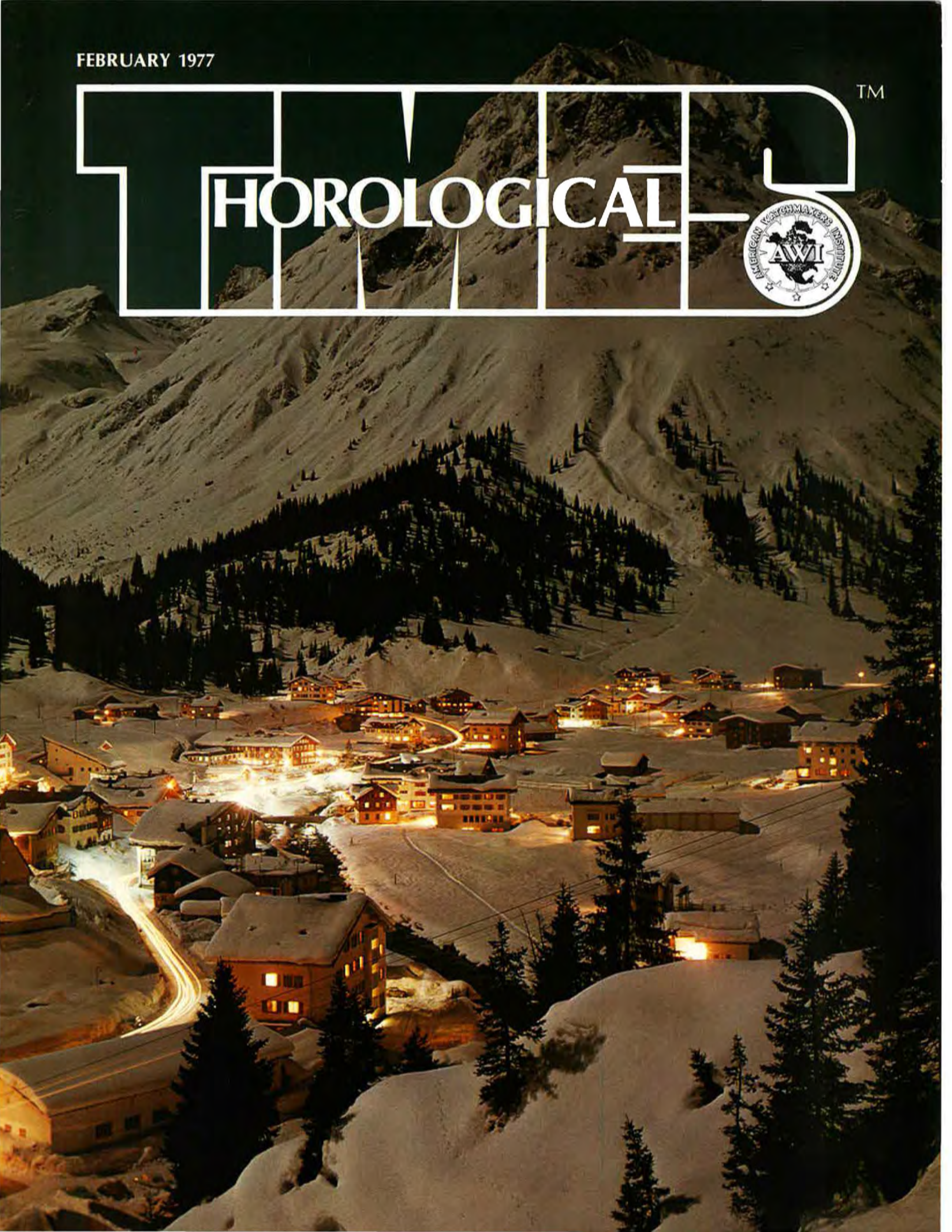
FEBRUARY 1977

# HOROLOGICAL TIMES



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# HOROLOGICAL TIMES

Volume I, Number 2 February 1977

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American Watchmakers Institute

## CONTENTS

**FEATURES**



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# Editorial

Twenty-five or thirty years ago, watchmakers had to know how to bezel and friction jewels, alter and fit balance staffs, change mainsprings, free dial trains, check depthings, set up escapements, and spend a good portion of their time at the lathe and in treating cold rolled steel. Ultrasonics as applied to cleaning watches had not as yet entered the picture, and dynamic poise was unheard of. The enigma of the word "waterproof" had only to be dealt with occasionally, and self-winding watches were a rarity on the watchmaker's bench. The man who overhauled six watches a day was due for a nap after his dinner, and then spent a period of that evening, to those who would listen, on braggadocio.

Today, seldom do jewels chip or crack, staffing is occasional, mainsprings are unbreakable, and checking depthings on watches is passe. On new watches, escapement errors may be found in one watch out of 500. Assembled cleaning with ultrasonics, modern lubricants, dynamic poise, and good timekeeping caused by fast trains have made the watchmaker's task easy, EXCEPT he must now know the ohm, transistor, calendar and dates mechanisms, positive and negative, and bridle tension. These are among but a few of the areas in which he must be adept. To be a complete watchmaker, he must be knowledgeable and skilled from lock and draw to coil resistance.

That is the challenge and task of the modern day watchmaking school instructor.

# The Presidents' Message

by James H. Broughton

## THE HUSH HUSH SUBJECT

To me, the most challenging and distasteful part of our profession is something every watchmaker in the world has, a comeback. While we don't like to admit it, they are there. We have to take care in the way a comeback is handled.

While, in my opinion, it is no disgrace to have a comeback, it is a disgrace not to handle it correctly. If you feel that your comebacks are more than they should be, spend as much time as necessary to find your problem.

I have been checking with watchmakers throughout the United States about their comebacks. My question is usually this, "What percentage of comebacks do you have?" Out of 243 questions, the answer averages 5 percent. This is not to be a guideline for you, as some had a low average of ½ percent while others had 6 percent. I am just relating my findings to you.

There are so many different types of comebacks, there is no way I will attempt to list them. The retail watchmaker, who meets his customer, has an advantage over the watchmaker who sits in a back room or the trade shop watchmaker. The retail watchmaker can approach the customer who is returning the watch for correction and find out what the problem may be. To give an example: Customer returns watch complaining it will not run 24 hours. The watchmaker looks at the watch, sees the crown is worn badly or very small, returns the watch to the customer and asks him to wind it. After watch has been wound by customer, the watchmaker finds the watch is only half wound. He can pretty well assume the customer is not winding the watch all the way up at any time. He in turn can sell the customer a new crown. The majority of the time this will be the only problem.

The watchmaker who sits in a back room or the trade shop watchmaker, can get this same watch and it will be marked, "comeback, please repair." This is where the real problem begins—there is no history about the watch.

When a watchmaker finds himself in this position the only thing he can assume is the watch is not correct. A comeback of this nature takes more time than the original repair. The only thing he can do is start at the beginning and that is the crystal. Is the crystal catching the hands? Are the hands catching on each other? Check the hands for clearance from the dial. Does the cannon pinion feel loose? Is the dust resistant crown frozen and holding in the setting position? Does the water resistant crown have a good feeling? Check the watch for magnetism while still in the case.

When removing the watch from the case, be a little cautious with ladies movements—be sure the case is not touching the escape wheel. Now that the watch is out of the case, again check the hands for clearance, check the crystal for signs of hands rubbing that you may not have been able to see when looking through the crystal. Remove the hands and dial, check hour wheel (could be frozen on the cannon pinion). If there is a dial washer be sure it is the right size. If there is no dial washer, should there be one? Check cannon pinion, minute wheel and all setting parts for rust, missing teeth, and broken parts. Setting levers and clutch levers that have worn tips can cause the winding and setting to skip or slip. Minute wheel and setting wheel posts that are out of line can cause a stopper that will not necessarily show up when setting the watch by the crown. Always check the lower shock springs and cap jewel screws, they can be loose.

Now that we have checked the dial side, we are ready for the balance of the watch. After putting the watch in our movement holder, we may spot what we think may be the problem. The hairspring stud screw is missing. This may not be the problem at all. We are now seeing a great number of our better brands of watches coming in with friction studs. The hole is there and so are the threads. They have just left the screw out and frictioned the stud in. A few years ago we could usually tell an inexpensive movement; most all had this type of stud. Not so today.

We are also seeing more hairsprings with epoxy instead of stud pins. Some of these can be loose in the epoxy, causing the hairspring to move up and down, causing it to be out of the flat. This can also apply to the collet. If the hairspring is to your satisfaction, next we should check the balance wheel and staff: the wheel to be sure it is in the round and flat, the staff for broken, bent or burred pivots.

The next in line to be checked will, of course, be the escapement. This starts with the roller jewel. Is it tight, the right size, straight and is there proper clearance when entering the fork? Check the guard pin, could it be bent? Before checking drop, lock, and slide, be sure the pallet stones are not chipped or loose. Loose pallet stones can drive you right up the wall. If you have been unable to adjust the escapement properly, check the pivots on the pallet arbor, they could be bent.

I have been having a repeated problem with new watches loosing a lot of time. Checking the watch on a timing machine three positions is very good while the dial down position is slow. The reason for this is the pallet fork. Shellac on the pallet stones is too thick, causing a drag on the main plate when in a dial down position.

If you have not already done so, now is the time to check the self-winding to be sure it is in proper working order, providing this is an automatic watch. Don't be satisfied with running the train down. Take the train wheels out and check each one for broken or bent pivots, rust, and broken or bent teeth.

Mainsprings, now—that is another source of trouble. We are finding more and more mainspring barrels that say, "Do not open." A lot of these "do not open" barrels are having broken mainsprings. According to the companies that make these barrels, we are to buy a new barrel with mainspring and arbor. With the exception of two or three models that I have come across, I have been successfully opening these "do not open" barrels, and replacing the mainspring without buying the barrel and arbor. If the watch you are working with has a steel mainspring, it should be replaced with a no-break mainspring.

In the automatic mainspring barrels, be sure the bridle is operating properly. A bridle on the mainspring that is slipping will cause the mainspring to unwind part of the way and will no doubt let the watch stop overnight. This same mainspring will work all right during the day, when the watch is being worn.

With the the movement completely disassembled, the jewels and bushings are the next to be checked. We all know that cracked jewels and worn bushings are good reasons for a watch to stop. This includes the barrel as well as the center wheel.

Movements with off-set center wheels also have a center pipe. These center pipes can be pushed down causing the sweep wheel or pinion to be too tight. In most cases, the shoulder of the center pipe should be tight against the plate.

Since you have gone this far, you might as well peg the holes or jewels and polish the pivots, in case of a spot of rust or a burr.

*(continued on page 48)*

# ELECTRONIC DIAGNOSTIC PROCEDURE
## ESA 9180-81-82-83

**by Gerald G. Jaeger**

**CMW**

When estimating or troubleshooting in any watch, whether it be mechanical or electronic, speed and accuracy are a prime concern. In the case of electronic, balance wheel, or stepping motor watches, it is extremely important because of the high cost of replacement of any of the electronic components. We must be able to recognize component failure with a few quick electronic checks. By the same reasoning, we must be able to quickly establish if our problem is electronic or mechanical.

In this article I will confine my specific procedures to the ESA 9180 series; however, the watchmaker who includes electronic and electric timepieces in his daily routine of repair will see that these steps can be modified and applied to most of these types of timepieces. In future articles, I will tie some of these similarities together and come up with a procedure applicable to most. The watchmaker attempting to repair this timepiece must have the EBAUCHES SA Technical Communication No. 27. This bulletin is available from either The Watchmakers of Switzerland Information Center, New York, or AWI Central, Cincinnati.

The first consideration is, do we have sufficient power to run the watch?

**Check No. 1.** (Figures 1 and 2.) The point here is that we remove the case back only and remove neither the movement nor the cell from the watch. Set the VOM selector to read DC Voltage on any range over 1.5 V and at or under 10 V. In the case of the meter in Figure 1, we would select the DC Volts range and set our selector at 3 V. (Check No. 1, Figure 1.) Observing the proper polarity, we will place our + (red) meter probe on the positive (+) bridle No. 4401, which is indicated by a + on Figure 2. We will place our – (black) probe on the negative (–) bridle No. 4405, indicated by a – on Figure 2. Some of the earlier watches will use a mercury cell whose voltage when new and in good condition is 1.35 V. The recommended cell is now a silver-oxide cell with a voltage of 1.55. This presents the possibility of two different voltage readings, either of which would be correct if the cell were still good. In the 1.35 V cell, if the reading is below 1.10 V and in the 1.55 V cell, if the reading is below 1.30 V, the cell should be replaced.

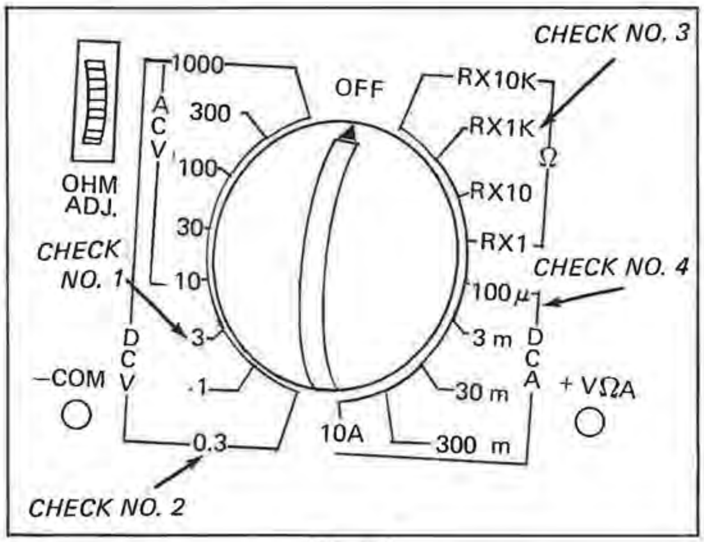


Figure 1

**Check No. 2.** Having determined that the cell is good, or having replaced it with a new cell in good condition, we will quickly check the complete electronic unit. We can accomplish this by turning our range selector to the DC Volts range and choosing the lowest reading on our meter. On the meter pictured in Figure 1, we would set our selector at 0.3 V

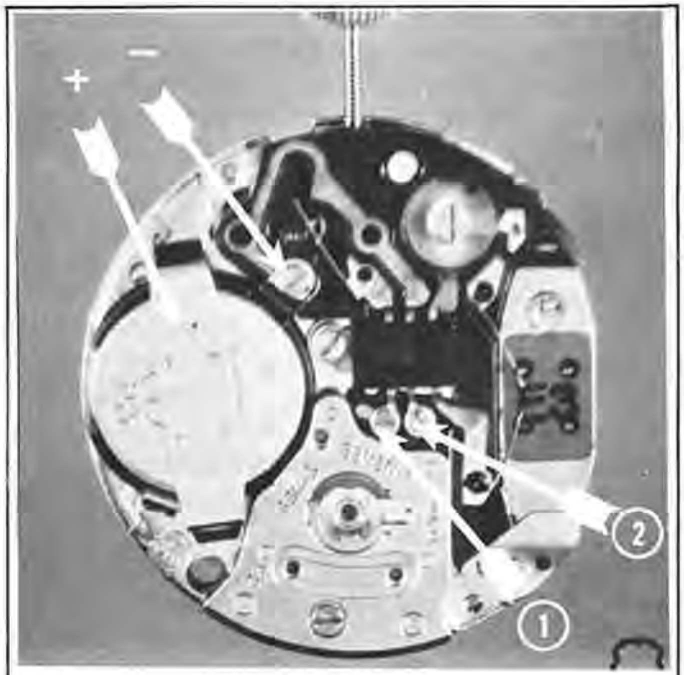


Figure 2

(Check No. 2, Figure 1.) Place one meter probe on the lead from the integrated circuit to the coil at the point indicated by No. 1 on Figure 2. Place the other meter probe at the point indicated by No. 2 on Figure 2. There is no need to observe polarity on this check, so either probe can be placed at either point. In Figure 2, we show the two screws removed, but in your watch, the screws would still be secured to the movement. This test is made with the crown pushed in at the running position. Our needle should alternately deflect to the right and to the left at one-second intervals. If it does, we know the complete electronic circuit is functional. If we do not get the proper needle deflection, we would have to complete the other electronic checks as indicated in Technical Communication No. 27. Assuming that after these checks we still have an inoperative electronic circuit, we would have to replace it. The point to remember is that we here are diagramming a few quick electronic checks for quick estimating and diagnosis.

Assuming we get the proper needle deflection in Check No. 2, we would continue with Check No. 3.

**Check No. 3.** This check is to quickly test the condition of the coil. It can be done with the cell either in or out. I find it easier to do with the cell in the watch. Remove the two connecting screws which complete the connection from the integrated circuit to the coil. They are located at points No. 1 and No. 2 on Figure 2. Carefully spring the two leads up so that they do not make contact with the lead wires from the coil which are located directly under them. Choose the resistance range and set the selector of your meter at RX1K. This is resistance times 1,000. Some meters may read RX1000. Either is correct, as they are the same, K indicating 1,000. In this check it is not necessary to observe polarity, so our probes can be applied to the two leads directly under the leads from the integrated circuit. You can see that they extend beyond either side of the leads from the integrated circuit and can easily be probed without touching the leads from the integrated circuit. Our meter should read 3 on the ohms scale. This would tell us that our coil resistance is correct. The coil resistance can read from 2.5 K to 3.2 K and it will be correct. We can also test the resistance of the coils by removing the cell and applying our meter probes directly to the connecting screws No. 1 and No. 2 in Figure 3. Some may prefer this method, but the positive bridle (cell strap) may be a bit difficult to remove with the movement in the case. The meter reading should be the same as in the previously explained coil resistance test. If the coil is open or shorted, it must be replaced.

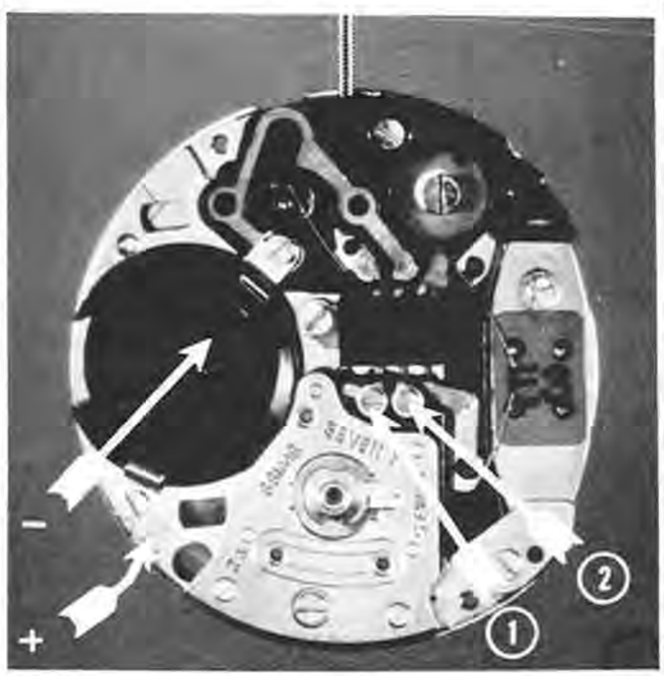


Figure 3

**Check No. 4.** This test will reveal if the watch is drawing or using more current than meets the manufacturer's specifications. It can be accomplished in two different ways, depending on the type meter you have. The majority of the meters being used today do not have an independent power supply. On those that do, we can fit the recommended cell for the watch into the meter and use it to supply current to the watch when making a consumption test. On the meters that do not, we have to use the cell while it is in the watch as the source of current to power the watch and have it connected in series with the meter while doing so. This can be accomplished by removing the bridle No. 4401 (cell strap). This bridle acts as the connection between the + pole of the cell and the main plate which is the ground of the circuit. Set the selector of your meter at 100  A (100 micro amps), Check No. 4 on Figure 1. With the cell in the movement place the positive lead of your meter on the back of the cell, which is the positive pole of the cell, and place the negative probe anywhere on the main plate; avoid touching any of the circuitry or plastic with the negative probe during this test. Your meter should read not more than 16 micro amps (16  A) when using a 1.35 V cell and 19  A when using a 1.55 V cell. This reading will be somewhat confusing, as the needle on your meter will be pulsing once each second but you can read it at its peak. I have found the peak reading will read somewhat higher than the actual consumption. If you have a meter fitted with a condenser the needle will slowly move up to the actual consumption reading. Few watchmakers have a meter of this type, as it is an adaptation which applies specifically to watchmaking and is relatively new.

If your meter has an independent power supply, merely insert the cell in the enclosure on the meter and select the lowest micro amp ( A) position and place your positive meter probe on the main plate, indicated by the + in Figure 3 and the negative meter probe on the negative bridle No. 4405 indicated by – in Figure 3. As indicated in Figure 3, the cell is not in the watch. Your consumption reading should be the same as the check using the cell while in the movement as the power supply.

We have just explained how to make the consumption test in the ESA Quartz resonator watch. In the ESA 9180 series we should have revealed a high current consumption prior to Check No. 4, as a train blockage will not be revealed by a consumption check, since there is not a mechanical connection between the electronic system and the mechanical system. The most common cause of a high consumption in this movement would be a low coil resistance.

Many manufacturers recommend a current consumption test. I personally doubt the value of this test, as in most cases, we are merely confirming what we have already proved. In the case of the balance wheel electronic watches, if a mechanical blockage or drag is present in the train, the damping test will reveal this. Excessive friction anywhere in the watch will also show up as a high current consumption, so both tests are proving the same thing. Frankly I feel the mechanical test is superior to the electronic test on any watch where there is a mechanical linkage between the balance and the train. In most cases the resistance of the meters on the market today, when inserted into the watch circuit to measure consumption, will not provide enough current to bring the amplitude of the balance up to a high enough motion to read consumption. If the balance is not at its maximum swing, the consumption reading will be high. This test may be practical in the future when more watchmakers have meters specifically designed for this purpose. Until then I feel the damping test is superior. In fact, most balance wheel watches of electronic design and electrically powered cannot even be made to run when the present meters are connected into their circuit.

In the electronic watches where there is not a mechanical linkage between the resonator and the train, a high consumption reading will most always be the result of a lesser coil resistance than specified by the manufacturer.

Assuming that our electronic checks all work out, then we know our problem is mechanical. We are all professional watchmakers and are well trained at solving mechanical problems. The procedure we are trying to follow is very similar to that which should be followed in diagnosing problems in spring-driven watches. Checking the mainspring is equal to testing the cell. In both cases we have checked out our power supply. Checking the electronic circuit and the integrated circuit and coil is equal to checking the time train and escapement.

In all cases the checking must be made quickly and accurately in order for us to repair electronic watches

*(continued on page 48)*

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# Inside the Clock Shop

## with James L. Tigner

### INTRODUCTION TO CLOCK CLEANING WITH TIPS ON DISASSEMBLY

Ultrasonics offers a superb method for cleaning clocks, and its advantages become undeniable where cleaning is done without disassembly. Nonetheless, ultrasonics is not all things to all people. Unless you own the large-size tank (9½ in. x 11½ in. x 6 in.)—at a cost of something like $500.00—you will be limited to cleaning clocks one at a time, and frustrated not infrequently at finding your tank too small for the job you have just taken in.

Hand cleaning, properly performed, still does an excellent job, and at a fraction of the cost. Furthermore, when two or more clocks are cleaned at once, hand cleaning becomes *faster* than cleaning by a small-to-medium-size ultrasonic tank.

*Inside the Clock Shop,* as announced in its opening article last month, is dedicated to the watchmaker who would like to get into clock repair a little further, without it costing him an arm and a leg. This being so, the method of cleaning we'll talk about has got to be hand cleaning. Besides, all the information needed for cleaning ultrasonically can be obtained from the manufacturer.

My preference in cleaning solutions is the water-base type, for reasons we will go into later. I think the commercial concentrates are all good, if you don't mind doing a little work with a scrub brush. But for the scrubless method we're going to explore, something more powerful is needed.

I know of nothing better, or cheaper, than the home brew variously known as the American, Home-Made, or Daniels Solution. The ingredients, which can be bought at any laboratory or scientific supply house, are oleic acid, acetone, strong ammonia (28%), and water. The proportions vary with the user. I like it strong and prefer the formula used by Jesse Coleman—1 part oleic acid, 2 parts acetone, 4 parts ammonia, 8 parts water.

Ideally, the water should be distilled, or boiled, but I have never used anything but water straight from the tap (medium hard where I live), and have had no problems. Ideally again, warming the solution makes it work better, which for that matter might be said of any cleaning solution. But once more in the interest of saving time, and because when fresh the stuff is so powerful anyhow, I use it cold for the most part, and with good results. But after cleaning something like 8 or 10 clocks, it no longer packs its original wallop, and I sometimes warm the solution, which enables me to squeeze another job or two out of it before the final discard. It should never be heated warmer than is comfortable to the touch. That is warm enough for the ammonia fumes to let you know they are there!

The detailed steps of the cleaning procedure will necessarily vary with each clockmaker, because of differences in available facilities, equipment, personal preference, etc. Let me describe how I do it, and you can adapt to your own particular needs any ideas you will find useable.

For an opener we will pick a clock that because of wear has to be taken all the way down. Now I'm sure it isn't necessary to tell a watchmaker how to take a clock apart. But there are differences between clocks and watches, and at the risk of trying the patience of the experienced, perhaps I should tick off in rapid fashion things to watch for, which could be helpful to the man just getting into clocks.

First of all, clock repair is a dirty business, and when possible should be done on a separate bench. If not possible, a paper towel on your watch bench will help to avoid a mess, until the clock can be cleaned.

Letting a mainspring down with a winding key is full of hazards, both to your knuckles and to the clock. Let-down keys are in all the catalogs, or you can make one from an old broom handle for use in conjunction with a winding key. Just saw a slot in the end of the stick to fit the key wings, and drill a hole to take the shank. Make it about 5 in. long and you are all set, although I would hesitate to use one of these on a really powerful spring, as in a large chime clock.

Steel C-rings that come free with an order of new mainsprings make handy retainers for slipping around an open mainspring before letting down, and should be saved in various sizes. Usually the C is almost an O, and an end has to be sawed off so that the remainder represents about a 3/4 circle. If you haven't as yet built up a collection of these, a mainspring can be tied off with about 3 or 4 turns of sturdy twine wrapped and tied around the spring and pillar post.

Since both hands are needed for the let-down operation, one to hold up the clock by way of a suitably-sized screw driver and the other to brake the let-down key as the mainspring slowly unwinds, some means must be found for holding the clock firmly in place. A good vice will nearly always serve this purpose. Grip the corner of the plate nearest the spring being let down.

With the power off both trains, the pivots will now lie loose in their holes, and the holes can be the more easily checked for wear. Use a finger to rock the mainwheel back and forth, while watching the back and forth slap of the next wheel's pivots. If a bushing is indicated, scratch a small x by the side of the hole. If the hole just needs to be closed, mark an o by its side. Do the same thing with each succeeding wheel, until all holes needing attention have been marked. Watch it, though: a pivot hole can be badly worn but so gummed-up the pivot may show no side shake at all—a sign in itself that something is wrong.

Before the plates are taken apart, you may want to mark the meshing of the striking gears. This presupposes that while the power was still on, you checked the striking and found it working correctly. Clockmakers who are old hands at this usually don't bother with witness marks. They can assemble a striking or chiming train faster by knowing the function of each part. But for the man not all that experienced, it may be helpful to make a little scratch line on mating wheel teeth and pinion leaves. In lantern pinions the line is scratched on the brass disc; on solid pinions, a corner is filed off the mating pinion with a needle file. In rack and snail strikers, aligning witness marks can be scratched on the gathering pallet and the pivot on which it it is pressed. On ¼-hour chimers the same thing can be done to the ¼-hour counting cam and its pivot. The basic principles involved in striking and chiming will be analyzed, of course, in later articles, so that witness marks can be kept to a minimum or eliminated altogether.

So now we are ready to remove the nuts or pins from the pillar posts and lift off the top plate. Incidentally, a set of socket wrenches is a great speeder-upper for this work, although a pair of pliers will do the job. Take out the striking train first. Most of the wheels will be fitted with pins, cams, counting slots, etc., so there is no danger of confusing them with the going train and no reason for keeping them separate during the cleaning process. However, take note of the main and second wheels. These may have no features that immediately distinguish them from the going train, and it is wise to mark them with a small s. In the case of going barrels, not only the barrels but the covers and arbors as well should be marked. Some striking clocks have identical mainwheels except for one winding clockwise and the other counterclockwise. A little head scratching could result from a clock assembled with mainwheels interchanged!

It's no trick to pry off a barrel cover, turn the winding arbor in reverse to free it from the mainspring, and lift it out. Getting the mainspring out of the barrel without appreciable distortion, while not quite so easy, becomes easy enough—except for the really powerful ones—when you have done it a few times. Hold the barrel with one hand, grip the inner coil with a pair of pliers in the other hand, and with both hands turning in opposite directions to wind the spring, yank it out in one motion. The slight bed-springing that results from this operation is of no practical consequence, and can be corrected by simply pulling down on the higher outer coil until the spring lies flat.

Unhooking an open mainspring from the mainwheel winding arbor can be an exasperating job where the 4 or 5 innermost coils are badly set, and the arbor hook is only a straight pin. I do it by placing the key on the winding square, turning the whole assembly over, and clamping the key in the vise. The spring is then turned counter to its winding direction until considerable resistance is met. With one hand maintaining this reverse tension and the other levering a screwdriver blade between the arbor and the inner coil, the spring will slip clear of the hook. It can now be pried up from the mainwheel by another and larger screwdriver blade.

While a mainspring is commonly removed from a barrel by hand, as described, winding one into a barrel by hand just can't be done without significant distortion. This is so in clocks even more than in watches, since the walls of a clock barrel are higher than those of a watch barrel in proportion to their respective diameters. All of which means a mainspring winder is a must.

What to do. Well, the catalogs all show a very inexpensive, but adequate, winder for loop-end springs. And for hole-end springs they show two English style winders—one small and modestly priced, the other large and not so modestly priced. The small one will handle anything up to and including the standard 400-Day springs; the large one just about anything that will cross your bench. And then there's the Horolovar 400-Day winder, also for hole-end springs whether 400-Day or not, up to the smaller size chime springs. It's quite sturdily built and priced about midway between the two English style winders. All of these winders will insert a spring, but they will not remove one from a barrel. With a little ingenuity all of them could be adapted to wind loop-end springs also.

You might want to look into a new winder on the market that will handle both loop-end and hole-end springs; and both insert and remove springs of all sizes from their barrels, without damage to either barrels or springs. Nothing fancy about it, but it's sturdy and well machined. Sells for about $90.00. Should you like further information, write its maker:

Merril D. Dye
7 Northern Blvd., P. O. Box 263
Hagaman, N.Y. 12086

I would add at this point that neither AWI nor *Inside the Clock Shop* recommends *any* product or service. Mention of any products or services is only in the way of providing information to members for their consideration.

So now our clock is disassembled, and we are squared away, ready for the actual cleaning. And, with that cliff-hanger, we'll close the door of the clock shop until next month when we'll cover the whole cleaning procedure. □

**LAW ENFORCEMENT INQUIRY**

The case back of a ladies platinum watch is pictured above. The watchmakers' marks are D 20967 M and M 3364. Please notify AWI Central with any information.

## INCOME TAX INFORMATION

### New Tax Forms Coming

The Revenue Service is busy revising the tax forms you will need to file your tax returns for 1976, along with updated instructions. After the forms and instructions are revised, printing them will involve 100 commercial printers, the government's own printing offices, 31 million pounds of paper, 1.5 billion copies of forms and pamphlets. These will be distributed in 30,000 places–government offices, banks. Five different "tax packages" must be mailed to 85 million taxpayers. The forms will be late, as they won't be delivered right after Christmas as in past years. They probably won't even be in the mail until mid-January. You can also expect a delay in state and local forms that are pegged to the federal tax. They cannot be firmed up until IRS finishes.

### Couples with One Unemployed Spouse Get New Tax Breaks

As the law now stands, only the working spouse can contribute to an IRA, and then only the lesser of $1,500 or 15% of his or her compensation. But, after 1976, the maximum will be $1,750 for a married taxpayer who contributes to a separate IRA for a nonworking spouse.

### Planning to Hire Your Youngster?

If you plan to hire your son or daughter, make sure to treat him the same as other employees or you lose the tax breaks. Putting your offspring to work can seem like a good way to take care of his allowance and to provide yourself with some tax breaks, but don't be too casual about the arrangement. The IRS looks closely at deductions for wages paid to your own family members. So, it's important to keep the usual records showing amounts paid and hours worked. Otherwise, the IRS may claim you paid more than the going rate or there was no bona fide employment. Hiring your youngster need not jeopardize your claiming him as a dependent on your return. No matter how much income he receives, you are still entitled to the dependency deduction as long as you provide over half of his total support for the year and he either won't reach the age of 19 this year or is a full-time student for at least five months.



There are two kinds of people in the world – those who are always getting ready to do something and those who go ahead and do it.

# THE OSCILLATING OR FLOATING BALANCE

**by Marvin E. Whitney**

**CMW CMC**

In the oscillating or floating balance, the balance staff has been replaced by a tube or hollow balance shaft, into each end of which is frictioned a jewel. Passing through this tube or hollow balance shaft is a length of non-rusting spring steel wire (Nivarox) which is tightly drawn and secured to the upper and lower arms of the balance carrier or support bracket. Thus, with the balance hanging in an oscillating or floating manner from a spiral spring, only the lightest contact is made with the jewels. Hence, the friction is so negligible that the jewels need no oil and are best left dry. Oil, particularly when it thickens, will reduce the balance motion and eventually stop the clock. (See Figure 1.)

The helical or cylindrical spring which is used in lieu of the conventional type of hairspring is attached at the lower end by a collet on the tube, while the upper end is secured to a collet which is part of the carrier or bracket assembly. Halfway the length of the 16 coiled, armature wound helical spring, the hairspring changes direction, for it is bent back upon itself so that one-half of the coils are wound in the reverse direction of the coils of the coils of the other half. (See Figure 2.)

During the balance oscillation, half of the helical spring will contract while the other half will expand an equal amount, or in other words, when one half is wound towards the right hand side, the other half is wound towards the left hand side. This permits the balance wheel to always turn in the same plane, thus eliminating the tendency of the balance to ride up and down the wire.

### Escapement

Instead of a watch-type roller table, the roller is a flat C-shaped ring of about 330 degrees and the roller jewel is replaced by a pair of highly polished steel pins. The upper ends of the pins are driven into the underside of the balance arm or hub near its center, while the lower ends of these two impulse pins are driven into the C-shaped ring which holds the ring

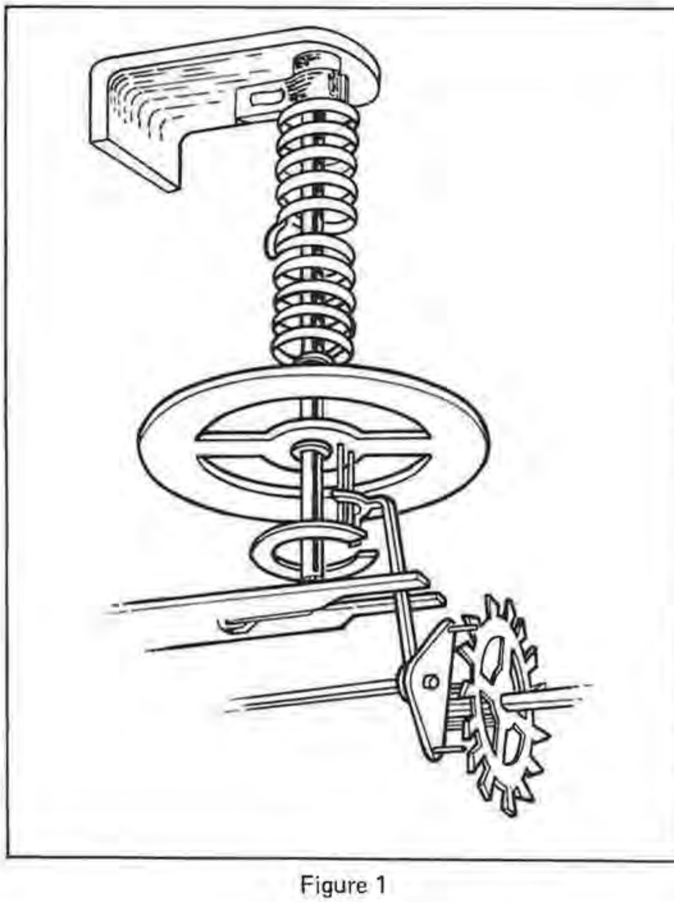

Figure 1

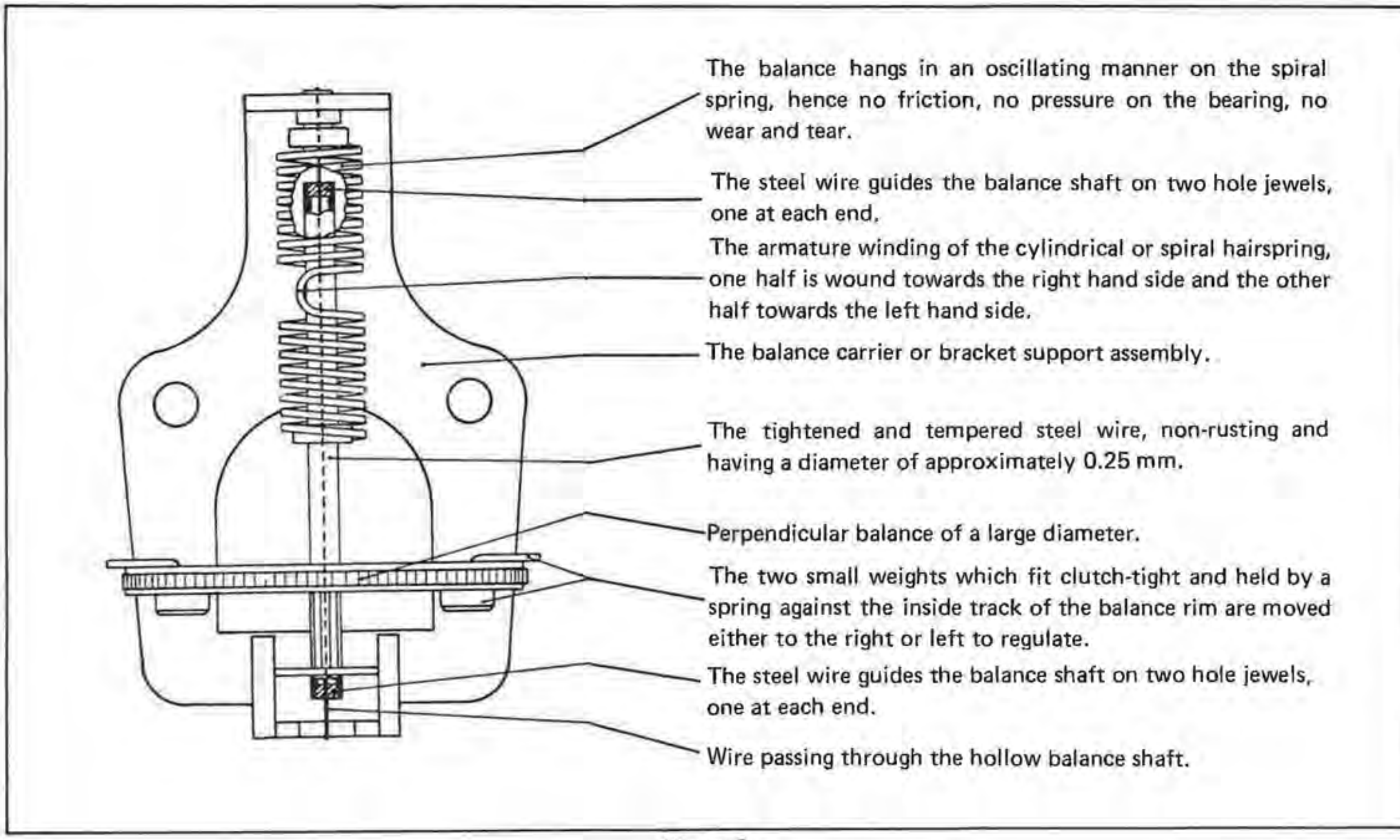


Figure 2

suspended from the rest of the balance assembly. The purpose of the two pins is based on Savage's invention; it supplies the impulse closer to the center of oscillation, necessary in this type of escapement. (See Figure 3.)

The fork itself is quite different from conventionally-designed forks. The fork slot end of the pin lever pallet is bent at right angles to allow the fork slot to engage with the two steel impulse pins while the pallets operate in a vertical plane. One fork horn is made longer than the other which serves as the guard pin. The longer piece is bent parallel to the lever and extends downward alongside the C-shaped safety ring. This bent-over piece provides the safety action to the escapement. When the balance moves in one direction, the long horn passes back through the gap in the C-ring and the safety action is between the long horn and inside surface of the C-ring. (See Figure 4.) The horn may be bent to adjust the safety action. The banking function is provided by having the lever operate between two prongs that extend out from the balance carrier or support bracket.

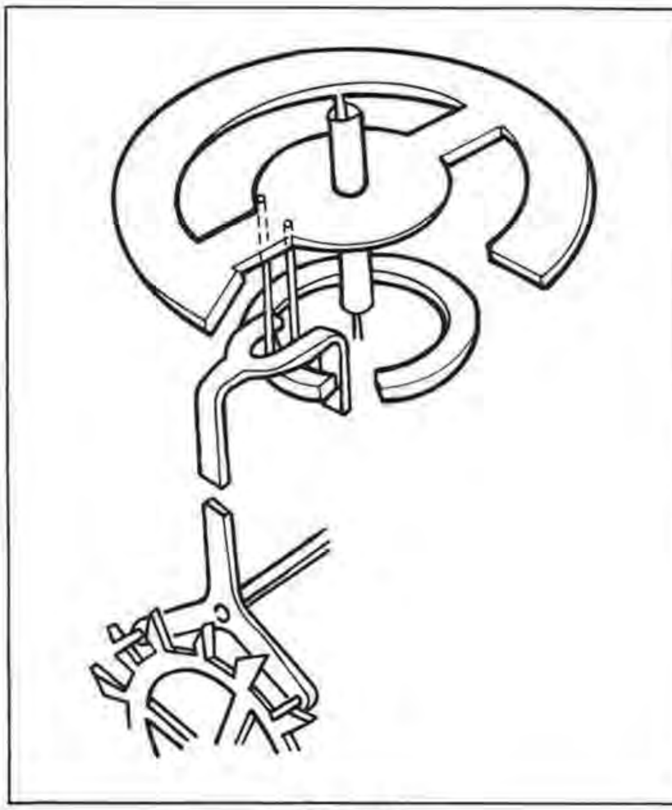

Figure 3

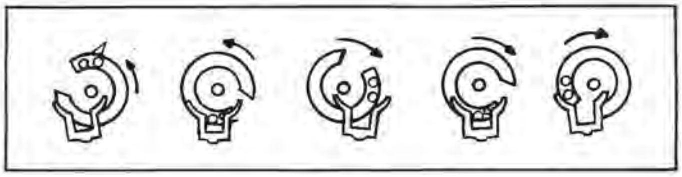

Figure 4

**Regulation**

In most instances, this timepiece is not equipped with a conventional regulator and cannot, therefore, be regulated while it is running. Regulation is achieved by adjusting the timing weights on the balance wheel. The balance is fitted with two small weights which fit clutch-tight and held by a spring against the inside track of the balance rims. These tracks are not concentric, but are in a diminishing spiral. Moving the prongs of the clamp in one direction will carry the weights toward the inner spiral or closer to the center—producing a faster rate. Away or outward will result in a slower rate.

**Repairs and Cleaning**

The balance carrier or bracket assembly support, being attached to the plate, can be easily removed by removing either two screws or nuts. Little needs to be done to this assembly unless it has been dropped or roughly handled. The steel wire may be replaced by prying up the tabs that hold the wire ends on the back side of the balance carrier or support bracket. A new wire (having a diameter of approximately 0.25 mm) is passed up through the balance tube or shaft. One end of the wire is attached to the lower tab and the tab bent downward. Then the new wire is positioned along the underside of the bracket, the balance is positioned between the two support arms, and the wire is fed up through the hollow tube or shaft. Then a slight amount of finger pressure is applied on both support arms, squeezing them together. While maintaining this pressure, bend the wire back over the top of the support bracket and secure to the upper tab. When you release the finger pressure on the carrier or bracket arms, the wire will be drawn taut. Then check the balance wheel to see if it floats centrally along the wire. If any adjustment is required, insert a small screwdriver blade or a tapered collet tool in the lower collet slot and gently ease the collet up or down, thus centralizing the balance wheel.

To place in beat, shift either the upper or lower collet slightly, using either of the tools mentioned above. Occasionally, the upper collet has a finger and with a greater amount of clearance between the collet and carrier, the moving of the upper collet is easier and safer.

For cleaning purposes, the balance unit is not disassembled. Clean by stringing on dip wire. Dip in any good clock cleaning and rinsing solutions. Dry over warm gently blown air.

To start, turn the minute hand slightly forward and then backward or stroke the balance wheel with a camel's hair brush. □

## CHANGE IN ZODIAC DISTRIBUTION IN THE U.S.

Zodiac Switzerland announces a change in the distribution of their products in the United States.

Effective immediately, Trauner Inc. is no longer Zoidac's agent in the U.S. Details regarding the creation of a new distribution company will be forthcoming in the near future.

Moreover, after-sales service is now secured by Zodiac Service Department, P.O. Box 567, in Lititiz, Pennsylvania 17543, tel. (717) 626-0204, to which all watches to be repaired should be addressed.

It is the intention of Zodiac, Le Locle, Switzerland to continue to service the trade in the best possible manner.

## ATOMIC CLOCK DETERMINES LENGTH OF A SECOND

Tests of the latest generation of National Bureau of Standards atomic clocks, NBS-6, demonstrate that it determines the length of the second to within 0.85 parts in $10^{13}$ (8.5 parts in 100 million million, or comparable to about one second in 370,000 years). The determination of the second to this accuracy reveals that the international atomic second, maintained by the International Time Bureau in Paris, is too short by about 11 parts in $10^{13}$. The new NBS-6 cesium beam clock is twice as accurate as its predecessor. NBS-6 achieves this improved performance through the use of its beam reversal capability, improved magnetic field stability, and better techniques for directly evaluating systematic frequency offsets due to the electronic system and the microwave cavity structure.

# In the Spotlight

## by Orville R. Hagans

CMW CMC FBHI

**FROM THE ORVILLE R. HAGANS MANUSCRIPT AND PHOTO LIBRARY**

EARLY WATCH MECHANISMS
English, French, and Swiss Movements
Of the Period 1750-1900
By Ernest A. Cramer

PART 2

Cylinder or "horizontal" escapement was invented by Thomas Tompion, the "Father of English Watchmaking," in 1695. Under his improvements the watch began to embody the scientific principles and accuracy of workmanship which made it a dependable timepiece. The cylinder escapement was generally used by George Graham. It dispensed with the then common vertical crown wheel (hence the term "horizontal") and permitted thinner watches. This escapement is frictional, the balance being carried on a hollow cylinder whose bore is large enough to admit the teeth of the escape wheel. The cylinder is cut away where the teeth enter and the impulse is given by the wedge-shaped teeth striking against the edge of the cylinder as they enter the leaf.

Tompion made other improvements. The balance spring made changes necessary in the watch structure, such as the cock covering the balance and balance spring with wide firm foot, and the key-actuated regulator (note the principle on Tobias Watch). Tompion made other improvements: the substitution of the chain for catgut, the minute hand, the second wheel planted at the center of the movement, the enamel dial, milled teeth for wheels and pinion, the removal of the tangent set up screw from the plate to the pillar plate, and general improvement in accuracy and steel finish. (Paul M. Chamberlain, *It's About Time.* London, The Holland Press Ltd., 1964.).

Some notes on the mechanism shown in Figure 1 follow.

1. Dial Plate–showing hour wheel, minute wheel, stop attachment for second hand, tension wheel, and stop.

2. Pillar and Pins–Which hold top and lower plates. This type of pillar was used with the earliest movements made.

3. Underneath Section of Dial.

4. Examples of Balance Cocks–Center one with birds, flags, and armored head.

5. Top Plate–Wheel and sector regulator. Note cap jewel for escape wheel.

6. Mainspring Barrel and Cap–Confines steel spring, between 14 and 17 inches long.

7. Barrel Arbor–The axis of the barrel around which the mainspring is coiled.

8. Fusee Barrel–Top section grooved cone-shaped, fully interposed between mainspring barrel and center wheel. In winding, the fusee chain (originally a catgut cord) is drawn from the mainspring barrel on to the fusee barrel, the first coil on the larger end. Thus, the mainspring, when fully wound, uncoils the chain from the smaller end of the fusee. As it runs down, it gets the benefit of increased

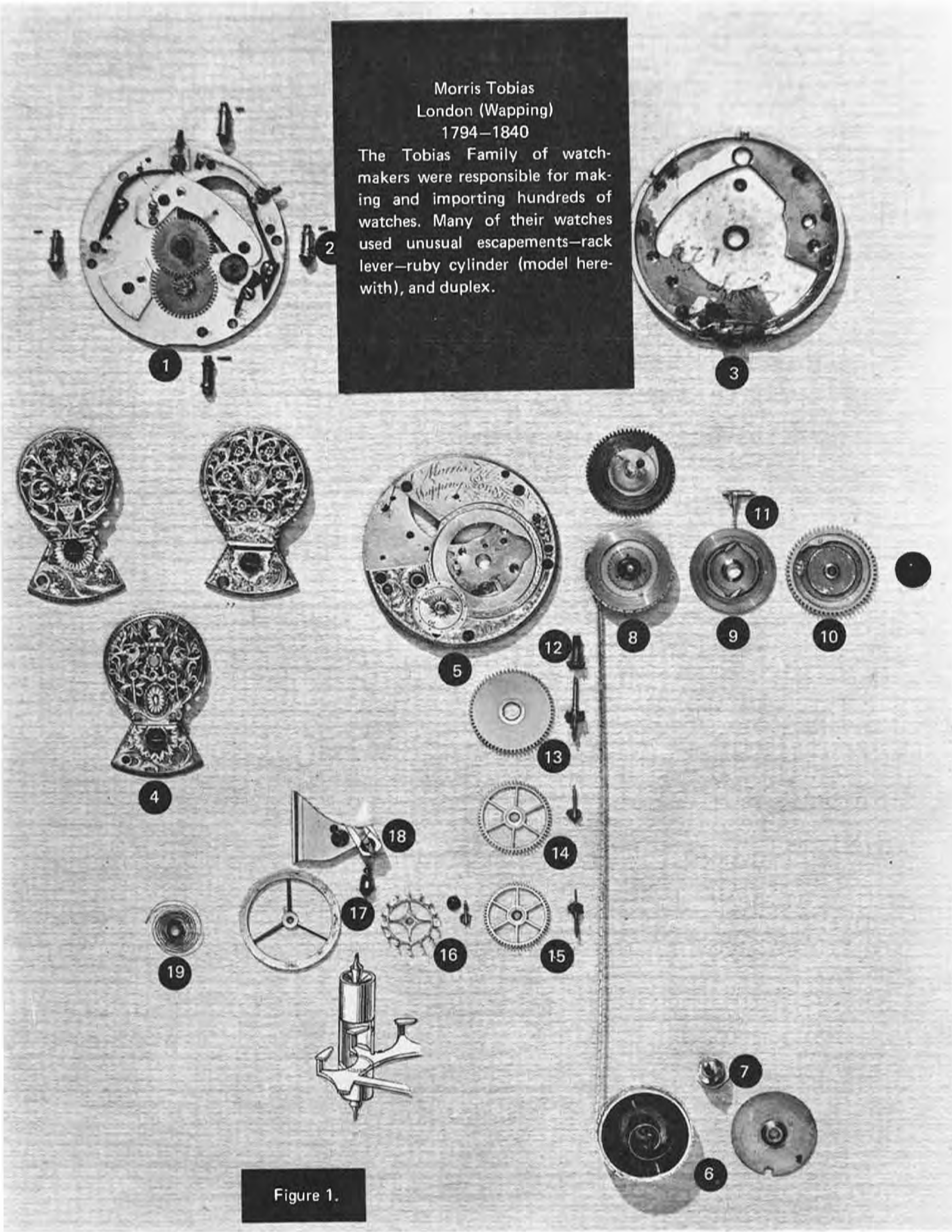
Morris Tobias
London (Wapping)
1794–1840
The Tobias Family of watch-makers were responsible for making and importing hundreds of watches. Many of their watches used unusual escapements–rack lever–ruby cylinder (model here-with), and duplex.
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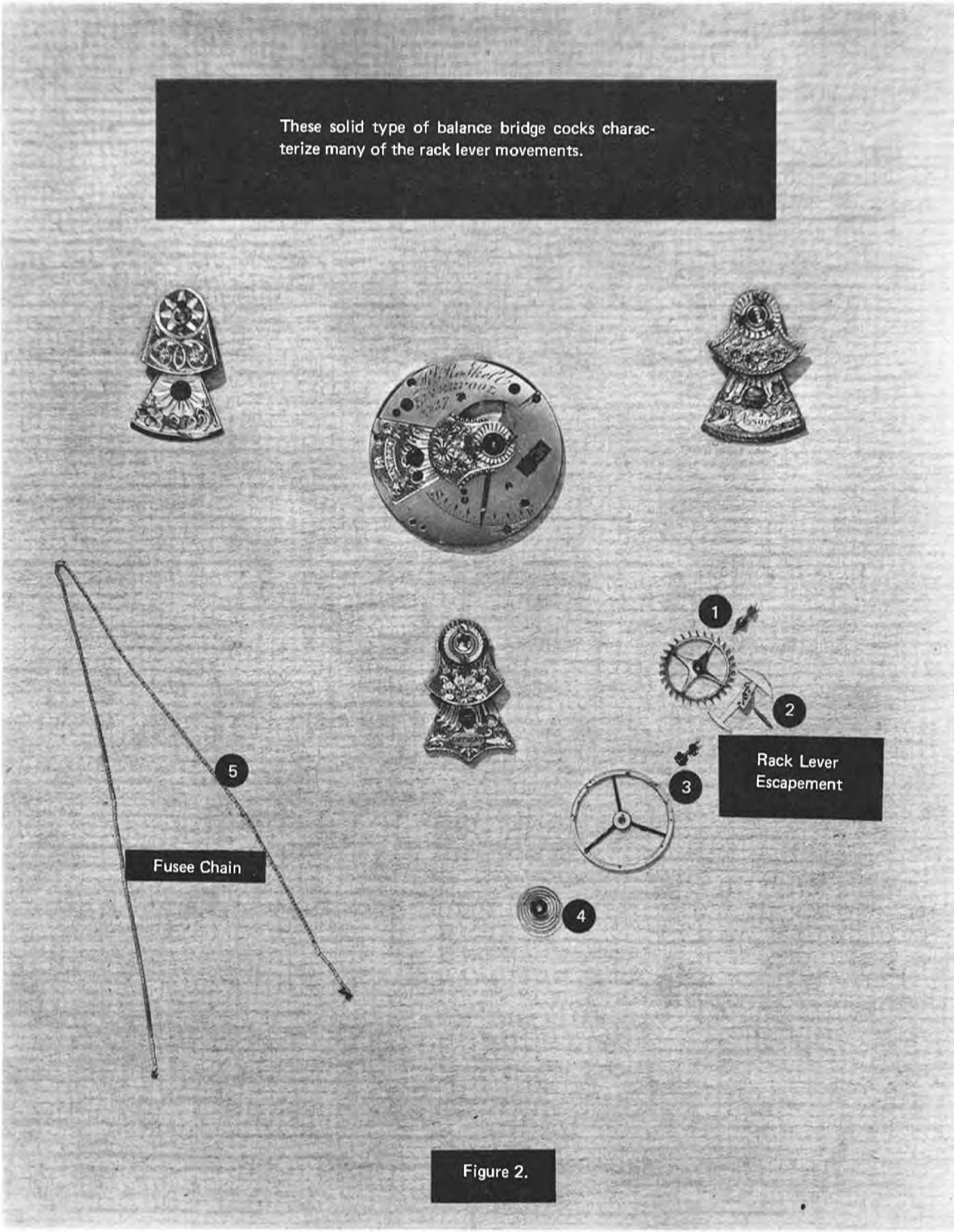
Figure 1.


These solid type of balance bridge cocks characterize many of the rack lever movements.
1
2
Rack Lever Escapement
3
4
5
Fusee Chain
Figure 2.

leverage by reason of the greater diameter of the lower part of the fusee.

9. Going Fusee.

10-11. Maintaining Power Attachments–So that watch does not stop while being wound. Invented by Harrison.

12. Cannon Pinion.

13. Center Wheel and Pinion.

14. Third Wheel and Pinion.

15. Fourth Wheel and Pinion.

16. Escape Wheel–(Note wedge-shaped teeth) pinion and washer.

17. Balance Wheel and Cylinder–Note hollow section where escape wheel teeth entered and gave the necessary impulse to balance wheel.

18. Lower Balance Bridge–Fastened to underneath of top plate.

19. Hairspring.

**The Rack and Pinion or Rack Lever Escapement**

Christian Huygens (1629-1695 , the celebrated Dutch physicist, seeing the desirability of a greater swing of the balance in order to better utilize the balance swing, constructed what he called a pirouette, which consisted of a gear on the verge, pitching with a pinion on the balance arbor.

In 1772 the Abbe d'Hautefeville published a description of an escapement which employed a pinion on the balance staff, actuated by a segment of a gear connected on a common center with an arbor. This was patented in England by Peter Litherland in 1791, and many movements were made in Liverpool, going under the name of rack and pinion, or rack lever escapement. (Chamberlain, *It's About Time.*)

The movement shown in Figure 2 was made by Robert Roskell of Liverpool, 1805. He made a great number of watches, and many incorporate the rack lever escapement. A description of the movement follows.

1. Escape Wheel (29 teeth) and Pinion.

2. Rack Lever and Staff.

3. Balance Wheel and Balance Staff–Pinion is on balance staff.

4. Hairspring–Both Huygens and the Abbe d'Hautefeville can be credited with applying the hairspring to watches.

5. Fusee Chain.

**Duplex Escapement**

This escapement is usually credited to Pierre LeRoy about the year 1750, although some of the elements of the idea, it is claimed, were previously used by Dr. Robert Hooke (1635-1703) in London, and Jean Baptise Dutertre in Paris. Much later, 1782, a patent was taken out in England by Thomas Tyrer.

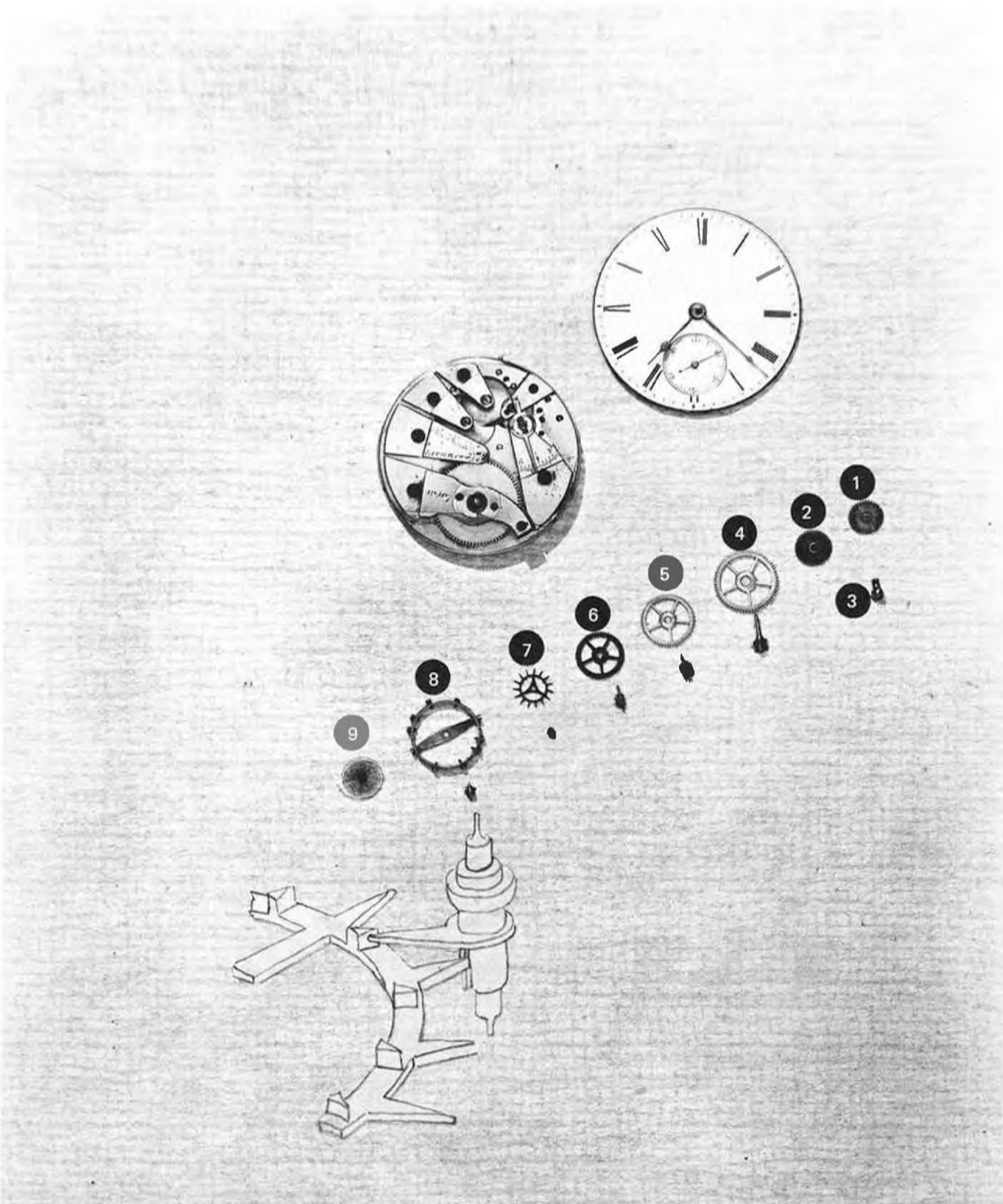



Figure 3.

The early forms of the duplex had the escape and impulse wheels separately formed, but these were later combined into one wheel. This type was in great favor in England up to the middle of the 19th century for fine watches, but the superior qualities of the chronometer and lever supplanted it. (Chamberlain, *It's About Time.*)

The escape wheel has two sets of teeth. Those farthest from the center lock the wheel by pressing on a hollow ruby cylinder fitted round the balance staff and notched so as to permit the passing of the teeth as the balance moves in a direction opposite to the wheel's motion. The second set stands up from the face of the wheel, and one gives impulse to the pallet every time a tooth leaves the notch. This is not a detached escapement, but there is little friction. As improved, this escapement was used in the famous Waterbury watches.

Shown in Figure 3 is a movement made by Robert Roskell, Liverpool, 1798-1830. Roskell made a great many watches using the verge, duplex, and Litherlands rack lever escapements. Most all duplex escapements were used in the Swiss bar style movements. These style movements were increasingly used by many makers. The movements were very thin and extremely plain.

1. Minute Wheel.
2. Hour Wheel.
3. Cannon Pinion.
4. Center Wheel and Pinion.
5. Third Wheel and Pinion.
6. Fourth Wheel and Pinion.
7. Duplex Escape Wheel and Pinion.
8. Balance Wheel and Duplex Staff.
9. Hairspring. □

---

**The universe looks jagged and broken only to those who are jagged and broken. Repair yourself.**

escapement module barrel arbor pendulum balance staff quartz crystal verge chimes main wheel ratio hairspring potence push button crystal capacitor crown diode stepping motor fuzee mainspring transistor frequency lathe condenser staking tool capacitor trimmer suspension spring light emitting diode detached lever repeater

liquid crystal loupe tweezers attraction friction buff amplitude poise endshake resistor analogue stop works gear lubrication calendar torque

# Questions and Answers

## by Henry B. Fried

CMW CMC FBHI

### THE DULL GONG

Q. I have a 16 Size Waltham Minute Repeater, the movement No. 3793750 also has Pat. June 1888.

My question is about the chimes. They circle the movement one in each direction. One of these chime springs broke off even with the block that screws to the plate of the movement. I managed to drill the block and get the chime spring back in the block quite tight, but the sound is much duller than the other chime. Do you know of anyplace I might be able to purchase a set of chimes or do you know of any other way to repair?

Thank you.

John Green
Phoenix, Arizona

*A. Your gong cannot be bought again and there is no need to buy one. The reason your gong sounds dull is because it does not contact a full surface inside the pier block. What you should do is to gold-solder the gong to its block. Use heat shield around the other parts of the gong that you wish to protect while using a low-grade or rather a low-melting gold solder (better than silver for such a job). I have done these repairs often and it works out quite well and the sound is good. Waltham repeaters are rare items and try to preserve these. Thanks for the S.A.S.E. Many ask many questions but don't think of including that stamped envelope.*

**Mainspring Power**

Q. I have on the bench an English, fusee chain drive that is marked J&W Pickering on the plate with "Atherstone" and the SN 12664 on the barrel bridge. It is approximately 18½ ligne KW.

The mainspring was broken and turned out to be 19x5x17 Dennison. This appears to me to be rather strange for such a watch. Can you advise me if this is true and if not, what strength mainspring should it have.

Thank you.

Vernon L. Lacey
Fort Riley, Kansas

*A. Fusee watches require stronger springs than regular, modern watches because there are more pivots, more wheels and a more frictionalized escapement to overcome as well as other factors.*

*However, since modern springs are more efficient and are of better steel than the oldtimers, you may find it expedient to order one a strength or two weaker.*

*The hallmarks on your watch case would have told me the exact year in which it was made.*

**Junghans Story**

Q. Is it worthwhile to purchase the *Junghans Story* of which you write? Please advise.

Hazel I. Schneider
Yreka, California

*A. Telling you whether to buy this is like being asked in a desolate lumber camp, "Is* that *the only girl in town?"*

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- ☐ IN ADDITION, please ship ______ sets of special trimming tools, needed for regulating quartz movements, @ $9.95/set.

Name ____________________

Address ____________________

City ____________ State ______ Zip ______

**Bulova VC-10 Cleaning Machine**

Q. Appreciate the article you wrote in Jeweler Circular-Keystone concerning the operation of the Bulova VC-10 cleaning machine. Everything was well explained and I was very interested until your article stated the mainspring barrels of automatic watches need to be taken out of movement before cleaning the movement. If this is done, it will add considerable time to the cleaning of these watches.

I was wondering if there are any other little problems that will cause the cleaning process to be extended, such as removing the substances that are put on jewels at the factory to keep the oil from spreading over the jewel or if special solutions have to be used in the machine.

Will the solutions deteriorate if they are only used, say twice a week? This means it would take six weeks before changing the solutions figuring on 250 watches that are being cleaned.

I would appreciate any information that you found in your investigation of this cleaning method that will help me make a decision to purchase.

Walter S. Morris
Greenville, South Carolina

*A. The extra precaution of removing barrels from watches assures that the lubricants mixed with the molybdenum disulfide in the barrels will not be dissipated and retard the proper distribution of this mainspring lube. If the barrel is a well-sealed barrel, some watchmakers prefer to allow the barrel to remain but since this device allows so many watches to be cleaned at once the extra barrel removing precaution is well worth the extra time.*

*The epilame that is put onto the jewels to prevent oil migration is designed to withstand many cycles of ultrasonic cleaning and thus the VC-10 agitation, not being ultrasonic will not remove that layer of epilame substance.*

*As for the deterioriation of fluids within the cleaning jars, these will remain active up to about eight weeks. The jars are fairly well airtight and thus the evaporation of the more volatile substance or liquids making up the homogenized cleansers and rinses will not be overly affected after a few weeks. Like most experiences, each watchmaker learns just what tolerances he can allow with certain cleaning habits and repair techniques and you too will experience your own, best method of economical operation of these devices.*

**Threaded Crown Supplier**

Q. Please advise where we might obtain a threaded Oyster type crown to an Eta 2782-Lexon on Dial, with Pierpont Watch Co. in back of case.

Thank you.

Jack Glusman
Philadelphia, PA

*A. The Lexon watch, I'm told, is a special model imported for the Bloomingdale chain of department stores.*

*Crowns are expensive and are available from John A. Poltock Co., Inc.; 93 Nassau Street; New York, New York 10038.*

*It will be necessary to send the complete case* only *and not the movement as there are many specialized crowns for this model watch.*

**Jacot Movement**

Q. Please help!! Need any and all information you may have about the following watch: it measures from top of crown to base 63 mm. It is 49.5 mm in diameter and 14.5 mm thick. The hunting case is stamped: warranted 18, Carat Fine. The white dial with Roman numerals has Chas. E. Tascot. Hand-engraved on back of intercase is 26368 Chaux-de-Fonds. The movement is 17 lignes, "Patented Sept. 1872," movement no. 26368.

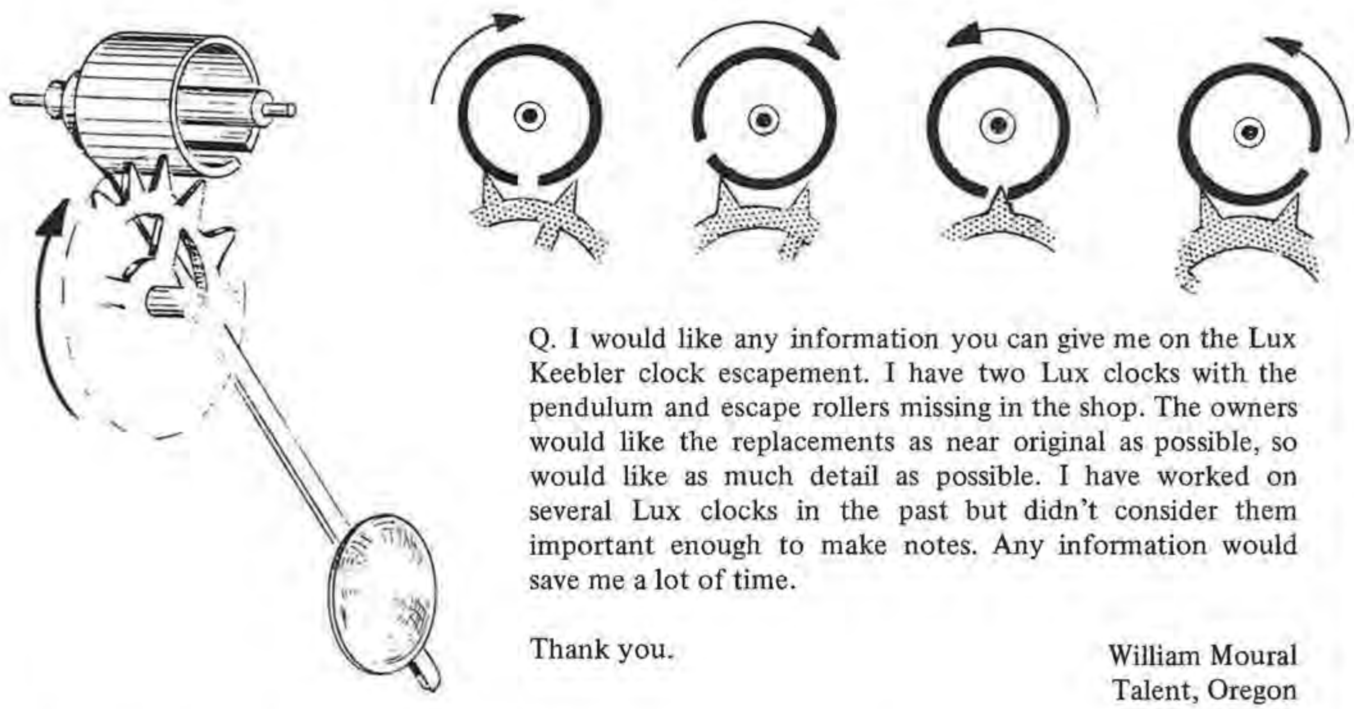
Any help you may give would certainly be appreciated.

Quinton Blevens
Rossvile, GA

*A. The real maker of the watch was Charles E. Jacot of leLocle and La Chaux De Fonds who operated in the last half of the 19th century. He and others in his family made many, many watches which were exported to America.*

*Jacot was one of the first to patent a stem winding device for watches (1852).*

## KEEBLER LUX CLOCK ESCAPEMENT



Q. I would like any information you can give me on the Lux Keebler clock escapement. I have two Lux clocks with the pendulum and escape rollers missing in the shop. The owners would like the replacements as near original as possible, so would like as much detail as possible. I have worked on several Lux clocks in the past but didn't consider them important enough to make notes. Any information would save me a lot of time.

Thank you.

William Moural
Talent, Oregon

*A. The Keebler Lux clock escapement is really a simplified type of cylinder escapement. The escape wheel is merely a wheel of pointed teeth driving the pendulum directly in one direction with every other swing of the pendulum. It is one of the simplest, if the simplest of escapements. The sketch above should explain this. The tooth of the escapement rides against the polished surface of a hollow cuplike cylinder which has a narrow slit along its side. When the pendulum swings in the clockwise direction, its slit skips past the tooth but on the return swing, the tooth enters the slit and pushes the pendulum along, the pendulum, by virtue of its motion continues with the overswing allowing the tooth to drop off and the next tooth to bank or lock against the cuplike cylinder which is firmly attached to the pivoted pendulum (no suspension spring). The pendulum swings nicely between two pivot holes. I do not know whether the parts can be had any longer. However, if your clock escapement is not one that ticks every other swing (in one direction only) then replacement movements small enough to be fitted can be had of German origin. The Keebler Lux clocks are being collected today by collectors.*

**Watchman's Clock**

Q. I have a watchman's clock made by the Chicago Watchman's Clock Co. of Chicago, Illinois, with a Waltham 8-Day Movement and with a patent date of 11/26/12. It has these markings on the inside case– on lever 109122; on case D16320; and under place inside case 6543210987654321. I need help in getting the movement out of the case to repair it, as the movement needs work.

Randy Chambers
Fort Worth, Texas

*A. All my buyers guides and trade indexes from 1916 onward do not list this company.*

*Waltham 8-Day clocks were used in many devices and I have seen these in numerous systems. Some would defy revelation of methods of removing the movement until one knows something about the Waltham 8-Day movements. Most of these are secured to these heavy cases, metal or plastic, by large machine screws in the back of the case which terminate into about a two-millimeter thread into the movement bridge directly. Loosening these also loosens the movement and it then can be dropped or taken out from the front of the case. The winding system also*

*reveals methods of removing these. Sometimes the winding unit is a stem and bezel gear into a unit which meshes against the crown or the ratchet wheel. Removing the winding unit then can also free the movement from the case. Other instances, the bezel and glass, held by a split, friction ring allows the glass to be lifted out and may also reveal screws which secure the movement. My guess is the first I listed above. If all above suggestions fail, send a photo of the clock or good detail sketches.*

**Chelsea BPH**

The Chelsea Clock Company, Chelsea, Massachusetts, made a variety of ship's bell striker clocks using a jewelled lever escapement.

Can you tell me if all of these clocks used the standard 18,000 beat escapement?

Thank you, kindly.

A. Friedenthal
Detroit, Michigan

*A. The Chelsea bought their escapements mostly from Howard and from Waltham and these were 18,000 V.P.H. They're the same escapements used on bank vault clocks for the most part.*

**Source for Odd-Shaped Crystals**

Q. This is not technical in nature, but information I would like to have.

All the lectures, seminars, articles, etc., have advised repair shops to be in a position to take in all quality repairs and if unable to do the job, have a trade shop who can subscribe to this.

Now comes the 17 J fashion watch with its oddball crystals (large ovals, hexagon and octagon) that I am unable to fit from my crystal system, and my crystal fitting company is sending them back with the comment "not available."

Do you know of a source?

James H. Climans
Richmond, VA

*A. For odd-shaped watch crystals, try Electroseal Glassfit Corporation; 43 West 47th Street; New York, New York 10035.*

*I have made numerous calls and inquiries to help and the above is what I've been able to come up with. We try to help in as many areas as we can. Use your membership for this purpose.*

**Early Elgin**

Q. I have come in contact with this movement. Can you give some information, as I think the mainspring has been replaced and may be the wrong size, though it runs very well but not long enough.

It is an 18 size, 7 jewel hunting key wind, and set full plate no. 406991 the name T. M. Avery engraved on main plate in back on the barrel bridge ELGIN the name on the dial is ELGIN NATIONAL WATCH CO. The balance wheel is solid and three spokes on screws in balance wheel.

The Book by Roy Ehrhardt has no listing of this except as per number approx. 1864 mfg.

W. H. Bullock
Brandon, FL

*A. Your fine sketch reveals a seventeen sized, 1st model Elgin, T. M. Avery model. Only 17,000 were made of these, and thus fairly rare. Avery was an officer of the company. The dates you mention are correct, though I suppose you meant 1876. The very first Elgin (No. 101, now in the Elgin collection at Disneyworld, Orlando) was made in 1867.*

**Who Repairs Edwards Clocks**

Q. A customer brought in an electrically operated chiming clock that is also hooked up to the front and rear door.

The markings on the clock are Grandfather's Clock Chime, No. 1490; Edwards & Company, Incorporated; Norwalk, Conn.

Is the company still in existence; if so, may I have the address; if not—is there anyone repairing these clocks?

A. Zalatoris
Chicago, IL

*A. I have made a few long distance calls for you and contacted the Edwards & Co., Inc. They are at 90 Conn. Ave., Norwalk, Conn. 06856.*

*However, for repairs you will have to contact by phone, Mr. Dick Davis at the Illinois branch of that company at Edwards & Co., Inc.; Lombard, IL. Their phone is (312) 963-6990.*

*They will not accept any repairs until prior arrangements have been made with this gentleman.*

**Fusee, Buyers Guide, Hands, and Concord**

I'm enclosing S.A.S.E. and paper for your reply to my problem.

I need to know where I can get fuzee chains for the old English watches. In this Boston and suburban area, we are getting a lot of the old pocket watches both American and English as well as European in for repair, and as you know every once in a while a chain is broken. I know some bench men repair these, but I confess that the thought of it bothers me. Henry Kamlot in Boston says he has them, but to get Henry to dig anything out of his stock is almost impossible now, so I desperately need another source of supply, either in this country or in England. LaRose was listed a couple of years ago as having them, but they do not.

Also how does one get hold of an annual publication which used to be called the Jewelers Buyers Guide, a big thick book which told where anything in our business could be obtained. AH&J said that it came from Radnor, Pa. but I wrote there and never received a reply.

Also I have in a fine old pocket chronograph with regular hr. minute and small seconds hand, and large sweep hand which starts, stops, and returns by pushing crown. At some time it had a celluloid crystal which rusted the hands and so they all need to be replaced. The hour wheel pipe and canon pinion (floating type) are very large, and no one around here can supply hands with sockets that large, as well as the large sweep hand with long pipe. Who in your area would have these, or if not there, who in Switzerland could they be ordered from? I understand there are material houses in New York which do not advertise but which have all kinds of hard-to-get material.

Also do you have the New York address of the Concord-Cortland people. I need a ratchet wheel for one of their old eight day clocks, or do you know of some other material house which might have it. Not available in Boston.

Thanks for whatever help you can give me with the above.

R. Stanley Payne
Gloucester, MA

*A. For fusee chains and their repair, write to Fred D. Powell; 9531 Riverside Drive; Niagara Falls, N.Y. 14304.*

*The Jewelers Buyers Guide is a publication of the Jewelers Circular-Keystone and is published yearly as an extra issue at no charge to subscribers. Their address is Jewelers Circular-Keystone; Chilton Way; Radnor, Pennsylvania 19089.*

*For the odd hands you may try S. Greenglass; John A. Poltock, Col, Inc.; 15 Maiden Lane; New York, N.Y. 10038.*

*Concord Watches; 1345 Avenue of Americas; New York, N.Y. 10019. They are the same people you want who carry those fine, small clocks.*

**Slave Clock Pendulum**

Q. Please explain what is meant by a Slave Clock Pendulum.

Thank you for this opportunity.

John F. Williams
Greenacres, Washington

*(continued on page 48)*

# Understanding Electronic Timekeeping

By Tom M. Hyltin
EE

## THE INTEGRATED CIRCUIT

### Part 2

**The Watch Circuit**

When looking at an electronic watch module, the integrated circuit is sometimes obvious and sometimes completely hidden from view. The task it does and the way it performs its task are not at all obvious. In this section, we will examine the jobs the IC does, the way the IC is mounted in and connected to the watch circuits, and some ways that integrated circuits fail.

The integrated circuit performs all functions performed in the normal watch by the miscellaneous gears from the balance wheel to the hands, including the various setting mechanisms. It is the integrated circuit that makes the quartz oscillate and divides the quartz frequency to one pulse per second. In the analog quartz watch, this is all the integrated circuit does. In the digital quartz, however, the IC further counts seconds, minutes, hours (and possibly day, date, and month); contains all of the setting functions and provides the voltages and currents required to drive the LCD (liquid crystal display) or the LED (light emitting diode) display. Only in the past 2 to 3 years has it been possible to perform all of these functions in one integrated circuit.

Going back in time, to do all the logic and counting functions that a watch integrated circuit does using vacuum tubes would have required between 500 and 800 vacuum tubes (it would fill two cabinets six feet tall), and require about 10,000 watts of electric power or about the power consumption of 10 electric irons. Even doing a watch circuit function with normal integrated circuits, the kind that military equipment and computers are made out of, would require 40 to 50 IC's and a power drain of maybe 15 watts. While this is a great improvement over vacuum tubes, the space required and the amount of power required are not consistent with the job of an electronic wrist watch.

What size and power consumption are consistent with the job of an electronic wrist watch? For this, we must refer back to mechanical wrist watches. Figure 1 shows the relationship between watch diameter and internal volume for many sizes of wrist watches.

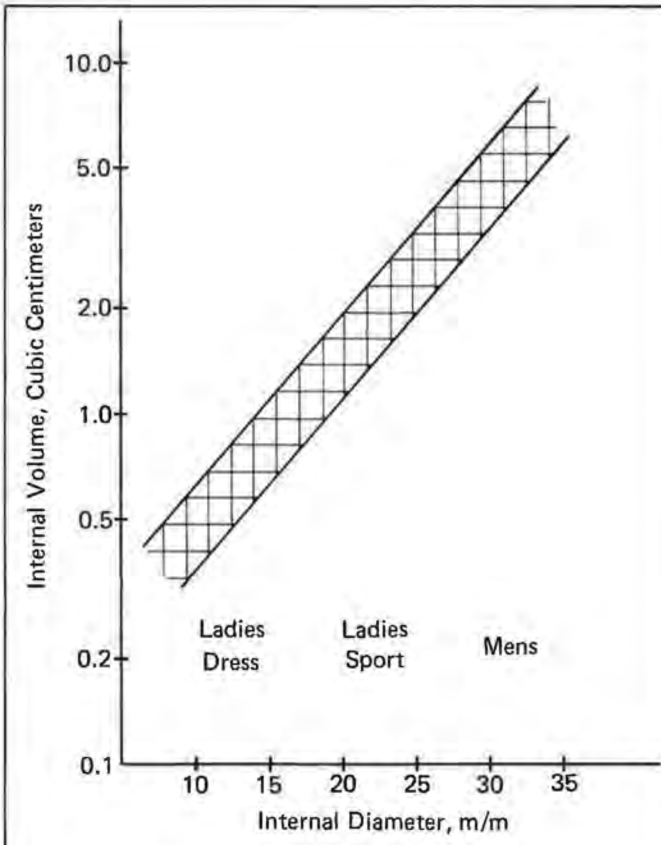



Figure 1. Internal Volume of Watch Cases for Different Watch Sizes

Larger diameter watches have internal volume of 6 cubic centimeters, where the smallest ladies' have an internal volume of ½ cubic centimeter. For a man's watch using two of the largest batteries of suitable size (these store 225 milliampere-hours* each), there would only be 450 milliampere hours available. Since there are 8,760 hours per year, for these batteries to last one year, there can be no more than .051 milliampere (51 microampere) current drain for the watch.

Using two batteries of this size ends up with a watch at the very large end of the scale and thick. It is more reasonable to expect the use of batteries with capacity totaling about 100 milliampere-hours in a man's watch, and 30 to 40 milliampere-hours in a lady's watch. The total power available to drive the average watch must, therefore, be less than 12 microamperes for the battery to last a year, and for a lady's, less than 4 microamperes.

To do this requires a factor of about two million improvement in current consumption compared to the integrated circuits that were available ten years ago. These are now available.

A breakthrough of this magnitude generally results from a completely new way of doing things. For low power integrated circuits for watch application, there has been developed not just one approach to doing circuits at this low power, but two completely different approaches–each with its own advantages and disadvantages.

**A Look at IC Technology**

In order to discuss integrated circuits, it is necessary to go briefly into some of the "alphabet soup" terminology. The following list should be used as a brief glossary of terms for understanding the IC:

1. The first transistors in commercial production were *bipolar* transistors. There are two types of bipolar transistors: *NPN* for normal operations with a positive power supply, and *PNP* for use with negative voltage power supply.

2. Likewise, the first integrated circuits in large volume production were bipolar IC's. These were generally manufactured using the NPN transistors, and would operate off a single 5 volt power supply for logic circuits.

3. About the time of the development of the integrated circuit, there was the development of the *Field Effect Transistor (FET).* These are devices that depend upon electric fields in the semiconductor to turn on and off the current flow, rather than using a small current flow to control a larger current flow, as is the case in bipolar transistors and IC's. FET's were made both in type N material, which had the anode positive, and type P material, which had the anode negative, similar to bipolar transistors.

4. Between 1965 and 1970, manufacturers began to build and sell field effect integrated circuits. These were generally of the type having a metal control element, a silicon oxide layer between the control element and the silicon underneath. This stack gave rise to the word, metal-oxide-semiconductor, or MOS device.

5. Early IC's, mainly for calculator and other computing applications, were type P MOS structures, or P-MOS.

The listing of the various IC technologies needs to be interrupted briefly here by a discussion of logic. Logic is performed in semiconductors (and vacuum tubes, too) by having the device turned "on" for one logic state and turned "off" for the other logic state. Two of these logic elements are often connected in pairs so that when one is turned one, the other one is always turned off–a configuration called a "flip-flop." This is the type of element used extensively in watch circuits to divide the frequency from the quartz oscillator down to the seconds, minutes, hours, days, dates, and months, as required for the watch operation. This approach to logic means that for every transistor that is turned off and is not drawing current, there is one transistor turned on and drawing current. As a result, a P-MOS IC performing a watch function would require approximately 1/5 watt for the logic functions. (From two batteries, there is a maximum of 76 millionth of a watt available continuously for one year operation).

With increasing understanding of semiconductor processes, it became possible to manufacture type N MOS devices and type P MOS devices on the same IC

*A milliampere is 1/1000 of an ampere of electrical current. For comparison, a penlight bulb requires about 30 milliampere current. A milliampere-hour is a unit of energy for a battery. This would be one milliampere for one hour. One penlight AA cell contains about 600 milliampere-hour and will power a 30 milliampere bulb for 20 hours.

bar. A logic element, instead of the choice of being on or off, could therefore be made by placing a type P-MOS device in series with a type N-MOS device, as shown in Figure 2. When one device was turned on, the other was turned off; therefore, current never flowed. The only current required for this device is leakage and switching current.

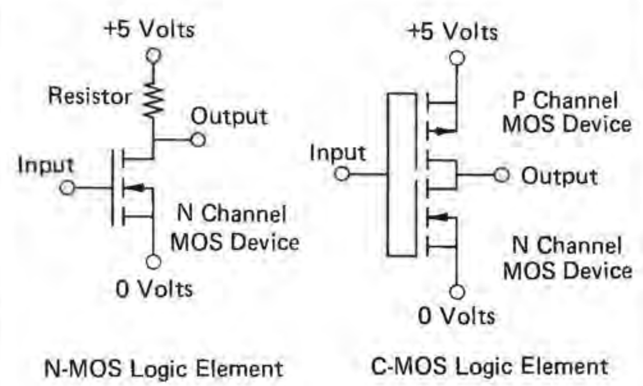



Figure 2. Logic Element in MOS and C-MOS

6. The term expressing the use of two MOS transistors of different polarity in series is complimentary MOS, or C-MOS. A C MOS integrated circuit at rest will draw only a few billionths of a watt power for its leakage, and when operating, as driven by a 32kc quartz for watch application, may draw only 5 to 10 millionth of a watt.

7. In the meantime, bipolar integrated circuit terminology also progressed, and it became possible to operate bipolar logic elements where, even though a device needed to be drawing current, the current that it drew was only a few billionths of an ampere. A way of manufacturing bipolar circuits was also developed that allowed as close a spacing in bipolar as was possible in MOS. This bipolar circuit configuration has also been used for watches, and is known as *Integrated Injection Logic*, or $I^2L$.

No one device is a panacea for all problems. The C-MOS represents the ultimate in low current operation, but its ability to supply the high currents required for LED displays, was inferior to that of bipolar IC's. Many IC's for LED watches required external transistors to drive the LED display. The $I^2L$ integrated circuit was capable of currents necessary for driving the LED, but could not achieve as low a power consumption as was achieved by C-MOS when driving a liquid crystal display.

At present, the status is that both C-MOS and $I^2L$ are being used for LED digital watches. There is no advantage to the customer or the watchmaker of one over the other–it strictly represents an economic trade-off on the part of the manufacturer. Accuracy, reliability, and other consumer and service factors should be equivalent. The slightly higher power consumed by $I^2L$ is completely masked in the LED watch by the power consumed by the display.

In the liquid crystal watch, C-MOS is used exclusively. It is not expected that $I^2L$ circuits will be developed for liquid crystal watches.

We have already compared the functions performed by an integrated circuit to those performed in a mechanical watch. A diagram of the functions performed in an electronic watch IC is shown in Figure 3. The oscillator portion of the circuit is very similar to the oscillator circuitry used to drive an Accutron type tuning fork. The countdown from 32.768 khz is 15 stages of divide by 2 to reach one pulse per second. If we remember that the integrated circuit can only divide by two, then some of the constraints become obvious. A divide by 10, for units seconds, is four stages of divide by 2 (which gives a divide by 16), but with the appropriate interconnections to reset to zero when the count reaches ten. The tens for seconds is three stages of divide by 2 with connection to reset to zero when the count reaches 6. Counting for minutes, hours, and date goes along very similarly. The only other portion of the integrated circuit which does not have a direct counterpart in the mechanical part, is the voltage multiplier that is required to power the liquid crystal display.

A divide by 2 stage of the integrated circuit is shown in Figure 4, and the entire watch integrated circuit is shown in Figure 5.

Once we have the integrated circuit, then what? In an examination of watch modules, nothing that looks like an integrated circuit is visible. This is because the

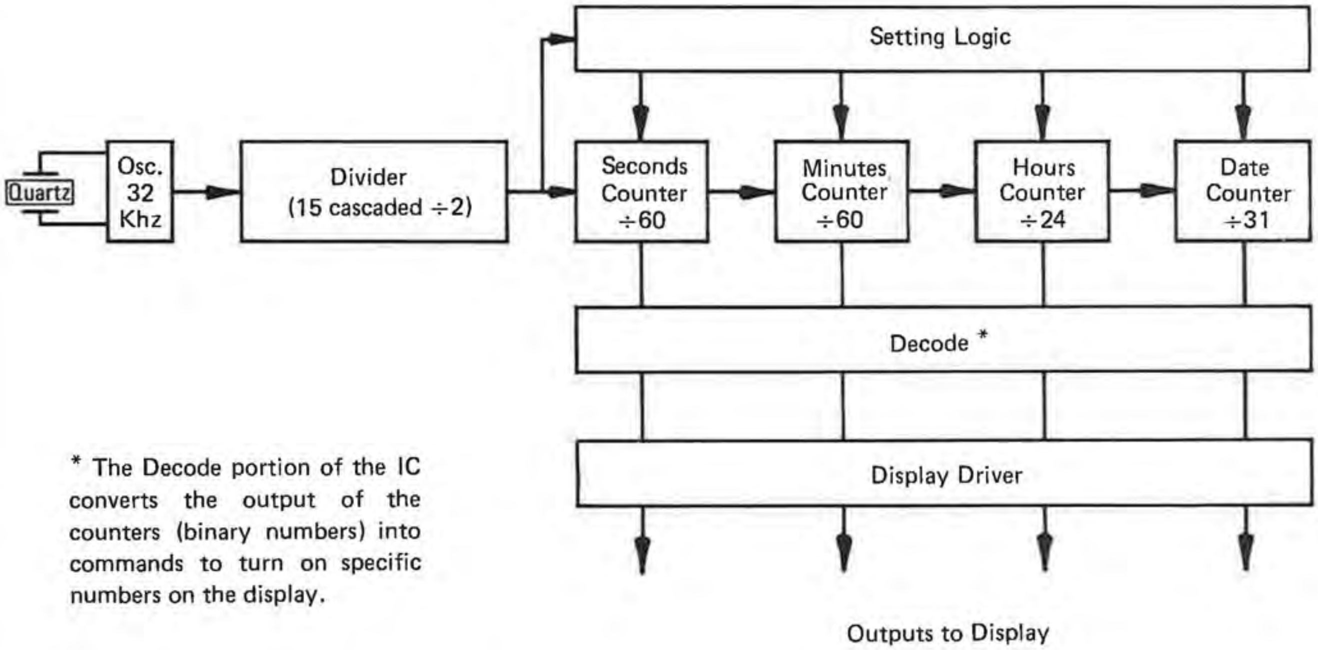



Figure 3. Block Diagram of Integrated Circuit

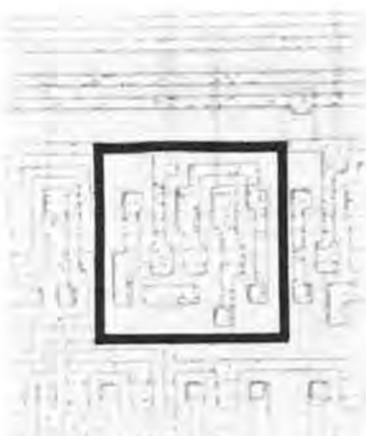


Figure 4. Micro Photo of Divide-by-Two Portion of Watch IC

Figure 5. Micro Photo of Watch Integrated Circuit

integrated circuit must be mechanically protected so that handling in manufacture does not scratch or smear the metal pattern on the integrated circuit or pull off the wires that make contact to the IC. It must also be protected from atmospheric problems. Pure distilled water condensing on the IC is not too much of a problem, but the water that leaks into a watch is not pure. It often contains some salt and repeated condensation and drying of water containing salt on the IC can provide unwanted conductive paths between the metalization on the IC and can also actually cause a failure within the silicon itself over a longer period of time.

The first protection used for integrated circuits was a hermetically sealed package, where contact was made between the package leads and the integrated circuit with fine gold wire. It was filled with an inert gas and then hermetically sealed. During the last ten years, plastic packaging of integrated circuits (where the plastic is molded to make a solid block with the IC) has become very popular and the reliability data on integrated circuits completely surrounded by plastic has been as good as the reliability of the hermetically sealed IC's. Both types of construction are used in electronic wrist watches. A watch module using a packaged IC is shown in Figure 6, and a watch module having a plastic encapsulated IC is shown in Figure 7. The plastic of Figure 7 is applied in the open and then cured.

Figure 6. Watch IC Mounted in Hermetically Sealed Package

**Making the Digital Watch Serve the Customer**

Even with the quartz, the IC and the display present, it must be "tamed" to be a watch usable by the customer. The "taming" is centered in two areas of endeavor: deciding what functions to put (and not to put) into a digital electronic watch, and deciding what is the best approach for both the customer and the manufacturer for setting purposes.

Electronic watches are no different—the trend has always been that a business starts simple, rapidly gets more complex and then a point of diminishing sales appears or diminishing return on investment is reached. The digital watch already in its short lifetime has been through several generation steps. Going back in history, though, the first watches out were hours and minutes only. The next step was the addition of seconds, primarily in the LED, followed closely behind by a 31-day month calendar, as is available in mechanical watches.

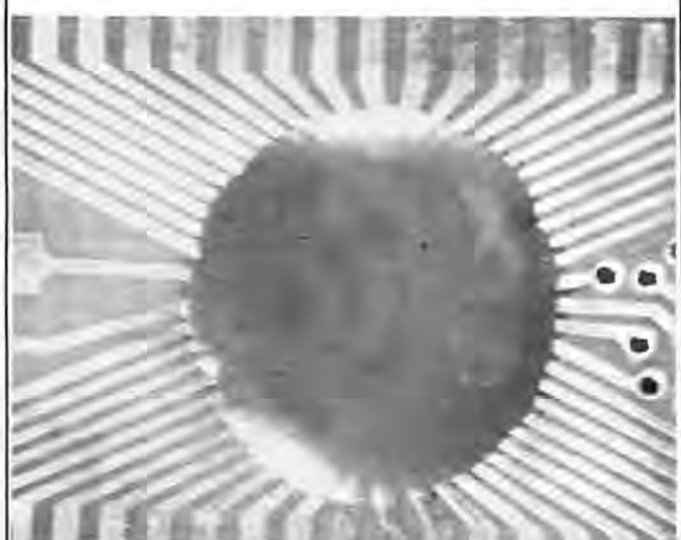


Figure 7. Watch IC with Open Encapsulation

At this point, digitals began to flex their muscles. While it is difficult to make a calendar in mechanical watches that compensates for the number of days in the month, it is fairly easy in electronic watches. The five function watch, which shows month and date, enables the use of something that is referred to as a "smart calendar." It knows that not all months have 31 days and can put in the appropriate 28 days for February and 30 days for those months that only have 30 days. The smart calendar has been available in both the LED and the LCD since mid-1975.

Adding the day of the week was more of a display problem than it was an IC problem. There have been two schools of thought: one, to have a symbol or abbreviation representing each day of the week manufactured into the display, and then to either illuminate the day symbol or to draw a circle around it. An example of this type of display is shown in Figure 8.


Figure 8. Watch Showing Day of Week by "Flag."

Another approach to day of the week (as well as the name of the month) is referred to as "alpha-numeric." The display is modified so that it can form both alphabet letters and numbers. The same display that shows the time can show the day of the week and date when the function button is depressed. An example of this is shown in Figure 9. The main drawback to this approach is increased complexity of the display, plus every language requires a different IC modification.


Figure 9.

Watch Showing Day of Week using Alpha—Numeric Display.

The digital watch is an accurate timer, therefore, adding stopwatch functions to the digital watch is comparatively straightforward. Timings to the 10ths and 100th of seconds can be accommodated by changes in the IC, and keeping track of elapsed time, as well as the local time, requires the addition of seconds and and minutes counters and the ability to display the information in these counters upon demand.

The situation is very similar on the alarm watch. An alarm watch requires only the addition of a counter into which the alarm time is set. The information stored in these counters is continuously compared with the time and when the two match, the integrated circuit produces a signal, which is used to drive a buzzer. The main problem involved in the alarm watch has been in the electromechanical portion—the buzzer.

To go beyond the functions which are available in mechanical watches is a natural path for the digital watch, but the needs of the consumer are not known and much experimentation is required. This is especially true with watches having broad multiple function capabilities, as in the recently introduced Casio X-1, where the watch—besides showing local time—can function as a counter, as a stopwatch, shows the day of the week, and can show the time in seven different zones. A comparable problem of customer utility is presented by the calculator watch. Long term appeal of these watches will depend upon their usefulness to the user. This, in turn, depends upon both the capability of the watch and the user's ability to operate it. The user will not carry an instruction manual for his watch.

**Setting the Digital Watch**

Accompanying the changes in function of the watch, there have been changes in the way that the watch is set. The first hours/minutes only digital watch used two push buttons. One to advance hours, the other to do minutes, and pushing both buttons simultaneously set seconds to zero and held them there until the buttons were released. An early LCD that showed seconds, minutes, hour, and date had four push buttons on the back of the watch—the push buttons for date, hours, and minutes advanced at one count per second while the push button was depressed, and the push button for seconds reset seconds to zero and held them there as long as the push button was depressed.

With the coming of the function button to call up different functions of the watch, a sequencing type of setting became practical and popular. The most popular means of setting now is use is sequential, using a recessed corrector push button. One push of the corrector button causes the display to show only the month. Month correction is made by depressing the function button and the month will change at one month per second. Again depressing the corrector button will cause date to be displayed, and then further pressing of the corrector button will call up hours and then minutes, and then return to normal operation. Accurate time will not be lost unless minutes has been readjusted. If minutes has been adjusted, seconds will stop and will not start again until the watch has been returned to the normal operating mode and the function button depressed. This allows accurate synchronization of seconds with time standards such as WWV.

There are many variations of this setting sequence. In watches by some manufacturers, instead of the month, date, hour, minute being displayed one at a time, the number to be updated is caused to flash. In an effort to reduce costs (the corrector button does add cost to the watch case) there has been an experiment with eliminating the corrector button and shifting into set mode with 5 rapid pushes of the function button (within a 2-second time period) at which time the various functions begin to cycle through on their own, displaying each function for 10 seconds only if there has been no further depression of the function button. If you wish to change hours, for example, five rapid pushes of the function button will call up the reset mode and this will cycle through month, date, and then to hours. While hours is displayed, the function button is again depressed until the proper hours appears, then the watch will cycle on through back to normal operating mode. Whether this type of automatic setting sequence becomes popular, depends upon the desires of the buyer. This is one of many experiments being tried by manufacturers to bring the best value to the customer at the lowest cost.

**IC Reliability**

The driving force in the early development of the integrated circuit by the military was the very high reliability with which the integrated circuit could do complex jobs. During the intervening years, the failure rate of integrated circuits has been reduced to a point to where only an extremely small fraction will ever show a failure and most of these are due to induced failures—that is, failures of the integrated circuit caused by problems outside the IC.

Let's talk first about the failures that are not induced but are present within the IC's themselves. These can be divided into two classifications. First are the defective IC's that the IC manufacturer and the watch manufacturer both failed to detect during manufacturing. The other is the IC's that were once good but go sour during the course of use.

First, the problems that the manufacturer fails to detect. Here we need a bit of sympathy for the manufacturer. It is not uncommon to have a defect in an IC that will cause high battery drain only at a given time on a given day. For example, at 9:00 P.M. every September 12th, it is possible for an IC to go into a high current mode of operation and discharge the battery. To detect this problem, the IC manufacturer and the watch manufacturer need to test every IC in every possible time and date and in every possible mode at a test speed which is slow enough to pick up high current modes. Most manufacturers make an effort to do this, and most of the failures of this type are found prior to products being shipped to customers. Most are found, but not all.

The IC's that fail after they leave the factory are really few and far between. IC failures after test and not due to outside problems are due to a problem in manufacturing that will affect most or all of the watches made from IC's of that lot. The most common problem in this uncommon classification is a change in the voltage it takes to turn the field effect transistors in the C-MOS on and off. As manufacturing controls become more sophisticated, the probability of this kind of problem occurring is reduced.

A much larger classification of IC failures is induced failures, and, again, these failures come from two sources. One, failure to provide proper protection for the IC, and two, static electricity. Providing protection of the IC from mechanical damage and moisture was discussed earlier. Manufacturers have all learned from prior experience and are providing protection that the integrated circuit needs.

A much more difficult to control source of induced failure, however, is static electricity. MOS devices are by their very nature susceptible to static electricity problems. The "O" of MOS stands for an extremely thin silicon oxide layer (it would take 1000 to be as thick as this piece of paper). If the breakdown voltage of this layer is exceeded, the device will be permanently destroyed. This breakdown voltage is normally in the range of 20-50 volts.

Static electricity is a very potent force. When we walk across a carpet in a dry room, a spark 0.1 inch (2.5 mm) long between our finger and the doorknob means that we have generated 10,000 volts of static electricity potential between our body and the doorknob. Static electricity is generated whenever any two nonconducting materials are rubbed together. In the digital watch module, there are many such opportunities. The plastic parts used in the watch module are non-conductive. A cloth used to clean the module would also be non-conductive and could generate enough static electricity to cause the module to fail.

The problem of susceptance to static electricity has been recognized since the first MOS devices were manufactured, and all devices currently in use have static electricity protection at all input and output lines. The protection devices do not provide complete protection, and even with the best available protection, a 10,000 volt spark will generally cause device failure. Static electricity suppression while servicing the module will be discussed extensively in the later installment of this series on servicing.

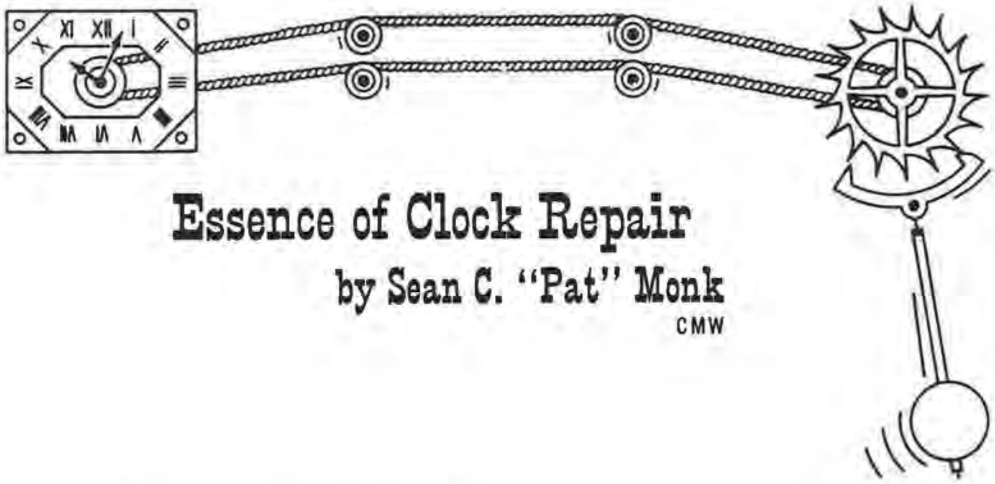
**Boundaries of Integrated Circuit Capability**

There is no doubt that the horizons will be greatly expanded for the instrument that people wear on their wrists and call a watch. In the relatively brief history of electronic timekeeping, we have already reached the calculator watch. An article on integrated circuits for watch applications would not be complete without discussing future capabilities and limitations.

Performing digital logic (in a reasonable amount) is simple for the IC, so counting the vibrations of quartz and computing the time is a natural—as is adding a calculator function (the keyboard represents the problem, not the IC).

In a group of applications that would be more dif-

*(continued on page 49)*



# Essence of Clock Repair

by Sean C. "Pat" Monk
CMW

## THE WATERBURY (LADDER CHAIN) HALF–HOUR STRIKE
### Part XX (circa 1900)

This is an extremely simple, yet effective and long-lasting movement—a movement that should serve as a base for the aspiring mechanic who must familiarize himself with all types of American floor and shelf clocks fitted with wire lift and lock for operating the strike mechanism at each half hour. Ingraham, Welch, Ansonia, Seth Thomas, Terry, and most other American clocks of the same period (earlier and later) are controlled in much the same fashion. The movement in question employs the standard 30-tooth escape wheel, with an approximate "square-recoil" escapement. To refresh our memories, we must remember that the "square-recoil" escapement is one which employs a pallet-escape wheel combination in which the pallet arbor, the escape wheel arbor, and the two corners of drop lock contact of the pallet with the escape wheel, form a square. The geometric experts, of course, will be able to supply a much more "technical" definition than mine. However, the purpose of these articles is to relay an understandable description to the bench mechanic.

**The pendulum length,** once again, is the standard "40-inch" (actually measured, in this case, at approximately 38 inches) from the point of suspension to the center of gravity of the pendulum bob. Some variation from the carefully-calculated arrangements of this type may be due to its unusual anchor (pallet): not conforming to the regular English, or French anchor. The Waterbury anchor, made of solid steel, is perhaps an American concoction; more learned experts and horologists in this field will, undoubtedly, have comment on my deductions. This is as it should be. Be that as it may, the tolerances involved, the four musts, perfect drop, slide, draw, and lock, are by no means visible. The period of oscillation of this movement might, therefore, be considered somewhat unstable and unstandardized. One thing we have observed: *the importance of "perfect beat."* This clock must be most accurately set in beat, *or it will not function.* After that, it will perform as well as any other type of American escapement not using the English anchor.

The movement itself is mounted between two medium-heavy brass plates. The "going" (running) and strike chains operate on two large-diameter brass main driving wheels. Each of these wheels carries a pair of side-protecting plates to prevent "override" of the chains. The teeth of these two main driving wheels are large-gapped and serrated, the tooth corners made somewhat epicyclic. The latter allows the rough metal chain to roll smoothly over each tooth with the minimum of binding. Two brass-shelled lead-filled weights operate the going and strike trains, via the ladder chains. The weights should be approximately seven pounds each.

The "square recoil" escapement measures approximately 7/8 in. square sides. The pendulum is manufactured in two main parts: the upper wooden section carrying the suspension spring and brass fitting (which encompasses the pallet brass-impulse, or actuating pin) and the lower wooden section which carries the pendulum bob. The lower pendulum section is fitted with a brass clip-on hook for attaching to the upper section.

**Repair on the "going" train.** The usual worn pivot holes can be detected and tested by forcing a screwdriver blade against the pivots. Excessive play in such should be visibly pointed out to the customer, especially to those who tell you it's been "up in the attic since grandfather died . . . . and probably only needs a drop of oil." Show the customer and remind him, kindly, that when grandfather died it was more than ready for a good "bushing" job, as well as proper cleaning. So! Experience has taught us that the most pernicious point of wear is in the escape wheel holes themselves, especially on the rear plate. The latter is a thinner plate and mounted separately to the main clock plate. *Do not remove the plate's rivets,* but if necessary, bush it attached to the main plate. There is little danger, this way, of throwing the wheel off-center.

**Repairs on the strike train.** First, let us observe that there is only one hammer. The hammer must be properly balanced to strike the gong-rod without bounce. There are two actuating arms on the hammer arbor (the latter being situated at the top of the plate. See Figures 1 and 2. These arms are adjustable, being made of soft steel, malleable without being too brittle, or too spongy. They may be bent into position, if necessary, in order to get the lift just right. Also, if one looks closely at the wheel (top right of the sideview in Figure 1) you will observe the hour

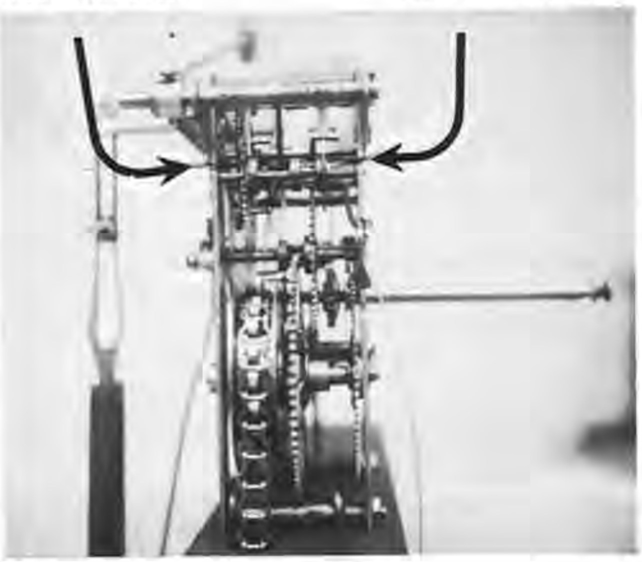


Figure 1

count wheel. This wheel is cut with two deep slots at 180 degrees to each other. The purpose, of course, is to arrest the strike actuating lever so that striking will occur at the hour and half-hour. The drop lock pin should be observed to drop into the slots cleanly at the striking points. If not, its arms may be bent to accommodate this procedure. The hour-trip wheel (top left of the sideview, Figure 1) has two brass pins inserted, facing toward the clock center. These pins have a habit of becoming worn over a long period of running, and may be found to be excessively grooved. They should be replaced if really bad, or rounded off with a smooth file, in order to prevent binding of the trip lever which engages with it. The hour trip wheel, via its two brass pins, operates the hammer-lift arms.

**The hammer.** In order to prevent "double bounce" on the gong rod, the hammer head should be fitted with a good fibre, or hard plastic tip. Make sure

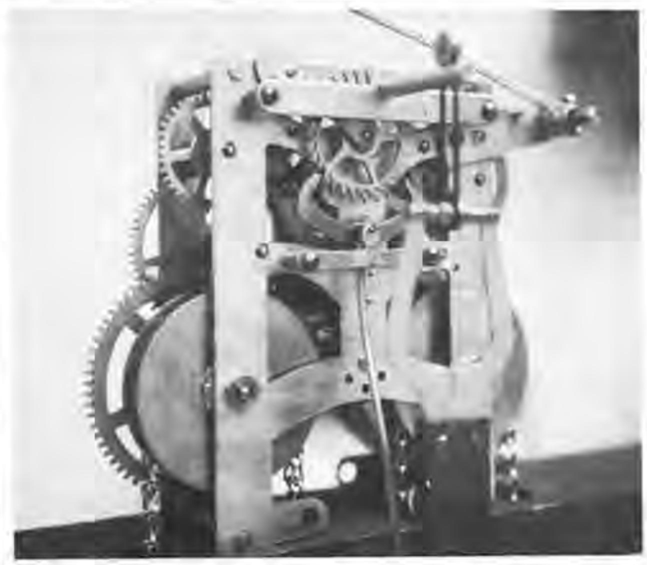


Figure 2

that there is enough length to this tip, so that a fair and variable adjustment of the actuating arm can be made, without bounce. This will also ensure a softer, more mellow tone, and the customer will pronounce you as a "wizard" for being able to perform such a "miracle." Too much hammer metal is often the case with old clocks, which makes it impossible to get a good tone, or avoid "double bounce."

**The ladder chain** must be thoroughly inspected to make sure that the links are not kinked, or bent. Just one malformed link can cause a stoppage to the going or strike train. Each link should be checked for malformation. In addition, the chains should not (in most cases) be reversed. Put the chains back the same

*(continued on page 49)*

# Advanced Horology

## FOR THE YOUNG WATCHMAKER

## by William O. Smith, Jr.

**Part 8**

There are three ways in which levers may be employed, which are shown in Figure 40 as types "A," "B," and "C." For each lever shown, the dimension "X" represents the length of the lever arm extending from the fulcrum or axis to the acting force "A.F."

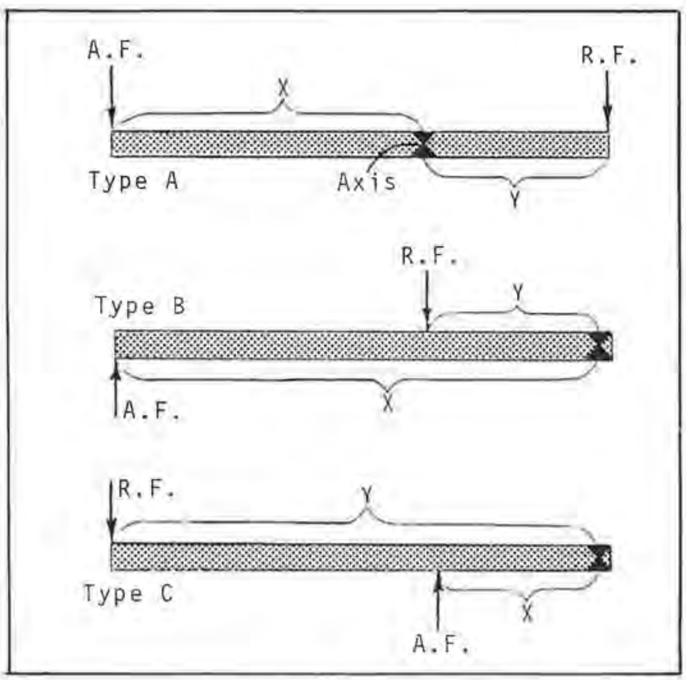



Figure 40

The dimension "Y" represents the length of the lever arm extending from the fulcrum to the resistance force "R.F." By dividing length "X" by length "Y," the mechanical advantage (M.A.) is determined.

$$X/Y = M.A.$$

If the input side "X" of the lever is longer than the output side "Y" of the lever, then the mechanical advantage is greater than one. If the input side of the lever "X" is shorter than the output side of the lever "Y," the the mechanical advantage is less than one. Only when the input side of the lever is the same length as the output side will the mechanical advantage be exactly one.

Thus, in the type "A" lever the mechanical advantage may be greater than one, less than one, or just one.

Type "B" and type "C" levers require little explanation. Type "B" lever has a mechanical advantage of one or more than one. Type "C" lever has a mechanical advantage of one or less than one.

There are no other ways in which levers can be used. Therefore, all levers in all mechanisms fall into one of the categories of levers shown as "A," "B," and "C."

The mechanical advantage simply indicates how much the input force is multiplied at the output. For example, if a lever has a mechanical advantage of 10, then 10 lb. resistance at the output side could be balanced with a force of one pound at the input.

Now in order to move from the theoretical to the practical, a look at different types of levers used in mechanisms is necessary.

There are many mechanisms to select from for this purpose. Clock mechanisms with their many types of levers would be ideal, or the area of complicated watches would do equally well. It really makes little difference which mechanism is used. The main objective is to emphasize important mechanical principles that apply to all mechanisms.

Since the chronograph is a rather familiar mechanism, and because of its prevalent variety of levers, the chronograph mechanism has been selected.

**Type "A" Lever**

Figure 41 shows the actuating mechanism of a chronograph. When the button "U" is depressed, the actuating detent lever "D" pivots on its axis and the opposite end of the lever moves in the direction shown by the arrow "E." This action through the connecting link "N" turns the castle wheel "S" one ratchet tooth. When the button "U" is released, the spring "T" returns the lever and button to their original positions.

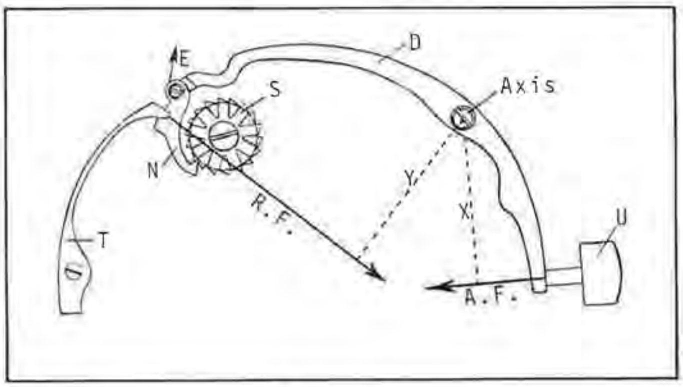



Figure 41

It is apparent that the actuating detent lever is a type "A" (Figure 40) lever. When the button "U" is depressed, the direction of acting force "A.F." is shown by the arrow. The resulting effective arm length if indicated by the dotted line "X." Likewise, the direction of *resisting force* produced by spring "T" is shown by the arrow "R.F." The resulting effective arm length is indicated by the dotted line "Y." (The resistance put up by the castle wheel is neglected for the moment. That is, no resistance other than that of spring "T" is being considered.)

Since the effective arm "X" is a little shorter than the effective arm "Y," the mechanical advantage is slightly less than one. Remember, type "A" levers can have a mechanical advantage of less than one, more than one, or one.

**Type "B" Lever**

Figure 42 shows the engaging mechanism of a chronograph. Wheel-over-fourth wheel "D" is fitted to the long pivot of the fourth wheel. (Fourth wheel not shown.) The intermediary wheel "K" is engaged with the wheel-over-fourth wheel, but moves in and out of engagement with the seconds wheel "N." The seconds wheel "N" has a long pivot to which the sweep second hand (not shown) is attached.

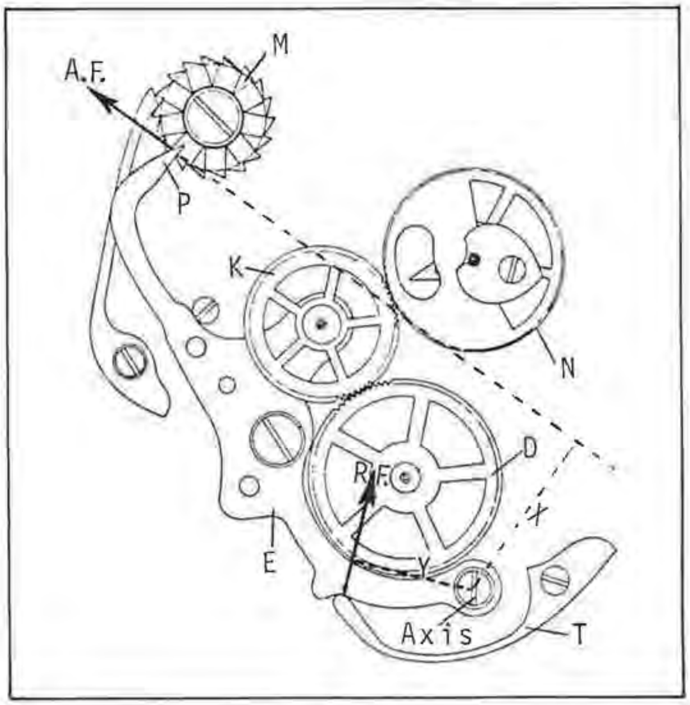



Figure 42

The chronograph pivoted detent "E" interacts with the columns of the castle wheel "M." At the position shown, the spring "T" is holding the beak "P" of the chronograph pivoted detect between two columns of the castle wheel. When the castle wheel is turned clockwise from the position shown, a column of the castle wheel will act upon the beak, forcing the beak out from between the columns. The chronograph pivoted detent is a type "B" (Figure 40) lever.

The effective input and output arm lengths are shown by the dotted lines "X" and "Y," respectively. "X" represents the input effective arm length which extends from the axis of the lever to a position perpendicular to the direction of the acting force.

"Y" represents the output effective arm length which extends from the axis of the lever to a position perpendicular to the direction of resisting force. (The resisting force is applied by spring "T.")

In type "B" levers, the mechanical advantage must be one or more than one. In the case illustrated, since the effective arm "X" is longer than the effective arm "Y," the mechanical advantage is greater than one.

**Type "C" Lever**

Figure 43 shows the return to zero mechanism of a chronograph. When the button "H" is depressed, the lever "N" pivots on its axis "P," causing the other end of this lever to press on the flyback lever "D." In this way, the flyback lever is forced to pivot and return the hearts "S" and "K" to zero. The lever "N" is a type "C" (Figure 40) lever.

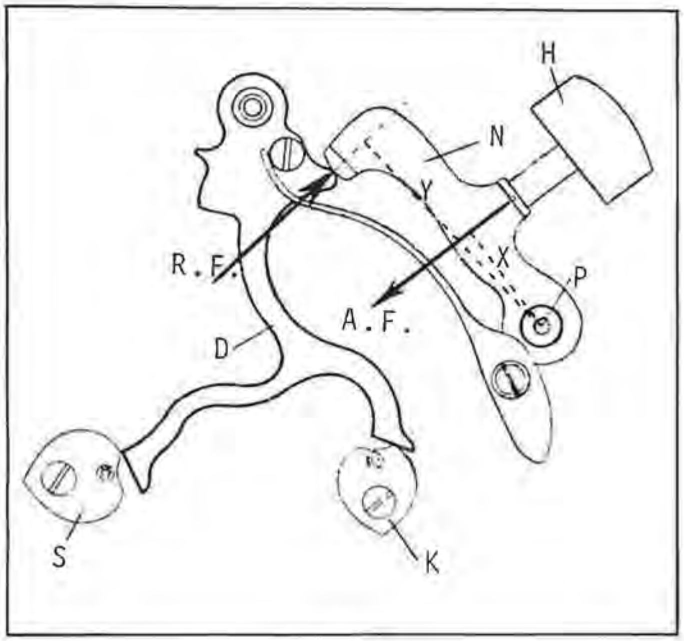



Figure 43

The effective lever lengths "X" and "Y" are shown by the dotted lines. Since effective arm "X" is shorter than effective arm "Y," the mechanical advantage is less than one.

If the button "H" were placed directly over the end of the lever at the position of resisting force "R.F.," the mechanical advantage would be one instead of less than one.

It is important, when dealing with a problem in a complicated mechanism, to examine the leverages of the parts involved. This immediately gives one a better perspective of how the mechanism really operates and aids in determining proper corrective measures.

Note that in making the calculation to determine the mechanical advantage, only the effective arm lengths are considered.

However, when one is called upon to design a part, the effective lever or arm is just one of the levers to be considered.

In every type of lever there are really three levers. (See Figure 44.) These are:

1. The effective lever
2. The actual lever
3. The physical lever

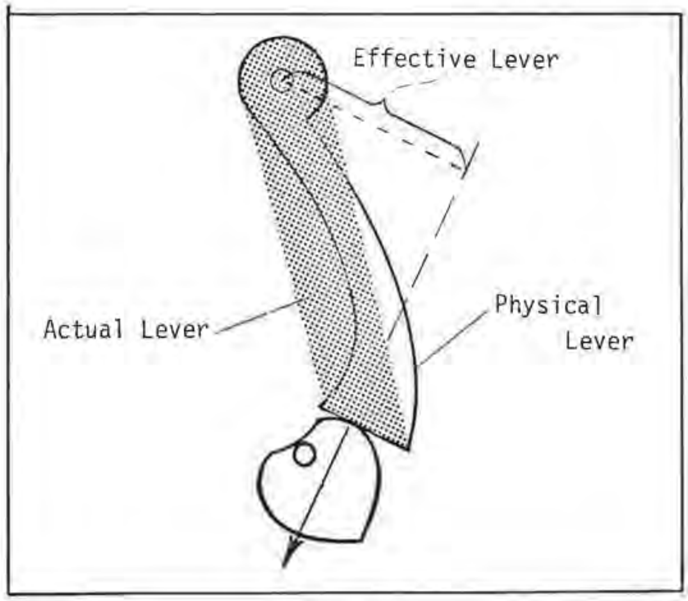



Figure 44

The *effective lever* is the one that has been examined at great length in these articles. The *physical lever* is, of course, the lever itself. (The physical lever is shaped many times in odd ways, for purposes of clearing other parts and for strength.)

The *actual lever* is the lever made in its simplest possible form.

*(continued on page 49)*

# BENCH TIPS

The common sewing needle, with its point altered to perform a specific function, is included in the inventory of many watchmakers. The shapes to which these needles have been fashioned and the purposes they serve seem to be limited only by the imagination and ingenuity of the watchmaker using them. Some prefer to wait till a particular need arises and make one to solve that problem. Others keep a selection on hand that have proved useful. Here are a couple that you may wish to add to your collection.

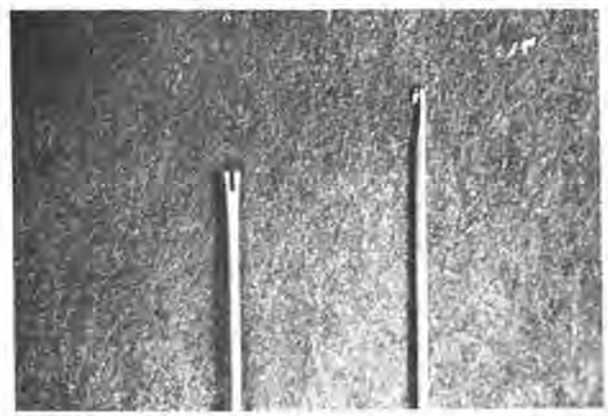
The two with the plastic handles have been made from a needle having a long narrow eye. On the one at the top, one side of the eye has been cut away to form a long narrow hook. Its purpose is to position

the index guard on 214 model Accutrons. The space allowed to make this adjustment is small and dangerously near the pawl finger. If the guard has to be raised, to be centered, it is difficult to accomplish with a larger tool. The hooked needle does this conveniently.

The middle needle has the end of the eye cut away, making an ideal tool for manipulating a kif type jewel spring. The prongs of the needle are pressed against the shoulders of the spring until the tab is dislodged from its holding position. The reverse procedure puts it back in place. Inasmuch as the needle is held at an angle over the jewel and the pressure applied on each shoulder is equal, there is little chance of the spring flipping away.

The needle embedded in the cork and enclosed in the bottle is a magnetized needle, the use of which is becoming increasingly popular for removing hard to reach broken stems, broken staff pivots, and a large number of uses. This is a suggested method of storing it. There is no danger of its coming into contact with others tools or parts.

The plastic handles on these needles are made from discarded knitting needles. These are available in many sizes and colors. They tool very easily, and they are impervious to most solutions commonly used by the watchmaker.



This is an enlarged view to show in more detail the needles just described.

### RCA TO BUILD HYDROGEN CLOCK

RCA is one of two contractors selected by the U.S. Navy to determine the feasibility of using hydrogen maser clocks, precise to one second in three million years, in Global Positioning System (GPS) satellites. RCA's Astro-Electronics Division, Princeton, N.J. received an $835,000 contract from the Naval Research Laboratory to develop the clock, which derives its precision from energy level transitions in hydrogen atoms. The ultra-stable hydrogen clock is being developed for possible use aboard the Navy's Navigation Technology Satellites.

AWI technical bulletins AWI hot line AWI bench courses AWI horological times AWI museum AWI employment service AWI films and slides AWI ad assistance AWI library AWI home study AWI certification AWI federal liason AWI scholarships AWI awards

# AWI NEWS

By Milton C. Stevens

**EXECUTIVE SECRETARY**

## TECHNICAL BULLETINS ARE NOT ENOUGH

Until twenty-five years ago, the craft of watch repair remained relatively unchanged. Watchmakers who became masters in the watch repair profession could reasonably expect to maintain their position as a master craftsman in that chosen field so long as their eyes remained good, and their hands steady. The master watchmaker of the 1950's is not necessarily a master watchmaker today. He may not have lost any of his skill, but the time industry has expanded to the point where he must keep pace with the technological changes which have occurred during this period. If he hasn't kept up with these changes, he can expect to be considered as a master watchmaker in the field of mechanical watches only, certainly not a master watchmaker in the total timekeeping industry.

Today's master watchmaker has had to learn to deal with production methods in watch repair for increased productivity. The master watchmaker has had to become proficient in the repair of an overwhelming number of automatic mechanical watches, most of which currently employ the use of a multitude of sophisticated day and date mechanisms. The exploding field of electronic watches has made it necessary for the master watchmaker to become familiar with new terms and tools as he services electromechanical watches, tuning-fork watches, quartz analog, and now quartz digital watches.

During Ewell Hartman's tenure as President of the American Watchmakers Institute, the need for practical watchmaker training for electronic watches became clear. Mr. Hartman experimented with, and developed, the popular AWI bench course. Today the bench course is the main thrust of AWI's training program. AWI has presented bench course training for thousands of AWI members in all corners of the country. The courses include actual repair experiences with five of the most widely used electronic watches today. These five include three electromechanical calibre and two quartz analog calibre.

In the new era of solid state watches, many watchmakers have become frustrated over the apparent lack of technical information made available by the manufacturers of these new timepieces. When the mechanical watch reigned supreme, it was customary for a technical bulletin to be forthcoming from each manufacturer as he introduced a new calibre. Master watchmakers could use these technical bulletins to familiarize themselves with the new models as they reached the market. One reason for the lack of such bulletins today is the high cost of producing them, but cost is not the only factor.

Some companies have reasoned that because electronics is involved, today's watchmaker does not have the technical background required to master the new electronic watch from a technical bulletin alone. Many fear that he will do more harm than good. Highly respected individuals in these watch firms have expressed doubts at the ability of today's watchmaker to repair these watches at all unless they receive extensive training. They stress that shops must be willing to make an investment in the proper tools necessary to service these new timepieces. We endorse this premise. If a watchmaker is going to service electronic/solid state watches on more than just a casual basis, he is going to be required to acquire a thorough understanding of certain basic electronic concepts as they apply to the time industry. He must invest in proper equipment, which includes a digital timer and a good multimeter. He must know how to use this equipment.

# WE SALUTE
## THESE NEW MEMBERS!

ANGUISH, Terry O.—Eastlake, OH
BACHMANN, Robert J.—Topeka, KS
BARTHOLOMEW, Fred I.—Mesquite, TX
BENNET-ALDER, Leon—Casa Grande, AZ
BENSON, Brian—Whitehall, MI
BOYD, Ted Jr.—Beardstown, IL
BROWN, David—Cleveland, OH
BURDEN, Peter A.—Mobile, AL
CAIN, M. R.—Roanoke, VA
CANTY, Merv—Cleveland Heights, OH
CARLISLE, David L.—Mobile, AL
CHARBONEAU, Ellen—Shaker Heights, OH
COLLINS, Larry W.—Mobile, AL
COLLINS, H. L.—Mobile, AL
CRIPE, Arden L.—Rossville, IN
DARRAH, Ralph E.—Woodbury, CT
DAVENPORT, Gregory D.—Mountlake Terrace, WA
DAWLEY, Marlin Dale—Cleveland, OH
DAY, Thomas H.—Chicago, IL
EVERHART, Forest L.—Thomasville, NC
FIELD, Donald R.—Lancaster, PA
FUNKHOUSER, C. G.—Franklin, VA
FURST, Bill—Cleveland, OH
GRANT, Saginaw III—San Jose, CA
GREENE, Larry D.—San Francisco, CA
GREER, Robert W.—Coshocton, OH
GRUBBS, Fred—Cincinnati, OH
GUNTER, Lee—Elberta, AL
KERR, James W.—Cyrene, MO
KLEIN, Bruce—University Heights, OH
KNADJIAN, Noubar—San Leandro, CA
LAMBERT, Mervin R.—St. Louis, MO
LANGE, Steve—Mobile, AL
LOCKE,Ward D.—Baldwinsville, NY
LOVE, David A.—Montgomery, AL
McCREARY, Lucas M.—Whiting, IN
NAKANO, Paul Y.—Honolulu, HI
NIBERT, Benny E.—Mission, TX
NICHOLS, Art—Sarasota, FL
PENNY, George A.—Amherst, VA
RANKINS, Fredrick—Prichard, AL
REY, Maria—Cleveland, OH
ROEHRICH, Roland—Pittsburgh, PA
ROSKOWSKI, Henry S.—Pittsburgh, PA
ROUNICK, Jack—Cleveland, OH
SCHMIDT, Colleen—Milwaukee, WI
SEYLER, Lawrence—La Crosse, WI
SPARKS, Roger—Cleveland Heights, OH
SUNG, Gregory K. Y.—Houston, TX
THOMPSON, Jeff L.—Independence, MO
VINCENT, David R.—Clifton Park, NY
WATSON, Elsie—Seattle, WA
WHITE, Henry H.—Mt. Pleasant, SC
WHITE, Lois S.—Dayton, OH
WOLFF, John W.—New York, NY

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Many watch firms have sought to insure adequate service for their product by establishing service centers in various regions across the country; others contemplate similar arrangements. Service centers have been successful to some degree, but most manufacturers will admit that local service of their product, service at the point of sale, is by far the most desirable. Large sums of money have been expended by some companies for watchmaker training programs. This is especially true in the effort to train watchmakers to service the tuning fork watch. Many companies have done very little in this field. Several companies have cooperated fully with the American Watchmakers Institute in its education program. They have provided the necessary practice movements, technical information and materials required for AWI instructors to reach a large number of professional watchmakers each year.

It is our contention, that once the watchmaker has received AWI or manufacturer training, and once he has acquired a basic understanding of electronics as it relates to the time industry, the traditional system of providing technical bulletins to these individuals will once again enable the professional watchmaker to cope with most of the solid state watches. Our faith in the professional watchmaker can only be justified if the professional watchmaker is willing to spend the necessary time, money, and effort required to master basic electronics and to invest in the necessary tools.

So that the public will be able to recognize a competent repairman for electronic watches, AWI has developed an Electronic Watch Repair Specialists certificate, title, and examination. We are completing work on a correspondence course in micro-electronics as it relates to the time industry. Both the examination, title, and the correspondence course will be ready by mid-year.

The course will consist of sixteen lessons. Through the use of manipulatives and practical kits each student will learn the basic electronic concepts he needs to understand the new electronic/solid state watches. He will learn to properly use the new tools and equipment required to service these new timepieces. Each student will actually repair an electro-

*(continued on page 49)*

### THE PRESIDENT'S MESSAGE

*(continued from page 5)*

Some of you are going to say, all the problem was to begin with was a screw loose in the train. In my opinion things are not that simple. What you do not know is, that screw, in working its way to where you found it, could have caused some damage, such as a burr on a tooth of a wheel, a bent tooth or a broken tooth. The only true or sure way of knowing is by disassembly.

Well, the watch is finished and cased, timed on the machine and checked on the bench to your satisfaction. Your job is done. On your way to lunch you overhear a salesperson delivering this watch to its owner. The owner is thanking the salesperson for asking the watchmaker to adjust the watch, as it was gaining three minutes a week. Mr. Watchmaker, don't do what you have in mind to do. The courts are hard on someone who commits murder.

You are now in a position to change your profession for a few minutes. You must become an educator. All persons connected with your store should be made aware of this kind of problem. Let them know how many manhours were wasted because time was not taken to write a few words on a piece of paper and attach it to the watch.

I am fully aware all types of movements have not been covered, such as calendars, chronographs, alarms, electric, etc. The point is there. I hope it gives you some food for thought.

Repeating my opening remarks, comebacks are challenging and distasteful. □



### ELECTRONIC DIAGNOSIS PROCEDURE

*(continued from page 8)*

profitably. We must determine if our problem is electronic or mechanical. Granted, these timepieces are new to many watchmakers, but with a little effort and dedication, they too will become second nature.

The checks as I have outlined them are applicable directly to the ESA 9180 and 9181. A quick look at the picture of the component parts of the ESA 9182 and 9183 should enable you to make the same checks on that caliber.

The American Watchmakers Institute has three complete bench courses available to members and Affiliate Chapters. For complete disassembly and reassembly along with detailed instruction, be sure to attend them when they are in your area. □

### QUESTIONS AND ANSWERS

*(continued from page 31)*

*A. A slave clock pendulum is one which is maintained by its own mechanism; i.e., a periodic weight released to slide along an incline plane on an extension on the pendulum rod. The "slave" portion denotes that the purpose of this pendulum is to supply a periodic impulse to a completely or almost completely free pendulum. It is this latter, master's purpose that, so freed of association with any escapement or duty to 'count' the train that makes it so accurate. This master pendulum, in turn, synchronized with the slave (or vice versa) then dictates when the slave is out of synch, etc. This was the principle of the Hope-Jones, Shortt pendulum clock system.*

*All this is covered in the book,* Electrical Timekeeping, *by Hope-Jones, (N.A.G. Press, Ltd.)*

*Incidentally, the slave pendulum also had a hook pallet which gathered up a tooth of an indexing wheel which released the weight every half minute. The remainder of the intercommunication between both pendulums was by electrical communication.* □

## UNDERSTANDING ELECTRONIC TIMEKEEPING

*(continued from page 39)*

ficult but still possible are those jobs requiring audio amplification for various types of communication, or vocal announcement of time, and voltage to digital converters, as might be used for digital indication of temperature or barometric pressure. Problems for which there are no good integrated circuit solutions include radio frequency selection, or tuning, as required to make FM and AM receivers. It is also beyond the capability of IC's to do the processing of data that would be needed for most biological monitoring and digital display of blood pressure, pulse rate, breath and skin resistivity.

Within these constraints, though, are many jobs that can be effectively performed by the integrated circuit in a digital watch; the addition of a memory IC would allow the daily list of appointments to be entered into the watch and played out on request. Further use could be made by combining the watch functions and the memory so that birthdays, anniversaries, and important engagements could be stored and then remind the user of the approaching dates. The problem to be solved here is a means of inputting this information.

The digital electronic watch has brought new vitality into the watch manufacturing business and is bringing new products to the consumer for his consideration. It is called PROGRESS. □

## ESSENCE OF CLOCK REPAIR

*(continued from page 41)*

way as they came off, unless, of course, someone has previously removed them and put them on in reverse.

We might mention, in finality, that not just American manufacturers made ladder-chain movements. The former Pequenat Company (originally of Berlin, rechristened Kitchener, Ontario) of Canada, made many such. Many of the cases were made of solid oak. Ofttimes the clock glasses, especially the "regulators" were marked "Canadian Time."

Good and successful "ladder-chaining" to all aspirants. □

## ADVANCED HOROLOGY

*(continued from page 44)*

*Important*: In designing a lever for a mechanism, one normally deviates from the simplest possible form (actual lever) only when necessary. Whenever any deviation from the simplest form is made, then the physical lever becomes different from the actual lever.

The *effective lever*, which has been the topic of several of these articles, is of prime importance. It is the effective lever that must be considered at all times by the designer because it is essentially the *effective lever* that determines how well the mechanism will operate.

All questions and comments should be addressed to:

William O. Smith, Jr.
1304 Briarwood Drive
Champaign, Illinois 61820 □

## AWI NEWS

*(continued from page 47)*

mechanical and an quartz analog watch. While repairing these watches, the student will learn concepts which will have "carry-over" to many similar timepieces he will encounter in the trade.

During 1977 AWI will attempt to reach an even larger number of members with its bench courses. Because of their popularity it will often be necessary to restrict registration to AWI members and to members of AWI Affiliate Chapters. We will welcome the opportunity to bring bench course training to areas we haven't reached before. To do so, we seek the cooperation of several individuals in these areas who are willing to make local arrangements for meeting space, and to assist with registration and promotion. We urge AWI members in these areas to contact us now so we can arrange to bring these programs to your area. □


## MASSACHUSETTS

Members of the Massachusetts Watchmakers Association recently held their Twentieth Anniversary Convention. In the morning, displays were set up by I. Albert's Sons, Inc., Mahar & Engstron Co., Al Rudnick of Watchmakers of Switzerland Co., Speidel, Wyler Watch Company, Bristol Ring Co., Diamona Ring Corporation, Elgin Watch Company, Imperial Pearl Company, Volpey/Fisher Company, and Watchmaster Productions Division. In the afternoon, Guest Speaker Phillip Minsky gave a highly interesting talk on the advantages of a gemological education for the modern watchmaker. A surprise speaker was Max Fargotstein of Fargotstein & Sons of Memphis, Tennessee, who gave a short talk on the Retail Watchmaker/Jeweler and his role in society today.

Al Rudnick of WOSIC gave an update on Ebauche Digital Watches. At this time the ladies were treated to a jewelry fashion show, with Mrs. Elaine Glavin providing commentary on jewelry donated by Lang Jewelers. In the evening, there was a cocktail hour followed by a delicious dinner and dancing. Throughout the day, 47 door prize drawings were held, with the Grand Prize being a Bulova Accutron. MWA President Charles J. Glavin, and his committee, Al Carucci, Norm Rubin, Isadore Solomon, and Mr. Alden Jack of A. Jack's Press were responsible for this successful convention.

A meeting was also held on November 16, with guest speakers, Sanford A. Roth, General Manager of Voltec Corporation, and Louis Zanoni, a consultant with Timex and also associated with Voltec Corporation. The subject was "The Traditional Watchmaker Can Service Digital Watches." Both guest speakers are highly qualified in this area.

## PENNSYLVANIA

The Watchmakers Association of Pennsylvania held a meeting on November 9 in Pittsburgh. At this meeting, Gean Patton, one of the members, presented a talk and demonstration on basic electronics. The information he provided was most helpful for those who work on battery-driven timepieces.

Paul Fehrenbach was the "Member of the Month" in the monthly Association bulletin.

## CALIFORNIA

The Bay Area Watchmakers Guild was founded on June 13, 1976, and since then, membership has grown to approximately 120 from all over California. After the first seminar by the American Watchmakers Institute, two more successful seminars were held, and the Guild plans to have a minimum of four major seminars each year.

The Central Watchmakers Guild held its annual dinner meeting on November 21 in Fresno. President Don Stover arranged to have Bill McDonald as guest speaker. Mr. McDonald presented a slide show on "The Diamond."

## OKLAHOMA

The Green Country Watchmakers Guild held a watch seminar on November 7. Mr. Grey Lawrence, Watch Instructor at Oklahoma State Tech. held a watch seminar on the ESA 9158 movement. The Guild invites students at that school who are studying Horology to attend their seminars.

## INDIANA

The Northern Indiana Guild met at the Broadmoor Lighthouse Restaurant in Merrillville on November 10. This was the last meeting for 1976. The Madison Guild met at the Four Seasons Restaurant in Greensburg on November 4. At this dinner meeting, the following officers were elected for 1977: President—Robert Lows, Vice President— Lloyd Hull, Secretary-Treasurer—Marshall Richmond, and Guild Representative—Lee Huntington.

The Watchmakers Association of Indiana is also tentatively planning several major events for 1977, including an all-day program in April, a workshop for June, and the fall convention tentatively planned for September 24th and 25th.

### NEW YORK

At the December 6th meeting, the Horological Society heard a special travelogue by Henry B. Fried. Election of officers was also held.

The Society is also announcing a provocative and exciting panel discussion entitled, "The Future of the American Watchmaker," to be presented on March 7 at Hotel Picadilly in New York City. Speakers include Herb Novick from the Bulova Watch Co., Jean-Pierre Savary from Watchmakers of Switzerland, Milton Putterman from Seiko Watch Co., Ralph Kalichman from Helbros Watch Co., Henry B. Fried, and Irving Albert, President of H.S.N.Y., who will act as moderator. This will be an audience participation program including a question and answer period.

### TEXAS

The Texas Watchmakers Association held their Christmas party on December 21 at Albritton's Cafeteria. A gift exchange for both men and ladies was held at the party.

### COLORADO

The UWCAC held an AWI Seminar on November 14, with President Wes Van Every presiding. At the meeting, Mrs. Josephine Hagans reported on activities of the Chapter meetings at the AWI Convention in Cincinnati. Mr. Orville R. Hagans reviewed progress of the new AWI museum, AWI business, and the HOROLOGICAL TIMES. A motion was made by Orville Hagans to change the by-laws to permit Associate Membership, non-voting, by persons in related fields. Motion was seconded by Philip Lombard and was passed. Mr. Gerald Jaeger, AWI representative, gave a presentation on the many services which AWI provides for its members. A Slide and Sound Presentation of a new simplified Swiss Watch, AS 5200-5206 Battle Time was shown. Vice President Ray Rennemeyer gave an excellent demonstration of clock wheel cutting. C. Fred Winder demonstrated a prototype of a clock mainspring winder that, when completed, should almost eliminate the personal danger inherent in removing and installing clock mainsprings. A variety of other tools used in clock repairing was available for examination and discussion. A buffet lunch followed. Burt Einspahr and Dennis Seth won the door prizes.

On March 6th, the UWCAC-AWI Spring Seminar will be held, and will include a bench course on the Seiko Quartz Watch. A special program for clockmakers will also be given. Also at the March meeting, election of officers will take place. □

## REC REPORTS

### Fall Class Graduates

The Gem City College fall graduation was held on November 6 at Vermont Street Methodist Church in Quincy, Illinois. Graduates numbered 122, including the business, fashion, and horology divisions. The address was presented by the Reverend John N. Keller, who brought the message that work opportunities today are at the zenith level. This certainly holds true in the horology career field. Choice positions are available for our ambitious graduates.

The graduates, their parents, and friends, who attended the graduation, enjoyed the reception that followed and a chance to visit with the instructors and others.

### New Members for PSI Delta Omega

On Friday, November 19, two new members were initiated into the Psi Delta Omega Fraternity. They were Phil Simon and Mike Mikolas. Any male student of horology is eligible for membership in this fraternity. The purpose of this organization is to provide social and fraternal fellowship for the horology students.

The Psi Delta Omega fraternity was organized in 1916 by a group of horology students at Bradley Polytechnic Institute in Peroria, Illinois. It was the only national fraternity organized for the watchmaking profession. We now have a Beta Chapter at the Kansas City School of Watchmaking in Kansas City, Missouri.

Anyone interested in membership is invited to ask for particulars from any current member or the sponsor.

## BECOMES CERTIFIED AT SIXTEEN

Robert L. Smith, CW, has successfully completed the AWI Certified Watchmaker exam. This in itself would not be of special interest, except that he accomplished this feat while he was sixteen years old. Bob works with his father, Les Smith, in their AGS store located in Mt. Carmel, Ohio. Les is an AWI Director, and well-known as the instructor for AWI's Seiko Quartz Watch bench course.

Young Mr. Smith started in watch repair at the age of twelve. He began by removing watch movements from their cases and then cleaning the cases and

Robert L. Smith, CW

bands to prepare them for delivery to the customer. One year later, Bob began to work on pocket watches and two years after that, he tackled ladies and gents wrist watches.

In addition to earning a fine grade on the AWI exam, Bob has completed workshops on the ESA 9154, ESA 9157-58, ESA 9200, ESA Quartz and the Seiko Quartz.

Bob is an amateur photographer; he helped his dad make the slides which are used in the Seiko Quartz workshops. He has assisted Les in some of the local Seiko Quartz programs. Now that he has reached the ripe old age of seventeen, he has even been known to beat the "old man" on the golf course on occasion.

## HONOR ROLL

We acknowledge the following contributions to the AWI Building Fund.

Contributions to the AWI Building Fund are tax deductible, and will aid in the retirement of our building indebitness.

Each contribution will be noted by a listing in the Honor Roll column of the HOROLOGICAL TIMES. Contributions of $25.00 or more will be acknowledged on a plaque which will be permanently displayed in the new AWI building.

Contributions can be sent to:

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Cincinnati, Ohio 45211

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# NEW PRODUCTS

The Custom Mark V Gemolite Model A, manufactured by Gem Instruments Corporation, combines superior optics and wide magnification range for making dramatic, professional diamond presentations. This handsome, impressive instrument is now available for immediate delivery.

The Custom Mark V Gemolite Model A features the StereoStar/Zoom optical system, which eliminates the image blackout experienced in other types of microscopes when changing power. This feature allows jewelers and customers to examine gems with a continuous flow of magnification. The long working distance of 4 inches makes the Custom Mark V Gemolite Model A ideal for examining gem materials,

working with stones and jewelry under magnification, and viewing hand-held items.

### SWIGART HEAVYWEIGHT DONATION

Mr. Ed Soregel and Mr. Harry Best of E. & J. Swigart Co. made a recent visit to AWI Central to present a whopping 190 pounds of used batteries to the Education, Library, and Museum Trust. Mr. Milt Stevens, Executive Secretary, accepted the donation for the Trust, and praised the effort put forth by the company and its associates.

Harry Best, Ed Soregel, and Milt Stevens

The illuminator base on the Custom Mark V Gemolite Model A produces a softly diffused, yet directional light that is ideal for the examination of diamonds and colored stones. A diaphragm baffles the unused light, preventing fog and flare in the lenses. Dark field illumination or transmitted light is available simply by turning the control lever.

Jewelers using the Custom Mark V Gemolite Model A can offer customers the opportunity of viewing in full detail the quality of the gems they are considering. With the built-in turntable base, you can easily set up the gem and then smoothly turn the instrument toward the customer without losing continuity in the presentation. The synchronized eye pieces permit easy adjustment to fit each customer.

For complete information on the Custom Mark V Gemolite and other selected jewelers' instruments, write Gem Instruments Corporation, 1660 Stewart Street, P. O. Box 2147, Santa Monica, Ca 90406.

# Classified

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**HOROLOGICAL TIMES; P. O. Box 11011; Cincinnati, Ohio 45211; (513) 661-3838**

## THE TRADESMAN

**Clock repair material and tools.** Manufacture of clock springs, dials, escape wheels, verge kits, weights, all types of brass & steel stock and custom made parts. Catalog Postpaid \$1.00. Tani Engineering, Box 338, Atwater, Ohio 44201.

**Pocket Watch Case Repair.** Bezels–Hinges–Dents–etc. Tick Tock Specialties, 308 N. McLeansboro Street, Benton, Illinois 62812.

**Quality** watch repair. Antique American and Hi-Grade specialist. Certified Accutron Technician No. 2784. Harvey's Watch Shop, Shoppingtown Mall, DeWitt, New York 13214.

## FOR SALE

For quick action on merchandise, tools, showcases, etc.

Vigor test meters made exclusively for watches. Used less than five times in seminars. Supply is limited. First come basis. Make check for \$20.00 payable to AWI.

Soldering Irons, Ungar Princess. Complete with tip which is ideal for minature soldering. Used one time to assemble solid state movements in an AWI workshop. Supply limited. First come basis. Make check for \$7.00 payable to AWI.

## WANTED TO BUY

Book "Practical Bench Work for Horologist" by Louis and Samuel Levin. Thos. E. Cook. 2115 E. 91st St. Indianapolis, Ind. 46240. 317-846-8797.

## HELP WANTED

Reach the help you need in HOROLOGICAL TIMES.

## SITUATIONS WANTED

This column is free to AWI members. You may use this column every fourth month at no cost. HOROLOGICAL TIMES will also keep your ad confidential, and mail all inquiries directly to you.

# Calendar

FEBRUARY

4-5—Jewelers Circular-Keystone Management Institute; Warwick Hotel; New York, New York.

6-9—RJA's Spring Trade Fair Conference; New York Americana and Hilton Hotels; New York, New York.

6-9—San Francisco Gift Show; Civic Auditorium, Brooks Hall; The Showplace; San Francisco, California.

**13—AWI Watchmakers Seminar; New Orleans, Louisiana; AM Speakers: Henry B. Fried, Orville R. Hagans, Robert A. Nelson; PM Bench Courses: ESA Quartz Watch—Gerald Jaeger, Instructor; ESA 9157-9158 & 9200 Electronic Watches—James Broughton, Instructor; Sponsor: The American Watchmakers Institute; Holiday Inn—Airport; New Orleans, Louisiana.**

13-14—Golden Nuggets Spring Jewelry Show; The Showplace; San Francisco, California.

18-19—Retail Jewelers Seminar; Sponsor: Independent Jeweler Magazine; Dallas, Texas.

20-23—Seattle Gift Show; Civic Coliseum; Seattle, Washington.

20-25—Dallas Spring Jewelry Show; Dallas, Texas.

27—AWI Bench Course; Repair of ESA 9157-58 & 9200; Sponsors: Northern Illinois Watchmakers & AWI; Holiday Inn—O'Hare; Shiller Park; Chicago, Illinois.

MARCH

4-7—California Jewelers Association Convention; Riviera Hotel; Palm Springs, California.

7—Horological Society of New York; Regular Meeting; New York, New York.

13—AWI Seiko Quartz Bench Course; Instructor: Les Smith; Sponsor: Pennsylvania Watchmakers Association & AWI; Holiday Inn, Pittsburgh Central (Greentree); Pittsburgh, Pennsylvania.

19-20—Missouri Watchmakers Association; Watchmakers and Jewelers Convention; Drury Inn, Springfield, Missouri.

22-27—WMJDA Annual Convention; Canyon Hotel; Palm Springs, California.

25,26,27—Bulova Advance Training Program for CATs; Sponsors: Cincinnati Watchmakers Guild—Bulova Watch Company; Cincinnati, Ohio.

27—AWI ESA Quartz Watch Bench Course; Sponsor: AWI—WAO; Instructor: Gerald Jaeger; Youngstown, Ohio.

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BASEL,
BÂLE, 8.12.1976

Basle Fair 1977

Dear Mr. Fried,

Many thanks for your nice letter dated November 30, 1976. I am glad to hear about your tour project for next year to welcome your group on April 24, 1977 in Basle.

We expect that you will arrive with your group in Basle at about 10 a.m. and we will welcome your group at our foreign visitors' office in front of Building C. Since the Fair is rather crowded, I wouldn't suggest a guided tour of the Halls but would propose that everyone of your party enjoy an individual visit of the Watch and Jewellery Fair. However, if requested, we can organize a guided visit for a small group.

We would then offer a buffet-type lunch at about 2 p.m. to your party. On this occasion, they could meet officials of the Fair and representatives of the exhibitors' Committee.

We will issue by the end of February 77 a detailed brochure containing the list of exhibitors with their products and the plans of the Halls. This brochure can be sent to you in due time.

We would appreciate knowing the number of participants you expect. In order to avoid any waiting for registration at the Fair we will send you in advance the necessary cards to be filled in, which you can forward to us before coming, so that we can have the entrance tickets (free of charge) ready for your group.

Should you need any further information or advice please don't hesitate to let me know.

I am looking forward to meeting you again and hoping you and your wife are keeping well, I remain

Yours very sincerely,

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