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ELECTRICAL HOROLOGY SOCIETY
Chapter No 78

February 1979
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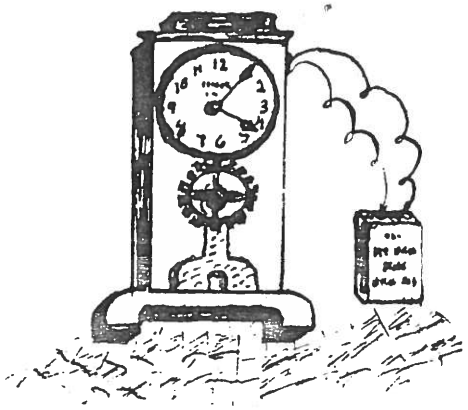
Martin C. Feldman, Editor



Hello fellow enthusiasts:

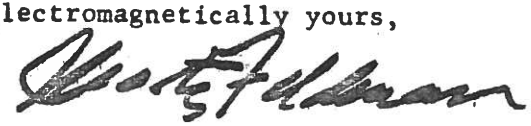
Electrical horology has really been given a good exposure these last few weeks as I was invited to speak to the New York Chapter--#2 where we had over 600 people who saw a slide show of American and European electrics. The response was very good. Many people said, "I never realized there were so many interesting electrical clocks to be collected". The lecture will have an added advantage as now some people who had electrics lying around will probably bring them out for exhibit or for sale. Our 2nd Vice-President, Bruce Levy, was invited to speak in N.Y. at the Westchester Chapter and gave a very informative talk amply illustrated with slides. Of particular interest was the various English clocks which Bruce and Maxine Levy photographed on one of their trips to England. His talk also was very enthusiastically received which once again shows us that proper exposure to a subject can mean the difference between acceptance or rejection. In a recent Newsletter which Chapter Presidents receive from Headquarters the results of a survey were summarized concerning activities and statistics of various Chapters. The following are some salient points which I would like to share with you. They found that most Chapters had at least one Vice-President and 20 had two. Most Chapters were not incorporated. Dues averaged between $2 and $10 per year with a mean of about $5.00. Chapter members averaged between 26-100 with three Chapters having over 500 members with most Chapters reporting they were growing. The number of meetings per Chapter had a mean of about 4 per year with most meetings on a Sunday during the daytime. Several Chapters offered repair courses and many had lectures at the meetings. A large number of Chapters reported exhibits at each meeting as well as having a Mart. I found that our own Chapter falls within the average for dues and activities as compared with the other Chapters. We do differ in that we publish a regular Journal six times per year and that we cannot meet as a group, other than at National Conventions, since we are so spread out throughout the country and world. However, local meetings are encouraged and three to four are held in the N.Y.C. area every year. When asked what services Chapters would like to see National Headquarters provide, some suggested a universal membership while others wish to keep NAWCC a truly "hobby group". Some Chapters wished more emphasis in the

Bulletin on Chapter Activities while others wished less space devoted to such material. The Bulletin Editor is looking into publishing another series of Bulletin reprints which have been requested very often in addition to the ones already published. Museum space was asked for individual Chapter exhibits and the curator remains available for such implementation. It would be nice if our own group could get involved in such a project! A good suggestion was that Chapters forward to National a list of speakers that they have found as being able to offer good educational programs. The list will be complete with subject, speaker's addresses, phone numbers, estimated expenses above travel costs, etc. National indicated they would be pleased to compile such a list. Some members wished to have a National Insurance Plan for their clocks, but it was felt that since insurance varies locally, it would probably be a better idea to arrange for such coverage on one's own.

This month we are offering an interesting article by Bruce Levy which describes some of the basics in the repair of early battery clocks. Bruce, as many of you know, restored the Kennedy Clock now located in the NAWCC Museum. This clock is similar to the Bentley Clock which is based on Bain's invention. We hope Bruce will be writing another article about this clock in the near future. We also are including some original instructions for the Standard Electric Master Clock. I have taken the liberty of including some information of kits available from Colin Walton Clocks in England. Also, please remember that dues for 1979 are due now, and if not paid you will be dropped from the mailing list. Please don't let your membership lapse as trying to receive past Journals may be difficult since we only print a very small number above our needs!

Enjoy this Issue!

Electromagnetically yours,



Martin C. Feldman,FNAWCC

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MART

WANTED: Self-Winding C.C., N.Y.--80 beat Style F Movement--140 Beat Mvt.-12" Dial--Sweep Sec. Hand. Bill Dillon,1495 S.Macon St,,Aurora,CO.80012 (303) 755-2070

REPAIRS: All early battery clocks including Pooles, Barrs,Tiffany Never-Winds, Eurekas, etc. Specializing in Bulle clock repairs using original parts. One month maximum time for all repairs. Martin C.Feldman,620 Reiss Place,Bronx,NY 10467

WANTED: Electrical Horological Literature of any type.-Martin C. Feldman

WANTED: Unusual Electrical Clocks- A. Marx, 105 Bayeau Rd. New Rochelle,NY 10804

FOR SALE: BULLE "Clockette", small crystal repeater type; $350; SWCC,N.Y. wood case: $125; SWCC, N.Y. Round Metal Case; $90 postpaid L. O'Briant, 3516 Swift Dr., Raleight, N.C.27606

FOR SALE: Tiffany Neverwind, small size G.R.O. Replated-$150.00. Barr-GRO $165.- Poole, early model # in the 2,000-G.R.O. $225.00 All U.P.S. prepaid. Charles Roth, 2 Circle Lane, Roslyn Hts, N.Y. 11577

WANTED: Any unusual early electrics. top prices paid. Will also pay finders fee for anything that can be purchased.

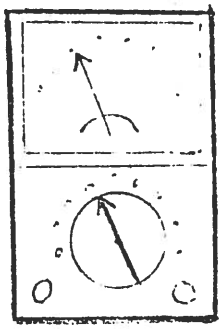
Charles Roth

WORKING WITH ELECTRIC CLOCKS - A SHORT PRIMER

By: Bruce C.Levy

Practically all electric clocks, at least those dating before the era of the transistor, are in many ways similar to "ordinary" mechanically driven clocks- they have gears, pinions, escapements, etc. However they differ because electrical energy is used as the power source to maintain movement. Therefore a screwdriver, pliers, files, etc. are not by themselves adequate tools to work with these machines. The type of extra equipment required need not be fancy nor expensive. I have listed below what I consider the most important extra equipment, including a short discussion of each item regarding their use, cost and availability.

(1) A volt-ohm-milliameter (V.O.M. for short)



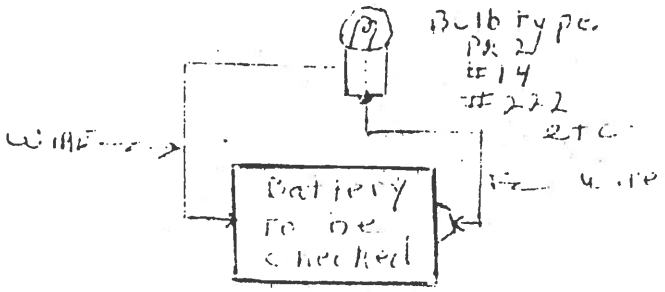
This instrument will measure volts applied to a clock, current (in milliamperes) a clock is using, and resistance of such things as wire coils as well as helping to locate shorts or breaks in wiring. It can be obtained for under $10 (Lafayette Radio part #38A9056 or Radio Shack #28-4012 kit form). Both these models are somewhat limited in their ranges but are adequate for most uses; they are extremely compact and will fit in the palm of one's hand. Slightly more sophisticated models costing $20 to $25 will have a greater range of coverage but obviously they cost more and are not quite as portable.

(2) A soldering iron (rated at about 25 to 30 watts) Radio Shack #64-2067 $2.99 or Lafayette #99A80350 $2.99. Personally I have found it a great convenience to invest in a small rechargeable soldering iron with nicad batteries. The cost ranges from about $14 to $25. The most convenient ones have a recharging stand. One just lifts the iron from its stand, presses a button and proper heat is available in 5-10 seconds. There are no cords to pull or tangle in your work, and a built-in bulb lights up the area to be soldered.

(3) Rosin core solder (a small package about 79¢). Do not use acid core solder as it will cause corrosion in electrical work!

(4) Contact cleaner spray. Generally sold for T.V. sets to clean contacts on the channel switch but excellent for contacts on electric clocks. Get the spray can that comes with a long tube in order to direct the liquid spray directly on the contacts and not shower the whole mechanism. Price $1 to $2 and is available at almost any electronic specialty store.

(5) Battery tester. It is sad when one embarks on repairing a clock that only needs fresh batteries. All that is needed is a small flashlight light bulb rated at 1.5 to 3 volts (to check 1.5 volt batteries) connected to about 6" of wire to each contact.



If the bulb glows brightly the battery is good. With a little experience one can recognize brand new fully charged batteries from those that are slightly run down. One cannot check batteries with a voltmeter alone because a battery practically completely run down may indicate the same voltage as a brand new one if it is not placed under load (that is doing work such as lighting a bulb).

(6) Alligator clip leads (Jumper cables).
These are a great help in temporarily connecting wires from one point to another, or experimenting on what goes to where in "basket cases". They cost about $2.50 for a package of 10 leads with clips on each end. Generally the slightly heavier duty cables (cost a bit more) hold up a lot better. They also offer less resistance to the current in a circuit.

(7) Battery holders
Very frequently old battery holders will be rusted and corroded and a new one will have to be installed. They come in various sizes for "A", "C", and "D" batteries as well as holding from one to six batteries.

(8) Power supply (battery eliminator) with variable voltage control.
Sadly this costs a bit more. In years gone by Lafayette Radio had inexpensive models with a built-in voltmeter and low range milliameter for less than $17, but alas no more. I noted in the 1979 Radio Shack catalog one available for $39.95 (part #22-123). Heathkit has one for $27 without the meter but one could use the V.O.M. described before to monitor voltage or current (#1P2728). Not only is the variable voltage power supply a great convenience, but it is helpful for trouble-shooting a clock that is requiring a higher voltage than normal to maintain power. For example, in a Bulle electric clock which is requiring 4 volts (it should only need 1½V) to maintain going power--one can clean the contacts and see if the voltage can be reduced, or try to remagnetize the magnet*, tighten all electrical contact screws, clean the mechanical parts of the movement etc. There are some large wall master clocks which require 12 to 24 volts D.C. and that is a lot of small batteries connected in series! Also some of these clocks have rather high current requirements and replacing batteries once a week or more often can be very expensive. For these high voltage and current requirements some kind of power supply is more sensible. Battery eliminators used for small radios or toys are fine for the high power drawers such as the large maste clocks just described.

And finally if one is no longer interested in battery clocks the expense invested in this equipment is not all lost!! (Perish the thought.-Ed.)

(1) V.O.M. - check light bulbs, check voltage in a wall socket, in resistance position can even be used as crude lie detector!
(2) Soldering iron - become an artist and use heated tip to draw burn pictures on flat pieces of wood.

*Generally difficult to do as the magnet is tripolar!

(3) Solder - stretch it out and connect it to rabbit ears (antenna) on TV for better reception.

(4) Contact cleaner spray - believe it will work to anaesthetize butterflies if you collect them.

(5) Battery tester - when you can't find a flashlight you might use this to light up your way.

(6) Alligator clips - hang up the laundry.

(7) Battery holders - now this might be useless, they seem a bit too large to place under one side of a small table pendulum clock to bring it back into "beat".

(8) Power supply - use it to operate a small transistor radio in an emergency when you have no more batteries, or consider it an investment and sell it - the price on this type of equipment seems to be rising faster than inflation.

REFERENCES

Radio Shack, 2617 West 7th Street, Ft. Worth, Texas 76107

Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L.I.,NY 11791

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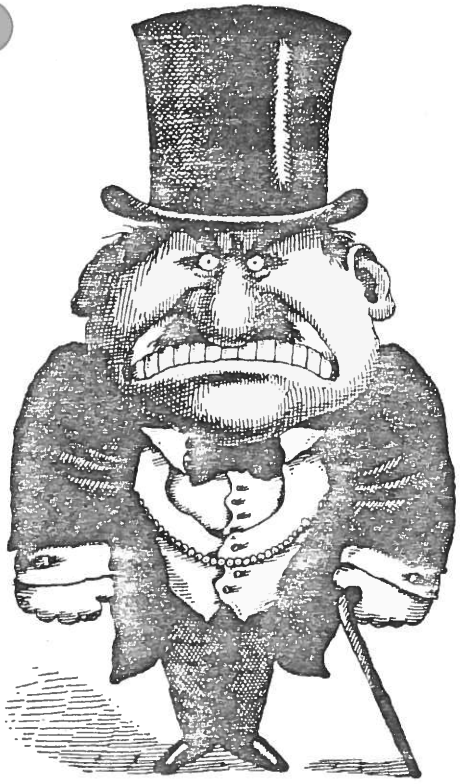

What does mean mean?
Well, it means mean:
'I **mean** it'.
It means mean:
'I mean you're a **mean** man'.
It means mean:
'I mean you're a mean man
of **mean** estate'.
And it means mean:
'I mean you're a mean man
of mean estate who
hews to the golden **mean**'.

PLEASE CHEER OUR TREASURER UP!

SEND DUES TO:

Mr. Charles Roth
2 Circle Lane
Roslyn, NY 11577

Bulletin No. 44.

See April 1979 For A Better Copy

MASTER CLOCK INSTRUCTIONS

(1) Hang the clock on a screw or lag bolt not less than $\frac{1}{4}$" diameter. Drill the hole for this support so that when screwed into place the outer end will be higher than at the point where it enters the wall. When the clock is hung it will then have a tendency to slide back against the wall.

After the clock is hung and the pendulum installed, move the bottom of the case to right or left until the pendulum top is directly in line with the center of the pendulum scale, hold in this position and after lowering one end of the pendulum scale insert a $2\frac{1}{2}$" x No. 12 round head wood screw in the hole provided back of the scale and make sure that the case is absolutely firm at the bottom. It may be necessary to mark the location of the bottom hole and remove the case from the wall in order to drill and plug the hole. Rawl plugs are suitable for this purpose.

TO PLACE METAL PENDULUM IN POSITION

(2) Remove nut and stirrup on bottom of pendulum rod. Hold rod securely downward and slip pendulum bob on rod (bob should hang with spring on back at top), screw nut until top edge of bob comes even with pencil mark on rod. This will give a fairly accurate rate, and rate can be made closer by screwing nut up or down as is necessary. Raising bob will rate clock faster, and lowering, slower. One turn of this nut will change the rate of the clock approximately, 2½ seconds in 12 hours. Extreme care must be taken not to lift or twist rod when in position as the suspension spring is very delicate. See that verge lever rocks in position in the slot for same in pendulum rod back of movement.

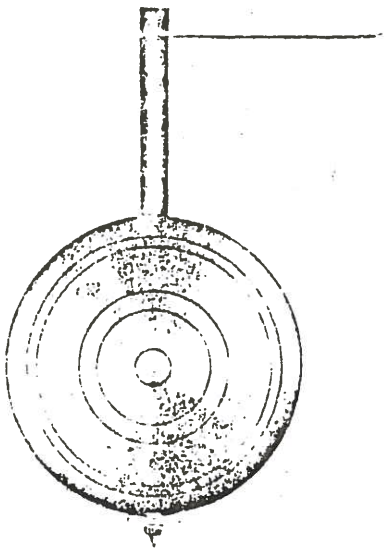

Fig. 60

PLACE MERCURIAL PENDULUM IN POSITION

(3) When the clock is equipped with a pendulum of this type, it will be found that it has been shipped outside of the clock case and must only be assembled after clock is placed in position. Hang the rod on the suspension spring which is secured to the upper part of the iron frame back of the movement, being careful not to twist or bend the spring; then slip the fork of the verge lever over the pendulum rod. Next fasten the two tubes of mercury into place. Be careful to avoid changing adjusting nuts A or B as these are carefully adjusted at the factory while the clock is being regulated.

(4) The pendulum may need further regulation after installation, in which case proceed as follows:

Turning regulating nut "A" Fig. 61 to the right raises pendulum, rating clock faster; to the left lowers pendulum, rating clock slower. This nut is marked with 50 divisions at its upper end and turning it two divisions will affect the clock regulation approximately one second in 12 hours. After clock is roughly regulated fairly accurate by means of nut "A" fine regulation may be secured with nut "B" without stopping the pendulum. Nut "B" is a micrometer adjustment and one complete turn of it will affect the regulation of the clock but a fraction of a second in 24 hours. This nut is fitted to turn freely and can be turned either way with a lead pencil while pendulum is in motion.

Fig

TO CONNECT MASTER CLOCK TO BATTERY CIRCUITS, ETC.

(5) Follow the wiring diagram closely, noting the numbers marked on same and also stamped on the back of the master clock near the connectors. Terminal No. 1 at left of case should be connected to the negative side of the storage battery and + battery to the positive side. Terminals No. 2 and No. 4 are only used when a program clock in separate case is included; then both of these connect directly to similar numbers on the program clock; No. 2 on master clock to No. 2 on program, and No. 4 to No. 4. No. 7 terminal is for connection to auto charger, and auto lighter when used.

(6) Secondary clock circuits are numbered 1-C, 2-C, 3-C, etc., and to each terminal is connected one side of a circuit; No. 1 circuit to 1-C, No. 2 circuit to 2-C, etc., the other side of each circuit being connected to the + bus bar. Where there is a separate secondary clock control cabinet No. 5 will be used to indicate the impulse circuit on or in that cabinet, also on top of master case. (No. 5 was formerly used to indicate the secondary clock terminal on a one circuit master clock.)

Where the program is installed in the master clock case, the switches will be in the back of the case at the bottom and the push buttons below the door on the outside.

OPERATION OF MASTER CLOCK (7) To start master clock, first see that all single point switches are open. This disconnects the secondary clocks and prevents them from scattering. Then press the strap key marked "Wind" in bottom of case 54 times slowly, and, after winding, start the pendulum and see that it swings up to the screws on the scale.

(8) See that the second hand advances evenly at each swing of the pendulum; if it does not, locate the beat adjusting screw attached to the escapement at the top of the movement and turn it slowly in one direction or the other until the movement of the second hand becomes uniform. The clock will then wind itself every minute without assistance so long as the battery is in good condition.

(9) When it is necessary to remove the dial from the master clock, care should be taken in replacing the hands; the second hand being adjusted to point exactly to 60 at the top of the seconds circle and the minute hand directly over the proper minute division at the instant the secondaries jump. The pendulum will have swung to the left at the same instant.

(10) When the master clock is arranged to control a number of secondary clocks, it is usually equipped with one milliammeter, and a pilot dial for each circuit. In case of only one circuit of secondary clocks the milliammeter is connected into the circuit permanently. When more than one circuit, a strap key for each circuit is provided which will connect the milliammeter into any circuit for testing. Each circuit is equipped with a single cut-out switch. A strap key is also provided with which one or all circuits may be set.

OPERATION OF SECONDARY CLOCKS (11) Secondary clocks with dials up to and including 14 inches diameter may be set separately by turning hands forward or backward. Large dials may be set individually with dry batteries at connectors. All secondary clocks on circuit or circuits may be set forward by depressing and releasing strap key marked "Clocks" in bottom of master clock. This will set secondaries forward one minute for each depression of key. Care must be taken not to press key when second hand on master clock is near 60. Key must never be pressed rapidly and especially if large dials are being used. With small dials it can be pressed once a second but with large dials two to four seconds should elapse between depressions. The pilot clock may be set individually ahead or backward by pressing downward on the setting stem found on the upper right-hand side and turning to the left or the right.

(12) When setting an individual circuit ahead, open all switches, except the one in the circuit to be set. Press the key marked "Clocks" the requisite number of times and then close the switches. When a circuit is fast open the switch controlling it and leave it open until its pilot clock indicates the correct time; then close the switch after the second hand has passed 60.

MILLIAMMETER (13) This instrument is connected permanently in the circuit when installed in single circuit series systems, and should indicate at least 150 milliamperes when the secondary circuit is closed; if it fails to indicate this the secondary clocks are likely to lose time or scatter. In master clocks controlling more than one circuit, the milliammeter is connected to the strap keys at the bottom of the case marked "Test Keys." These tests determine the condition of the different circuits in reference to battery, for it is necessary to have the circuits as nearly balanced as possible. If one circuit has more clocks than the other, or others, sufficient resistance should be connected in series with the lighter ones to cause a uniform reading on the milliammeter. When a master clock is equipped with a milliammeter and more than one circuit of series clocks, any circuit may be tested by depressing it's test key and observing the milliammeter, as the latter registers the amount of current flowing in the circuit each time a test key is depressed. Not more than one key should be depressed at a time. Tests should only be made between five seconds past and five seconds of any even minute, on account of possible interference with the contacts in the master clock and scattering of secondary clocks.

BATTERY GAUGE (14) This instrument was formerly used and is connected and used the same as the milliammeter, but should indicate not lower than NORMAL, when the secondary clock circuit is closed. Clocks are likely to lose time or scatter if indication is lower than this.

(15) The foregoing instructions on "Battery Gauge," and "Milliammeter," apply only where a series system of apparatus is used. When battery gauge or milliammeter is used with a multiple system it is connected permanently in series with the relay magnets and is used to indicate the condition of the battery but does not indicate condition on the secondary circuits.

MISCELLANEOUS (16) ALL JOINTS IN THE SYSTEM WIRING MUST BE SOLDERED AND WELL TAPED. BE ABSOLUTELY SURE THAT ALL SCREW AND BOLT CONNECTIONS ARE PERFECTLY CLEAN AND TIGHT.

For a series system of clocks No. 14 or No. 16 rubber covered copper wire should be used where wires run inside of buildings, and not smaller than No. 12 hard drawn weather-proof copper wire for outside wiring. Where wires are to be run in tunnels, ducts or other places where a wet condition is likely to exist, lead covered cables should be used.

Where a multiple (parallel) system of time apparatus is to be installed, the size of wire necessary depends upon the amount of apparatus to be operated and length of circuits, and reference should be made to wiring diagram for instructions as to size of wire.

(17) Never use a clock battery for any purpose except for operating the master clock and such other apparatus as may be permitted by this company.

MASTER CLOCK MOVEMENT SHOULD BE CLEANED AND OILED AT LEAST EVERY TWO YEARS.

For further information address home office or nearest branch.

MAIN OFFICE AND FACTORY

THE STANDARD ELECTRIC TIME COMPANY

89 Logan Street, Springfield, Mass.

BRANCHES:

1228 Munsey Bldg., Baltimore
625 S. 18th St., Birmingham
10 High St., Boston
901 Mutual Life Bldg., Buffalo
217 Latta Arcade, Charlotte, N. C.
1510 Monadnock Bldg., Chicago
1333 Union Trust Bldg., Cleveland
83 South High St., Columbus
716 Mercantile Bank Bldg., Dallas
562 Penn Street, Denver
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918 Western Ave., Seattle
110 S. Cedar St., Spokane

THE STANDARD ELECTRIC TIME CO. OF CANADA, LTD.

Works, 726 St. Felix St., Montreal, Que.

Printed in U. S. A.

Bulletin No. 45.

PROGRAM CLOCK INSTRUCTIONS

Program Mechanisms are mounted in either the master clock case or separate case.

Program Ribbons are of either 12 hour or 24 hour length.

(1) Where program mechanism is mounted in separate case, hang the case on the wall near the master clock by means of a strong screw through hanger at top of the case. Then put a small screw through back of case near the bottom to hold the case securely in position, after which remove all cords from the movement that was placed there for shipping.

TO PLACE PAPER RIBBON ON MOVEMENT

(2) All program clocks leave the factory with calendar drum or 12 hour shift set at 6 a. m., so that ribbon should be put on before program clock is started. At this position place ribbon on sprocket drum so that 6 a. m. on the ribbon comes directly where contact fingers meet contact bar, then down around the spool on the bottom left, then up around spool in center, then around bottom outside spool on right. Where 24 hour ribbon is used a double set of idler spools are provided. When changing ribbon, be sure that it is replaced so the calendar drum changes when 6 a. m. on the ribbon is directly under the contact fingers.

PUNCHING SCHEDULE ON RIBBON

(3) A suitable punch for this purpose is included with all program clocks. Use this with the open side up so that the division lines on ribbon can be readily seen. **Punch hole exactly between lines,** leaving a margin on the edge of the ribbon of about 1-16" uncut. This is necessary to retain strength of ribbon where cut and prevent curling of corners. Two schedules can be cut on each ribbon, one on each side of center holes.

TO CONNECT PROGRAM WITH MASTER CLOCK, BELLS AND BATTERY

(4) Where program mechanism is in separate case, follow the wiring diagram closely in regard to numbers marked on the diagram and stamped on the program clock near connectors on top of the case. No. 1 on program case is the negative battery terminal. No. 2 on program case must be connected to No. 2 on master clock case and is the connection between the master clock duration contact and program movement frame and contact bar. No. 4 on program case must be connected to No. 4 on master clock case and is the connection between the program circuit closer on the master clock movement and program magnet coils. The connector marked B+ is for positive battery and may be connected to either the + bus bar on top of the master clock or to positive battery direct. B- is the common return wire from the program movement and relay magnet coils. The connectors marked "Bells" are for connection to bell circuits; the bells being wired in multiple and in all cases the coils should be wound to high resistance. The return wire from each bell circuit should be connected to the bar, and should be connected to some return to positive battery. Where bell control boards are used, bell returns are terminated therein, and connections made there between them and the program clock. A wiring diagram is furnished with each clock system.

SETTING OF PROGRAM

(5) To set program movement on time with the master clock the lower lever on the left of the movement depressed and released will move ribbon forward one minute for each depression. To run off several hours quickly, depress lever with one hand and with the other hand turn main ribbon drum, by the knurled nut in front, nearly up to time; then finish by moving ribbon to exact time by depressing lower left hand lever a sufficient number of times, care being taken in noting position of the second hand on master clock, as contact (for operating program mechanism) is made at 30th second for the next minute. For example, at 12:15½ the program should move to 12:16. The 12 hour ribbon makes one complete turn in twelve hours, and the 24 hour ribbon makes one complete turn in twenty-four hours. At the end of the 12 hour period the black calendar drum moves forward one division. This controls the contact fingers by 12 hour periods, allowing the fingers to connect with contact bar through the properly punched holes or preventing the contacts according to the position of the pins placed in calendar drum. To set the rubber calendar drum, set the ribbon forward as directed above until the drum moves one position, then advance it by depressing and releasing the upper left hand lever until it shows the proper day directly at the bottom, after which set the ribbon to time.

CALENDAR DRUM

(6) This drum has one row of fourteen holes in alignment with each finger, one hole for each 12 hour period during the week, and a pin in any particular hole will hold finger out of contact and keep bells silent on the circuit that finger operates, for the twelve hours that the pin is in position. For example, hole in line with Monday on drum is open, pin is placed between Monday and Tuesday, left open Tuesday, pin between Tuesday and Wednesday, etc., to Saturday

night, then pins in each hole to Sunday night. This allows finger to make contact Monday morning to Saturday night during the day and keeps the bells silent at night, also Sunday. This arrangement can be varied to suit any requirements by changing the position of pins, or adding pins.

(7) If the program clock should by accident be set ahead of time, it will be necessary to spin the ribbon all the way around again, or to stop it until correct time is indicated by it.

DO NOT TRY TO TURN EITHER CALENDAR DRUM OR RIBBON DRUM BACKWARD.

(8) If only one circuit of bells is to be operated, schedule can be varied for some particular day or days by connecting the circuit to two or more of the connectors marked "Bells," and interchanging the pins on calendar drum according to the schedule desired, using one edge of the ribbon for part of the week and the other edge for the remaining day or days.

(9) When program mechanism is mounted in separate case one push button and one single point switch for each circuit is located on the upper left hand side of the case. The switch lever when closed will allow bells to ring automatically on the particular circuit it controls according to the schedule punched on the ribbon. When the switch is open, bells will not ring automatically. The push button directly over the switch will ring bells on its particular circuit regardless of the position of switch or ribbon.

(10) Where the program is installed in the master case there will be no connectors marked No. 2 or No. 4 on top of the case. The switches will be in the back of the case at the bottom and the push buttons below the door on the outside. Other directions same as for program in separate case.

PROGRAM RELAYS

(11) The relays are adjusted at the factory and require no further adjustment. The contacts are made of tungsten and can easily be detached and renewed, although they have an extremely long life. The small graphite rod at the top of the relay is a high resistance shunt placed across the terminals of the magnet to quench the sparking at the contacts in the master clock.

DON'TS FOR PROGRAM CLOCK

(12) Don't lubricate any part of a Program Movement.
Don't forget to keep the door locked to keep out the dust.
Don't fail to examine the connections on the top of the case to be sure that that they are right.
Don't leave the switches open and expect the clock to ring the bells automatically.
Don't forget to see that the calendar drum is set correctly before setting the ribbon.
Don't punch the holes in the ribbon on the line, for they should be punched between the lines.
Don't punch the holes in the ribbon too near or too far away from the edge; 1-16" from the edge is correct.
Don't bend the fingers that make the contact through the ribbon; they are adjusted at the factory and should not be changed. The end of the finger should rest on the ribbon midway between the lines, not on the line.

(13) For further information address home office or nearest branch.

MAIN OFFICE AND FACTORY

THE STANDARD ELECTRIC TIME COMPANY

89 LOGAN STREET, SPRINGFIELD, MASS.

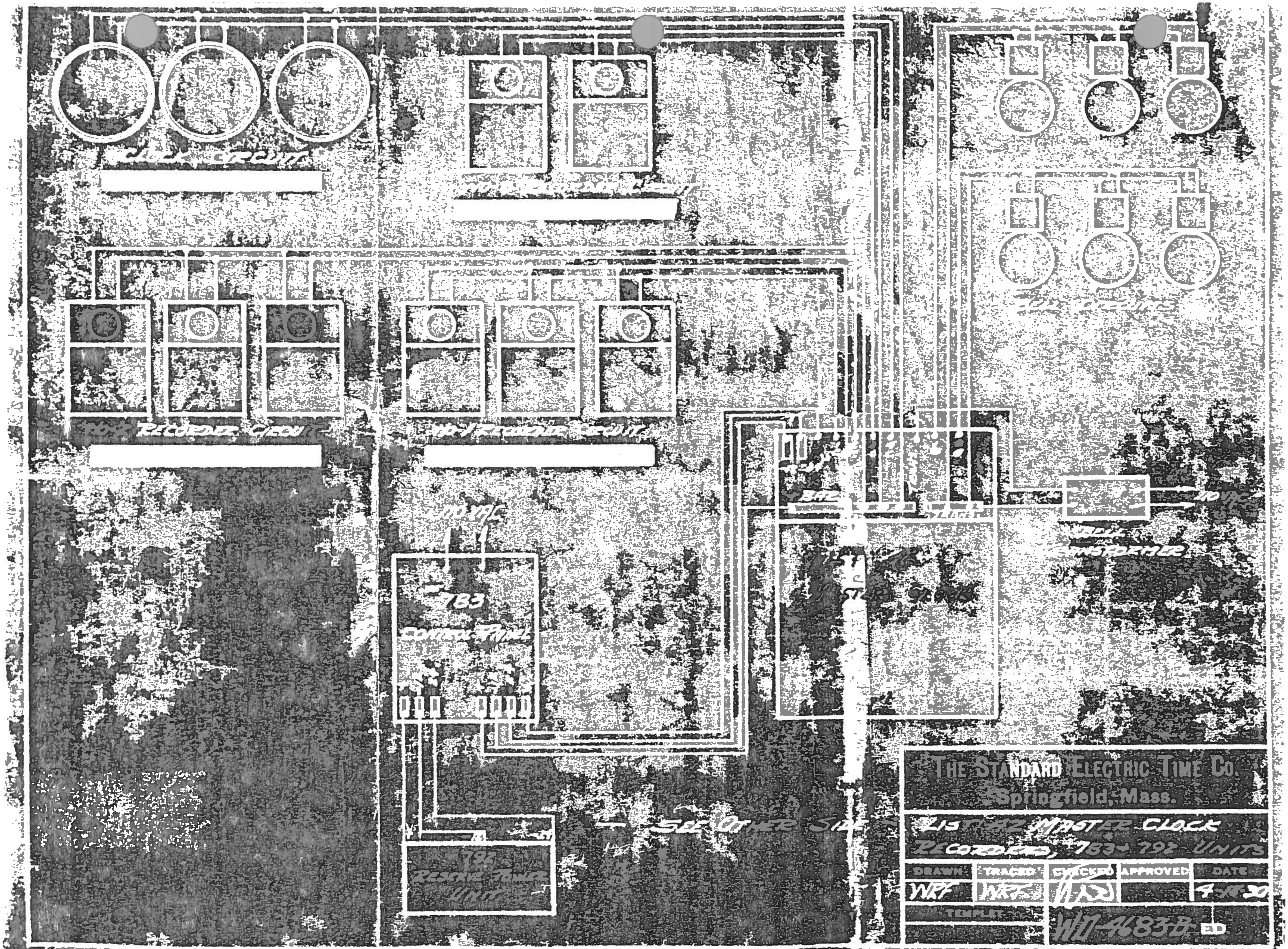
BRANCHES:

BALTIMORE—1228 Munsey Bldg.
BIRMINGHAM—625 South 18th St.
BOSTON—10 High St.
BUFFALO—901 Mutual Life Bldg.
CHARLOTTE, N. C.—217 Lotta Arcade
CHICAGO—1510 Monadnock Bldg.
CLEVELAND—1335 Union Trust Bldg.
COLUMBUS—83 South High St.
DALLAS—716 Mercantile Bank Bldg.
DENVER—562 Penn St.
DETROIT—806 Donovan Bldg.
KANSAS CITY, MO.—Mutual Bldg.
LOS ANGELES—124 W. 4th St.
MINNEAPOLIS—745 McKnight Bldg.
NEW YORK—50 Church St.
PHILADELPHIA—1612 Market St.
PITTSBURGH—Bessemer Bldg.
PORTLAND, ORE.—229 Pine St.
SAN FRANCISCO—390 Market St.
SCRANTON—148 Adams Ave.
SEATTLE—518 Western Ave.
SPOKANE—110 S. Cedar St.

THE STANDARD ELECTRIC TIME CO. OF CANADA, LTD.

WORKS, 726 ST. FELIX ST., MONTREAL, QUEBEC

Printed in U. S. A.

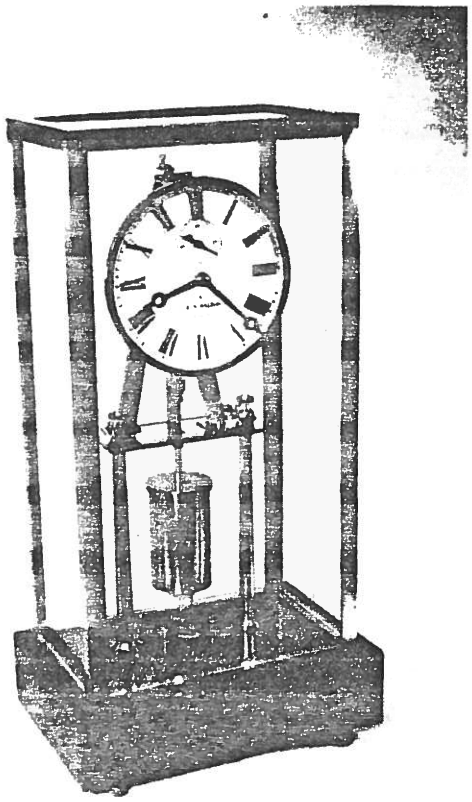


CLOCK CIRCUIT
No. 2 RECORDER CIRCUIT
No. 1 RECORDER CIRCUIT
110 V AC
783
CONTROL PANEL
792
RESERVE POWER
UNIT
SEE OTHER SIDE
MASTER CLOCK
110 V AC
TRANSFORMER
THE STANDARD ELECTRIC TIME Co.
Springfield, Mass.
LIST 42 MASTER CLOCK
RECORDERS, 783-792 UNITS
DRAWN
TRACED
CHECKED
APPROVED
DATE
WRF
WRF
TEMPLET
WD-4683B

COLIN WALTON (CLOCKS)

11, Tythe Close,
Gazeley, Newmarket,
Suffolk. **Tel. Newmarket 750125.**

The K I 0·5 Second Pendulum Battery Driven Clock



The completed clock.

The K I Clock Kit is designed primarily for the Model Engineer who has an interest in horology or wishes to build something different.

The clock, when complete, stands 17″ high by 9″ wide by 6″ deep and looks an attractive feature in any room.

The basic requirements to build the clock are a small lathe, drilling machine, silver soldering facility, and the usual small tools, taps and dies etc. The kit is designed to take out the problems of wheel and pinion cutting, winding coils and depthing the train of wheels correctly. Thus leaving you the pleasant task of straight forward machining and hand work to complete the clock, in the knowledge of not having to search for the correct materials and that the end result will be a successful time piece, both pleasing to look at and accurate.

The clock is based on the well known Hipp principle, and is driven by a 3 volt flashlamp battery with a lifespan of about 9 months.

The kit shown in the photograph below consists of the following:

All the materials including brass, screws, steel, etc.

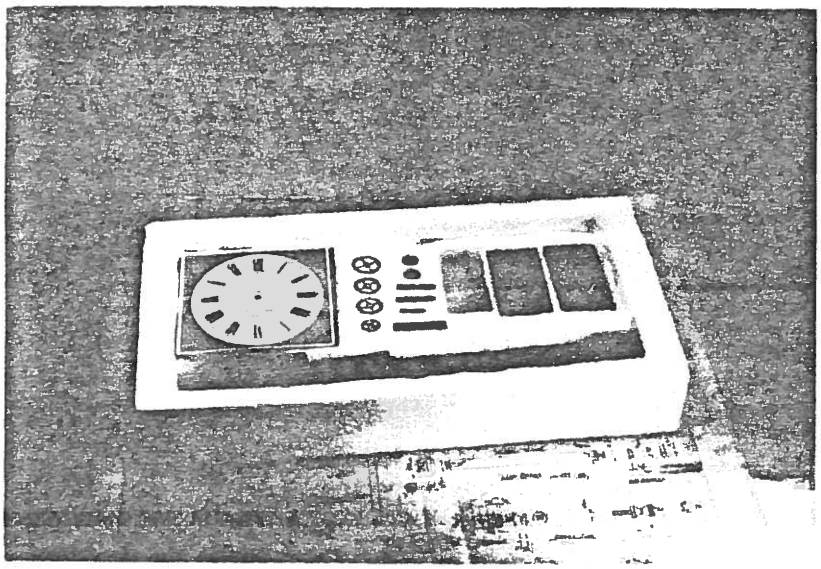
The wheels ready cut and crossed out, and the pinions complete ready for assembling.

The solenoid coils ready wound.

One engraved pendulum scale.

Two silver contacts.

A full set of drawings and instructions.



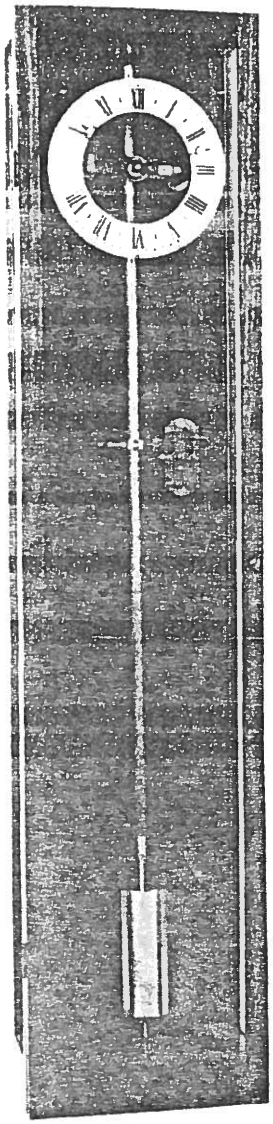
The K I kit of parts.

The kit does not include the glass panels for the cover, the wood for the base or the battery.

COLIN WALTON CLOCKS
11 TYTHE CLOSE
GAZELEY, NEWMARKET
SUFFOLK

TEL. NEWMARKET 750125

THE K.2 1 SECOND PENDULUM WALL CLOCK



THE COMPLETED CLOCK

The K.2 is the second electrically driven clock to be offered as a kit, following the success of the half second electrically driven clock, the K.1., and the very popular clockmaker's depthing tool.

It is an imposing timepiece, having an overall length of 47" and width of 10½".

The K.2 was originally built in 1969, and has proved to be a most successful and reliable timepiece. It incorporates the Scott notched wheel principle in its design, which operates the impulsing for the one second pendulum, which is an intriguing feature of the clock.

This model is aimed at the constructor who wishes to incorporate more cabinet making skills and a little less clockmaking to obtain what is an elegant and accurate clock. To complete the clock you require a small lathe, drilling machine and the usual small tools.
The kit consists of the following items:-

All the materials including brass, screws, steel etc., to make the clock mechanism.
Silver plated chapter ring 8" diameter.
The wheels ready cut and crossed out, and the pinions complete ready for assembling.
The solenoid coils ready wound.
A full set of drawings and instructions.

The kit does not include the wood or glass for the case, as the constructor may wish to choose his own timber, although detailed dimensions and instructions are provided in the kit.

To: COLIN WALTON CLOCKS,
11, Tythe Close,
Gazeley, Suffolk,
CB8 8RS.

Please send me ..... K.2 Wall Clock kit(s) at £31.00 each, p. + p. + VAT £3.00 extra.

I enclose a remittance of £ ..... (Cheques should be crossed and made payable to Colin Walton Clocks)

Name: .....

Address: .....

..... Date: .....

COLIN WALTON (CLOCKS)
CLOCKMAKER & RESTORER
11 Tythe Close, Gazeley,
Suffolk
Tel. Newmarket 750125

Mr. M.C.Feldman,
President, Electrical Horology Society,
620 Reiss Place,
Bronx,
NY 10467

15th. January 1979

Dear Mr. Feldman,

Please find enclosed details of the two electric clock kits which we currently produce. A number of the K.I. Clock kits have been sold to the U.S.A. and Canada.

We are aware of the high postage costs, and are able to offer "export" kits, which exclude the heavy brass, thus keeping postage costs to a minimum. The K.I.Clock kit is made up of the following items:-

Drawings, instructions and parts list @ £3·25
Solenoid coils and silver contacts @ £2·00
One pair movement plates, ready drilled @ £2·00
One set wheels, one wheel and pinion assembly, two pinions all ready, cut, @ £8·00
One dial @ 80p.

The K.2 "export" Clock kit is made up of the following items:-

Drawings, instructions and parts list @ £3·25
Solenoid coils @ £2·00
Movement plates, jig drilled @ £2·50
One set wheels, one wheel and pinion assembly, two pinions all ready, cut,
one Scott notched wheel @ £10·00
One silver plated chapter ring @ £5·00
One suspension spring, silver contacts @ £1·00

In either case please add £3·30 + 70p. insurance for air mail, or £2·20 + 70p. insurance for sea mail, and 60p. bank handling charge for cheques drawn on an overseas bank.

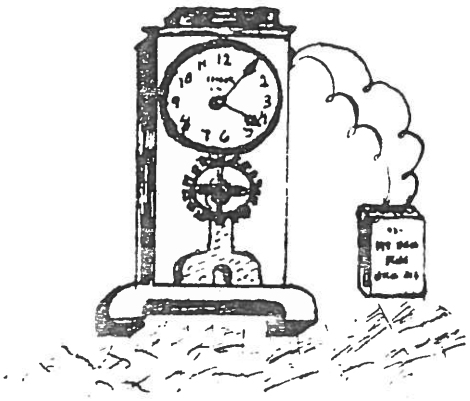
If we can be of further assistance please do not hesitate to contact us.

Yours sincerely,

for Colin Walton Clocks

The
JOURNAL
OF THE
ELECTRICAL HOROLOGY SOCIETY
Chapter No 78

April, 1979
VOLUME V---ISSUE #III
Martin C. Feldman, Editor



Hello fellow enthusiasts:

First a few words of apology and explanation regarding the poor reprinting of the Standard Electric Clock Company master clock set-up instruction sheets. I very much regret this happening but the printer had a poor copy to start with. He made every effort to improve on the copy by printing on one side only which is a first for our Journal, and a very expensive one as well. Unfortunately, his efforts were unsuccessful. We have succeeded in obtaining a better copy, and as I do not see the Journal for sometime after it is printed, I can only hope that the second attempt is much better. Last month we included some information on electrical clock kits from the English firm of Colin Walton. George Feinstein has sent for the kit and advises that it would be much better if one would not order the export kit, but the complete kit, which is available to our British cousins. He feels that it is well worth the extra postage and expense for the additional materials which have been left out in the export kit. George has not begun to construct the kit yet, but he will have more to say in a future issue.

In the February 1978, VOLUME IV--#1 Issue of our Journal we printed an excellent article by Paul Hopkins which described his modification of a Matlock-Collins Clock. Paul has continued his original work and now offers us a timer in order to verify the accuracy of this clock. In addition we will be printing a further modification of this timer so that it can be used to rate other non-electronic master clocks. This article will be run in a series of two, and probably three, installments.

Enjoy this Issue!

Electromagnetically yours,

Martin C. Feldman, FNAWCC

A TIMER FOR CHECKING AN ELECTRICALLY IMPULSED CLOCK AGAINST RADIO STATION WWV

In a previous article for the Electrical Horology Society I discussed work that I had done using electronics to count pendulum swings and to magnetically impulse the pendulum.[1] After the article was finished, I saw a copy of an issue of the Horological Journal which contained one part of a 7 part series on pendulums written by A. D. Bateman.[2] That issue led me to subscribe to the Horological Journal, retro-actively so as to obtain Bateman's whole series. Included in the series were references to a precision clock built by Mr. Bateman using electronic pulse counting,[3] and to a timing device built to check his clock against the British equivalent of our WWVB.[4] In obtaining and reading copies of Mr. Bateman's papers, I learned that my efforts had been preceded by several years, and that a couple of my statements closely resembled thoughts expressed by Mr. Bateman. Therefore, I shall start off by saying that the idea for this timing device came from Mr. Bateman, as described in the Feb., 1973 Horological Journal.

After deciding to try to make a timer, my first thought was to follow Bateman and use the 60 KHz signal broadcast by WWVB. However, I quickly decided that receiving the 60 KHz signal would be rather difficult, so I looked for another approach. (I have since learned that a WWVB receiver is commercially available for approximately $100.00). My next idea was to use WWV, and the tones contained in its broadcast signals. After reviewing the tones available it appeared that the 1000 Hz tone heard at the start of every minute (except on the hour) offered the most advantages. Therefore, the overall scheme shown in fig. 1 was reached.

Briefly, the circuitry works as follows: The WWV signal is amplified, clipped, and put through a 1000 Hz band-pass filter. The 1000 Hz signal which is passed by the filter is amplified again and then rectified by a full wave bridge. The output of the bridge is applied to a "Schmitt Trigger". (A circuit with a lot of hysteresis. It takes approximately 3 volts to turn this gate "on", and the gate will stay "on", then "of", then "on" again). The output of the Schmitt trigger is used to start a "timer-controller" circuit. When this circuit operates, 1000 Hz pulses are allowed to be "gated", or fed, to four counter - readout devices. These devices count the pulses passed by the gate while the timer-controller is turned "on". In normal operation, shortly after the "timer-controller" is turned "on", the pendulum will be impulsed. Through an optical coupler and a buffer gate, a "stop" pulse is sent to the "timer-controller", stopping the pulses from going to the counter-readouts. The counter-readouts will display the number of pulses which have been fed to it, which will be the number of milli-seconds between the "start" pulse and the "stop"pulse. Of course this can also be read as seconds, 1/10's (0.1) of seconds, 1/100's, (0.01), and 1/1000's (0.001) of seconds. If the "start" pulse is not followed by a "stop" pulse within approximately 15 seconds the timer times-out to stop the pulsing. A reversing switch allows the operation to be started from WWV and stopped by the pendulum, or vice versa. However, I have found it preferable to keep my clock a few seconds slow, thereby starting the timer with WWV, and stopping it with the clock.

The first hurdle to clear in the design was that of the 1000 Hz filter, so I turned to my electronic experts, Jim Warren and Roger Lee. The first circuit tried was what is called a "Phase Locked Loop". This is a circuit in which the

input produces an output, part of which is fed back to modify the input, which changes the output, etc. until a stable operating condition is obtained and maintained. This circuit did act as a filter, but the time required to obtain the output was inconsistent. Sometimes it operated in 10 milli-seconds, and sometimes it took 20 milli-seconds so the Phase Locked Loop was rejected. The next approach was a circuit called a "twin-T", filter. An "op-amp" (operational amplifier) is used with the "twin-T" resistance-capacitance filter network in the feedback circuit of the amplifier. This circuit appeared to work consistently, so design progressed toward the rectifier and Schmitt trigger. It was soon obvious that the signal applied to the rectifier was too small. I had been using what is called a single-ended op-amp, with a +5 volt power supply, resulting in a limited output level. Using a different op-amp and a double-ended supply of $\pm$ 12 volts greatly increased output levels where obtained. The Schmitt trigger then operated consistently 2 to 3 milli-seconds after the application of a 1000 Hz tone at the input. Of course, this $\pm$ 12 volt requirement complicated the power supply, but "you don't get something for nothing".

The opto-coupler circuit used to isolate the pendulum pulse from the timer circuits seemed straight forward. However, it was found that the opto-coupler itself could not control the "controller-timer" properly, so the buffer "and" gate was added. As noted on the wiring diagram, the resistor in series with the opto-coupler is a function of the voltage level of the input pulse.

The next consideration was the source of the 1000 Hz pulses which the counters actually count. If the device is to have resolution to 1 milli-second, which the counters can handle, the number of pulses must be correct, which means that the frequency must be correct. If 10 seconds elapse between "start" and "stop", 10,000 pulses will be involved. For 1 milli-second accuracy this means 1 part in 10,000, or .01%. If we are looking only for clock rate it could be argued that this accuracy is not too important as long as the pulse rate is constant. However, a crystal controlled oscillator is the only practical way to obtain a constant pulse rate, therefore crystal accuracy was deemed necessary. At that point, Jim Warren pulled out a circuit board which he had built and then put aside, consisting of a crystal controlled 10 MHz oscillator, and the necessary divide by 10 stages to provide 1000 Hz pulses.

The whole package was then put together, and tested on the work bench-with great success. WWV was then applied to the input, and all (you-know-what) broke loose. The 10 MHz oscillator did a great job of messing up WWV. The first approach at getting around this problem involved turning the oscillator on and off at the start and finish of the timing cycle. This worked - after a fashion - but WWV was still obliterated while the oscillator was running, and the oscillator did not always come up to frequency instantaneously.

In order to get away from these oscillator problems, a search was made for a lower frequency oscillator. By a stroke of luck a 96 KHz crystal was found in a piece of obsolete equipment. Using it, and duplicating its circuitry, gave a fine 96 Khz signal. A divide by 8 stage, followed by a divide by 12 stage gives the desired 1000 Hz. There is no longer interference with WWV, and the oscillator is allowed to run continuously. However, one minor bug did appear. My "shop" is not heated as well as it might be, and I found that the timer needed a warm up time of approximately 5 minutes. A change of resistance from 1.5 K to 1.8 K in the oscillator circuit resolved this problem. It is obvious when the timer is not counting seconds in step with WWV so there is no real danger of taking incorrect readings.

To be continued:

TIMER PARTS LIST

DIODES AND IC'S

2	1458 Dual OP-AMP
1	7414 Hex Schmitt Trigger
1	7408 Quad "and" Gate
1	7404 Hex Inverter
1	7492 Counter
1	7493 Counter
4	TIL-306 Counter - Displays
1	555 Timer
1	2 Amp 50 PIV (min.) Full Wave Bridge)
1	1 Amp 100 PIV (min.) Full Wave Bridge)
1	MC7812CP + 12 V. Regulator
1	MC7912CP - 12 V. Regulator
1	MC7805CP + 5 V. Regulator
2	1N4002 Diodes
4	1N914 Diodes
1	1N4733A 5.1 V Zener Diode
1	4N32 Opto-Coupler

CAPACITORS

3	1000 MFD 25V Electrolytic
2	1 MFD 50V "
1	2 MFD 12V "
1	10 MFD 25V "
2	.01 MFD Silver Mica (in filter)
1	.02 MFD " " " "
1	.005 MFD Disc
1	.05 MFD Disc

RESISTORS

3	1K Ohm
2	2.2K Ohm
1	33K Ohm
1	470K Ohm
3	10K Ohm
1	1M Ohm
1	27K Ohm
1	1.5K Ohm
1	1.8K Ohm (see text about this value)
1	1.5K Ohm
1	20K Potentiometer
2	10K Potentiometers (preferably ganged to facilitate adjustment)

NOTE: 1/4 Watt Adequate For All Resistors.

TRANSFORMERS

1	Power Transformer	115/24V CT @ 0.4 Amp
1	Power Transformer	115/7.5V @ 0.6 *
1	Audio Transformer	(transistor radio output transformer, or impedance metching transformer)*

* "On Hand" items used here, so exact rating or part number no known. A 6.3V 1A transformer probably satisfactory.

MISCELLANEOUS

1	8"x6"x3 1/2" Bud Box	4	16 Pin IC Socket
1	4 1/2" x 6 1/2" perforated plug-board	3	8 Pin IC Socket
1	Plug-Board Receptable	1	6 Pin IC Socket
1	2 Conductor Phone Jack	5	14 Pin IC Socket
1	DPDT Toggle Switch	1	40 Pin IC Socket
1	SPDT Toggle Switch (3 position)	1	40 Pin Header
1	SPST Toggle Switch	4	Pin Jacks
1	Fuse Holder and Fuse	1	96 KHz Crystal
1	Push Button With "Make" Contact	1	Line Cord

WWV RECEIVERS

Caringella Electronics Model STR-1
Caringella Electronics Inc., P.O. Box 727, Upland Cal., 91786

Radio Shack Timekube No. 12 - 159
Radio Shack, Fort Worth, Texas 76101

Next meeting will be held June 10th, at the home of Bruce & Maxine Levy. Please write or call for confirmation of reservations. Time 2:00 p.m. phone # 516- WE 5-2994
3 Saul Place, Plainview,N.Y. 11803

****

MART

REPAIRS: **All early battery clocks including Pooles, Barrs, Tiffany Never-Winds,Eurekas, etc. Specializing in Bulle clock repairs using original parts. One month maximum time for all repairs.**
Martin C. Feldman, 620 Reiss Place, Bx.NY 10467

WANTED: **Electrical Horological Literature of any type. Martin C. Feldman**

WANTED: **Unusual Electrical Clocks-A. Marx,105 Bayeau Rd.New Rochelle,NY 10804**

WANTED: **Synchronome Master Clock; Large secondaries--Henry Weiland, 8946 W. Grantosa Dr.,Mil.,Wisc. 53225--Tel.:414-463-4681.**

FOR SALE: Large Standing International Master-Has large brass bob, oak case, large IBM controlling mechanism, activated by clock. Inside case. GRO $650.00
Bernie Heyer, 49 Cherry Tree Lane, Roslyn Hts. L.I. 11577

UTILIZE YOUR MART--$2.50 per 4 lines!!!!

Printed circuit board production for the craftsman

by W H Bossons

Why bother

A CONSIDERABLE number of readers of HOROLOGICAL JOURNAL have, following the recent series on electronic timekeeping, written to me on the subject of PCB production asking how easy is it, for a complete stranger to this black art, to make his own.

I will try to set out, step by step, the various processes from very first principles using a minimum of special equipment.

Even if you are going to buy ready-made boards for the HJ clock (now that they are, at last, available) or are not interested in making a quartz crystal timepiece, the techniques, with little modification, can be applied to other allied production problems.

Very simple photo-etched boards with only a few components look so very much better than wandering wires and make-shift terminal blocks. An electrically maintained pendulum clock needs a battery holder and connector; insulated supports to contacts and hairsprings can be made with provision for spark reduction circuits and pressed-in terminal pins for leads are much neater than screw terminals. On some designs an etched circuit would, of course, be quite out of place but I think we all have enough sense of what is right and what isn't to understand that.

First steps

Since, like so many readers (I suspect), my own performance with a hand graver on a sheet of brass is pretty awful I have resorted to acid etching of dials, etc, from time to time since machine-produced engraving can look just what it is – mechanical. Here, just as with a PCB, the finished product is no better than the original "artwork". In all these matters we start with a metal surface and etch it away with a suitable chemical, leaving metal visible where we want metal. With a "printed circuit" (which really is only "printed wiring" in our case) we etch right through the thin metal to the insulating substrate, protecting the metal (copper) film with a "resist" where we want wiring to remain; the resist is then removed from the remaining copper strips and there is our circuit.

In the most simple method the wiring is drawn onto the surface of the copper-clad insulating sheet with an acid resisting ink or paint and the unwanted copper chemically removed.

There are two snags here:

1 The terminal pins of many electronic components have to be accomodated with precision so the holes in the PCB must be located for drilling with similar precision. It is hard to do this freehand with a pen or brush.
2 Whilst working directly on the board care must be taken not to allow dirt or grease from the hands to contaminate the copper surface where it will hold back the etching action of the acid.

This leaves us with two, very much better, methods of producing a professional board. Both are quite practicable for small quantity production and I use them both for "one-offs" in preference to the resist pen. They can be used, with advantage, for etched dial or name-plate production and with suitable acids for making small and complicated parts in thin metal foil; shims, gaskets, springs, – even hands.

With the first method we still work directly on the surface of the item to be etched but with pre-cut, self-adhesive shapes, letters and tapes. These are available in acid-resisting qualities from a number of sources (see notes at end). Groups of holes, such as the two rows of eight holes on a typical IC can be located with relative precision this way. Good looking terminal "pads", such as circles or tear-drops are also available as are arcs of circles in a range or radii. The snag, of course, is that if you make a mess of the etching or if anything else goes wrong you must start again, from scratch, with the production of the art-work. A further difficulty arises with the actual location of the lines and other symbols on the copper if you are copying the circuit from an original in your notebook or, perhaps, in a printed work. People have done this with carbon paper – or so the story goes!

The second method is to prepare your original on transparent, stable, plastics film, perhaps over a printed grid of lines on a 0.1 in pitch and use this as a master to print, by photographic methods, onto a copper clad board which carries on its copper surface a photo-sensitive resist which can be developed and then used in the acid bath in the usual way.

For the small-scale user this last method must seem a counsel of perfection but with the materials now available it is simple and quite cheap. The advantage of having a permanent record of the circuit which can be used again or just filed for reference is well worth the extra effort.

Materials

Actual boards

Copper clad boards (un-drilled, of course) are available from a number of sources, even over the counter in many electronic shops such as the Tandy or in the USA, the Radio Shack chain. These are either on a glass-cloth/resin base or on SRBP (synthetic resin bonded paper). They may be either single or double sided. Except for the cheapest applications it is by far the best to use the glass based material. It cuts and drills well and is not too hard on drills. If one has to drill the stuff for a living then carbide tipped drills are available but I have found good HSS drills more than

adequate for my own use. The thickness of the copper foil is usually measured by weight per unit area but I doubt if you will be given any choice. We would normally use single sided material since the relative location of circuits on two sides of one board calls for special techniques for which we have little need.

So-called "surplus" material is often available in hobby shops or by mail order and the monthly, electronic magazines often contain advertisements for this. It is perfectly satisfactory and can be at much reduced prices.

Photo resist

Two types are available. A positive resist will give a copper strip from under a black line on the transparent master. A negative resist will result in the copper being *removed* from under the artwork – useful for engraved lettering – later to be filled with black wax. To make life easy for us boards already coated with a positive resist are now readily available and if stored away from heat and light have a shelf life, I find, of at least a year. See notes, below, for suppliers.

If you wish to coat your own boards, or perhaps to photo-etch on other base materials then the real problem is to get a uniform coating. Again, there is a choice. One can obtain, for example from Messrs, Kodak, both negative and positive photo-resists but only in rather large quantities. I believe the smallest available is a quart or its metric equivalent. After thinning to a working consistancy with a suitable solvent (such as xylol) this is poured over the copper surface and distributed evenly by "whirling" or spinning the plate, horizontally, at about 500 r/min. all in subdued light. This never appealed to me and the alternative method seems much more suited to our needs.

A positive photo-resist is available in aerosol form in small packs, one brand being "Fotolak" (see notes below). It comes with its own developer but I believe a 5% solution of caustic soda can be used to develop as a (poorer) alternative. Provided one starts and finishes the spray away from the edge of the board this gives good results and would be a preferred way to photo-etch (say on brass) if pre-coated boards were not available.

Etching solution

Although other solutions are used in industry, the almost universal etchant used by amateurs is ferric chloride. 60 grams in 100cc of water is a usable strength. Ferric chloride is bought as a powder, usually from the same source as the actual boards; the solution stains badly and is corrosive. Label the bottle clearly, keep it away from foodstuffs, children and pets. Should you get a splash in your eyes wash them with lots of clean water – quickly. Keep it off your skin as much as possible and away from cuts etc. If you swallow it drink plenty of water followed by milk of magnesia and, to be sure, call your doctor. It is used by the ton these days but better sure than sorry. Dispose of it as you would any toxic waste – after use it will contain copper salts which can harm animals, vegetables – and septic tanks!

Master art-work

A stable, transparent plastics sheet is by far the best material to use Melinex (or Mylar) film is ideal and is much used in drawing offices. It can be either plain or lightly etched to take ink. If you tape it to a piece of graph paper (1/10 in squares) your circuit will be square, the lines parallel and the holes at the standard pitch of multiples of 0.1 in. If you are taking the circuit from an illustration then it can be taped in place over the original. Use masking or draughting tape to avoid damaging the original.

→ *page 34*

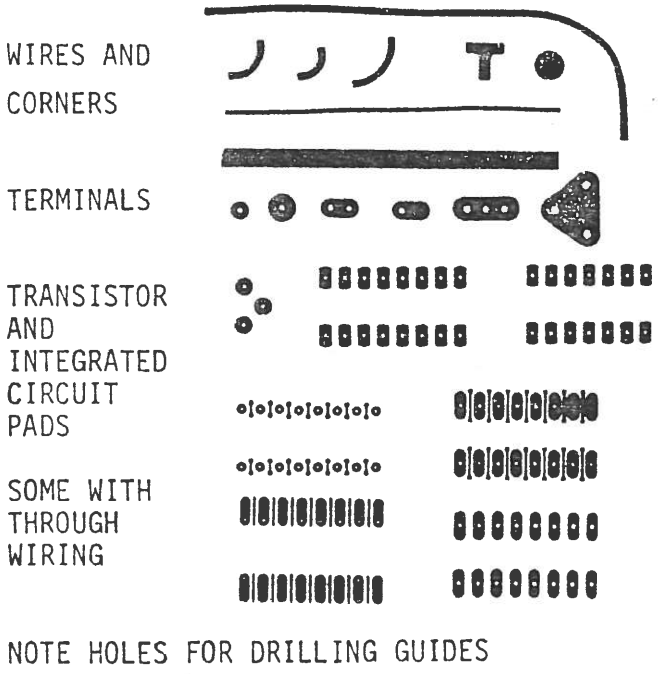


Fig 1 Typical "pads" and "wires" used in master artwork.

Lines and pads

Small packs of mixed "pads" and lines (for the actual "wires") are available and most of these are acid resistant so that the same supply can be used for making photographic masters or for applying to a non-resist-coated copper surface for a simple, one-off job. A selection of these is shown in fig 1. Self-adhesive, creped, black tape is also to be had in precision widths down to 0.02 in; quite tight bends can be negotiated with this and the degree of "stick" is perfect. It can be lifted from the plastics film and re-located to make a job look just right. For the larger user many of the standard terminal pads, transistor and IC terminal-pin layouts are available also as die-cut, adhesive symbols on continuous reels of backing paper. Again, suppliers are listed below.

Methods

Mask preparation

Whether on to the copper direct or on to a film master the procedure is the same:–

1 Design and check your circuit in your notebook. Eliminate crossings of wires since this will need wire links on the reverse (component) side of the board on assembly. Wires can often be re-routed to pass "through" resistors, etc (which are on the other side of the board) to avoid links.

2 Redraw, freehand will do, on 0.1 in graph paper to obtain an accurate spacing of critical terminal pin positions. If you are going to use pads as in fig 1 there is no need to draw their outlines in full, just dot the centres of the pins.

3 Tape the polyester (Melinex) film to the squared paper and position the adhesive pads correctly on the 0.1 in grid centres.

4 Using adhesive crepe black tape OR transfer (Letraset type) lines complete the wiring over your circuit in (2) above. *Note* that the terminal, IC etc, pads have a clear hole in the centre of each connection point. When the board is etched this will produce a small hole as an automatic "centre-pop" to guide your drill:– all drillings will then be as accurate as your positioning of the pads over the 0.1 in grid. Take care not to cover these holes in the pads with your wiring lines.

Figure 2 shows a circuit completed by this means with the addition of IC identification numbers using transfer lettering. As a matter of interest this circuit is the oscillator and first divider circuit of the HJ crystal clock series with a monostable multivibrator output to give 1 or ½ second pulses, ie, a complete quartz crystal escapement board.

Direct-on-copper masking

Follow steps (1) and (2) above so that you have your circuit on a true 0.1 in module. Place your graph paper over the (non-resist-coated) copper side of the laminate and lightly centre-pop or scribe through the terminal points and just two diagonal terminals of any IC patterns. Remove the graph paper and clean the surface of the copper (see below). "Now wash your hands". Trying to avoid contact between your fingers and the actual copper, position the pads using the pop-marks as a guide and follow the procedure of (4), above, then place a clean piece of paper or plastics over the complete pattern and press firmly over all the lines, etc, to ensure uniform contact – otherwise the etching solution may creep underneath. Naturally you have used acid-resistant pads etc (most of them are).

Exposure and development of coated boards

If you are using the recommended photographic technique you will need a simple printing frame to hold the mask in contact with the board. I use a piece of glass and two large spring clips to make a sandwich with the glass and a piece of flat metal sheet, and the circuit board + mask as the jam in the sandwich. The positive-emulsion coated board will be supplied with a black adhesive plastics film covering the sensitive surface so you can cut it to size, before exposing, in normal workshop lighting. After removing this safety cover work quickly, indoors in a shady spot. Position the mask over the board, clip it up in the frame and expose according to the board supplier's data. About six to ten minutes in daylight or at 4 in from two, eight watt UV lamps is about the average. Overexposure is unlikely, 50% overexposure is better than risking underexposure.

Unload the board in subdued lighting and develop, by inspection, in a plastic dish until the circuit is left as a blue-grey trace on a bright copper surface –

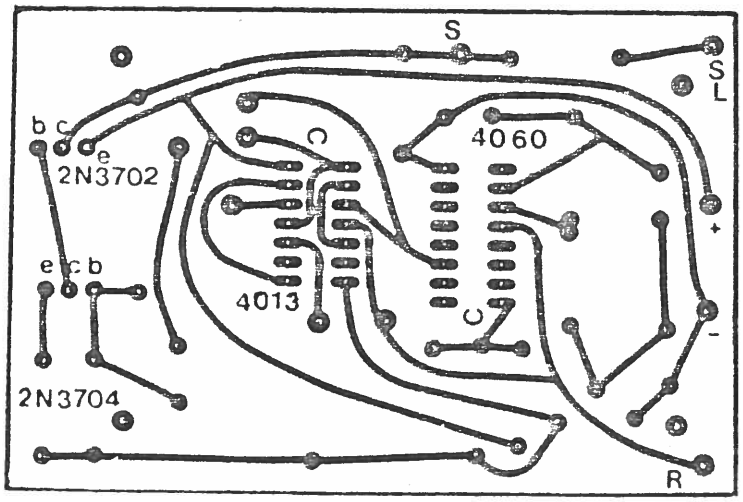


Fig 2 "Tape and transfer" master artwork for quartz crystal escapement board.

using the recommended chemicals (usually a three to five per cent sodium hydroxide solution) development at room temperature takes about 2 minutes. Remove the board from the developer and wash in running cold water. If the copper areas are not completely clear replace in the developer for about half a minute, remove and wash again. Used caustic solution should not be stored for re-use; dilute and flush away. (It is sold as a drain cleaner after all) If the board was a pre-coated one the above is straightforward enough. If you sprayed up your own substrate, with Fotolak or the like, the supplier's instructions will have warned you to leave enough drying time (in the dark) for the emulsion to have hardned *before* printing. I have found that about 30 minutes in a light-proof box on top of the domestic boiler ideal – but watch for dust in the wet coating. In any case, after development, the remaining image is not very strong, mechanically, so be careful with washing and handling.

Etching

By either method you now have a positive pattern of desired copper on the surface of the laminate defined either by the resist or by a combination of tapes and transfers. The copper surface of the coated board will be chemically clean from the developing bath, even so etching should not be delayed by more than, say, 24 hours otherwise the copper surface will pick up atmospheric contaminants. If you taped straight on to plain copper-clad board you should have started with a clean surface and, although cleaning solutions are available for board, I find a gentle rubbing with the finest grade steel-wool (before applying the pads but after the scribing through from the graph paper) very effective indeed.

The etching solution of ferric chloride in water will have been prepared as above. I store mine in a clearly labelled, one gallon plastics bottle. Always varnish over labels of such bottles to preserve them from damp. An unlabelled ferric chloride bottle is a menace in any household. The solution will keep and can be used many times until exhausted. It works much better warm so I stand my plastics bottle in a bowl of hot water (about 45°C), usually whilst developing the image.

Pour the ferric chloride into a plastics, photographic or similar, dish and slide in the PC board, copper side up. You will have to agitate the solution for most of the time to wash the dissolved copper away from the board surface. If you make a lot of boards it is worth while making a plastics board holder from, say, grooved Perspex sheet and supporting the board copper side *down* so that dissolved copper can fall away but you will have to turn it over from time to time to observe progress. Etching with a new, warm solution will take about 15 to 20 minutes. It is quite fascinating to watch and to reason out why some areas clear before others. It is a function of the agitation and the rate of removal of spent solution. The wanted copper will remain invisible beneath the resist and the epoxy-glass base will come through as a dirty yellow-white. When all looks well remove it from the solution, drain into the dish and then rinse well on both sides. If the masking was well done you will not have a failure.

With a plastics tundish or funnel transfer the solution carefully back to its bottle. Wash the dish in running water and look round for any splashes since if, like me, you perform in the kitchen, you might well not be asked again! Use plastics, photographic tweezers to handle the board in the dish.

Mask removal

The photo-resist is best removed with cellulose thinners or commercial grade acetone. Methylated spirits also works well on most with a little rubbing with a smooth cloth. The transfers etc can be quickly pealed away by lifting off with Sellotape and the surface cleaned again with meths. A gentle rub over with very fine steel wool will also bring up a bright copper surface and I usually delay this until I am ready to start soldering. In industry the circuit is now tin or solder coated and then covered with a varnish through which one can solder. For us this is not needed but, after soldering, I like to spray the copper side of the finished board with a clear lacquer. This keeps the copper shining through. If you do this remove soldering flux residues first, with meths and gentle rubbing with one of those so-useful brushes made from a bundle of glass fibres bound around with thread.

Well, thats it. You have a new technique at your finger tips. If you have sensitive finger tips perhaps you should wear protective gloves whilst handling the chemicals. Try a clock dial on copper-coated epoxy-glass PC base. Spray a base colour on after etching and before removing the mask, then remove the mask without damaging the paint, carefully polish the (raised) copper and varnish overall. The ferric chloride solution works quite well on brass – but if you try to etch, say, a dial don't forget to paint over the back to protect it from the ferric chloride. And the edges!

Suppliers

1 Uncoated, copper-clad SRBP and epoxy-glass boards
2 Positive resist coated boards
3 Aerosol positive resist (Fotolak)
4 Developing and etching chemicals
5 Normal and acid-resisting drafting aids (pads, crepe tape, transfers, etc)
6 Drafting grids, Mylar film.
7 Complete kits, UV exposure (printing) boxes, etc.

R S Components Ltd, 13-17 Epworth Street, London EC2P 2HA (Trade only)	– 1, 2, 5, 6.
Mega Electronics Ltd, 9 Radwinter Road, Saffron Walden, Essex CB11 3HU	– 1, 2, 4, 5, 6, 7.
G F Milward Electronic Components Ltd, 369 Alum Rock Road, Birmingham B8 3DR	– 1, 2, 3, 4, 6.
R J Blair of Byfleet, Ltd, 45 Grove Road, Chertsey, Surrey	– 5, 6.

Due to extreme pressure on space the Editor regrets that some features and news items have been held over until the December issue, which will be published on 1 December.

Reprinted with grateful permission from the Horological Journal, Nov., 1978
Many thanks once again to friend R. L. O'Briant for making the Journals available.

Bulletin No. 44.

MASTER CLOCK INSTRUCTIONS

(1) Hang the clock on a screw or lag bolt not less than $\frac{5}{16}$" diameter. Drill the hole for this support so that when screwed into place the outer end will be higher than at the point where it enters the wall. When the clock is hung it will then have a tendency to slide back against the wall.

After the clock is hung and the pendulum installed, move the bottom of the case to right or left until the pendulum tip is directly in line with the center of the pendulum scale, hold in this position and after lowering one end of the pendulum scale insert a $2\frac{1}{2}$" x No. 12 round head wood screw in the hole provided back of the scale and make sure that the case is absolutely firm at the bottom. It may be necessary to mark the location of the bottom hole and remove the case from the wall in order to drill and plug the hole. Rawl plugs are suitable for this purpose.

TO PLACE METAL PENDULUM IN POSITION

(2) Remove nut and stirrup on bottom of pendulum rod. Hold rod securely downward and slip pendulum bob on rod (bob should hang with spring on back at top), screw nut until top edge of bob comes even with pencil mark on rod. This will give a fairly accurate rate, and rate can be made closer by screwing nut up or down as is necessary. Raising bob will rate clock faster, and lowering, slower. One turn of this nut will change the rate of the clock approximately, 20 seconds in 12 hours. Extreme care must be taken not to lift or twist rod when in position as the suspension spring is very delicate. See that verge lever pin is in position in the slot for same in pendulum rod back of movement.

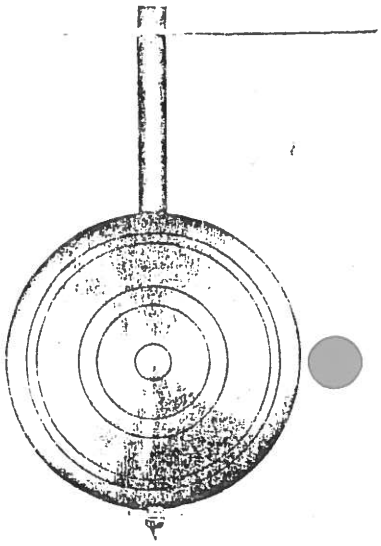


Fig. 60

PLACE MERCURIAL PENDULUM IN POSITION

(3) When the clock is equipped with a pendulum of this type, it will be found that it has been shipped outside of the clock case and must only be assembled after clock is placed in position. Hang the rod on the suspension spring which is secured to the upper part of the iron frame back of the movement, being careful not to twist or bend the spring; then slip the fork of the verge lever over the pendulum rod. Next fasten the two tubes of mercury into place. Be careful to avoid changing adjusting nuts A or B as these are carefully adjusted at the factory while the clock is being regulated.

(4) The pendulum may need further regulation after installation, in which case proceed as follows:

Turning regulating nut "A" (Fig. 61) to the right raises pendulum, rating clock faster; to the left lowers pendulum, rating clock slower. This nut is marked with 50 divisions at its upper end and turning it two divisions will affect the clock regulation approximately one second in 12 hours. After clock has been regulated fairly accurate by means of nut "A" finer regulation may be secured with nut "B" without stopping the pendulum. Nut "B" is a micrometer adjustment and one complete turn of it will affect the regulation of the clock but a fraction of a second in 24 hours. This nut is fitted to turn freely and can be turned either way with a lead pencil while pendulum is in motion.

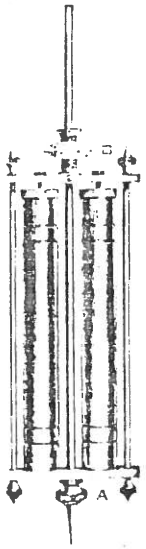


Fig. 61

TO CONNECT MASTER CLOCK TO BATTERY CIRCUITS, ETC.

(5) Follow the wiring diagram closely, noting the numbers marked on same and also stamped on the top of the master clock near the connectors. Terminal No. 1 at left of case should be connected to the negative side of the storage battery, and + bus bar to the positive side. Terminals No. 2 and No. 4 are only used when a program clock in separate case is included; then both of these connect directly to similar numbers on the program clock; No. 2 on master clock to No. 2 on program, and No. 4 to No. 4. No. 7 terminal is for connection to auto charger, and auto lighter when used.

(6) Secondary clock circuits are numbered 1-C, 2-C, 3-C, etc., and to each terminal is connected one side of a circuit; No. 1 circuit to 1-C, No. 2 circuit to 2-C, etc., the other side of each circuit being connected to the + bus bar. Where there is a separate secondary clock control cabinet No. 5 will be used to indicate the impulse circuit on or in that cabinet, also on top of master case. (No. 5 was formerly used to indicate the secondary clock terminal on a one circuit master clock.)

Where the program is installed in the master clock case, the switches will be in the back of the case at the bottom and the push buttons below the door on the outside.

OPERATION OF MASTER CLOCK

(7) To start master clock, first see that all single point switches are open. This disconnects the secondary clocks and prevents them from scattering. Then press the strap key marked "Wind" in bottom of case 54 times slowly, and, after winding, start the pendulum and see that it swings up to the screws on the scale.

(8) See that the second hand advances evenly at each swing of the pendulum; if it does not, locate the beat adjusting screw attached to the escapement at the top of the movement and turn it slowly in one direction or the other until the movement of the second hand becomes uniform. The clock will then wind itself every minute without assistance so long as the battery is in good condition.

(9) When it is necessary to remove the dial from the master clock, care should be taken in replacing the hands; the second hand being adjusted to point exactly to 60 at the top of the seconds circle and the minute hand directly over the proper minute division at the instant the secondaries jump. The pendulum will have swung to the left at the same instant.

(10) When the master clock is arranged to control a number of secondary clocks, it is usually equipped with one milliammeter, and a pilot dial for each circuit. In case of only one circuit of secondary clocks the milliammeter is connected into the circuit permanently. When more than one circuit, a strap key for each circuit is provided which will connect the milliammeter into any circuit for testing. Each circuit is equipped with a single point switch. A strap key is also provided with which one or all circuits may be set.

OPERATION OF SECONDARY CLOCKS

(11) Secondary clocks with dials up to and including 14 inches diameter may be set separate by turning hands forward or backward. Large dials may be set individually with dry batteries at connectors. All secondary clocks on circuit or circuits may be set forward by depressing and releasing strap key marked "Clocks" in bottom of master clock. This will set secondaries forward one minute for each depression of key. Care must be taken not to press key when second hand on master clock is near 60. Key must never be pressed rapidly and especially if large dials are being used. With small dials it can be pressed once a second but with large dials, two to four seconds should elapse between depressions. The pilot clock may be set individually ahead or backward by pressing downward on the setting stem found on the upper right-hand side and turning to the left or the right.

(12) When setting an individual circuit ahead, open all switches, except the one in the circuit to be set. Press the key marked "Clocks" the requisite number of times and then close the switches. When a circuit is fast, open the switch controlling it and leave it open until its pilot clock indicates the correct time; then close the switch after the second hand has passed 60.

MILLIAMMETER

(43) This instrument is connected permanently in the circuit when installed in single circuit series systems, and should indicate at least 150 milliamperes when the secondary circuit is closed; if it fails to indicate this the secondary clocks are likely to lose time or scatter. In master clocks controlling more than one circuit, the milliammeter is connected to the strap keys in the bottom of the case marked "Test Keys." These tests determine the condition of the different circuits in reference to battery, for it is necessary to have the circuits as nearly balanced as possible. If one circuit has more clocks than the other, or others, sufficient resistance should be connected in series with the lighter ones to cause a uniform reading on the milliammeter. When a master clock is equipped with a milliammeter and more than one circuit of series clocks, any circuit may be tested by depressing its test key and observing the milliammeter, as the latter registers the amount of current flowing in the circuit each time a test key is depressed. Not more than one key should be depressed at a time. Tests should only be made between five seconds past and five seconds of an even minute, on account of possible interference with the contacts in the master clock and scattering of secondary clocks.

BATTERY GAUGE (14) This instrument was formerly used and is connected and used the same as the milliammeter, but should indicate not lower than NORMAL, when the secondary clock circuit is closed. Clocks are likely to lose time or scatter if indication is lower than this.

(15) The foregoing instructions on "Battery Gauge," and "Milliammeter," apply only where a series system of apparatus is used. When battery gauge or milliammeter is used with a multiple system it is connected permanently in series with the relay magnets and is used to indicate the condition of the battery but does not indicate condition on the secondary circuits.

MISCELLANEOUS (16) ALL JOINTS IN THE SYSTEM WIRING MUST BE SOLDERED AND WELL TAPED. BE ABSOLUTELY SURE THAT ALL SCREW AND BOLT CONNECTIONS ARE PERFECTLY CLEAN AND TIGHT.

For a series system of clocks No. 14 or No. 16 rubber covered copper wire should be used where wires run inside of buildings, and not smaller than No. 12 hard drawn weather-proof copper wire for outside wiring. Where wires are to be run in tunnels, ducts or other places where a wet condition is likely to exist, lead covered cables should be used.

Where a multiple (parallel) system of time apparatus is to be installed, the size of wire necessary depends upon the amount of apparatus to be operated and length of circuits, and reference should be made to wiring diagram for instructions as to size of wire.

(17) Never use a clock battery for any purpose except for operating the master clock and such other apparatus as may be permitted by this company.

MASTER CLOCK MOVEMENT SHOULD BE CLEANED AND OILED AT LEAST EVERY TWO YEARS.

For further information address home office or nearest branch.

MAIN OFFICE AND FACTORY

THE STANDARD ELECTRIC TIME COMPANY

89 Logan Street, Springfield, Mass.

BRANCHES:

1228 Munsey Bldg., Baltimore
625 S. 18th St., Birmingham
10 High St., Boston
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1510 Monadnock Bldg., Chicago
1333 Union Trust Bldg., Cleveland
83 South High St., Columbus
716 Mercantile Bank Bldg., Dallas
562 Penn Street, Denver
806 Donovan Bldg., Detroit
Mutual Bldg., Kansas City, Mo.
Rm. 670, 121 W. 4th St., Los Angeles
745 McKnight Bldg., Minneapolis
50 Church Street, New York City
1612 Market St., Philadelphia
Bessemer Bldg., Pittsburgh, Pa.
229 Pine Street, Portland, Ore.
690 Market St., San Francisco
148 Adams Ave., Scranton
918 Western Ave., Seattle
110 S. Cedar St., Spokane

THE STANDARD ELECTRIC TIME CO. OF CANADA, LTD.

Works, 726 St. Felix St., Montreal, Que.

Printed in U. S. A.

Bulletin No. 45.

PROGRAM CLOCK INSTRUCTIONS

Program Mechanisms are mounted in either the master clock case or separate case.

Program Ribbons are of either 12 hour or 24 hour length.

(1) Where program mechanism is mounted in separate case, hang the case on the wall near the master clock by means of a strong screw through hanger at top of the case. Then put a small screw through back of case near the bottom to hold the case securely in position, after which remove all cords from the movement that was placed there for shipping.

TO PLACE PAPER RIBBON ON MOVEMENT

(2) All program clocks leave the factory with calendar drum or 12 hour shift set at 6 a. m., so that ribbon should be put on before program clock is started. At this position place ribbon on sprocket drum so that 6 a. m. on the ribbon comes directly where contact fingers meet contact bar, then down around the spool on the bottom left, then up around spool in center, then around bottom outside spool on right. Where 24 hour ribbon is used a double set of idler spools are provided. When changing ribbon, be sure that it is replaced so the calendar drum changes when 6 a. m. on the ribbon is directly under the contact fingers.

PUNCHING SCHEDULE ON RIBBON

(3) A suitable punch for this purpose is included with all program clocks. Use this with the open side up so that the division lines on ribbon can be readily seen. **Punch hole exactly between lines,** leaving a margin on the edge of the ribbon of about 1-16" uncut. This is necessary to retain strength of ribbon where cut and prevent curling of corners. Two schedules can be cut on each ribbon, one on each side of center holes.

TO CONNECT PROGRAM WITH MASTER CLOCK, BELLS AND BATTERY

(4) Where program mechanism is in separate case, follow the wiring diagram closely in regard to numbers marked on the diagram and stamped on the program clock near connectors on top of the case. No. 1 on program case is the negative battery terminal. No. 2 on program case must be connected to No. 2 on master clock case and is the connection between the master clock duration contact and program movement frame and contact bar. No. 4 on program case must be connected to No. 4 on master clock case and is the connection between the program circuit closer on the master clock movement and program magnet coils. The connector marked B+ is for positive battery and may be connected to either the + bus bar on top of the master clock or to positive battery direct. B+ is the common return wire from the program movement and relay magnet coils. The connectors marked "Bells" are for connection to bell circuits; the bells being wired in multiple and in all cases the coils should be wound to high resistance. The return wire from each bell circuit should be connected to the bar, or should be connected to some return to positive battery. Where bell control boards are used, bell returns are terminated therein, and connections made there between them and the program clock. A wiring diagram is furnished with each clock system.

SETTING OF PROGRAM

(5) To set program movement on time with the master clock the lower lever on the left of the movement depressed and released will move ribbon forward one minute for each depression. To run off several hours quickly, depress lever with one hand and with the other hand turn main ribbon drum, by the knurled nut in front, nearly up to time; then finish by moving ribbon to exact time by depressing lower left hand lever a sufficient number of times, care being taken in noting position of the second hand on master clock, as contact (for operating program mechanism) is made at 30th second for the next minute. For example, at 12:15½ the program should move to 12:16. The 12 hour ribbon makes one complete turn in twelve hours, and the 24 hour ribbon makes one complete turn in twenty-four hours. At the end of the 12 hour period the black calendar drum moves forward one division. This controls the contact fingers by 12 hour periods, allowing the fingers to connect with contact bar through the properly punched holes or preventing the contacts according to the position of the pins placed in calendar drum. To set the rubber calendar drum, set the ribbon forward as directed above until the drum moves one position, then advance it by depressing and releasing the upper left hand lever until it shows the proper day directly at the bottom, after which set the ribbon to time.

CALENDAR DRUM

(6) This drum has one row of fourteen holes in alignment with each finger, one hole for each 12 hour period during the week, and a pin in any particular hole will hold finger out of contact and keep bells silent on the circuit that finger operates, for the twelve hours that the pin is in position. For example, hole in line with Monday on drum is open, pin is placed between Monday and Tuesday, left open Tuesday, pin between Tuesday and Wednesday, etc., to Saturday

night, then pins in each hole to Sunday night. This allows finger to make contact Monday morning to Saturday night during the day and keeps the bells silent at night, also Sunday. This arrangement can be varied to suit any requirements by changing the position of pins, or adding pins.

(7) If the program clock should by accident be set ahead of time, it will be necessary to spin the ribbon all the way around again, or to stop it until correct time is indicated by it.

DO NOT TRY TO TURN EITHER CALENDAR DRUM OR RIBBON DRUM BACKWARD.

(8) If only one circuit of bells is to be operated, schedule can be varied for some particular day or days by connecting the circuit to two or more of the connectors marked "Bells," and interchanging the pins on calendar drum according to the schedule desired, using one edge of the ribbon for part of the week and the other edge for the remaining day or days.

(9) When program mechanism is mounted in separate case one push button and one single point switch for each circuit is located on the upper left hand side of the case. The switch lever when closed will allow bells to ring automatically on the particular circuit it controls according to the schedule punched on the ribbon. When the switch is open, bells will not ring automatically. The push button directly over the switch will ring bells on its particular circuit regardless of the position of switch or ribbon.

(10) Where the program is installed in the master case there will be no connectors marked No. 2 or No. 4 on top of the case. The switches will be in the back of the case at the bottom and the push buttons below the door on the outside. Other directions same as for program in separate case.

PROGRAM RELAYS

(11) The relays are adjusted at the factory and require no further adjustment. The contacts are made of tungsten and can easily be detached and renewed, although they have an extremely long life. The small graphite rod at the top of the relay is a high resistance shunt placed across the terminals of the magnet to quench the sparking at the contacts in the master clock.

DON'TS FOR PROGRAM CLOCK

(12) Don't lubricate any part of a Program Movement.
Don't forget to keep the door locked to keep out the dust.
Don't fail to examine the connections on the top of the case to be sure that that they are tight.
Don't leave the switches open and expect the clock to ring the bells automatically.
Don't forget to see that the calendar drum is set correctly before setting the ribbon.
Don't punch the holes in the ribbon on the line, for they should be punched between the lines.
Don't punch the holes in the ribbon too near or too far away from the edge; 1-16" from the edge is correct.
Don't bend the fingers that make the contact through the ribbon; they are adjusted at the factory and should not be changed. The end of the finger should rest on the ribbon midway between the lines, not on the line.

(13) For further information address home office or nearest branch.

MAIN OFFICE AND FACTORY

THE STANDARD ELECTRIC TIME COMPANY

89 LOGAN STREET, SPRINGFIELD, MASS.

BRANCHES:

BALTIMORE—1228 Munsey Bldg.
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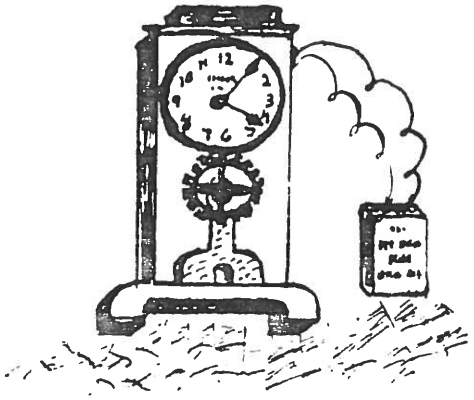
Martin C. Feldman, Editor



Hello fellow enthusiasts:

As we approach the summer, which has been rather wet in the New York City area, our Journal comes to you none the worse for wear in a dry, we hope, envelope! This month we complete Paul Hopkins' electronic "timer" article. In the next issue we shall bring you an additional article by Paul Hopkins which will show how to use this "timer" to rate a non-electronic master clock.

We also are including an article by Karl Koeneke which speaks to contacts. It goes without saying that contacts are vital and also a great problem at times to us as collectors of early battery clocks.

A ballot has been included for Chapter Officer Elections. All the present Officers are eligible for reelection, or you may choose a write-in candidate. Other instructions are on the ballot sheet.

Until we meet again in our August Journal, may we wish you a happy and healthy summer.

Enjoy this Issue!

Electromagnetically yours,

Martin C. Feldman, FNAWCC

readings. I mention this problem to alert anyone who might choose to make a similar timer.

One other feature worth mentioning was built into the gadget. Adjustment of 1000 Hz filter mentioned previously is made by 3 variable resistors. In order to be able to test or align the filter, the 1000 Hz pulses from the oscillator can be switched to the input. The adjustment can then be checked using tests points wired out to the front of the box.

Operation of the device is initiated by a three position toggle switch. Since WWV omits the tick on the 59th second of the minute there is a quiet time of approximately 2 seconds immediately preceeding the minute in which to operate the switch. After the tone comes in and the timer starts, the switch is returned to mid-position. The display shows increasing numbers until the pendulum impulse stops the pulse counting, and a number is left displayed. Of course, this is the amount by which the clock is slow with respect to WWV. The difference between this reading and one obtained previously quickly shows the clock rate. A reset push-button resets the counters and turns off the displays in preparation for the next reading.

Being a good engineer, I always take a series of readings. With a good WWV signal the timing spread will not exceed 3 milli-seconds. Also, with a good signal, the timer will respond to a "tick". Since the tick is only 5 cycles of a 1000 Hz tone the delay in getting timing started is obviously less than 5 milli-seconds. In making a series of readings, I include at lease one reading initiated by a tick. The tone at the beginning of the hour is 1500 Hz therefore, a test at that time has to be initiated by a tick.

Physically, the whole device is contained in a 3 1/2" x 6" x 8" Bud box, with most of the circuitry on one 4" x 6" board. I used sockets for the IC's, with wire-wrapped connections. The power transformers, 1000 Hz filter adjustment potentiometers, counter-readouts, and miscellaneous controls are mounted on the box. The use of the TIL - 306 displays eliminated the need for separate counter-decoder-driver circuitry, simplifying the wiring considerably. However, the current drawn by the 306's (approximately 200 milli-amps per digit) did call for a rather rugged 5 volt power source.

All circuitry is shown in Figures 2, 3, and 4. Some superfluous information appears on these diagrams in that I show the circuit board edge connections, and the pin numbers for the components mounted on a "header". A "header" is a helpful device which provides a convenient place for mounting and wiring the small circuit components such as resistors, diodes, and capacitors. Also, some device numbers show a fraction, e.g. 1/2 1458. This indicates one of the two op-amps contained in a single 1458 chip.

When I started this project, I was using a Heathkit short wave receiver. However, last summer I obtained a WWV receiver from Caringella Electronics, in Upland, CA. It is battery operated, crystal controlled, and is a real jewel. It is not unusual to hear the WWVH (Hawaii) time announcement. With this receiver a time measurement can be made at any hour of the day. Radio Shack also has a similar receiver.

Now that I am using this device, how much reliance should I put on the results I obtain? As long as I can trigger on a tick, I believe a rate calculation accurate to better than 5 milli-sec. is being obtained. I estimate propagation

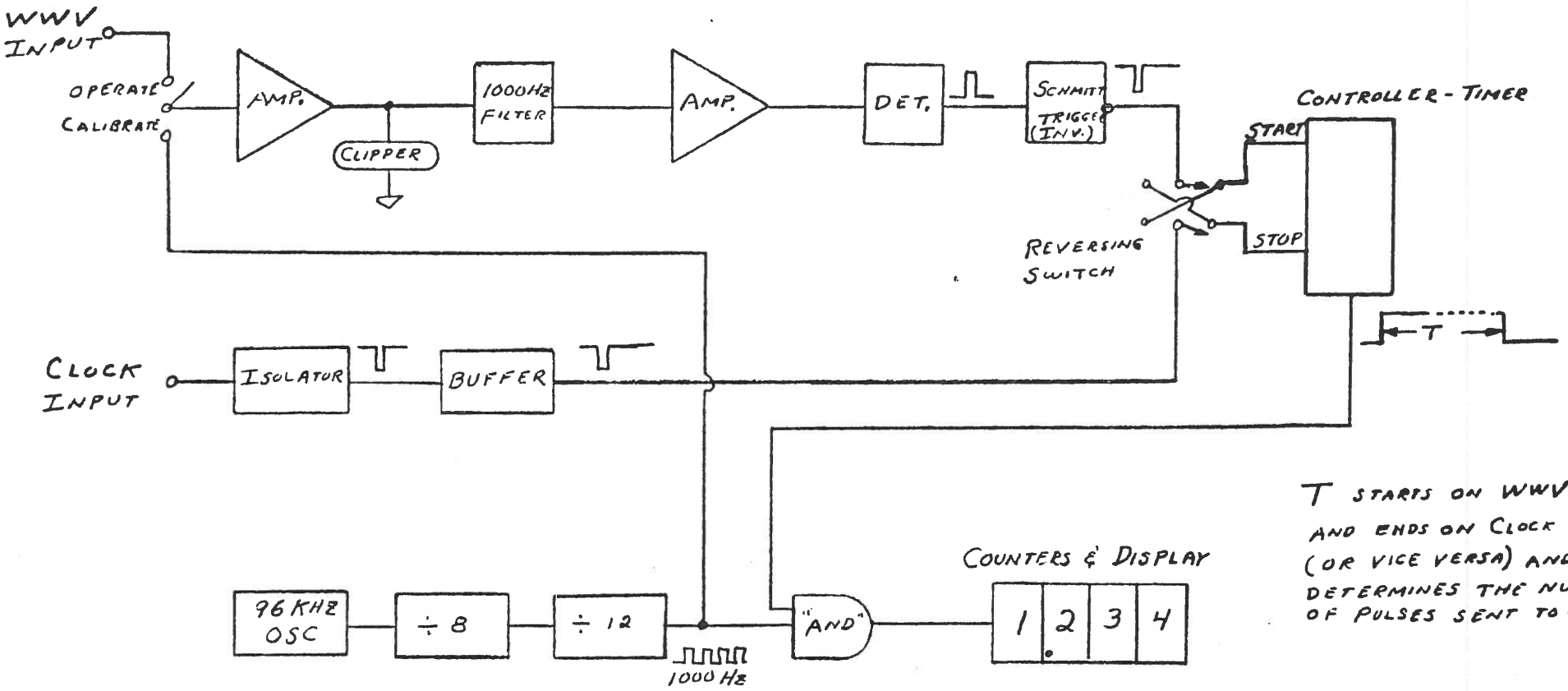
delay at 6 or 7 milli-seconds between WWV and Birmingham, and have no reason to suspect any deviation. Also, any delay in my receiver should be constant. Therefore, the 5 milli-second tick fairly well defines the accuracy. Theoretically one set of readings could be on the leading edge of the tick, with another set on the trailing edge, with the possibility of a 10 milli-second spread in the difference between readings. That is, a pendulum with perfect rate could be measured to have any where between .005 sec gain and .005 sec losing rate. Also, it is possible that the pulse which stops the counting is not being received consistently. However, these variations do not appear in any given series of readings. I have come to the conclusion that the average of any series of readings is accurate to within 2 milli-seconds, and therefore that a rate calculation is accurate to within 4 milli-seconds.

While this article is about the timer, I believe I should mention the performance of the clock as determined through use of the timer. I have refined my pendulum since writing the previous article, and I now have an Invar Rod, and a lead bob of about 15 lbs. with a compensating tube. (Very possibly over-compensated). However, the pendulum is on a brick-veneer wall, and is not enclosed. With these rather unfavorable conditions, it is not unusual to see the clock lose .1 to .2 seconds one day, and gain it back the next. However, the week of Jan. 15th, while we were on vacation, over an 8 day period the clock lost only .094 seconds. This leads me to believe that if the pendulum were in a case, the rate would reflect barometric pressure.

In conclusion, I have two observations to make. First, being an old vacuum tube technology man, I am continually amazed at what can now be done in such a small volume, with so few components, and with so little power input. And second, now that I can measure rate rather accurately, I am completely frustrated by the two rates exhibited by my clock -- too fast with a very small weight on the tray, and too slow without it.

I have tried to explain how this timer works, and some of the reasons behind the design. Certainly other schemes will work as well, if not better. I have derived a lot of enjoyment in making and using this timer, and I would like to encourage other EHS members to make and use a similar device. I would be happy to hear from any of our members, and if I have left some questions unanswered, I will try to answer them.

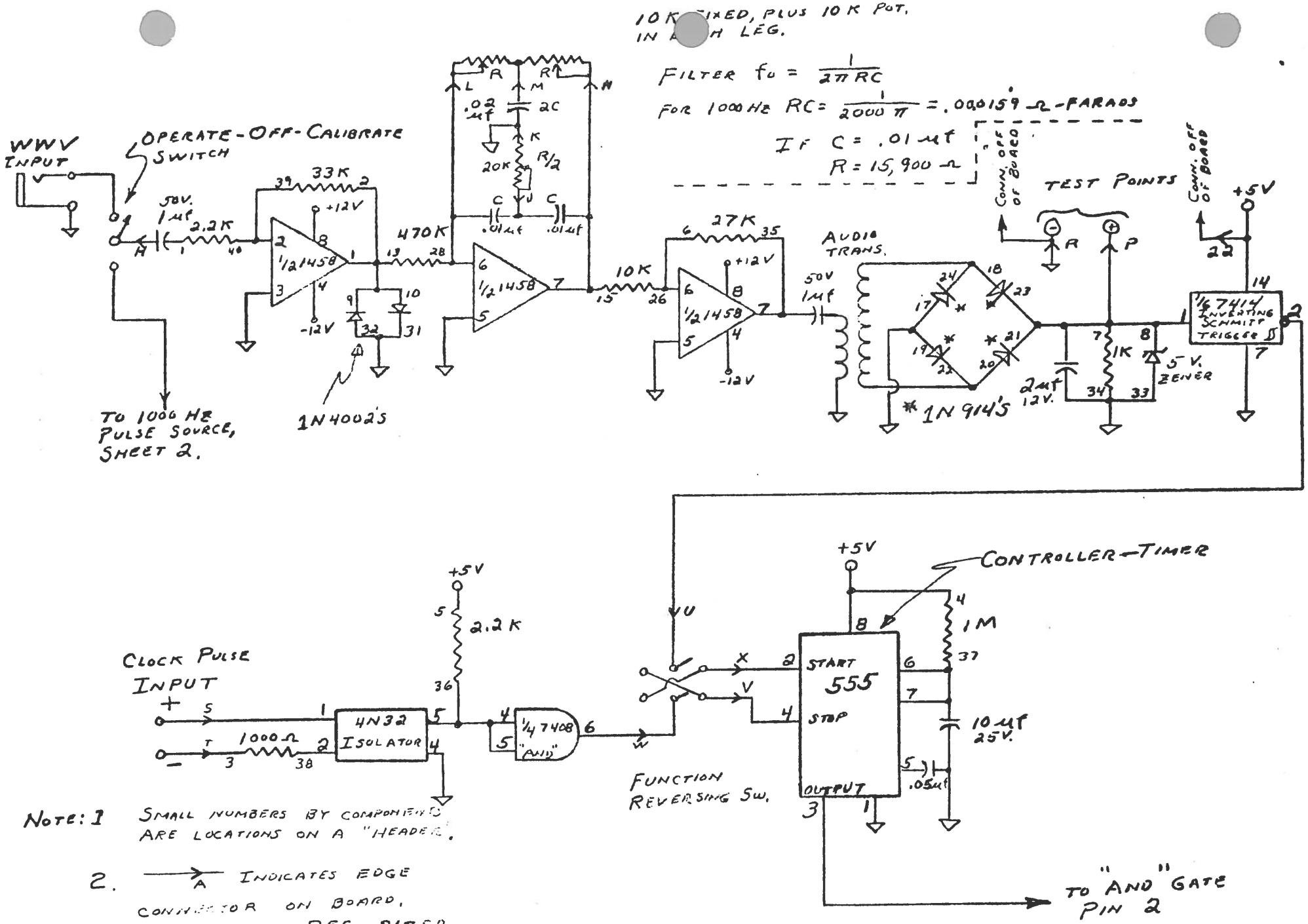
Acknowledgement:
1) Alan Heldman for his pictures.
2)Sandra Tooson for her stenographic help.
3)Mary Hopkins for putting up with it all at home.



TIMER — SINGLE LINE DIAGRAM

FIG. 1

CMH 12-19-78



NOTE: 1 SMALL NUMBERS BY COMPONENTS ARE LOCATIONS ON A "HEADER".

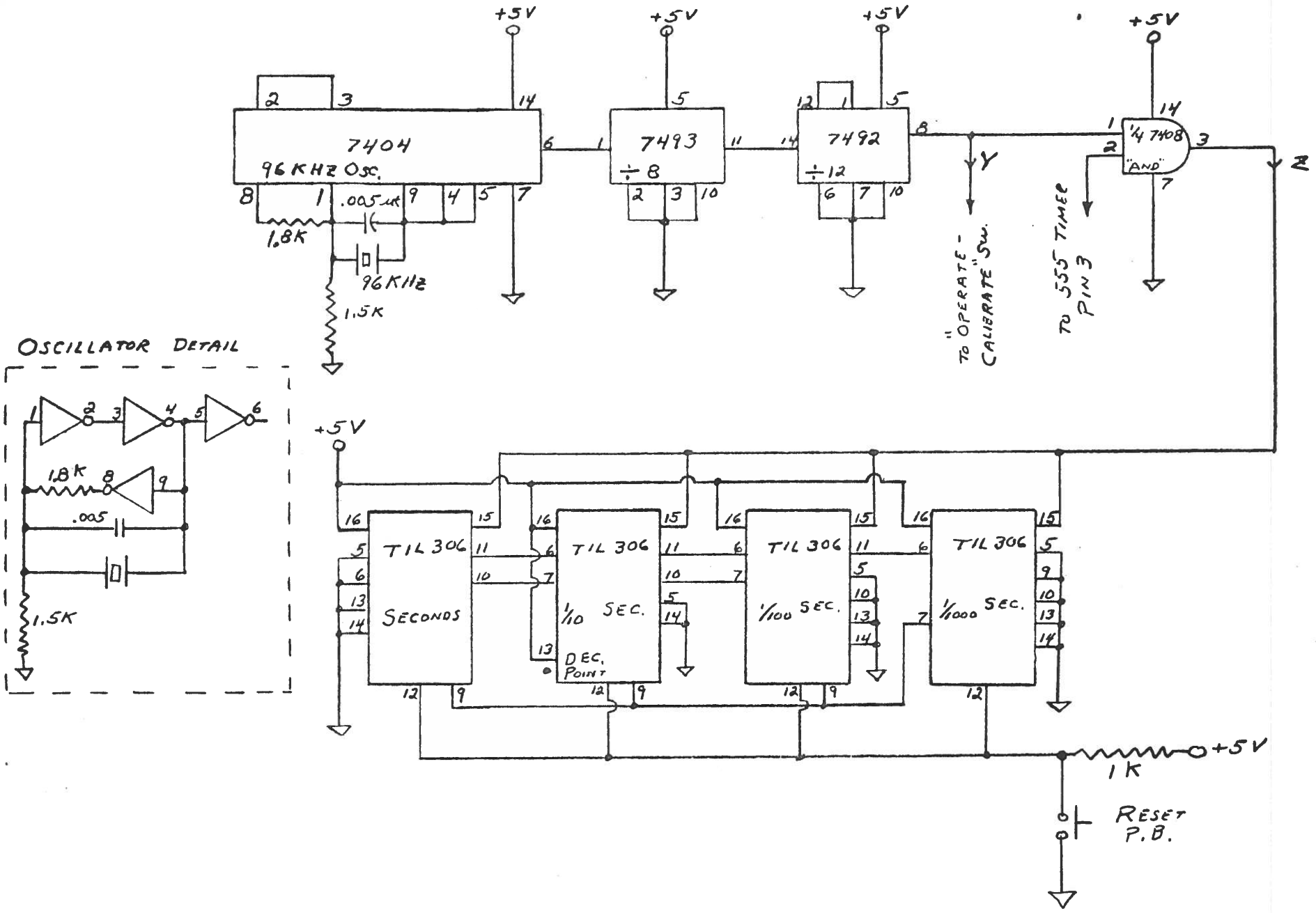
2. → A INDICATES EDGE CONNECTOR ON BOARD.

3 4N32 INPUT RES. SIZED FOR 10 MA CURRENT WITH 10 VOLTS.

TIMER - WIRING DIAGRAM SHEET 1

FIG. 2

PMH 12-19-78
REV 2-16-79

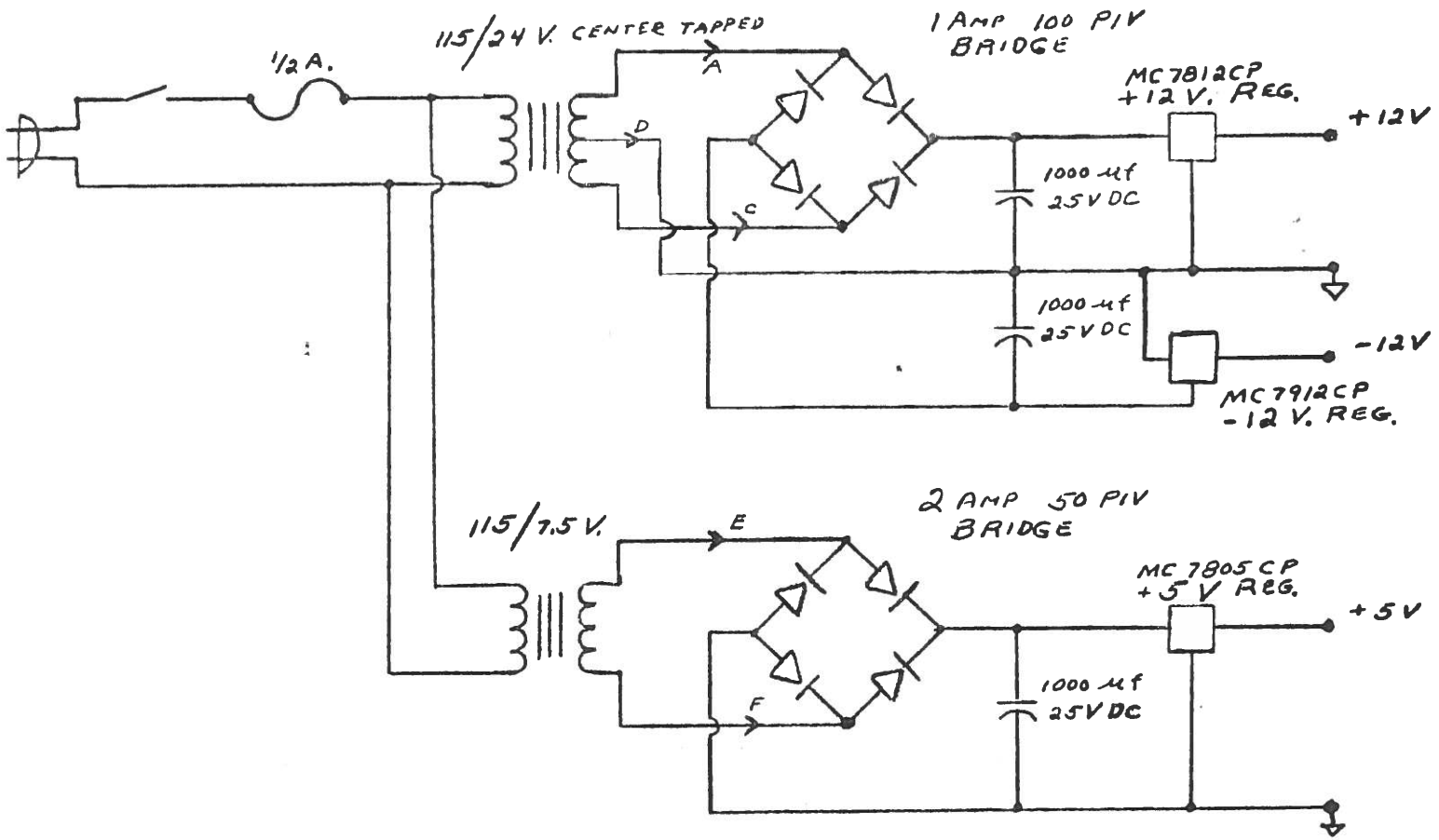


TIMER - WIRING DIAGRAM - SHEET 2

FIG. 3

PM 12-19-78
REV. 2-7-79

(6)



TIMER - WIRING DIAGRAM SHEET 3

FIG. 4

PMH 12-19-78

(4)

-373-

BIBLIOGRAPHY

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2) D. A. Bateman, Vibration Theory and Clocks (A 7 Part Series), Horological Journal, Brant-Wright Assoc., London, July 1977 - Jan.,1978.

3) D. A. Bateman, An Electronically Maintained Precision Pendulum Clock, Horological Journal, Brant-Wright Assoc., London, Jan.,1972.

4) D. A. Bateman, Measuring The Performance Of A Precision Pendulum Clock, Horological Journal, Brant-Wright Assoc., London, Feb.,1973

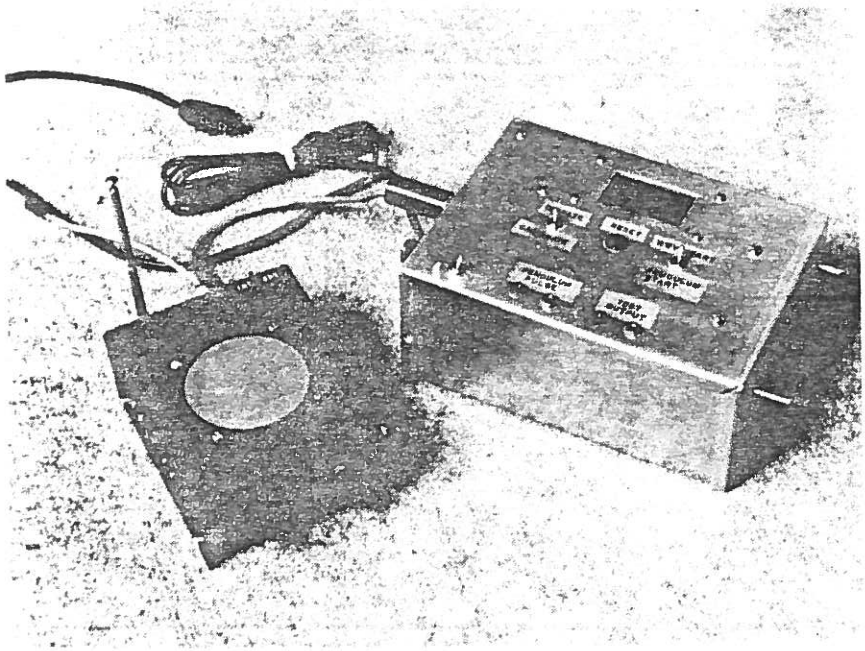
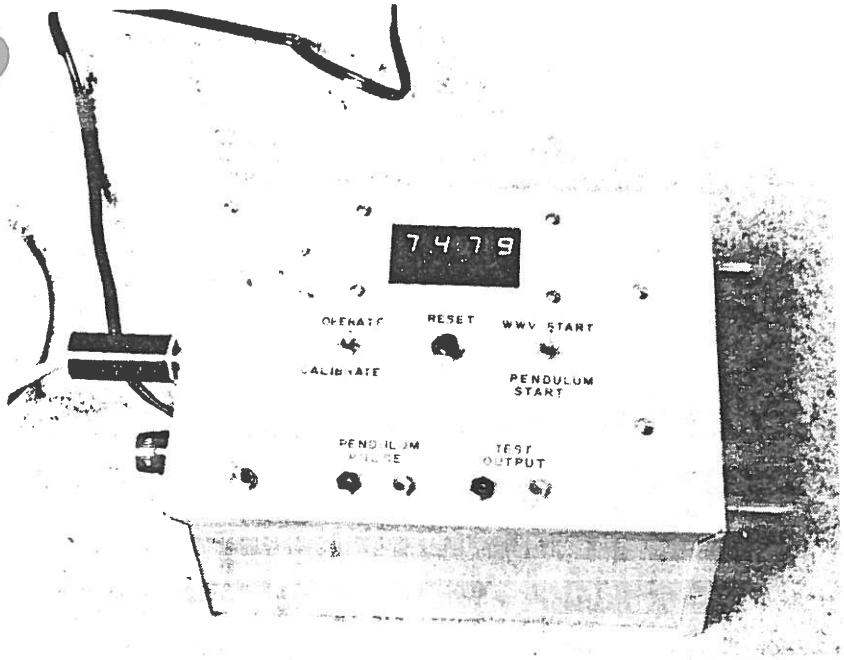


FIG. 1

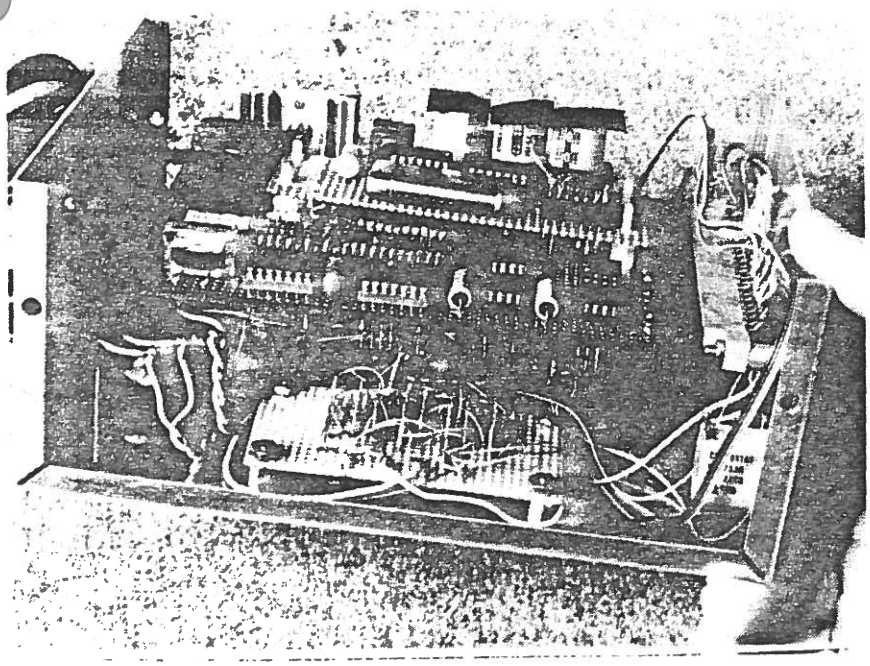
The Timer and the WWV receiver with the WWV output plugged into it.

FIG. 2



The Timer controls: input jacks for pendulum pulse input, and output jacks for use in aligning the 1000 Hz filter. A number was left displayed on the readout to show a typical reading.

FIG. 3



Internal view of the Timer with the main electronics board, counter-readout board, power transformers, and one adjusting potentiometer. The "piggy-back" oscillator board with 96 KHz crystal is also seen in addition to IC's, the "header", and power supply filters and regulators.

We wish to thank Mr. George K. Brown of the Deringer Manufacturing Co. of Mundelein, Ill. for his kind permission to reprint the following article which appeared in the March 23, 1978 edition of MACHINE DESIGN.

IDEAL SWITCH CONTACTS: A MATTER OF METALLURGY

The materials appropriate for electrical contacts in an automotive accessory switch are surprisingly different from those in, say, the horn button. And both of these differ from the preferred choice for a vending-machine switch. In fact, optimum switch selection nearly always goes beyond merely satisfying current and voltage requirements.

KARL KOENEKE
Chief Engineer
Deringer Mfg. Co.
Mundelein, Ill.

SWITCHING electrical current is a violent action that can be likened to a miniature lightning strike. As switch contacts open and close, heat generated by arcing can melt, vaporize, and otherwise disfigure contact surfaces. Moreover, this heat can cause reactions between the contact metal and airborne contaminants that create surface films which, in turn, increase contact resistance and generate even more heat. Thus, over a period of time, damage caused by electrical, mechanical, and chemical factors renders the contacts useless.

This damage is a fact of life that cannot be avoided. However, switching damage can be minimized to prolong contact life. One way, of course, is to adhere faithfully to current and voltage limitations specified in the device data sheets. Another way is to make sure contact materials are compatible with load and environmental conditions.

But the selection of appropriate contact materials seldom is straightforward. For a given contact metal, small differences in load and operating conditions make a profound impact on wear rate. As a result, contact fabricators supply over 60 different alloys to fit specific applications requirements. Fortunately, however, selecting the best alloy from all these options no longer requires exhaustive testing and analysis. Contact users now can simply use selection tables based on data obtained empirically from a broad spectrum of applications.

However, there are hazards in any rote application of empirical data. The knowledgeable switch specifier also must understand the mechanisms by which switch contacts wear and fail. Then when problems arise, he can begin a rational search for solutions rather than grope blindly among a bewildering array of options.

How Contacts Deteriorate

During each switching action, electrical contacts are physically altered until they eventually fail from welding or sticking, excessive resistance, contact transfer, or contact erosion.

Welding or Sticking: This condition can be caused by mechanical hangups, which often result from excessive material transfer and subsequent interlock caused by a wipe action. There are two other possibilities: butt-welding from heat generation caused by high resistance at the interface of the contact and arc welding caused by closing two molten contacts that have been heated by an arc discharge.

Excessive Resistance: Contact temperature is a function of the resistance of the contact interface. This resistance is a combination of contact-material resistance and the resistance of constriction, films, and particles. Constriction, caused by current crowding through very small areas at the contact interface, accounts for a significant amount of total contact resistance. The remaining resistance is caused by nonconducting or semiconducting particles between contacts. These films or particles are chemical and mechanical.

Chemical films are produced by oxidation, corrosion, or surface reaction to foreign materials. Mechanical films are caused by dust, oil, and other foreign materials. Contact failure usually results when the closed resistance is too high or the open resistance is too low.

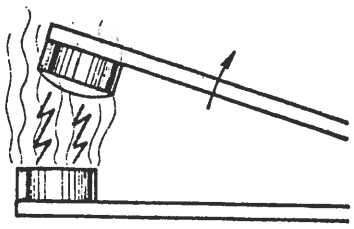
Contact Transfer: Under certain conditions contact material migrates from one contact to another. In ac circuits this transfer can be in either direction unless contact temperatures are not the same, in which case the material moves to the cooler contact.

Contacts actuated in synchronism with line frequency transfer material because they always break at the same point on the waveform. The effect is the same as breaking a dc circuit. In a dc circuit, material may transfer in one of two ways. Material transfer to the negative contact is commonly called bridge transfer. This condition results from operating the contacts below minimum arc voltage or below rated current values for a given material. Material transfer to the positive contact, usually termed arc transfer, is caused by operating the contacts above minimum arc voltage and current values.

Why Contacts Go Bad

In the course of doing their job, contacts that switch electrical current gradually wear out because of subtle mechanical, chemical, and metallurgical effects. The conditions shown here accelerate contact erosion.

Arcing



Cause: Inductive loads, excessive voltage.
Effects: Surface pitting, metal vapor deposition on nearby structures, contact welding.
Remedy: Use arc suppressors, increase contact spacing, use snap-acting contacts for dc and fast-make slow-break contacts for ac.

Contact Erosion: There are two types of contact erosion: mechanical and electrical. Mechanical wear in butting-type contacts is insignificant. In wiping or rotary action, however, mechanical wear is more of a problem. The main source of contact erosion, however, is arcing. Electrical energy in an arc heats the contact surface to the boiling point and causes material loss by vaporization. Such loss of material shortens contact life and can also degrade the dielectric strength of surrounding structures. Although characteristics of arc erosion vary between different materials, the rate of arc erosion for a given material is proportional to circuit current and the frequency and number of switching cycles.

Selecting Contact Material

Selecting a contact design requires the assessment of electrical, mechanical, environmental, and economic factors.

Electrical: Current directly affects all factors involved in contact problems. A high percentage of energy dissipated at the contacts is heat generated by constrictive resistance.

Normally, contact temperature rises during operation until it stabilizes when radiation and conduction losses equal the heat generated by contact resistance and arc energy. The extent of arc erosion, welding, and sticking is directly proportional to the energy dissipated at (and through) the contacts and, thus, is proportional to contact current.

Contact operating voltages are also important in contact selection. All contact materials have a characteristic arcing po-

TO BE CONTINUED

MART

FOR SALE: Poole Mfg. Co., NY w/dome $150.00; SWCC, NY 22" Sq.wood case $150.00; metal case 14" dial $125.00; Kundo swinger w/dome $95.00; Jaeger Watch Co., NY auto clock "Magnetric" fits 4 3/8" dash hole, 3½" dial $75.00; S.T. early AC manual start motor, chimes, $75.00; Sessions AC chime tambour $50.00; Eureka mantel clock--details upon request. L.O'Briant.

WANTED: Self Winding mech. for Std. Elec. master.
L.O'Briant, 3516 Swift Dr.,Raleigh, NC 27606

REPAIRS: All early battery clocks including Pooles, Barrs, Tiffany Never-Winds, Eurekas, etc. Specializing in Bulle clock repairs using original parts. One month maximum time for all repairs. Martin C. Feldman

WANTED: Electrical Horological Literature of any type.
Martin C. Feldman,620 Reiss Place, Bronx, NY 10467

WANTED: Unusual Electrical Clocks- A. Marx,105 Bayeau Rd. New Rochelle,NY 10804

WANTED: Synchronome Master Clock; Large secondaries.
Henry Weiland,8946 W.Grantosa Dr.,Mil.,Wisc.53225--Tel.(414)463-4681.

FOR SALE: Firehouse receiving unit with 1" tape (full roll including),take-up reel with spring motor. Main unit is glass enclosed with heavy brass and steel precision machining of all components. Electrically activated to punch a series of triangular holes as per signals received. This unit was used by the N.Y.C. Fire Dept. approximately during the early 1900's. A fine collector's piece in working order--$130.00 plus shipping,packing free!
Martin C. Feldman,620 Reiss Place, Bronx, NY 10467

WANTED: Pendulum Assembly for Synchronome clock. Would like to purchase either pendulum or entire clock or borrow so that copy could be made.
Art Bjornestad, P.O.Box 134, Verdugo City, CA 91046
(213) 249-2227

****

THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY NEEDS:
1: Original Articles.
2: More Mart Parcicipation.
3: Technical Questions.
4: New Members (for the Society).

****

New answer box by Drs. George Feinstein & Bruce Levy. Send questions on technical problems with SASE. Some answers will be published.

OFFICIAL BALLOT

ELECTION OF ELECTRICAL HOROLOGY SOCIETY OFFICERS

INCUMBENT CANDIDATES	YES	NO	WRITE-IN CANDIDATE
Martin C. Feldman, FNAWCC (Pres.)	☐	☐	
Alan Marx (Vice Pres.)	☐	☐	
Dr. Bruce Levy (Vice Pres.)	☐	☐	
Charles Roth (Treasurer)	☐	☐	

Ballot rules and explanations:

1) Vote either yes or no for each candidate. If a candidate is unacceptable and you wish to write-in a candidate of your choice, please do so in the space provided.

2) All candidates must be in good standing as members of the EHS.

3) All voters must be in good standing as members of the EHS.

4) The members elected will serve a term of two years.

5) Please have filled-in ballots returned to me by July 20, 1979. You need not put a return address on your ballot envelope as only members in good standing are receiving this ballot.

6) In the event of a tie between a listed candidate and a write-in candidate, and/or any other discrepancies, a run-off election will take place.

7) Send ballots to: Mr. Martin C. Feldman, 620 Reiss Place, Bronx, NY 10467

The
JOURNAL
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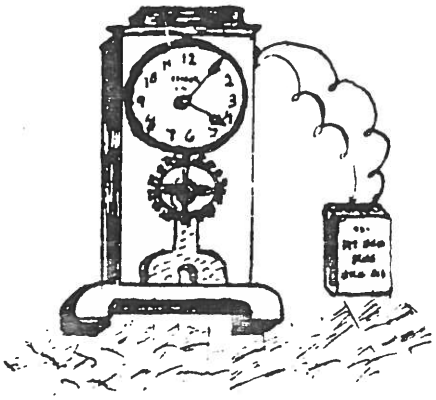
ELECTRICAL HOROLOGY SOCIETY
Chapter No 78

AUGUST, 1979
VOLUME V---ISSUE IV
Martin C. Feldman, Editor



Hello fellow enthusiasts:

We hope that this summer Issue finds all of you well and enjoying yourselves in spite of the fuel situation. I am pleased to report the results of our election. The entire slate was unanimously elected by 13.6% of our membership. Alan Marx and Bruce Levy remain as Vice-Presidents with Charlie Roth as Secretary-Treasurer and myself as your President. The Executive Board wishes to thank those who voted for their support and also those who did not for their implied acquiescence of our abilities. I am sure that I speak for the entire Board in saying that we hope during the next two years to continue to work for the ideals of our Chapter as well as continuing to bring you our bi-monthly Journal.

In this Issue we have a final short article by Paul Hopkins describing how his electronic timer can be modified so that it would be useful in timing a standard pendulum master clock. We also complete the reprint of Mr. Koeneke's switch contact article.

We have been sending the Museum Library, as a donation from our Chapter, copies of electrical horological patents which our Chapter purchased some time ago. Through the good work of fellow member, George Feinstein, we have been able to recently send some twenty patents of over 100 pages to the Library Reference Center. We feel that member Chapters as well as individuals who are in a position to increase the library either through book donations or copies of patents, articles, etc. should make every effort to do so. This service will be well justified as future collectors and researchers will have access to a very fine research tool.

Last but not least, we once again must request articles from our membership for our Journal. As you know material for our Journal which is approximately 96 pages long every year is very hard to find. While your Editor makes every effort to try and provide pertinent and interesting reprint material from his own as well as from other libraries, original articles are very much desired as they do offer material not found anywhere else as well as having a special interest for the membership when one of our own is the author. Please do not feel that you cannot write

as anyone can write. If you have an anecdote, short story, a restoration description, or a story about the "one that got away", please, by all means, write it up and send it to me. If there are any corrections in grammar, syntax, spelling, etc. we shall discreetly make these corrections giving the author full credit--of course. It is all part of the editorial function. So, jot down some thoughts and send them off to me today.

Enjoy this Issue!

Electromagnetically yours,

Marty Feldman

Martin C. Feldman,FNAWCC

********** MART **********

FOR SALE: Rare Rempe movement only--no face or hands. In good condition, but needs cleaning. Contacts excellent.----------$130.00

Boiler room brass cased round International Time Recording Co. slave, 4" face, 5" back diameter. Working condition---$55.00

Firehouse receiving unit with 1" tape (full roll including), take-up reel with spring motor. Main unit is glass enclosed with heavy brass and steel precision machining of all components. Electrically activated to punch a series of triangular holes as per signals received. This unit was used by the N.Y.C. Fire Dept. approximately during the early 1900's. A fine collector's piece in working order---$130.00 plus shipping, packing free!
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WANTED: Synchronome Master Clock; Large secondaries.
Henry Weiland,8946 W. Grantosa Dr.,Mil.,Wisc.53225--Tel.(414)463-4681

FOR SALE: Early SWCC rotary motor wall cl.,cherry 40" case;STANDARD ELECTRIC master cl.,52" early mahog. case; SWCC rotary motor mvt.,black iron mantle case; INTERNATIONAL TIME RECORDING master cl. from NYS prison--write for details.
Don Dean, Box 339, Altamont, NY 12009

TIMER ARTICLE ADDENDUM

Following submission of the original timer manuscript, Marty Feldman asked about the possibility of circuit revisions so that the device could be used on any "precision" clock. A review of the circuit showed it to be pretty simple for any one who wants that feature, which I had overlooked. Of course, it will require an external sensor, with leads brought out of the box.

By blind luck the 7408 buffer that I added between the opto-coupler isolator and the 555 timer controller is a two input "and" gate, with the two gates tied together. By separating the two inputs one input can still go to the opto-coupler, and the other input can be controlled by an external sensor. Either of these inputs can then stop the counter.

I have shown the use of a Texas Instruments (TI) TIL139 device. It is a combination infra-red (IR) source and IR detector, and is the same device I used in the original Matlock-Collins project. It was hoped that a spare gate in the 7414 chip could be used, but it would not work. Apparently the TIL139 is not compatible with the TTL 7414. As a result a CMOS 4081 chip was used. I would have preferred to use a CMOS 4093 Schmitt trigger chip, but didn't have one available to try.

In order to select the pendulum swing with which to stop the timer a high resistance "pull up" resistor plus a low resistance "inhibit" resistor controlled by a push button or toggle switch have been connected to the 4081 input. After the switch is actuated to take the "inhibit" resistor out of the circuit, the next pendulum swing in front of the sensor will stop the timer. I am not sure of the real necessity for this feature. However, it appears to be a good idea in that it should simplify the use of the timer by allowing the user to concentrate first on WWV and the "start" function, and then to shift

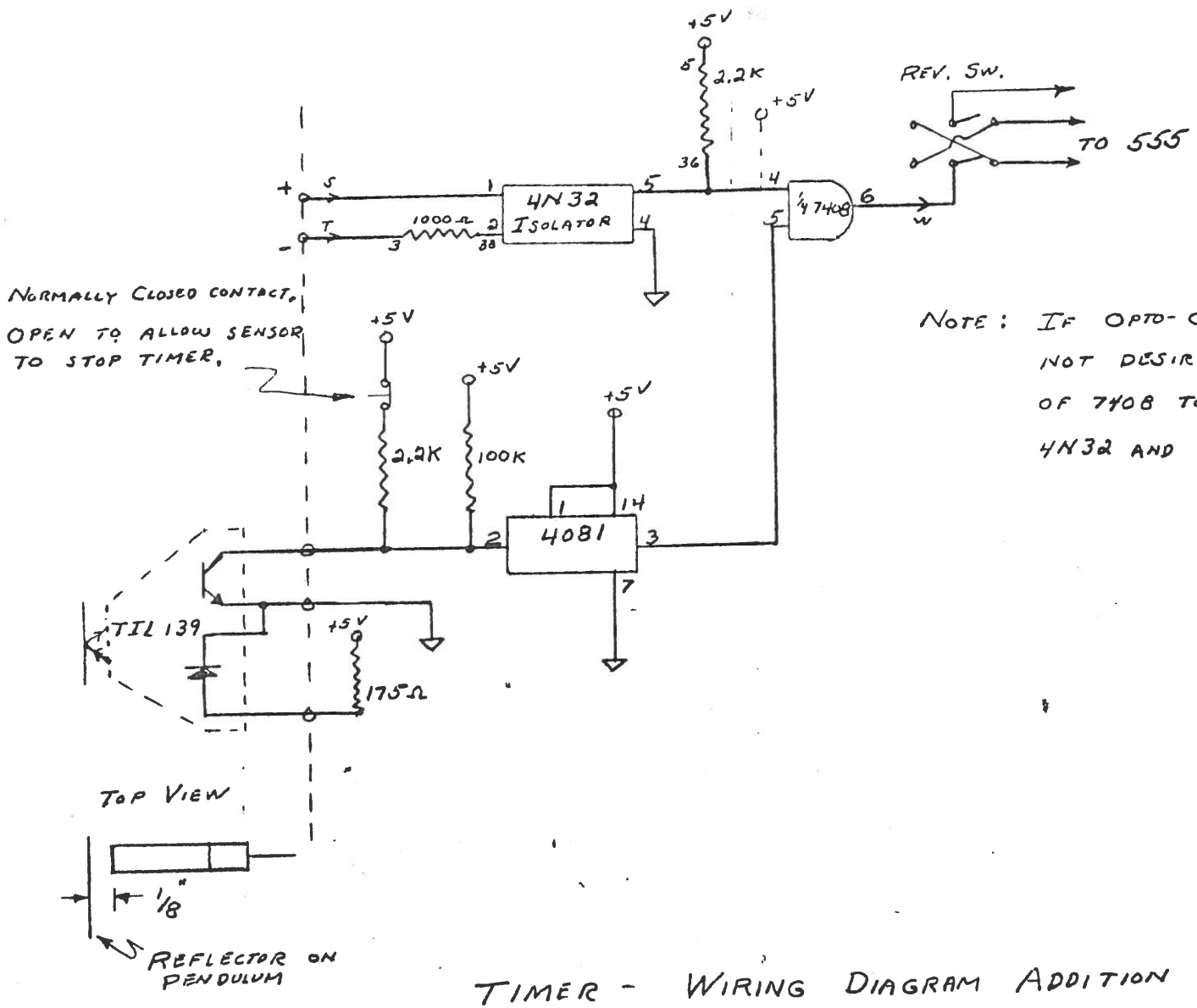
his concentration to his clock and to actuating the "stop" function.

It will be necessary to bring three leads out of the box for connection to the sensor, which will have to be mounted in close proximity to the pendulum. I would think the sensor should not be actuated until the last 10% or 20% of pendulum travel to one side or the other, thereby maximizing the time available for operating the "inhibit" switch, and minimizing possible ambiguity between pendulum swings. It will also be necessary to mount a suitable reflector on the pendulum. I have found that anything shiny works pretty well, with a piece of mirror working best of all. It should pass approximately 1/8" in front of the sensor.

While I mentioned the Texas Instrument TIL139, I have also made my own units using G.E. LED55B IR sources, and L14G2 IR detectors. I feel sure that other devices could also be used such as the G.E. H13B1 or H13B2, which are U - shaped source-plus-detector modules.

In conclusion, I would like to point out that this circuitry has not been built into my timer. However, it has been tested on a bread-board in the lab, and worked well. If there are questions, I will be happy to try to answer them.

Paul Hopkins
2717 Millwood Road
Birmingham, AL 35243



NOTE: IF OPTO-COUPLER USE IS NOT DESIRED CONNECT PIN 4 OF 7408 TO +5V. AND OMIT 4N32 AND 2.2K RESISTOR.

TIMER - WIRING DIAGRAM ADDITION
FOR USE OF PENDULUM DETECTION

PMH 4-3-79

FIG. 5

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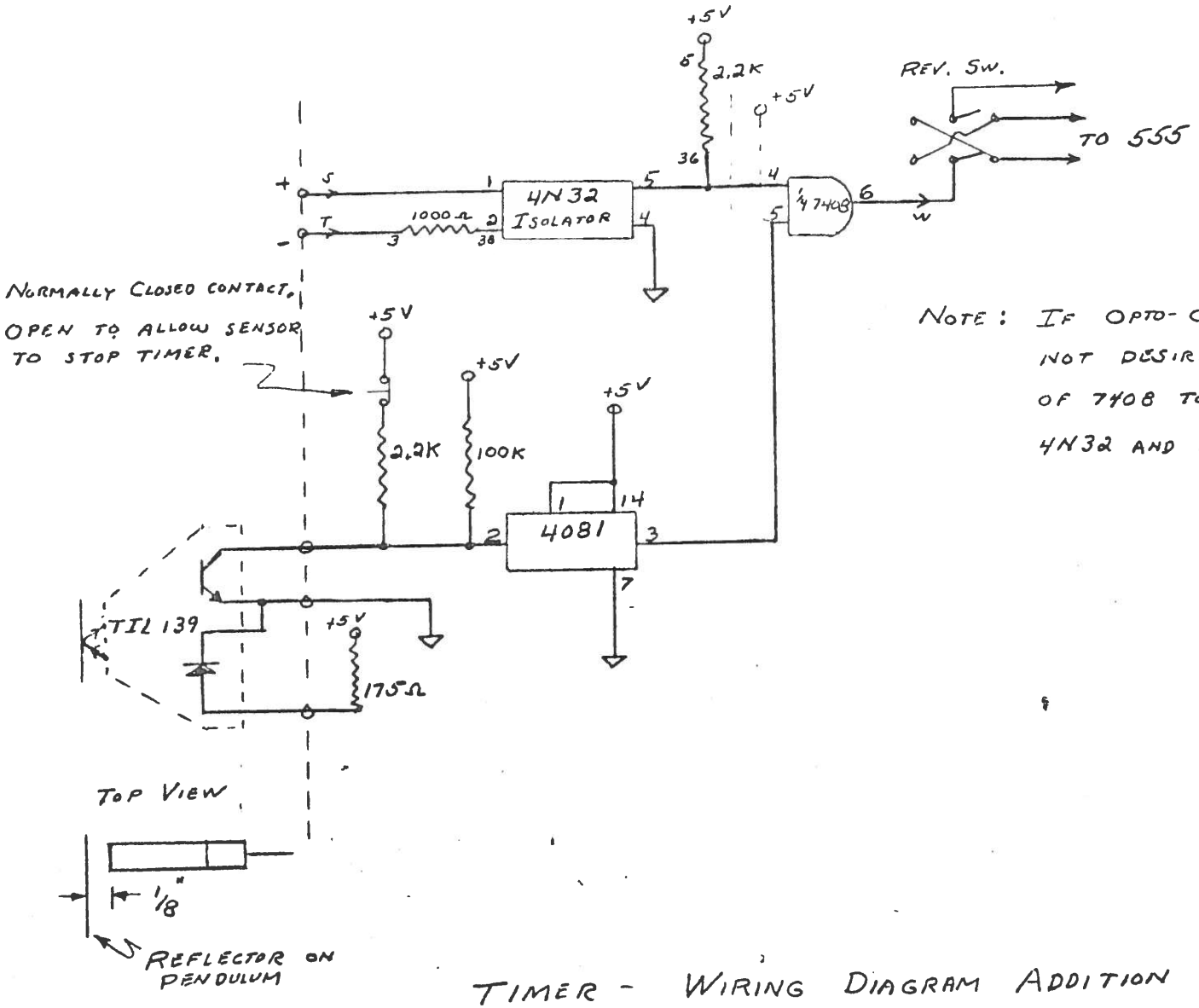

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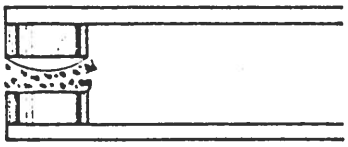
TIMER - WIRING DIAGRAM ADDITION
FOR USE OF PENDULUM DETECTION

PMH 4-3-79

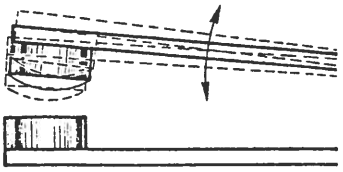
FIG. 5

Contamination and Film Formation



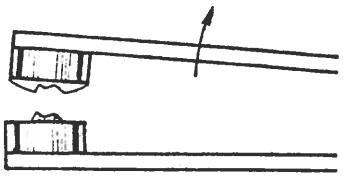
Cause: Humidity, airborne contaminants, chemical reactions.
Effects: Increased contact resistance and wear, increased heat, accelerated oxidation.
Remedy: Mount contact surfaces vertically, use protective enclosure or air filters, use sliding or wiping contacts.

Bounce



Cause: High-frequency switch cycling.
Effects: Excessive arcing, accelerated contact erosion.
Remedy: Decrease switching-cycle rate, change spring design or contact mass.

Transfer



Cause: Operation above or below specified electrical limits for contact material.
Effects: Transfer of metal from one contact to the other.
Remedy: Operate contacts within specified electrical ratings.

tential in the 10 to 20-V range. If the maximum voltage switched is below this range, no arc forms, but above this voltage arcing and subsequent material loss must be expected. In addition, the type of load has direct bearing on contact performance.

- Resistance loads are predictable and behave consistently.
- Inductive loads release a considerable amount of energy when contacts break the circuit.
- Capacitive loads have high current inrush.
- Motor loads, although basically inductive, have heavy starting inrush currents.
- Tungsten lamp loads require contacts of sufficient capacity to handle high inrush current.

To reduce arcing at contact points and ensure longer life, arc suppressors such as condensors, capacitors, and blowout coils can be used. But care must be exercised in choosing the type of suppressor; the best protective circuit is most often determined by testing.

Mechanical: Electrical device makers select contact materials partly on the basis of the mechanical forces used to close a pair of contacts. This force usually is the maximum the material can withstand without excessive wear or deformation. In addition, contact material is selected to be compatible with the type of service intended. For example, operating frequency or the number of make and break operations in a given time period determines contact life. One operating cycle each minute or longer is considered low frequency; from one cycle per minute to one cycle every 10 sec is intermediate frequency; and more than one cycle in 10 sec is considered high frequency. For low switch-cycle applications contact material must resist the formation of oxides and films during idle time. For high-frequency operation the contact design must withstand high temperatures and have good heat dissipation.

Closing and opening contacts faster than their intended cycle rate reduces contact life significantly and causes bounce or chatter. In these cases, some change in spring material or contact mass normally is required to obtain firm make and break action.

Also important in both ac and dc circuits is the speed of contact closure and separation. Snap-acting contacts are best for making and breaking dc circuits. In ac applications, a fast-make and slow-break design minimizes arc damage.

Another mechanical factor to consider is contact gap or space between contacts. Contact spacing in the open position must be great enough to prevent con-

tinued arcing, particularly in inductive loads with high counter-electromotive force. Finally, a certain amount of contact wiping may be advantageous or undesirable, depending on the application. For example, sliding contacts break through some films and can increase contact area. But in dc circuits contact wiping may eventually cause mechanical hangup between the peaks and craters on the contact surfaces.

Environmental: Film resistance caused by the operating environment can degrade contact operation and shorten life. Environmental factors that promote film formation include gases, fumes, foreign materials, high temperature, and high humidity.

Sulphur fumes are primarily responsible for tarnishing or silver sulphide formation on contacts. This film increases resistance and can cause open circuits. Hydrocarbon fumes have an adverse effect on platinum alloys. Certain organic materials used in electrical devices may outgas at high temperature, producing fumes that react chemically with contact metals. To combat these problems, many devices use contacts with gold flashing and plating.

Contaminants such as dirt, dust, lint, grit, and loose metallic particles increase arcing between contacts or cause excessive temperature rise. If enough particles lodge in the contact area, an open circuit results. In a dirty operating environment, good practice is to mount contact surfaces vertical.

Contact materials used in high-temperature applications must resist abnormal oxidation and chemical reactions. High humidity accelerates corrosion and oxidation.

Economics: Contact materials are expensive because they are made of precious or rare metals. Depending on material used and contact size, cost can vary from less than a cent to several dollars per contact. However, in all switches the prime requirement is dependable contact operation for a reasonable lifetime. Thus in some sophisticated switches

Application Guide

Switches used in automobiles all operate in similar environments. But minor differences in electrical load require the use of four different contact alloys for long life and trouble-free performance. For the same reason, the preferred contact material for vending-machine switches differs from that used in toys. As a result, contact fabricators supply over 60 alloy options to satisfy every conceivable operating condition. These tables, based on empirical data from proven switch and relay applications, simplify the search for the optimum contact material and serve as a guide to switch specification.

Contact Applications

Product	Reference Number (order of preference)			
Aircraft	**1st**	**2nd**	**3rd**	**4th**
Instruments	8	7	4	3
Relays — light	18	26	38	20
medium	38	40	41	42
heavy	50	42	40	41
Appliances				
Can openers	18	29	28	26
Clothes washers and dryers	18	38	26	28
Coffee makers	18	38	41	54
Irons	18	38	40	56
Ranges	18	22	38	42
Refrigerators	18	40	38	44
Toasters	18			
Automotive				
Circuit breakers	38	42	29	35
Directional signals	38	53	29	26
Horn rings	18	26	29	53
Ignition	60	62		
Seat switches	29	38	26	41
Stoplight switches	29	26	18	36
Voltage regulators	29	26	60	41
Window switches	29	38	26	41
Burglar and Fire Alarms	13	1	4	10
Circuit Breakers				
Air	51	49	47	48
Controls				
Elevator	18	26	38	40
Lighting	18	38	17	35
Motor	18	38	42	35
Lift Trucks	38	41	42	50
Relays				
Dry circuit	1	13	6	9
Light duty	18	58	22	26
Medium duty	35	38	40	42
Heavy duty	51	47	48	42
Telephone	13	4	3	2
Switches				
Light duty	18	28	21	22
Medium duty	38	37	56	35
Heavy duty	42	41	40	38
Rotary	43	44	46	26
Wall	18	26	29	54
Telephone				
Jacks	59	17	7	9
Relays	13	4	3	2
Thermostats	18	19	24	12
Toys	63	28	29	18
Traffic Signals	18	26	38	31
Vending Machines	26	29	18	38

cost may be immaterial; in other applications switch cost may be a major portion of total cost.

Contact configuration normally is selected to meet mechanical requirements of the switch. Most switches use a radius face against a flat face to make alignment and gapping easier. Special shapes are available for insuring positive contact and for increasing mechanical forces. Contact size is based mainly on current or energy requirements, economics, space available, and the designed life of the switch.

Contact Materials

Reference Number	Composition (% by weight)	Electrical Conductivity (% IACS)	Melting Point (°F)
	Gold and Gold Alloys		
1	99.9 min Au	77	1,945
2	75 Au, 25 Ag	16	1,885
3	72 Au, 26.2 Ag, 1.8 Ni	14	1,870
4	69 Au, 25 Ag, 6 Pt	10	1,885
5	50 Au, 50 Ag	45	1,830
	Platinum Metals and Alloys		
6	99.9 min Pt	15	3,215
7	95 Pt, 5 Ir	9	3,220
8	90 Pt, 10 Ir	7	3,250
9	85 Pt, 15 Ir	6	3,270
10	80 Pt. 20 Ir	5	3,299
11	95 Pt, 5 Ru	5	3,227
12	89 Pt, 11 Ru	4	3,260
13	99.9 min Pd	16	2,825
14	95 Pd, 5 Ru	8	2,900
15	90 Pd, 10 Ru	6	3,000
16	72 Pd, 26 Ag, 2 Ni	4	2,520
17	60 Pd, 40 Ag	4	2,440
	Fine Silver		
18	99.95 min Ag	105	1,761
	Silver-Platinum and Silver-Palladium Alloys		
19	97 Ag, 3 Pt	48	1,800
20	99 Ag, 1 Pd	79	1,762
21	97 Ag, 3 Pd	58	1,790
22	90 Ag, 10 Pd	30	1,830
23	75 Ag, 25 Pd	14	2,030
24	60 Ag, 40 Pd	21	2,240
	Silver-Copper Alloys		
25	92.5 Ag, 7.5 Cu	88	1,510
26	90 Ag, 10 Cu	88	1,500
27	72 Ag, 28 Cu	84	1,437
28	50 Ag, 50 Cu	75	1,607
29	75 Ag, 24.5 Cu, 0.5 Ni	75	1,441
	Silver Nickel		
30	95 Ag, 5 Ni	95	
31	90 Ag, 10 Ni	87	
32	85 Ag, 15 Ni	80	
	Silver-Cadmium Alloys		
33	95 Ag, 5 Cd	60	1,720
34	90 Ag, 10 Cd	47	1,670
35	85 Ag, 15 Cd	35	1,620
36	77 Ag, 22.6 Cd, 0.4 Ni	31	1,560
	Silver-Cadmium Oxide Materials		
37	95 Ag, 5 CdO	84	
38	90 Ag, 10 CdO	75	
39	90 Ag, 10 CdO	74	
40	86.5 Ag, 13.5 CdO	68	
41	85 Ag, 15 CdO	65	
42	83.2 Ag, 16.8 CdO	61	
	Silver-Graphite Materials		
43	99.75 Ag, 0.25 C	94	
44	99.5 Ag, 0.5 C	90	
45	93 Ag, 7 C	50	
46	90 Ag, 10 C	40	
	Silver Refractory Materials		
47	50 Ag, 50 W	60	
48	35 Ag, 65 W	50	
49	65 Ag, 35 WC	58	
50	50 Ag, 50 WC	48	
51	40 Ag, 60 WC	43	
52	35 Ag, 65 Mo	45	
	Miscellaneous Semirefractory Materials		
53	Ag, MgO, NiO	70	
54	90 Ag, 10 Fe	90	
55	99.7 Ag, 0.3 CaO	100	
56	90 Ag, 10 W	92	
	Miscellaneous Silver Alloys		
57	Ag, Hg	100	1,760
58	90 Ag, 10 Au	48	1,780
59	75 Ag, 25 Zn	40	1,300
	Miscellaneous Materials		
60	Tungsten	31	6,170
61	Molybdenum	33	
62	Equiaxed tungsten	31	6,170
63	OFHC copper	100	1,981

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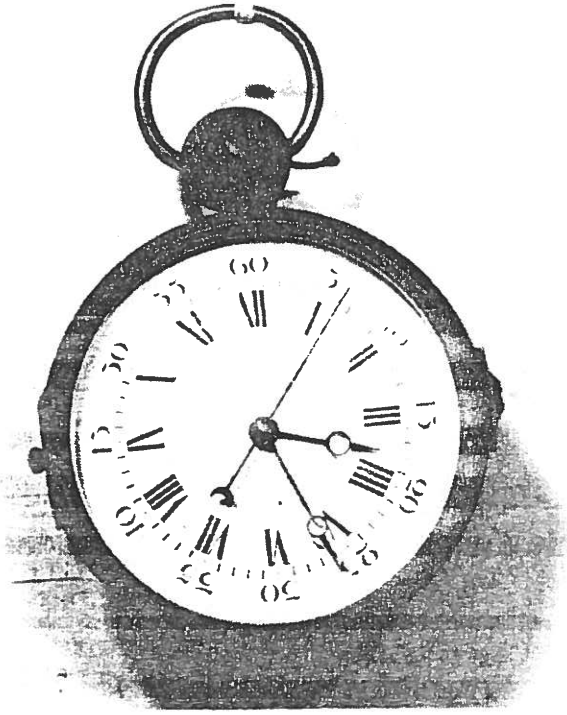

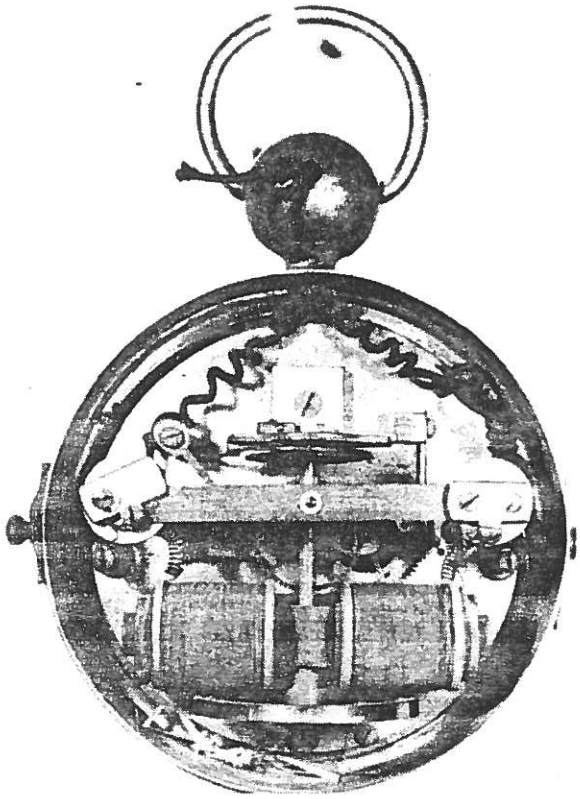

Can anyone identify this watch-clock? It appears to be of French origin dating probably in the 1880's. Please send any information to me at 620 Reiss Place, Bronx, NY 10467. Thank you.

Marty Feldman

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NOTICE

Dr. George Feinstein's column, the TIME MACHINE, has not been printed recently because members have not been sending questions in. This column was originally started as a mini-answerbox. Send you questions to Marty Feldman and Dr. Feinstein will try to answer them in his column.

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MAKE USE OF YOUR MART. You have the best chance of buying, selling, and/or trading your electrical horologica in our MART as our members are very interested in this material. Still only $2/4 lines. Send ads and Checks made out to EHS to Marty F.

MANY THANKS

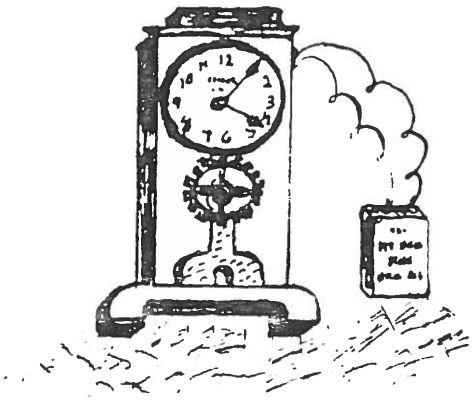
THE JOURNAL OF THE [illegible] HOROLOGY SOCIETY NEEDS:

1: Original articles!
2: More Mart participation!
3: Technical questions!
4: New members (for the Society)!

NEEDS YOU!

The
JOURNAL
OF THE
ELECTRICAL HOROLOGY SOCIETY
Chapter No 78

October, 1979
VOLUME V--ISSUE #5
Martin C. Feldman, Editor



Hello fellow enthusiasts:

This month we are pleased to bring you our Journal which marks over 7-1/2 years of continuous publication of a Journal devoted specifically to Electrical Horology. While we wish to thank the many people who have contributed material and those that are engaged in specifically publishing our Journal, a very special and major vote of thanks is owed to YOU, the collector and enthusiast of electrical horology. Without your continued support as evidenced through the letters we have received over the years as well as your financial support as members of the EHS---we would not have been able to continue. Our Journal which usually contains twelve pages is published bi-monthly for a total of approximately ninety-six pages per year devoted to writing about electrical horology. We are the only group in the world which publishes material consistently about this subject. Our Chapter has no other means of support other than dues. We do not hold luncheon meetings, nor have auctions nor raffles, etc. We rely on dues to bring you a Journal which we hope, and we know through your support, satisfies a need both present and future. Our Journal is being collected by the NAWCC Reference Library for inclusion in their files to be used by researchers in the future. For the past year-and-a-half we have barely made our expenses and have fought against asking for a dues increase until we no longer can fight the inflation of our times. It is with personal regret that we ask for an increase in dues to $10 per year starting January 1980. We have not had an increase for the past few years and I believe that is a victory for us. I am sure that you will support us and enable us to continue to bring you this Journal as we have done so reliably in the past. I wish to thank you all.

In this Journal the long overdue Index of our Newsletters and Journals which we have published since March 1972 is being printed. When compiling this index, I had some idea that we had done a great deal of work, but once I began to put everything together the vast amount of material we have published was astonishing. We are publishing an index of electrical horology articles found in the American Horologist and Jeweler by Orville R. Hagans. These two indices show a wealth of information about many of the common and some uncommon clocks which are being collected.

cont. pg.6 →

INDEX: NEWSLETTERS of the ELECTRICAL HOROLOGY SOCIETY, #1-10 (March, 1974- through Sept., 1974); JOURNAL of the ELECTRICAL HOROLOGY SOCIETY, VOLUMES I-V (Nov., 1974 through Oct., 1979).
Compiled by: Martin C. Feldman,FNAWCC

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Siemens-Halske Master clock, photo	JEHS Vol IV #3	June, 1978
Slave Distribution Panel by Richard Warburton	JEHS Vol 1 #5	Aug.,1975
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Stromberg Electric Clock Co., parts of master clock in schematic	JEHS Vol II #4	Aug.,1976
Synchronome Master Clock by Charles Aked	Newsletter #6	July, 1973
TIME SIGNAL, device, Illust.	JEHS Vol III #4	July, 1977
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ADDENDA: **Index, Elect. Horo. Art. in Amer. Hor. & J.** **Report, Book, SWCC Reprints** **Reprint, Data, Elix Reform Movement**	**JEHS Vol V #5**	**Oct., 1979**)

Directions for Installation and Care of Self Winding Synchronizing Clocks, reprint, 4½" x 6-3/4", 32 pages, paper, Self Winding Clock Publications, 1979, Price $4.

TEXT: This fine little booklet describes the care and maintenance of the various master clocks produced by the SWCC from their start approximately in the year 1884. It contains information not usually seen as early wet cell batteries, used to power these clocks, are illustrated and described. Both the rotary motor movement which was the earliest produced by this famous company and the oscillating motor movements are covered in the manual. Of interest and very rarely found, a description of calendar clocks is included as well. Rounding out the completeness of the booklet, there is information about the synchronizing mechanism of a typical master clock.

Instructions for Installation and Maintenance of Self-Winding Synchronized Clocks, reprint, 4½" x 6-3/4", 34 pages, paper, Self Winding Clock Publications, 1979, Price $4.

TEXT: This manual originally published in 1923 by the SWCC contains some of the information found in the first booklet we reviewed. However, in addition, there are many photographs of various models which can still be found by collectors. Of particular interest is a complete description of the Synchronizer for movement styles "A and C", The tilting contact for the style "F" master clock movement is clearly described and illustrated also. What is very helpful to many restorers of these clocks is a wiring diagram and this is found near the end of the booklet, both for the large master clock and railroad station clock.

Schedule of Parts Style "F" Minute and Style "F" (H-Seconds) Synchronized Movements, reprint, 5⅞ x 7½", 12 pages, paper, Self Winding Clock Publications, 1979, Price $3.

TEXT: This booklet probably printed initially during the early 1930s contains illustrations and descriptions of the components making up the master clock movement. While the parts are no longer available, the very clear photo reproduction of the parts will enable one to easily identify what is missing so a restorer would be in a position to advertise for the specific part or make one up as the case may be.

It is most gratifying to see the reprints of these manuals as this is the first time that they have been reprinted and available to collectors. It is also doubly heartening to see a member of the Electrical Horology Society form his own company which has begun specializing in reprinting material of particular interest to electrical horologists. Not withstanding their interest to those collecting electrical clocks, these manuals will be welcome by the average collector even if he does not have a SWCC clock, but as an addition to one's library, for their informative as well as historical value. The printing is excellent on good quality paper and it is easily read. For the low price being charged, these new publications, while they may be purchased separately, should be purchased as a trilogy for completeness. They are highly recommended to round out the ever burgeoning serious horologist's library.

By: Martin C. Feldman,FNAWCC

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EDITORIAL CONTINUED FROM PAGE 1

To round out this Journal, a description of the ELIX REFORM battery movement is included along with illustrations of its components and mechanism. This particular little movement, while modern, closely resembles many of the Remontoire movements which we all are so familiar with. They do turn up from time to time and are highly reliable and accurate.

On Page 9 the announcement of our next local meeting to be held in the N.Y. area is made. We hope to see many of you there for it will prove to be, as in the past, a most enjoyable and enlightening afternoon.

Enjoy this Issue!

Martin C. Feldman
Editor

Information Please!

A column in memory of the late W. H. Samelius -- educator, lecturer, technical editor, founder of this department in American Horologist & Jeweler, combining the best of his writings with current developments and questions in Horology. Address questions to Orville R. Hagans, 6930 East Girard Avenue, #408, Denver, CO 80224. No appraisals. Letters will not be answered unless accompanied by self-addressed, stamped envelope.

by Orville R. Hagans

Electrical Horology

THIS LIST of articles on Electrical Horology has been compiled from "Horology" and "American Horologist and Jeweler" from 1941 through 1975 by Mr. Anthony Prasil and Orville R. Hagans. Titles given in quotation marks, otherwise a description of the contents of the article is given.

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"The Bichronous Clock," J. E. Coleman, May 1941, pp 8-10.

"The Bulle Battery Clock," J. E. Coleman, Sept. 1942, pp 14-15.

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"The Analysis of a Watch Tick," Samuel Levine, June 1946, pp 31-34. (An article discussing the use of electronic equipment for the analysis of escapement sounds.)

"Rate Drift of Timepieces." Nat'l Bureau of Standards, Oct. 1950, pp 33-34.

Information about the Warren Battery Clock, March 1953, pp 34-36.

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Information about the Warren Battery Clock, April 1953, pp. 36-38.

Adjusting the Sangamo Electrically Wound Clock, April 1953, pp 49-51.

Information on Adjusting the Eureka Clock, May 1953, pp 54-55.

"The Elix Reform Battery Movement," A. S. Lissance, May 1953, pp 57-60.

"The Drawbaugh Electro-Magnetic Clock," Flora W. Smiley, June 1953, pp 34-36. (Description of clock patented 1889 and story of its inventor.)

"Historical Notes on Electrical Impulse Mechanisms for Small Balance Wheels," Marius Levet, July 1953, pp 19-26. (From an article of the same title in the No. 1 1953 issue, "Annales Francaises de Chronometric.")

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Information on adjusting the electric wind mechanism of Sangamo clocks, J. E. Coleman, Feb. 1955, pp 34-36.

Repair information for Tiffany Never-Wind battery clock, Dec. 1955, pp 46-47 and Mar. 1956, pp 38-39, J. E. Coleman.

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Description of a cordless synchronous clock, J. E. Coleman, Oct. 1956, pp 38.

History of Imperial Clock, J. E. Coleman, Nov. 1956, pp 37-39.

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Drawing of mechanism and repair information for Tiffany Never-Wind Clock, J. E. Coleman, March 1957, pp 44-47.

"Errors in Received Time Signals," Ronald L. Ives, April 1957, pp 20-22.

"The Kundo Transistor Clock," technical data, J. E. Coleman, June 1957, pp 40-45.

Hamilton Electric Watch Service Data, Sep. 1958, pp 16-26.

Technical information about Lip Electric Watch, Dec. 1958, pp 18-25.

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We wish to thank Orville R. Hagans for his kind permission to reprint the preceding article.

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MEETING NOTICE

On Sunday, October 14, 1979 the next local meeting of the Board and membership will be held at the home of Mr. & Mrs. Charles Roth. The meeting is by R. S. V. P. only, and Mr. Roth must be called for your reservation and time as well as for directions. His number is (516) MA-1-4540.

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The Elix Reform Battery Movement

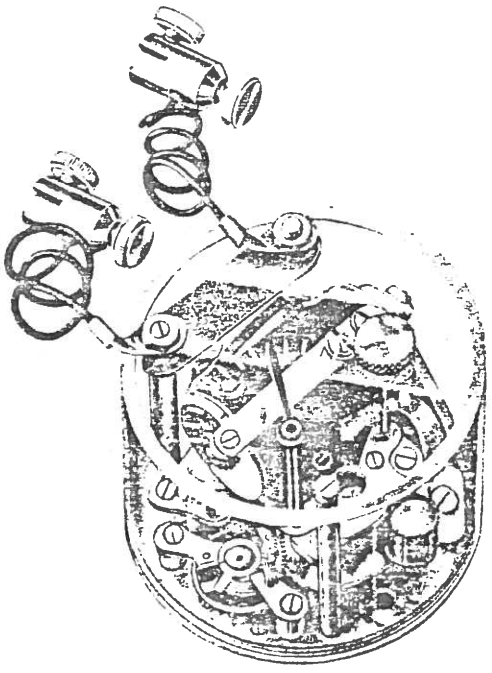
ALTHOUGH A. C. clocks have proven to be good timepieces in areas where the pulsations (cycles) of the a.c. current are very closely controlled, they are not free of disadvantages especially in rural parts of the country where power failures are quite frequent.

This is one of the reasons why spring wound clocks are still in use. But today more and more people are interested in obtaining clocks which do not depend on house current or which do not have to be wound.

Due to the increased demand for such timing devices, the attention of several Swiss manufacturers is focused on flashlight battery operated movements, offered through El Products Corporation, U. S. distributor.

The Elix Reform battery movement is among the latest developments of this kind, and has quite a few remarkable features to its credit.

1. The movement is equipped with a 7-jewel lever escapement, a nickel alloy balance and with an Elinvar temperature compensating hairspring.



Elix Reform Battery Movement

2. The mainspring is electrically wound at regular intervals, thus timing is independent of voltage fluctuations inherent in dry cell batteries. A "D" cell flashlight battery will operate it for at least six months.

3. All electrical parts are built to the strictest specifications and do not require any adjustments.

One can safely assume that the reader is quite familiar with the functioning of a conventional 18,000 beat watch movement and for reasons of space, the description of the Elix Reform will be limited to the rewind apparatus and its electrical components. (Drawings: Pages 58-59.)

Fig. 1 shows the electric circuit and parts of the winding arm.

As the mainspring unwinds, the winding arm (f) and its contact meet the contact point of the armature (b) and the circuit to the electromagnet (a) is closed. The energized electro magnet attracts the armature (b), the winding arm is pushed away, and the spring is rewound. Due to the momentum of the counter weights mounted at the extreme ends of the winding arm, a quick break of the contacts is caused and the armature returns to its initial position. Rewinding takes place about every 3 minutes. To protect the contacts from being burned by an induction spark, a noninductive resistor (c) is inserted in parallel.

During the rewind operation, the movement is receiving no power, a factor which would ordinarily result in an accumulated timing error. To eliminate this disadvantage, a maintaining spring is incorporated.

Fig. 2 shows a schematic view of the winding mechanism without the spring barrel. Fig. 3 shows a section of the complete winding mechanism. Fig. 4 shows the center wheel and maintaining spring.

The barrel (i) is stationary and fastened to the pillar plate (j). To permit adjustment of mainspring tension, tapped holes are provided on the barrel surface. Through

one of these holes the barrel is held to the pillar plate by means of the screw (k).

The winding arm has the function of the winding arbor, it has a hollow boss (g) to which the end of the mainspring is hooked. The click (d) mounted to the arm, takes into the ratchet wheel (c) and thus transfers the power of the mainspring. A click (e) which is pivoted to a pillar plate, locks the ratchet wheel while the mainspring is being wound.

On the underside of the ratchet wheel, which is also rotating on the center arbor, is a pin (h). The maintaining spring (b) is riveted to the center wheel. When assembled, the pin (h) passes through the loop of the maintaining spring and also through the oval hole in the center wheel. The maintaining spring, being weaker than the mainspring, is thus bent into line with this hole. While the mainspring is being rewound, the maintaining spring is striving to unbend, thus driving the movement.

Because the mainspring is rewound short intervals, the timing characteristics of the Elix Reform are excellent. Tests on the timing machine have shown that there is practically no variation between two winding periods. Very close timing adjustment is facilitated by a gear reduction on the regulator.

The movement is assembled with the greatest care and is shipped only after having passed several tests. Maintenance is reduced to a minimum because only the best oil is used. Like every other movement, it is supposed to be cleaned about every three years. The solid silver contacts are self-cleaning and require no care for at least two years.

Like other Elix models, the Elix Reform is equipped with a center mounting bushing. Two bushing diameters are obtainable: 1/4" and 7/16".

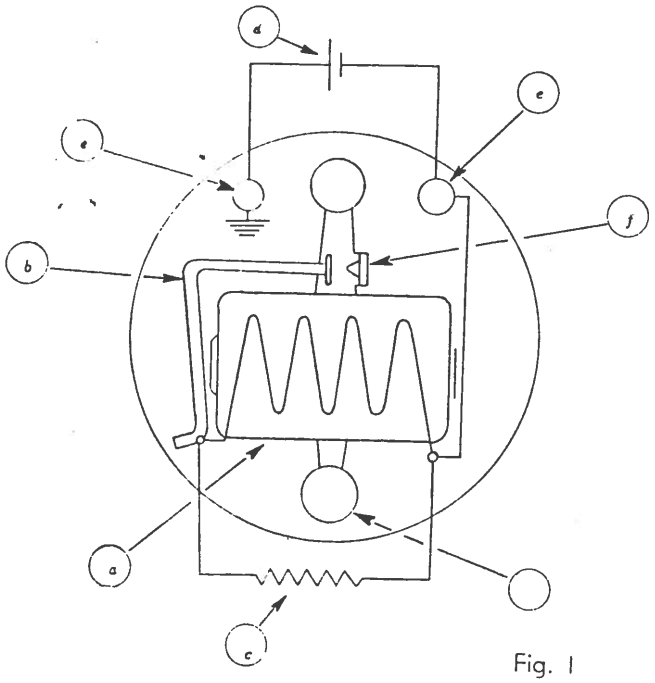


Fig. 1

(a) electro magnet, (b) armature and contact point, (c) resistor, (d) battery, (e) insulated connection, (e') mass connection to platine, (f) winding arm and contact point, (g) counter weights.

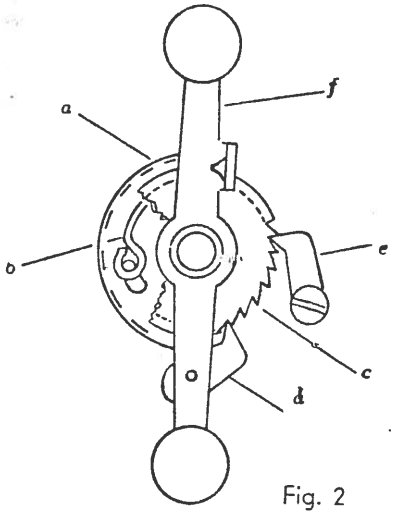


Fig. 2

(a) center wheel, (b) maintaining spring, (c) ratchet wheel, (d) click, (e) click, (f) winding arm, (g) boss.

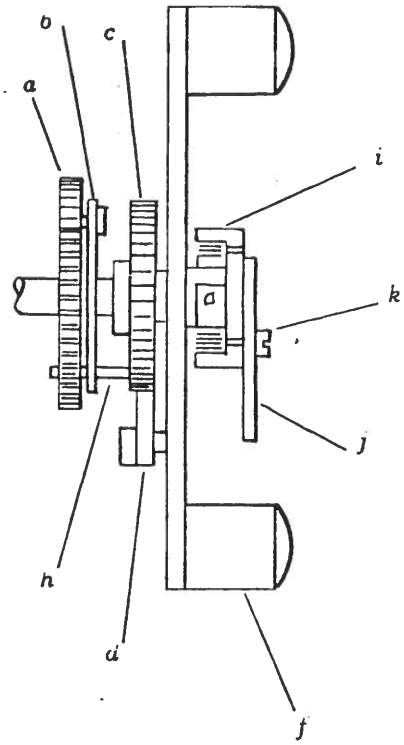


Fig. 3

(h) pin, (i) barrel, (j) pillar plate, (k) adjusting screw.

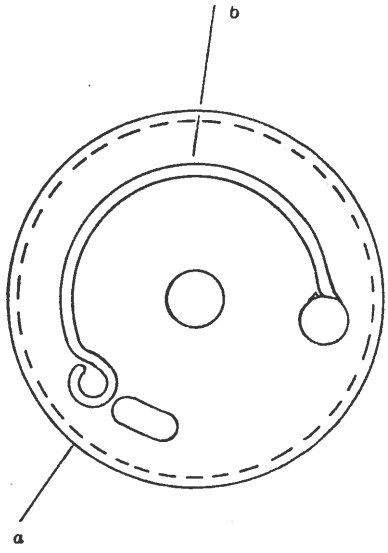


Fig. 4

Center Wheel and Maintaining Spring

We wish to thank Orville R. Hagans for submitting the above article and for his permission to reprint it.

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MAKE USE OF YOUR MART. You have the best chance of buying, selling, and/or trading your electrical horologica in our MART as our members are very interested in this material. Still only $2/4 lines. Send ads and Checks made out to EHS to Marty F.

MANY THANKS

M*A*R*T

FOR SALE: Eureka 1000 day beehive type wooden case $750. Eco Magneto Clock Co., Boston, 43" oak master case with #2 S.T. pilot clock and program mech., orig. glass with gold leaf lettering, master mvt. missing $400. Brillie Electrique 52" oak, complete time punch clock, slave mvt., card print mech. works $600. 12 V. SWCC round metal system clocks with sweep sec., send large SASE for list and $1.00 ea. for polaroids. Std. Elec. master, 48" oak $500. Lots of slave mvts., and cases, dials, etc. for slaves. AC "Quaker St. Mtr. Oil" adv. clock, all metal 22" OD Neon tube around dial, xfer missing $75. great for auto collector, dial needs restoring. SWCC 36" oak master not complete yet but will be $500 when it is. STD. Elec. Mstr. 63" oak w/pilot clock and gauge, very ornate $1750. Oak gallery sq. slaves 11" dials (2) Howards, (1) Seth Thomas $150. ea.
R.L. O'Briant, Box 1168, Raleigh, NC 27602

WANTED: Synchronome master clock in a good case. To be used with a Shortt Free Pendulum.
Cliff Haumiller, 960 E. Chicago St., Elgin, ILL., 60120---(312) 695-9111

FOR SALE: Self-Winding Clock Publications. New clock book titles, Send for list. Dealer inquiry invited. Self-Winding Clock Publications, P.O. Box 7704, Long Beach, CA.90807

FOR SALE: Rare Rempe movement only--no face or hands. In good condition, but needs cleaning. Contacts excellent ---------- $130.00

Firehouse receiving unit with 1" tape (full roll including), take-up reel with spring motor. Main unit is glass enclosed with heavy brass and steel precision machining of all components. Electrically activated to punch a series of triangular holes as per signals received. This unit was used by the N.Y.C. Fire Dept. approximately during the early 1900's. A fine collector's piece in working order----$130.00 plus shipping, packing free!
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REPAIRS: All early battery clocks including Pooles, Barrs, Tiffany Never-Winds, Eurekas, etc. Specializing in Bulle clock repairs using original parts. One month maximum time for all repairs. Martin C. Feldman

WANTED: Electrical Horological Literature of any type. Martin C. Feldman

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WANTED: Synchronome Master Clock; Large secondaries.
Henry Weiland, 8946 W. Grantosa Drive, Mil.,Wisc. 53225--(414) 463-4681

The
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Chapter No 78

December, 1979
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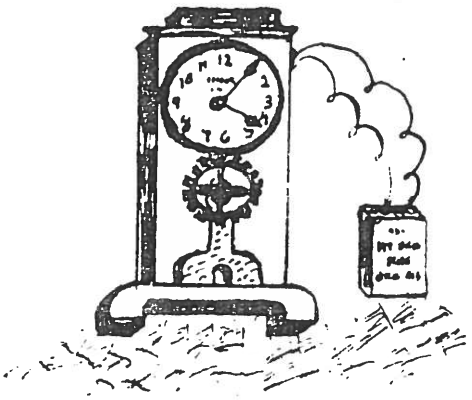
Martin C. Feldman, Editor



Hello. fellow enthusiasts:

This issue brings to a close Volume V of our Journal. This time of year is usually set aside to look back over the past accomplishments and to also set new goals and make new plans. As this retrospective applies to our Journal, I am very proud of our 96 page Volume V specifically written for the electrical horologist. In the coming year we plan to print many more interesting issues packed full of original articles, reprints of repair handbooks and catalogs, patent copies of early electrical clocks, a question and answer section and an expanded Mart. You will be seeing information about the Eureka clock, the Self-Winding Clock Co. of Brooklyn, NY, the Poole clock, the Sangamo clock---just to name a few! Bringing you this bi-monthly Journal is not easy---we all know just how little information is available about electrical clocks! But, with a little bit of luck and some perserverance we shall continue to publish. The EHS has many friends and it is quite difficult to mention all here, but there are several members who have sent us material for publication who must be mentioned and we do so with much appreciation. They are: H. Fried, O. Hagans, B. Krieger, M. Kurss, R.L. O'Briant, C.S. Robertson and H. Weiland. We must also thank our Sec.-Treas., Charlie Roth, and his office staff for getting the Journal printed and mailed out on time. To my secretary, Mary Sambrato, we wish a "Get Well Quick" as she injured one of her precious typing hands!--and we thank her for putting up with your editor as well as with all the confusion when the Journal deadline comes due. Our past contributors always are specially remembered. And we also must thank you---valued member, reader and friend---for without your support there would be no Society nor a Journal.

Please don't forget that the yearly $10 dues payment is now due. The small increase will enable us to defray printing and postage increases. Please don't delay. While you are thinking about it, write out your check and send it to Charles Roth, 2 Circle Lane, Roslyn, N.Y., 11577.

We are thinking of publishing a Roster of our members. If you wish your name deleted, tell Charlie when you send your dues in. Otherwise it will be printed.

We are indebted to Murray Kurss for the Sangamo Clock Repair Manual reprinted in this issue. Dr. Feinstein's ELECTRIC TIME MACHINE returns as well as a review of the excellent reprint of the 1908 SWCC catalog.

Have a HAPPY AND HEALTHY HOLIDAY SEASON AND NEW YEAR!

Enjoy this issue.

Electromagnetically yours,

Martin C. Feldman, FNAWCC

HAMILTON SANGAMO ELECTRIC CLOCKS

SERVICE BULLETIN

TO THE RETAIL JEWELER—This service bulletin gives a description of the principle and operation of Hamilton-Sangamo clocks with practical instructions for repair service. Your repair department should have it in their files.

NOVEMBER, 1929

HAMILTON-SANGAMO ELECTRIC CLOCKS HAVE THREE PRINCIPLE FUNCTIONING PARTS, AS FOLLOWS:

1. *The Escapement*
2. *The Motor*
3. *The Movement*

Each of these are easily accessible. Directions for servicing these units are outlined in the above order.

HAMILTON-SANGAMO CORPORATION

LANCASTER, PENNSYLVANIA SPRINGFIELD, ILLINOIS

Foreword

THE Hamilton-Sangamo is an electric clock that the retail jeweler fully understands. It is a combination of a fine clock movement with going barrel, with the working of which you are already familiar, plus a high grade lever escapement that you know all about, and a trouble-free motor that you do not have to know anything about. Consequently, the servicing of a Hamilton-Sangamo clock can be undertaken with the same assurance that you approach the cleaning and repairing of a Hamilton watch.

In this booklet we are explaining briefly the principles of Hamilton-Sangamo operation, and will outline the ordinary service requirements. We have avoided technical descriptions and wordy discussions because simplicity has been the keynote of Hamilton-Sangamo design.

No retail jeweler, or retail jeweler's watchmaker, need hesitate to open a Hamilton-Sangamo clock to service it. In the clocks that have been returned to us during the past three years we have found that in most cases the trouble could have been diagnosed and rectified in half an hour. In these days "passing the buck" is an expensive process. When dealing with an object so bulky as a clock, shipment for adjustment, repairs, or cleaning is a matter that may run into many dollars. These dollars obviously cannot be deducted from any one link in the chain of distribution without causing a certain amount of irritation or ill-feeling. Therefore we have no hesitancy in saying to every jeweler—"make up your mind to be a service station for Hamilton-Sangamo clocks and to render satisfactory service to your clients who purchase them." In this way you will be placing yourself in a position to increase your sales of Hamilton-Sangamo clocks and to reap the rewards that are bound to come by featuring and continuing to sell this as "the clock of railroad accuracy." Remember that every customer of yours who today carries a Hamilton watch is a logical prospect for the sale of at least one Hamilton-Sangamo clock.

The Hamilton-Sangamo movement is essentially a high grade clock with a jeweled lever escapement. The main spring of the clock is always kept wound to a constant tension by a small electric motor. All the movements are identical in principle and consist of three main parts—the escapement, the motor and the clock mechanism, including the barrel containing the mainspring. Escapement, motor, or barrel may be removed as a unit by taking out a few screws and without disassembling the mechanism proper.

Any movement may be taken out of the case as a complete unit for inspection. Clocks built prior to June 1st, 1929, carry the name Sangamo only, but in principle of construction and workmanship are identical with Hamilton-Sangamo clocks now being supplied. The only important difference in the operation of movements now in service is that recently built striking clocks have a single motor, in which construction the mainspring furnishes power for both the time train and striking train. In earlier clocks a second motor was employed to drive the striking train.

The Hamilton-built escapement in Hamilton-Sangamo clocks is similar to that used in the finest types of Hamilton railroad watches. It is mounted as a readily detachable unit on the front plate of all Hamilton-Sangamo clocks and thus may be removed and handled as an ordinary watch escapement for cleaning and repairing. Since all jewelers are familiar with watch servicing, this element of a Hamilton-Sangamo clock requires little further comment. Two classes of escapements are built, the round 11-jewel escapement with bi-metallic balance, highly polished parts, and damaskeened plates, and the oval 7-jewel escapement with mono metallic balance. Both are backed by the reputation of Hamilton Watch Company.

Lubrication of the escapement should be done periodically and Hamilton-Sangamo engineers have developed a special oil superior, we believe, to any available. This oil has the very desirable property of leaving no residue or gum of any sort should it dry out and the use thereof in Hamilton-Sangamo clocks is strongly recommended.

Jewelers are so familiar with high grade escapements that detailed comment is superfluous. In the event that any serious trouble is encountered in servicing the escapement, it should be mailed to the Hamilton-Sangamo service department at Springfield, Illinois. It is not necessary to send in the complete clock, as the escapement can readily be repaired so that it will function properly when reinstalled in the clock.

The motor is unconditionally guaranteed by the Sangamo Electric Company and is to be treated by the jeweler as a complete unit, requiring no servicing whatsoever. Motors are of two types: the earlier A motor and the recently developed C motor, as illustrated. It should be clearly understood that the two types are not interchangeable. The A motors run on ball bearings and

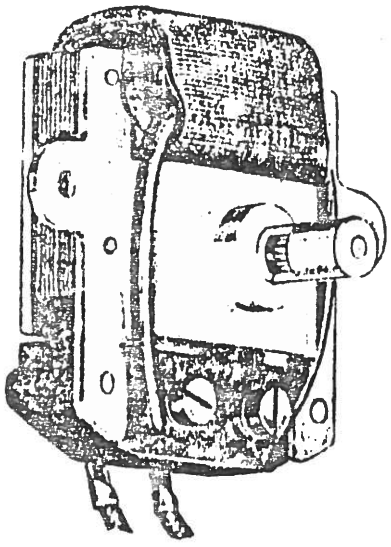


Fig. 1—Type A Motor

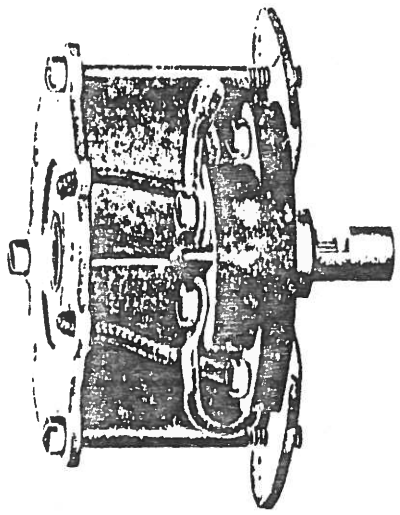


Fig. 2 Type C Motor

under certain conditions may develop a noise, possibly best described as a rattle or hum. These motors will be replaced without charge. The type C motor has a different bearing system and cannot, under any circumstances, become noisy. In the event of motor trouble of any sort, inform the company as to the type of motor involved, being sure to give the voltage and frequency shown on the nameplate, and a replacement motor will be sent. In case trouble is experienced with the motors on the earlier two-motor striking clocks, it is advisable to replace both motors.

The Clock Movement. The non-strike movement will offer no complications whatsoever to the jeweler's service department. The striking movement, however, has special features that require some comment. Some of the earlier clocks were built on the two-motor principle, in which one motor is employed to wind the mainspring and the second to operate the striking mechanism through a train of gears having no connection with the time train. The latest striking clock has a single type C motor which delivers power to the mainspring or the striking mechanism by means of a differential gear.

Principle of Operation. A brief description of the principle of operation of the non-striking movement will serve to illustrate the fundamental principles of construction of all Hamilton-Sangamo movements, either strike or non-strike.

As shown in Figure 3, the motor pinion engages with the fourth winding wheel (A), which in turn, through a train of wheels, rotates the barrel arbor through the first winding wheel (B). The mainspring is thereby wound up in the barrel (C) and in the usual manner furnishes power to the hands, the escapement (D) regulating the speed at which it unwinds. In order to govern the number of turns to which the mainspring is wound and thereby furnish a constant torque to the escapement, a governing mechanism is used to stop the motor when the mainspring is properly wound. As the first winding wheel revolves it winds the sleeve (E) into the barrel hub (F), causing the governor arm (G) to be pressed toward the back of the clock, and thereby forcing the governor arm screw (H) closer to the fourth winding wheel. By adjusting the position of this screw in the arm it may be made to act as a brake on the fourth winding wheel when the mainspring is wound to any desired number of turns. Stopping the fourth

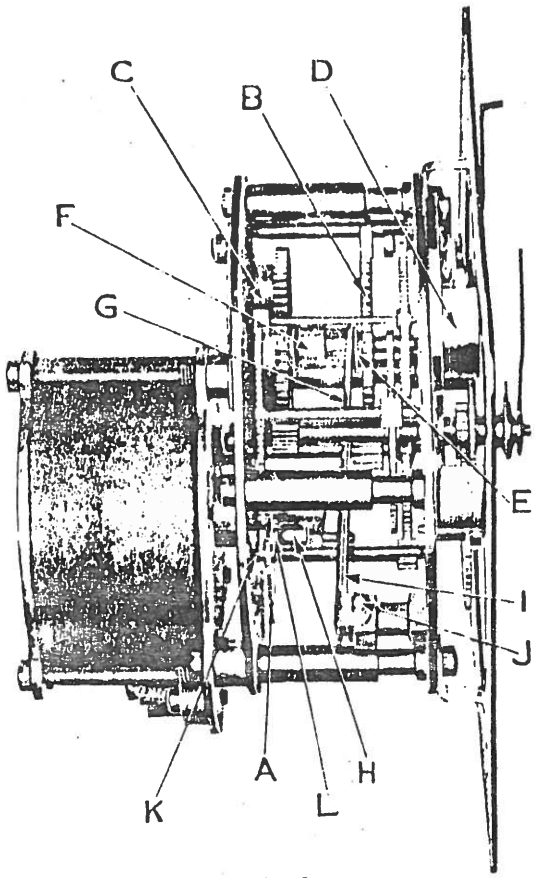


Fig. 3
Side View of Non-Striking Movement

A	Fourth Winding Wheel	G	Governor Arm
B	First Winding Wheel	H	Governor Arm Screw
C	Barrel	I	Governor Arm Spring
D	Escapement	J	Fulcrum Pin
E	Barrel Sleeve	K	Ball Bearing
F	Barrel Hub		

winding wheel of course stops the rotation of the motor, and the winding of the mainspring. Then as the barrel unwinds, when the mainspring furnishes power to the time train, the sleeve moves out of the barrel hub and the governor arm is pulled away from the fourth winding wheel by means of the governor arm spring (I). The motor then winds until it is again blocked by the pressure of the pad in the governor arm screw against the fourth winding wheel. This action is continuous, keeping the clock wound to a constant tension. The current is always on the motor, thereby eliminating troublesome contacts.

In view of the fact that motor, escapement, and barrel are removable as units, and that the striking levers are all accessible from the front, it should seldom be necessary to completely tear down a movement.

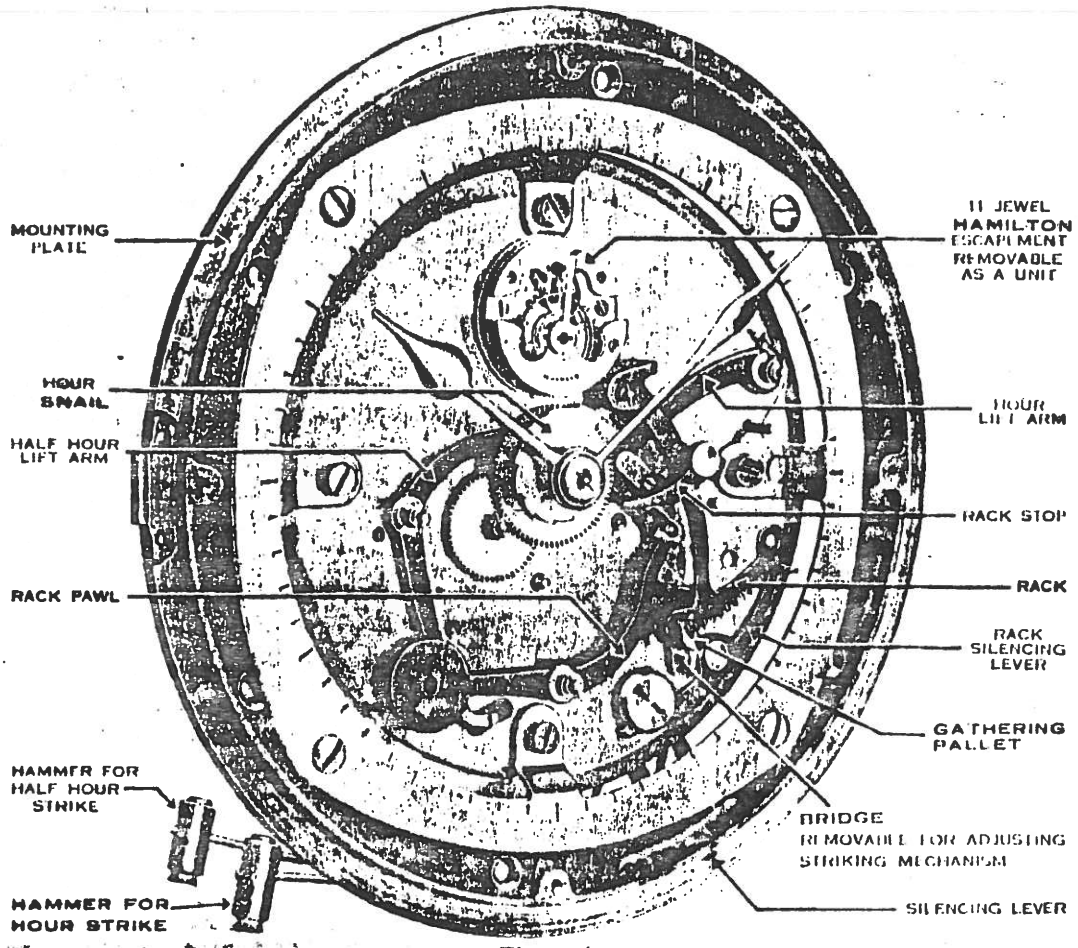


Figure 4
Front View of Two Motor Striking Movement

If necessary for any reason, this can be done by taking off the escapement and then placing the movement face down. Next remove the motor and then take off the barrel bridge, thereby exposing the barrel. Take out the fulcrum pin marked (J) in Figure 3 and lift out the governor arm. The barrel should then be taken out after which the back plate can be taken off. Care should be taken not to lose the small ball bearing (not supplied on some of the earlier clocks) under the back pivot of the fourth winding staff at the point marked (K) in Figure 3. In reassembling the clock, care must be exercised to have all wheels and cams in exactly the same position as when removed.

[illegible] (See Figure 4.) The earlier striking clocks were built with two motors, one to wind the mainspring and another to furnish the power for operating the striking release. The striking release mechanism is essentially the same as the standard rack and cam strike release which has been used for years on all types of striking clocks, so that repair or servicing of this mechanism is not greatly different from that of key wound striking clocks, with which all jewelry repairmen are familiar. Figure 4 shows a front view of the two motor striking mechanism, with names of the various parts, which may be a convenience, if repair parts are required.

The single motor type striking clock (see Figure 5) is supplied with the type C motor only. The reason for the change in design was to obtain a carry-over of both striking and timing with the current off. This is accomplished by introducing a differential in the winding train of the clock mechanism, which serves to distribute power from the motor to both the mainspring and hammer levers. In the event that the power is off, the mainspring will furnish power through the differential to actuate the hammers. The movement has the usual type of rack and release levers but with an ingenious spring action on the lift arm lever which allows the hands to be set forward or backward as fast as desired without injury to the movement, and without disturbing the striking sequence. The striking arms are actuated by the common type cam and pin wheel arrangement, with an adjustable fan to regulate the speed of strike.

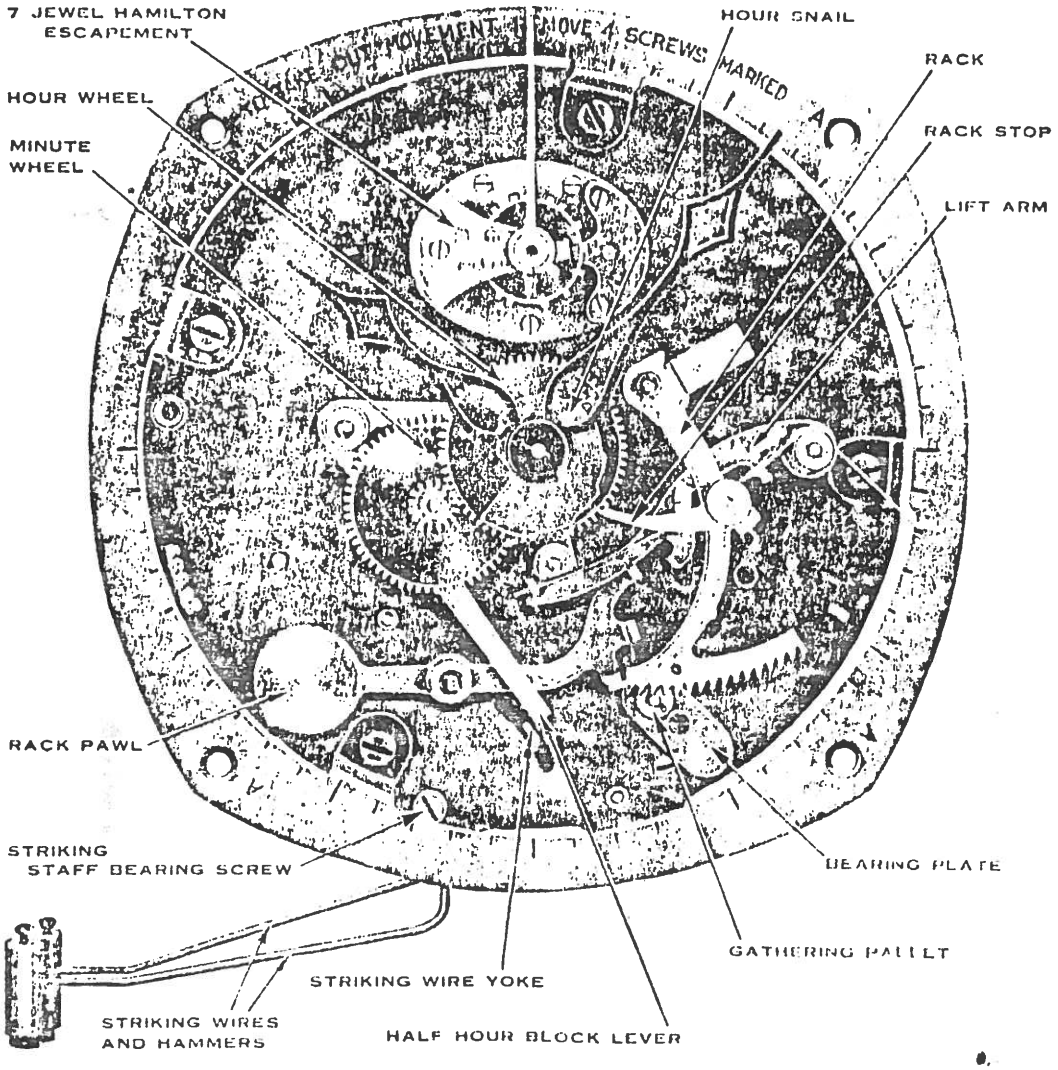


Figure 5
Front View of Single Motor Striking Clock

The servicing of Hamilton-Sangamo clocks is not a complicated proposition, and every jeweler can make his store a service station for his customers' clocks. Inspection of the movement can be easily made and in most cases the trouble located and remedied promptly. In the event that local repairs cannot be made, please write us fully so that directions can be given as to what service station can best take care of the work.

The following comments on a few of the difficulties which have come to our attention in servicing Hamilton-Sangamo clocks may prove of value.

Many time clocks are reported by the customer as stopped simply because the electricity has been turned off from the outlet to which the clock is attached. ***Wherever possible, clocks should be connected so that they cannot be cut off by a switch.*** The first thing to do is to connect up the clock to a circuit that is known to be alive and to see that the plug fitting into the back of the clock is making contact. Having made certain that the electricity is on, the movement should then be examined for mechanical troubles, with special attention to "freezing" of the brake to the fourth winding wheel, as described below.

In some of the earlier clocks, accumulation of dirt or grease caused "freezing"

of the brake stud to the fourth winding wheel, which prevents the motor from winding the spring. On later clocks this has been overcome by putting a spring (H in Figure 3) on the governor arm, thereby pulling it free from the wheel as the sleeve unwinds in the barrel. This trouble can be eliminated by the substitution of a new fourth winding wheel and governor arm, but in ordering such replacement parts the serial number of the clock should always be given.

Clock Striking Continuously. The chief cause of this trouble, which cannot occur on the latest type clock, is due to the fact that the pin on the third strike wheel does not engage with the rack pawl where it projects back through the front plate. When the rack is not in the striking position, the pin on the third strike wheel should just pass the stop arm on the rack pawl. Inspection of these two members will readily show the cause of the trouble and by slightly bending the stop arm on the rack pawl it can be easily overcome.

Clock Fails to Strike. The first thing to look for is to see whether the silencing lever has been moved to the striking position. If this does not cause the difficulty the probability is that the spring on the hour lift arm, as shown in Figure 4 or 5 is not quite strong enough to lift it out of engagement with the let-off disk. A small drop of oil should be put on the section of the hour lift arm which projects through the front plate and engages with the letoff cam and the spring on the hour lift arm should be strengthened by bending it slightly.

Motor Noise. This is not to be confused with motor noise, which is more like a hum or rattle and can only occur on clocks having the ball bearing motor. On any movements over 20,000 serial number developing this squeaking noise it is only necessary to put a drop of Neetsfoot oil on the leather pad (I in Figure 3) on the governor arm stud. After the pad has absorbed one drop of oil, put on another small drop and the trouble will be completely remedied as it is simply due to friction between the hard leather and the metal wheel.

Mainspring Breaks or Sets. Although the finest mainsprings obtainable are used in Hamilton Sangamo clocks, there is always the possibility of a broken, or set spring. Replacement of the mainspring is a simple matter, as it is only necessary to remove the motor and then the barrel bridge on the back plate. The barrel can then be removed when the governor arm is taken out. The strength of the mainspring is stamped in ink on the end of the barrel and a new mainspring or barrel should be put in of as nearly as possible the same strength. This is accomplished by pushing through the two large holes in the barrel wheel, forcing the cap off. The governor sleeve, which screws in the barrel hub, is backed out to one turn and a new spring placed in the wheel, after which the cap is snapped back on.

Correction of Improper Motion. Most accurate timing can only be obtained when the escapement has the proper motion. This should be between one and one-quarter and one and one-half turns on the balance wheel with an average of one and three-eighths turns being the most desirable. Improper motion of the escapement may be due to lack of lubrication, as discussed in the paragraph on the escapement, or to the fact that the mainspring is not wound to the proper number of turns. Regulation of the wind of the mainspring is accomplished by adjustment of the governor arm screw, as shown at (I) in Figure 3. When screwed further into the governor arm, the sleeve (E) must turn further into the barrel hub (F) before the brake pad on the tip of the governor screw makes contact with the fourth winding wheel to block the motor. This simply means that the mainspring is accordingly wound more tightly. If the escapement overbanks, the mainspring tension can be reduced by turning out the governor arm screw, which results in blocking the motor before the mainspring has reached the previous point of tension.

Lubrication. Service conditions largely govern the frequency with which Hamilton-Sangamo movements should be cleaned and oiled. When inspection shows the escapement or main pivots to be dry or dirty, the mechanism should be serviced as though it were a high-grade watch. The special oil mentioned under the paragraph on escapements should always be used, and for the main train pivots we recommend the use of Hamilton-Sangamoil M, especially developed for that purpose.

Regulation. Assuming that the escapement has the proper motion, accurate regulation of Hamilton Sangamo clocks can be effected by careful manipulation of the reg

ulator lever. Do not at any time move the regulator more than one-half division, either direction, as this will ordinarily be sufficient to cause a difference of about twenty seconds a day in the rate of the clock.

Accurate records of the structural details of all Hamilton-Sangamo clocks are kept at the factory under the serial number shown on the clock nameplate. Consequently any requests for information or orders for repair parts should be accompanied by a description of the clock, including serial number, voltage and frequency (all on nameplate) and if possible, the catalog number of the clock. The serial number is the most important data required.

Hamilton-Sangamo Escapement Oil

A specially compounded oil which will not become sticky
Per ½ ounce bottle, prepaid, 35c

Hamilton-Sangamoil M

Recommended for train pivots
Per ½ ounce bottle, prepaid, 35c

All shipments are delivered to transportation companies in good condition and signed for accordingly.

No claims can be allowed by us on account of railroad claiming that goods are improperly packed.

In case of CONCEALED DAMAGE, notify railroad company at once so that inspection can be made by them promptly. In that case secure notation on your paid expense bill or else insist on receiving copy of inspection report which can be used in filing your claim.

Do not send a Hamilton-Sangamo clock in to us for repair before writing us fully about the trouble, giving us clock serial number and all information possible. We will answer promptly and advise location of nearest service station at which clock may be repaired if necessary.

THE ELECTRIC TIME MACHINE

by Dr. George Feinstein
75-19 196th Street
Flushing, New York, 11366

QUESTIONS AND ANSWERS

From: M.L. King, R1 Box 135B, Godley, Texas, 76044

Q: In the article, "Ideal Switch Contacts; A Matter of Metallurgy", in the August, 1979 Journal of the Electrical Horology Society, on page 8 is the following statement: "...For example, sliding contacts break through some films and can increase contact area. But in d.c. circuits contact wiping may eventually cause mechanical hang up between the peaks and craters on the contact surfaces."

I have seen the peaks and craters on the "points" in ignition systems on cars. In the American Clock Co., Chicago movement, (described in Goodrich, "The Modern Clock", page 396) the contacts are platinum; what I assume to be self cleaning, etc. However the contacts on the springs are gone. Similar metals have more friction than two different metals. Brass and steel wear well. Seems like the knife (dropping) contact has worn out the smaller contacts on the spring, as they are worn smooth. Question: Should I replace the spring contacts with platinum, silver (hammer hardened), or 10K gold (hammer hardened)? The knife shows no appreciable wear.

In your opinion, would a sealed mercury contact switch that tips (rocks) to close the circuit, be as good or better than the knife switch?

A: If the platinum contacts are completely worn away they should be replaced in kind if possible. A suitable substitute material is fine silver.

I have examined several of these clocks and the contacts were all in good condition. Maybe too high an operating voltage was used in your clock. You should operate this clock at 3 volts, D.C.

The usual cause of deterioration of electric clock contacts is arcing when the contacts open. This arcing is produced by the collapse of the magnetic field around the electro-magnetic coils (inductive load). This collapse produces a back electro-motive force (E.M.F.) which can be 100 or more times as great as the original operating voltage.

To eliminate this arcing across the contacts, shout out the coils with a high voltage diode. When installing the diode, make sure the polarity of the battery is correct or the diode will burn out.

Even though the sealed mercury contact switch would probably work better than the knife switch, I would not use it on this clock since it would mean modifying the clock to a non-original design.

By the way, the peaks and craters on automotive "points" are not the ones described in the article since "points" are not sliding contacts.

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*****BOOK REVIEW*****

Every now and again, and often very infrequently, one finds a reprint which is done so well as to exceed the original in quality and appearance. Dr. Ben Honning, one of our EHS members, has just brought us such a reprint. This publication could almost be entitled, "Everything you always wanted to know about the clocks of the Self-Winding Clock Co.". It illustrates in half-tones, which must be seen to be believed, just about every clock the company produced. Master clocks, mantle clocks, tower clocks, gravity escapement astronomical clocks and even batteries are described and superbly illustrated in this encyclopedic little catalog. A rather unique touch is the owner registration with the company plus an owner certificate---only 1000 have been printed. This book is certainly a must for the electrical horologist and should be in every serious collector's library.(See adv. in our Mart for Pub. Co.)

Martin Feldman

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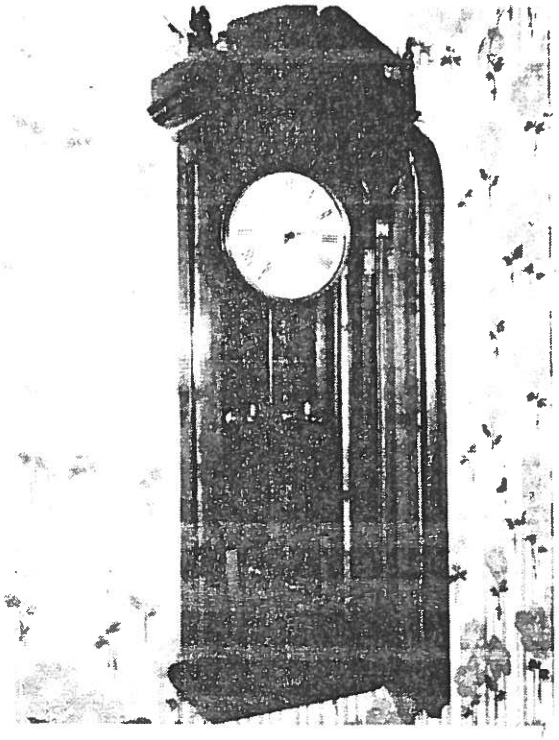
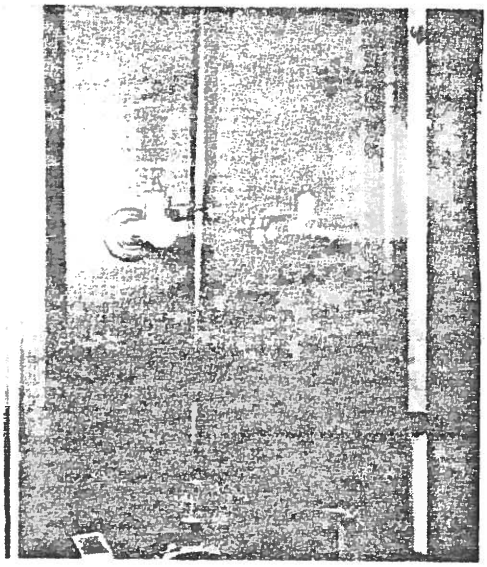
MEETING NOTICE: Jan. 27th, 1980--Call Bob McGuinness at 212-464-0042
* In Queens, N.Y. @ 2:00 p.m. *

Members at recent Fall meeting at home of C. Roth.
L to R front: M.Feldman,C.Roth,B.Levy,M.Levy
" rear: S.Kursh,R.McGuinness,G.Feinstein,
M.Swetsky,C. Dinner



S.A.Kennedy Clock in Roth [illegible]



Sliding contact of Kennedy Clock

Charlie pointing out highlight of clock.

M*A*R*T*

FOR SALE: Eureka 1000 day beehive type wooden case--$600.; Brillie Electrique 52" oak, complete time punch clock, slave mvt.,card print mech.,works--$300; 12 V. round metal system clocks with sweep sec.,send a large SASE for list; Std. Elect. master, 48", oak,$500. Lots of slave mvts. and cases, dials, etc. for slaves; AC "Quaker St. Mtr. Oil" adv. clock, all metal, 22" OD, Neon tube around dial (dial restored)--$100;STD Electric master cl.,63" oak w/ pilot clock and gauge, very ornate--$1750.;Oak gallery sq. sl.,11" dials(2 Howards),(1) Seth Thomas--$125.ea. R.L.O'Briant,Box 1168, Raleigh, NC 27602.

FOR SALE: Poole clock in morelite(bakelite type) mahogany lancet style case,totally mint and very accurate---$225 ; ATO clock, totally enclosed by glass(sides and top) mahogany base with large brass leveling screws,working-$200; ATO in burl walnut veneered case--$ 85.;Internation.Time Recording mst. clock,68" high,oak case, has optional bell ringing extender device, many relays,switches, and large 7-day multi-leaf 24 hour program drum with extra pins,wood pendulum with 8" brass bob. Entire clock and all mechanisms are one unit. This clock is perfect for the master unit in your house or apt, if you want to set up a master/slave system(will even turn your lights on and off with proper electrical set-up),slave available from R.L. O'Briant--above ad.Clock came from a girls' finishing school and is complete and running---sorry,no girls come with this clock!--at today's prices,a bargain at $800.; rare Rempe mvt. only--no face or hands. In good condition but should be cleaned(simple mvt--simple job). Martin C.Feldman,620 Reiss Pl.-7E, Bronx, New York, 10467---tel: 212-881-1619. (Packing free on small clocks--shipping extra)

REPAIRS: ALL EARLY BATTERY CLOCKS including Pooles, Barrs, Tiffany Never-Winds, Eurekas, etc. SPECIALIZING IN BULLE CLOCK REPAIRS USING ORIGINAL PARTS. One month maximum time for all repairs, Marty Feldman---

ANNOUNCEMENT: I regret to inform you that original Bulle parts will no longer be available for sale. We have 6 silk and brass suspension assemblies still available and they will be sold on a first come-first served basis---$5.00 ea plus a large SASE. Marty Feldman(address above)

FOR SALE: Self-Winding Clock Publications. New clock book titles, Send for list. Dealer inquiry invited. Self-Winding Clock Publications, P.O. Box 7704, Long Beach, CA.90807

WANTED: Synchronome master clock in a good case. To be used with a Shortt Free Pendulum. Cliff Haumiller, 960 E. Chicago St., Elgin, ILL., 60120---(312) 695-9111

WANTED: Electrical Horological Literature of any type. Martin C. Feldman

WANTED: Unusual Electrical Clocks. A. Marx, 105 Bayeau Rd. New Rochelle, NY 10804

WANTED: Synchronome Master Clock; Large secondaries.
Henry Weiland, 8946 W. Grantosa Drive, Mil.,Wisc. 53225--(414) 463-4681

WANTED: "Junker" early battery clocks, movements,parts,etc.Send details and $ wanted. ELECTRICAL CLOCK LITERATURE for possible reprinting in our Journal. Send to Marty Feldman.

MAKE USE OF YOUR MART. You have the best chance of buying, selling, and/or trading your electrical horologica in our MART as our members are very interested in this material. Still only $2/4 lines. Send ads and Checks made out to EHS to Marty F.

MANY THANKS