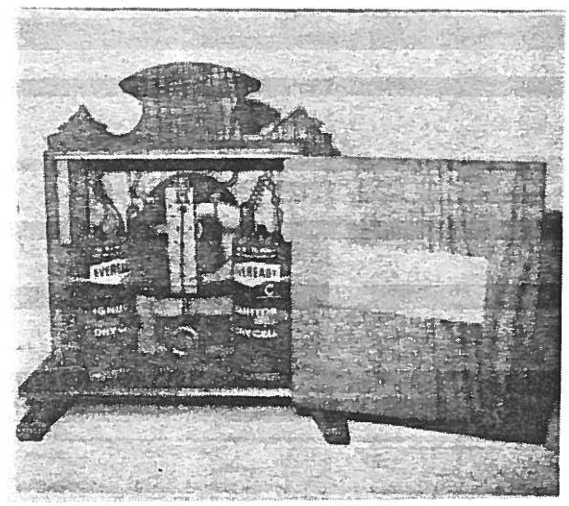
E.A.H.

Parts shown in Fugures 1 and 2.

a Clock-work plate
b Solenoid
c Armature
d Operating arm
e Contact control arm
f Rigid contact support
g Flexible contact support
h Insulating contact base
i Contact support posts
k Ratchet wheel (on minute hand arbor)
l Ratchet drive pawl
m Ratchet drive arm
n Ratchet holding pawl
p Power spring
q Silver contacts
r Armature trigger
s Armature axle
t Open gap on flexible contact arm
u Trigger carrier arm



Front view



Rear view

Mantel Rempe Mfg. Co. Clock

****

****