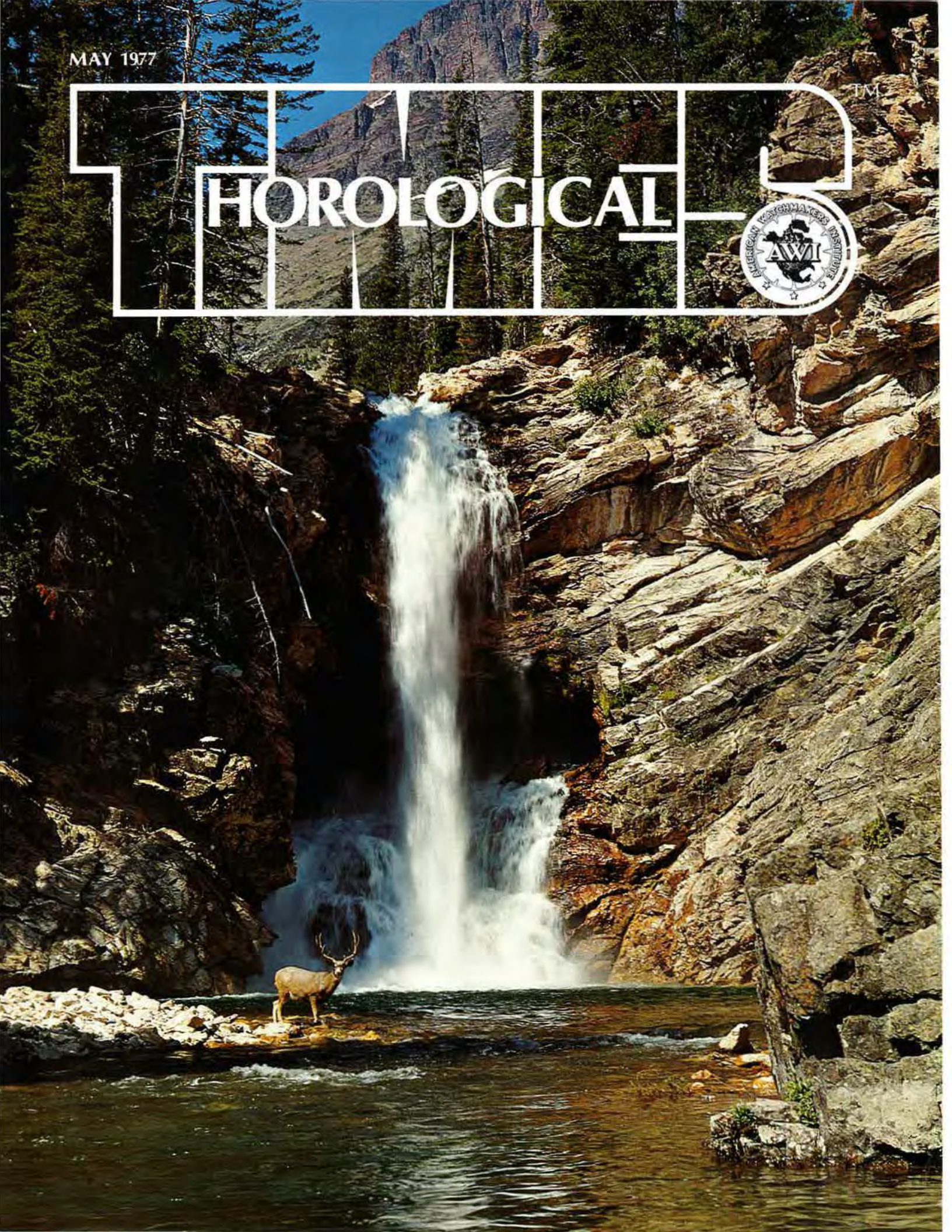
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HOROLOGICAL TIMES

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Editorial

A few years ago, an innovative man fostered the idea and method of recycling used automobile tires into doormats. His distribution of the product was well received by local merchants, and a profitable small scale business was formed.

The popularity of the product was such that a nationwide retailer found need of this item. A large order was placed, and the man sought financing for machinery and adequate space for super production capabilities. Employees were hired and the wheels of production turned at high speed. The first profitable order was almost filled and only a few more would have been needed to satisfy the lenders.

But then the large retailer informed him that they would only be able to pay him a fraction of what they had paid for the first order. Needless to say, he suffered financial ruin and his employees were without jobs.

Should you decide to place all your eggs in one basket, be sure you reinforce the handle (an iron-clad contract) lest it break. Otherwise, place a few eggs in each of many baskets so that if one handle should fail, you will not have lost all your eggs.

CORRECTION–APRIL ISSUE

In the article "The Art of Staffing" by Les Smith, CMW, on pages 36 and 37, two photos have been switched. Exchange Figure numbers on 22 and 24. All apologies are extended.

ABOUT THE COVER

Another beautiful scene from the United States is Trick Falls, Glacier National Park, Montana.

LETTERS to the Editor

Dear Mr. Broughton:

I heartily endorse your commendation of the many women who are indirectly related to the American Watchmakers Institute through their relationships to its male members. But I am appalled by your failure to acknowledge the women who are actively involved in the growth and continuation of AWI not via the men they may know, but as independent and capable persons. I am personally and in a larger sense, politically, offended by your assumption that only men participate in this organization.

So let's hear it for all the women who are directly involved in AWI and in the horological professions, as well as for those who "keep the home fires burning!"

Chris Rich
Marion, Michigan

Dear Ms. Rich:

My intent was not to discriminate against or offend the female members of the American Watchmakers Institute. Regardless of my intent it seems my presidential message in the March issue of HOROLOGICAL TIMES has done just that.

I apologize, Ms. Rich, for my error of omission.

Jim Broughton

About the new magazine–I imagine every word has been said as to how good it is. I just want to add this: my lovely wife wants to print the name "Horological Times" on her shirt, so I'll look at her all the time.

Raul Calle
Fairless Hills, Pennsylvania

I sent for your magazine, HOROLOGICAL TIMES, and received it on March 5, and have read it from cover to cover. I'm thrilled with all the information in it.

E. S. Howard

I recently received the February issue of HOROLOGICAL TIMES and have read it thoroughly. I am a novice, but avid, clock collector and I was gratified to see so much space devoted to clocks and clock repair.

Marcia Cosmoglos
Stow, Ohio

I have just recently become a member of AWI and received the first three issues of HOROLOGICAL TIMES within the past 10 days.

After pouring through these three issues I find myself shocked and disillusioned by the quality of the writing.

The articles that cover subjects with which I am familiar are so full of errors I have absolutely no confidence that I will not be misinformed in those articles about which I know essentially nothing.

I hope you will accept this constructive criticism in the spirit in which it is offered.

Examples of errors are: "Essence of Clock Repair" exhibits incorrect nomenclature. The January issue of "Advanced Horology" is vague as to whether an impulse is given to the verge or the escape wheel. I have some hope for "Inside the Clock Shop," even though

(continued on page 5)

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OREGON

At the February 14 meeting of the Oregon Watch and Clockmakers Guild in Salem, Past President Robert Silens received a plaque from Don Lehmann, President. The meeting, attended by approximately 40 members and guests, featured a clock program by Mr. C. E. Buchum III.



Left to right: Past President Robert Silers, President Don Lehmann, Vice President Dennis Allen

FLORIDA

The Florida State Watchmakers Association featured a "Super Seminar and Workshop" on April 16-17 at the Lakeland Hilton Inn. Mr. James Broughton, President of AWI, instructed a bench course on the ESA 9158 and the ESA 9200. The Jewelmont Corporation representative, Mr. Robert Moengen, presented two programs, "The Watch Material Story," and "Increasing Your Profits with In-Store Jewelry Repair." Paul Finne of FSWA explained electronics, with Joe Liebman conducting a workshop on striking mechanisms.

NEW YORK

The Horological Society of New York installed its newly elected officers in January. Irving Albert, President, stated that the Executive Committee has planned an exceptionally fine series of technical programs and he expects a banner year for HSNY.

On March 7, the Society presented a panel discussion on "The Future of the American Watchmaker," with guest panelists Henry B. Fried, Ralph Kalichman, Herb Novick, Milt Putterman, and Jean Pierre Savary. Irving Albert served as moderator for this event.

On April 7, the meeting topic was "The AWI and You," a comprehensive report by Ben Matz, area representative of AWI on the activities of the National Organization, its activities throughout the country, and its technical programs.

On May 2, the Bulova Watch Company will present the latest information on the new Accutron 219. A new step up motor model will be shown, with Don De Wolfe as guest speaker.

On June 5, the June "Social" will feature a trip to the Hayden Planetarium at Central Park West. Featured will be a new sky show entitled, "It's About Time."



Officers of the Horological Society of New York 1977. Seated L to R: Alvin Rudnick, Exec-Secretary; Howard Levy, V. Pres., Irving Albert, President; Geoffrey Levy, Recording Secretary. Standing: Harry Fisher, Jack Klass, Charles Sauter, Lou Gluck, Executive Committee Members; Peter Davis, Treasurer; Henry Loeser, Exec. Comm.; Julius Grenetz, Trustee; Ben Matz, Exec. Comm. Not present: Rudy Pezel, Fin. Secy., Julius Mandel, Sgt. at Arms; Morton Silver, Executive Committee.

TEXAS

The Texas Watchmakers Association held a meeting on March 15. At this meeting, delegates to the convention were selected, which was held on March 25-27. The Bench Tips Contest is in full swing, with prizes being given for the best two entries. Chairman Donald Cullison is taking the entries.

The five-day Accutron certification program was given March 29-April 2.

(continued on page 47)

Letters to the Editor

(continued from page 2)

the author does not state the strength of oleic acid in the Daniels solution formula. Also your typo error changing "click" to "clock" in the February issue of "Inside the Clock Shop" makes it read that a clock is being held by a screwdriver. The "Questions and Answers" feature by Henry Fried shows that he knows how to write and thoroughly knows what he is writing about.

I find that the March issue shows fewer inaccuracies than the two previous issues. What worries me is that no one seems concerned enough to write about the errors. At least there is no indication in the "Letters to the Editor" column.

Jacque Houser
Seahurst, Washington

Nomenclature in "Essence of Clock Repair" will begin using the accepted term plus the modern day term. Oleic acid is sold in one strength only, according to research made by Mr. Tigner. The typo of "click" to "clock" was exactly that, and caught only by you. Your praise of Mr. Fried is well taken, as is your statement that the March issue was improved. I have no answer as yet on "Advanced Horology" but will forward it as soon as it is received.

Editor

May I offer a suggestion? How about identifying your fantastic cover photos, perhaps on the contents page? I can't understand that you can overlook this.

H. Braunschweiger
Morristown, New Jersey

All of the transparencies that we use are not identified. When we can identify location, we will do so on the "Letters to the Editor" page. Thanks for your approval of our cover selections.

Editor

I enjoy the new journal very much. I have met so many nice people through watchmaking and collecting and as I read the journal I feel as if I know each author personally. That is because you fellows write with such a personal touch. Keep up the good work.

J.E. Lehnhardt
North Versailles, Pennsylvania

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The President's Message

by James H. Broughton

The position of the watchmaker has changed in the past 10 to 15 years. While it is still not on a par with other professions of its equal, it is far ahead from when the change started.

Not too many years have passed since the retail jeweler considered a watch repair department a necessary evil. There wasn't any way the watch repair department could show a profit to the retail jeweler.

The reason the watch repair department would not show a profit was very simple. The watchmaker was required to trim windows, sweep floors, be a salesperson, plus keep the watches repaired. He was also responsible for ring sizing and small jewelry repair, as well as the engraving. All utilities and rent were charged against the watch repair department's income.

The retail jeweler must see to it that all departments in his store show a profit. In a lot of cases the retail jeweler finds the watch repair department is not showing a profit. What is the first thing you do in a case like this? Talk to your watchmaker? Replace your watchmaker? There are several things a retailer should do before resorting to this. The retail jeweler should see to it that the watch repair department is keeping up with the changing times. Most retailers are not carrying their part of the load in this area. The retailer should send the watchmaker to all seminars and workshops that are held in the area. This should include all expenses. After all, they are deductible. Do not expect your watchmaker to carry this load. Your store will get the benefit from the additional education he or she receives. If there is a State Convention for watchmakers coming up soon, tell your watchmaker you would like for him or her to attend. Your watchmaker can learn a lot by rubbing shoulders with other watchmakers.

Most retail jewelers can only see one part of the jewelry business, and that is sales. I agree sales is most important. Just keep in mind that in order to make sales, you first have to have people entering your store. The watch repair department will bring more people into your store, percentage-wise, than any other department.

Are you, the retailer jeweler, devoting enough time to the watch repair department, or is this the department you ignore, except when you have a complaint? When was the last time you asked your watchmaker if there is anything that is needed to improve the watch repair department? Remember this department is still part of your store.

Your watchmaker is not just a mechanic. He or she has to be a first class salesperson to sell first class watch repair. He or she has to be somewhat of an electronics person in order to repair the electronic watches you are now selling. He or she has to be a buyer, in order to keep a good supply of workable material. He or she has to be a good bookkeeper, to keep proper records concerning your repairs. Your watchmaker has to be a mind reader, as well, because someone forgot to write on the ticket what the problem was with the watch when the customer brought it in for repair. In addition to all this, your watchmaker has to repair all the watches. No one else in the store can do this. In other words, your watchmaker has to be a general manager.

New watch comebacks is another place the retail jeweler causes the watch repair department to lose money. Every store has these, so don't feel ashamed. How do you handle this watch? Do you give this watch to the watch repair department to service at no charge? Why? The watch repair department should be given full credit for this type of repair. The repair of this watch should be charged to the watch sales department. After all, the watch repair department did not receive any credit for the sale.

Why did you buy the electric typewriter? Why did you buy the cash register that does all the posting and keeps your inventory control? The answer is simple, you wanted to speed up the process and make it more accurate. Well, why not do the same for your watch repair department? Is the old cleaning machine working as good as new? Is the timing machine up to date? Will it check the timing for all the watches that you are now selling? Does your watch repair department have up-to-date ultrasonic equipment? Is the lathe and staking tool in good condition? You don't expect your typist to furnish a typewriter, then don't expect your watchmaker to furnish his or her own equipment.

The time it takes to fit a watchband or remove links from one takes time away from the repair work. After all is said and done, if proper credit is given to the right



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Advanced Horology

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by William O. Smith, Jr.

Part 11

Gearing

It was pointed out last month that "uniform velocity ratio" is an important characteristic inherent in good gear design. It was further emphasized that "uniform velocity ratio" is the result of having the direction of force pass through the pitch point at all times during the action of teeth against leaves.

So far, the emphasis has been on wheel drive gearing. Needless to say, this type of gearing is important, as it is used in the time trains of conventional clocks and watches. Pinion drive gearing, however, must not be neglected because pinion drive trains are becoming more common in horological mechanisms. As a matter of fact, almost all time trains employed in electric-electronic watches and clocks are pinion drive.

The primary difference between wheel drive and pinion drive is that wheel drive gearing is step up and pinion drive is step down gearing. This aside, another important difference lies in the action of the teeth and leaves. Essentially, in wheel drive gearing it is the tooth *face* that acts upon the pinion *flank*. Thus, in wheel drive gear design, the greatest attention is given to the addendum of the wheel teeth and the dedendum of the pinion leaves.

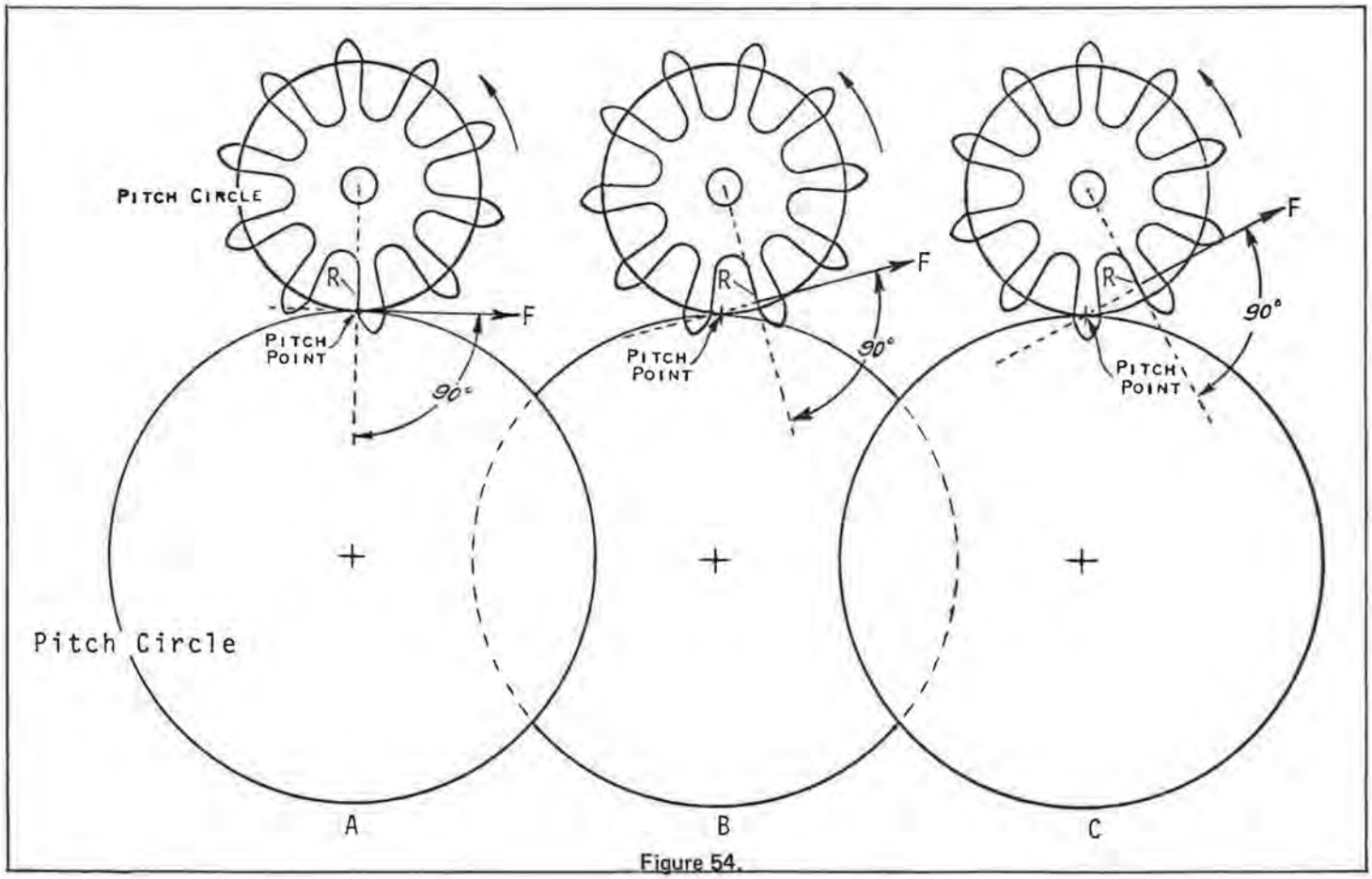


Figure 54.

Just the reverse is true of pinion drive trains. In pinion drive gearing it is primarily the *face* of the pinion leaf, acting upon the tooth *flank*, that occurs as the pinion drives the wheel. Thus, in pinion drive gearing, the greatest attention is given to the pinion addendum and the wheel dedendum.

To continue now with *wheel drive gearing*, three selected positions of a pinion as it turns counterclockwise are shown in Figure 54A, B, and C. The pitch circles are shown, as well as the pitch point location. As the pinion is driven from position A to B, to C, the face of a tooth (not shown) will act upon the leaf flank (R) of the pinion. Note the flank of the pinion leaves are radial. As the flank surface (R) is acted upon by a tooth, resulting directions for force (F) will always be perpendicular to the radial flank.

Now to have the direction of force pass through the pitch point and also be perpendicular to the pinion leaf flank, the resultant forces (F) must take the directions as shown in Figure 54A, B, and C. Thus, it follows that the point of contact of tooth against leaf, for each position of the pinion shown, should be at the point where the direction of force intersects the radial leaf flank (R).

For example, Figure 55 shows a pinion leaf flank being acted upon by the face of a tooth. The point of contact of tooth and leaf occurs at the point where the direction of force (F) intersects the radial flank (R) of the pinion leaf. Notice that the direction of force (F) passes through the pitch point.

Now compare Figure 55 to Figure 56. Figure 56 shows the pinion in the same position as Figure 55, but the face of the tooth is acting deeper into the pinion leaf. The point of contact of tooth and leaf occurs at the point where the direction of force (F) intersects the radial flank of the pinion leaf. The direction of force, however, does not pass through the pitch point, but passes slightly above this point. This error is due to the tooth face being of improper curvature.

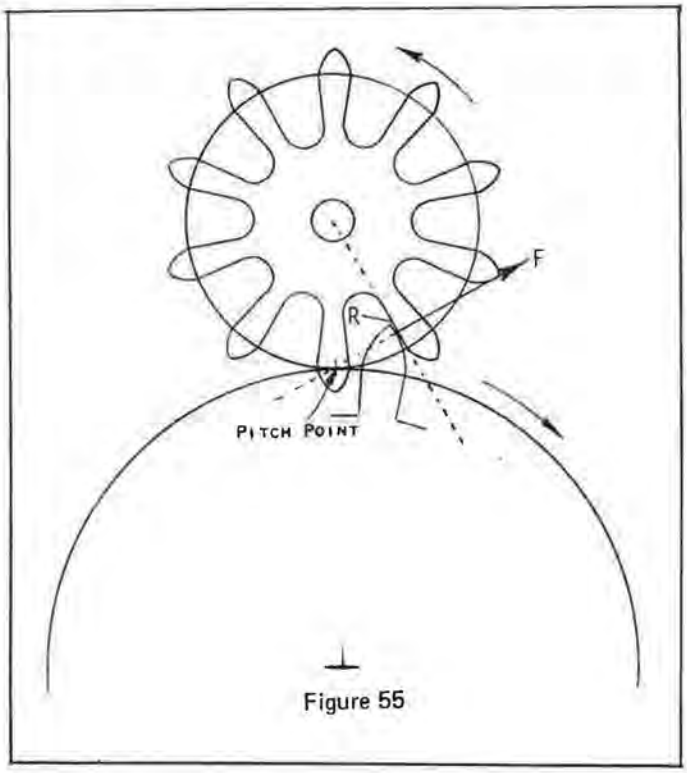


Figure 55

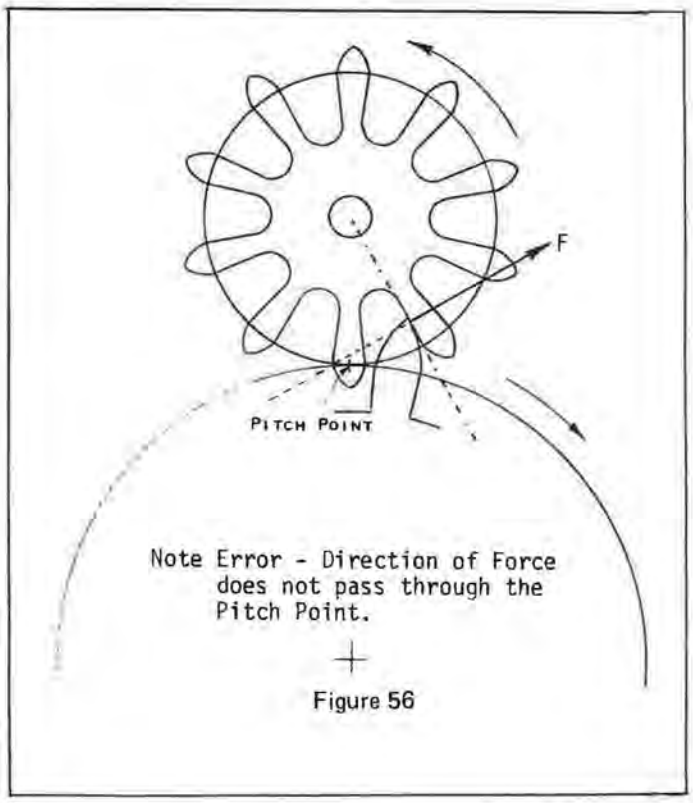


Figure 56

Next, compare Figure 57 to Figure 55. The pinion is shown in the same position as before. The point of contact of tooth and leaf and the resulting direction of force (F) are shown. Here again, the direction of force does not pass through

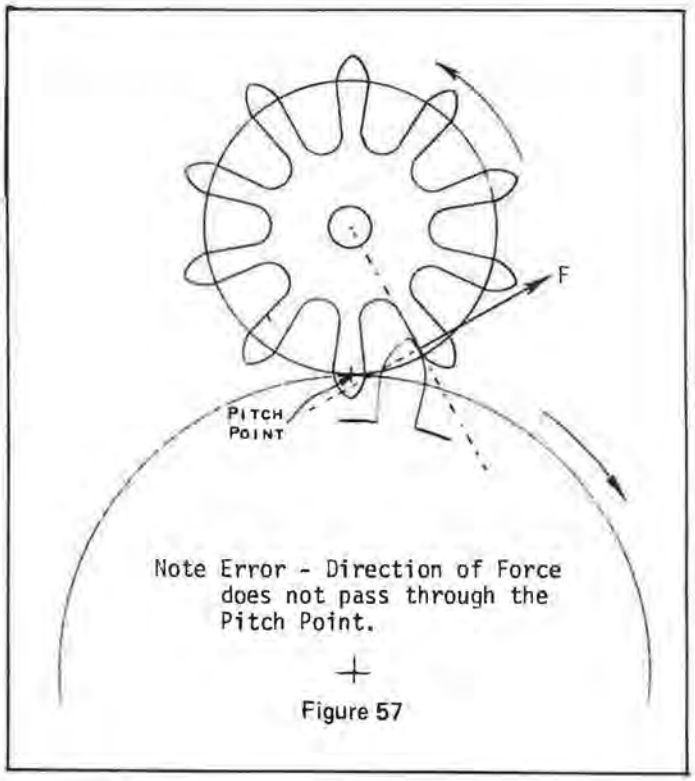


Figure 57

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the pitch point, but passes slightly below the pitch point. This error is also the result of the tooth face having improper curvature.

Notice that for the position of the pinion shown in Figures 55, 56, and 57, there is *only one point* at which the tooth face can contact the pinion flank and have the resulting direction of force pass through the pitch point. This point is shown in Figure 55 and is the direct result of having the proper profile of tooth face.

The question is, what curvature should be on the face of a tooth in order to have the direction of force pass through the pitch point at all times? The answer is that the epicycloidal curvature meets this requirement, as well as some other requirements that will be discussed later.

Epicycloidal Curvature

The epicycloidal curvature is a curvature described by a point on a circle as the circle is rolled without slippage on another circle. See Figure 58. The circle which is rolled is the generating circle, and the pitch circle is the circle upon which the generating circle is rolled.

Dot "d" represents a point located on the outer edge of the generating circle. As the generating circle is rolled, as indicated by the arrow, the dot "d" will describe the epicycloidal curvature. That is, as the generation circle is rolled, dot "d" will move successively to position 1, to 2, to 3, etc.

Next, as shown in Figure 58B and C, the generated curvature has been duplicated to produce the addendum of two teeth of different widths. Only a portion of the epicycloidal curvature is used for the purpose of forming the addendum. In the case illustrated, the curvature is represented by the first eight or nine dots. Notice that the wider the tooth, the higher the addendum. In addition, different size generating circles and pitch circles produce different curvatures, which also affect the height of the addendum.

Thus, it may be said that, theoretically, there are three things that determine the tooth profile and the height of the addendum: (1) width of tooth, (2) diameter of the generating circle, and (3) diameter of pitch circle. These three factors will be dealt with more later. For now, however, one should be cognizant of the following:

Width of teeth—The width of the teeth on a driver gear is usually one-half of the circular pitch. That is, the tooth and the space between the teeth are the same width.

Generating circle diameter—The diameter of a generating circle used for generating the addendum of the wheel teeth should be one-half the pitch diameter of the pinion. See Figure 59. This is only, however, for gearing in which the pinion leaves have radial flanks, such as shown.

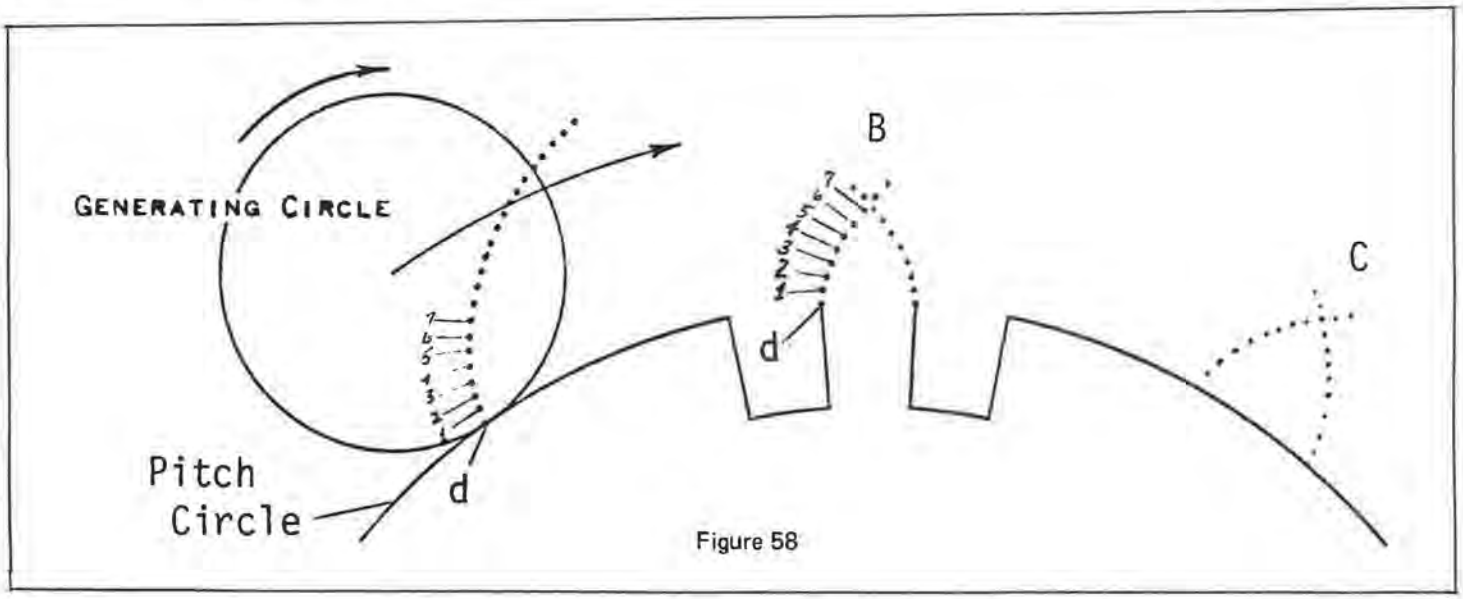


Figure 58

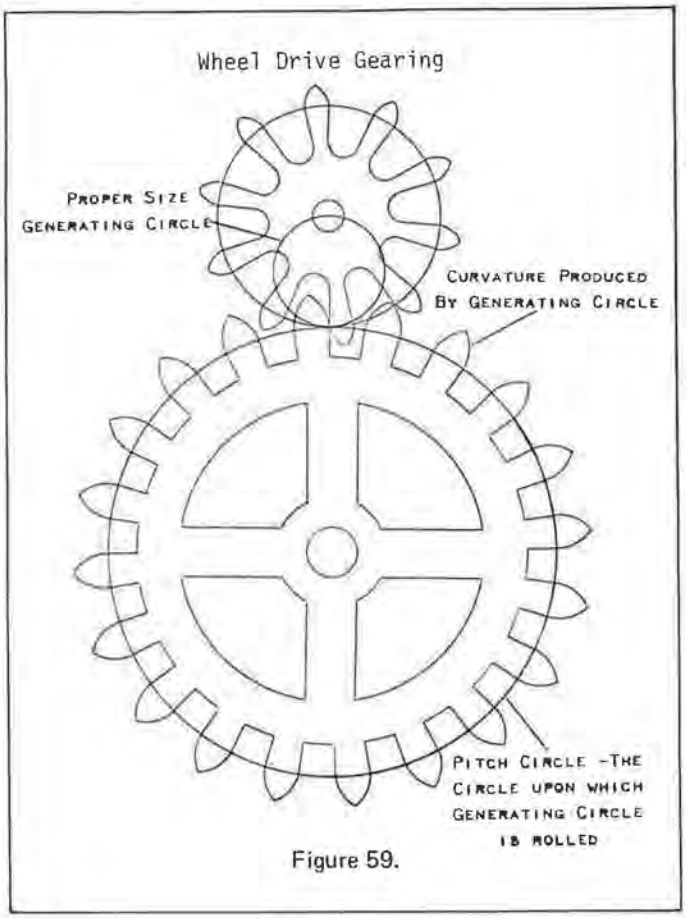


Figure 59.

Pitch circle diameter—The pitch circle diameters of mating gears must be in the same proportion as the gear ratio.

For example, if the driver gear has 30 teeth and the mating driver pinion has 10 leaves, then the gear ratio is 30 divided by 10 = 3 to 1. Since the gear ratio is 3 to 1, the *driver* gear pitch diameter must be three times larger than the *driven* gear pitch diameter.

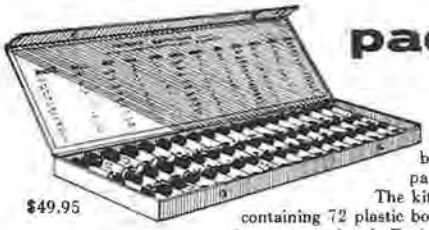
At this point, it is customary to have students of horology do some drafting of gears so that important characteristics of gear design may be observed. It has been the writer's experience in over thirty years of teaching horology that drafting experience is a necessary ingredient to a well-rounded technical education.

For those who aspire to be the thinkers and horological innovators of tomorrow, a knowledge of design, coupled with some drafting knowhow, is of paramount importance. A good place to begin is with the drafting of horological gears.

Drafting techniques for generating horological tooth forms are beyond the planned scope of these articles. For those who are interested in such pursuits, the writer will make available, upon request, a step-by-step procedure for generating epicycloidal tooth forms. A large, self-addressed, stamped envelope should be supplied by those requesting this material.

All questions and comments should be addressed to William O. Smith, Jr., Parkland College, 2400 West Bradley, Champaign, Illinois 61820.

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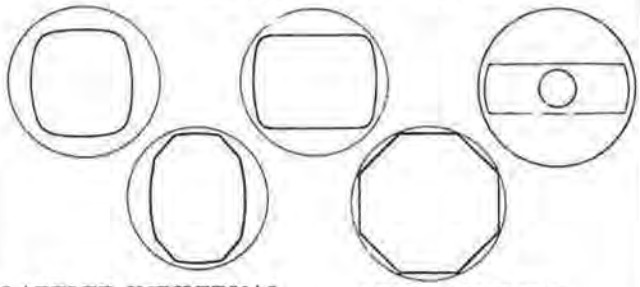


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THE ART OF STAFFING

By Les Smith
CMW

To pick up on poising from the last edition, the older screw type balances are heavier and slower than the new screwless type and therefore require closer poising. Since weight can be replaced with timing washers, removing weight doesn't present quite the problem that the screwless type does. Weight should always be removed, never added, to bring the balance into a poised condition. Should weight be added, and the watch is found to run slow, it would be difficult to remove the weight and keep the balance in a poised condition, since it wasn't evenly added to the wheel. After the balance has been poised and ready for timing, a balanced set of washers can be used to bring the rate within an acceptable range.

Screwless type balances should be poised with great care and no more weight removed than absolutely necessary. The wide range of the tailless regulator allows for considerable weight removal; however, there is a limit, and each staffing claims a certain amount. Since the weight can't be replaced, it's better to practice the method mentioned in the April edition and locate the heavy spot opposite the roller jewel, then bring the balance into an acceptable poised condition.

Incidentally, the metal which would be removed from the arm of a balance, as suggested in an earlier section, will have little or no effect on the time rate, since it was removed so near the staff. Theory teaches that the distance a weight is located from the staff has more effect than the weight itself. Also, time rate change is primarily dependent on the weight gain or loss around the rim, or it being removed toward or away from the staff, with the latter having the greater effect.

With the balance in a level and poised condition, the hairspring is ready to be replaced. Since it's almost impossible to remove the hairspring without slightly opening the collet, why not make it a practice to lightly tap it with a closing punch and eliminate the necessity of taking it back off and tightening it. This can be done on the bench block, but a more level condition can be obtained by using the staking tool. The punch must be kept level to avoid damaging the hairspring and it should just begin to enclose the collet. If it comes down over the collet too much, the hairspring could be badly distorted. Overcoiled hairsprings are pinned near the bottom of the collet and flat ones pimned near the top, so always do the closing where the punch is farthest from the pinning point.

The closing punch is recommended simply because there are no longer any collet closing tools being manufactured, at least good ones. A superb micrometer type tool was available some years ago, but is no longer on the market, so the punch is the most suitable tool available. It maintains the roundness of the collet while closing it. The closing should be done by lightly tapping the punch while observing the collet slot so it can be determined how much closing is taking place. Too much closing can result in difficulty in getting it on the staff, or damage to the collet. Possible damage to the roller or staff could occur because of the extra effort necessary to drive it on the collet shoulder, so close it only slightly.

Before fitting the hairspring to the staff, it's advisable to check the hairspring around the collet. Often it will be out of alignment, requiring some adjustment. If it is bent upward, as in Figure 30, it's better to do the adjusting before fitting it



Figure 30.

to the staff. A hairspring can be raised easily after it's fitted to the staff, but it is quite difficult to adjust downward. In order to lower it, place the collet on a broach or burnisher and adjust it downward and get it as level and concentric as possible. The final adjustment can then be done after it's fitted, by placing the wheel in a hairspring caliper, as in Figure 31, or as a substitute, using the trueing caliper.



Figure 31.

Hairspring adjusting in its entirety is a very lengthy subject and for that reason, only a few suggestions will be made here. First of all, hairspring work should never be attempted without using the finest hairspring tweezer available. Anything less will only create problems, no matter how expert the watchmaker. He will do more damage than good, if attempting to repair a hairspring with a tweezer of poor quality or bad condition. Secondly, and very importantly, don't touch the hairspring until it has been carefully studied to determine exactly where the adjustment should be made. Quite often the watchmaker sees a problem, reaches in and attempts to correct the problem, only to find out he has created an even greater one, so just a moment of careful study will pay big dividends.

Having fitted the hairspring, a final check should be made to be certain the hairspring is level and developing properly around the collet, and the overall condition of the body of the spring is good before attaching it to the bridge. The same precautions taken when replacing it were covered earlier in this article during the removal procedure.

The upper balance jewel should be left unoiled until the balance is checked for beat, endshake, hairspring condition within the watch, etc., for the simple reason that should it be necessary to remove the balance for any reason, the oil would not be spread to the hairspring as it might be if the jewel were oiled, so make all the adjustments to the balance assembly before oiling the upper jewel.

Getting the watch in beat requires the moving of the collet until the roller jewel centers the pallet exactly between the banking pins (assuming the pins are correctly adjusted). A self-starting watch is assured when the watch is properly in beat.

Correcting endshake is usually done by burring the bridge, using shims, or bending the bridge, so look for these before doing any adjusting. Often just smoothing down burrs that were previously raised is sufficient. It's also advisable to leave slightly more than the theoretical .01 to .02 mm because of thin plates, bridges, and tight-fitting cases which usually take up some of the endshake allowed.

Roller alignment should be checked and if necessary, adjust the fork to match the safety roller and jewel pin, before doing the final adjusting of the hairspring.

With the bridge in place and endshake corrected, the hairspring can now be checked and corrected where needed. It should be remembered that any adjusting in the round tends to throw the watch out of beat, so it might be necessary to readjust the beat condition at the end of the hairspring work.

(continued)

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Adjusting the hairspring in the flat should begin with the stud raised as high as possible. Excessive adjustment to the hairspring can best be done with the balance out of the watch. Also, adjusting the body downward might require lifting the balance out before attempting to lower it. In most instances raising the spring can be accomplished with it left in the watch. Adjust the spring to a near level, but cupped condition, and then, begin lowering the stud as the final leveling is done.

Both overcoiled and flat hairsprings can be adjusted this way. In the flat, however, the remaining comments on adjustment will primarily be directed toward the flat hairspring, since most springs are flat.

Getting the spring perfectly level isn't possible in many watches today. Often the designer has thinned the movement to a point where the hairspring must be tilted to avoid striking some part of the watch. Usually it must be raised quite high at the stud and tilted downward toward the center wheel to avoid touching the lower part of the regular key and still miss the center wheel. In the thinner watches, therefore, don't attempt to get the spring completely level, but rather, leave it slightly tilted.

Adjusting a flat hairspring in the round is anything but that; the only coil that follows a concentric pattern is the outer coil (regulating coil) and usually it goes just far enough to accommodate the full swing of the regulator. Actually the flat hairspring, if developing concentrically, is out of adjustment. In order to minimize the isochronal error that is inherent, as well as the normal position error, the spring must be adjusted to develop upward. When the balance is at rest and the movement being held in the pendant position (2–3 o'clock down position), the hairspring should be adjusted upward to exert a slight lifting action, which eliminates hairspring sag and actually has the effect of slightly lightening the balance in that position. Figure 32 shows a hairspring which has been adjusted toward the stud, while Figure 33 shows just the opposite. In both watches, the adjustment is upward or away from the two o'clock position.



Figure 32.



Figure 33.

The regulator pins should be adjusted to allow an absolute minimum vibration. This is essential to good timekeeping. As a matter of fact, most Japanese watches are adjusted so the hairspring doesn't vibrate at all, with the outer coil adjusted to lay heavily against the inner regulator pin, as in Figure 34. This greatly reduces the isochronal and position error. Obviously, if a watch comes in so adjusted, it should be left that way. While I don't recommend it for all watches with flat hairsprings, this method can be used where there is a position error that doesn't respond to other adjustments. Some of the older watches with flat hairsprings that traditionally have position errors can be helped by adjusting the hairspring to lay against the regulator pin. When the hairspring is so adjusted, the pins don't have to be tightly adjusted (Figure 34 shows the key and pin well apart), and this is no problem as long as the spring is tightly adjusted against the pin. It's very important that the spring doesn't leave the pin at any time during the oscillation. To check for this, turn the balance, in the direction that would normally lift the spring off, as far as the balance can be turned. If the spring remains against the pin, it has sufficient pressure.



Figure 34.



Figure 35.

To make the adjustment, the spring should be bent at the stud, in a manner that keeps the outer coil concentric and following the path of the regulator. The spring should be checked to make sure it remains tight agains the pin during the entire span of the regulator. For example, if it lay against the pin at the slow position, but begins to spring away as the regulator is moved to the fast position, it's easy to see that regulating problems would occur. Make sure to check it at different regulating positions when making the adjustment.

With the balance and hairspring adjusted, the upper balance jewel should be oiled and the watch is now ready for final regulation. If the watch in general is in good condition and the balance motion is sufficient, regulations should be little problem. If it's a screwless balance with a tailless regulator, final regulation is simply a matter of moving the regulator to bring the watch into time. Most commercial grade watches are left plus 15 to plus 30 seconds per day.

Screw type balances that are gaining time should be brought into relatively close time with timing washers being placed under opposite balance screws. Just be sure the screws are of equal size, so the same amount of weight is being moved outward, otherwise a poise error could be created during this final timing. Also, other problems can be created with timing washers, if not carefully selected. A washer too large in diameter, as shown in Figure 35, will often strike the movement during oscillation, causing very erratic timekeeping or even stoppage, so careful selection of the proper size and thickness is extremely important. It's much better to use several thin washers, placed under different screws, than to try to time it down with just one or two pairs of thick washers.

Some of the suggestions I have made might be in conflict with older watchmaking axioms, but they are proven methods that can be used by the average watchmaker in becoming proficient in staffing. It would be unwise to recommend methods that only the most expert lathe operator could accomplish. Good practical watch repairing without sacrificing quality workmanship has been the theme.

The unfortunate part of this article is that more is left out than printed. However, most that has been written lends itself to problems generally encountered, and then suggests solutions. It's hoped that someone has benefited. □

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Questions and Answers

by Henry B. Fried

CMW CMC FBHI

THE HOWARD TOWER CLOCK

Q. Please give me all the information you can about the Howard Tower Clock.

Wilson L. Suggs
Fort Walton Beach, Florida

A. First your pendulum length. Usually the complete pendulum is about 3 inches from the floor. The rod on Howards is of wood about 1 to 1½ in. square.

The suspension spring is a matter of trial and error. Prepare your rod, fit a brass cap on top about 2½ in. deep applied with rivets, square hole in top to accommodate a square brass about ¾ in. and 1½ in. or 2 in. long with slot in top to accommodate brass section of suspension spring.

The spring has to have brass top and bottom, well riveted. Same procedure as any regulator suspension, use a farily heavy section of a ¾ in. or 1 in. clock spring about 1½ to 2 in. long.

Your pendulum bob will require a steel casting about 25 to 30 lbs.

As to height of weight drop, you can overcome height by compounding your cable.

Your time weight will doubtlessly require 600 to 800 lbs. Your strike weight for a 1500 lb. bell will require from 600 to 1000 lbs.

These figures are rough and a lot depends on condition of movement. If it is in first class condition, proper bearings not worn and sloppy, use weight as required. I have owned several tower clocks, from small to 7 tons, all varied regarding weights.

As time permits I will check our files further to see if I have any factory information.

(Answer provided by Orville R. Hagans.)

Verge Staff

Q. We need technical information on how to make a balance staff for an 1800 period verge watch fusee drive. I have scant information on some but need something which goes into greater detail. Perhaps the AWI Technical Library has something you can loan me. My membership number is 4772 and CMW 65-4. An added bit of information on this watch is that the balance seems to have been cast directly to the staff?

J. Fletcher
Baraboo, Wisconsin

A. Enclosed you will find photocopies of the pages having to do with making a verge staff. This is from Gazeley's book, Watch and Clock Escapements, *and is available on loan to paid-up AWI members.*

The staff is not *part of the balance but is frictioned to the hub of the balance. Follow Gazeley's instructions closely.*

When time allows, I'll make up an article with detailed isometric drawings on the various ways in which these staffs can be made, but these instructions should suffice. Gazeley was one of the best practical watchmakers of his time.

Angelus 256

Q. I have an Angelus 256 movement in my shop for repair and in cleaning it, I find that I have reason to believe that the last person to work on it put it back together wrong and put in some wrong parts, as they used some regular screws in place of shoulder screws. Also as this movement has a somewhat more complicated date mechanism, I am having trouble being sure that the date mechanism is reassembled properly.

I would appreciate it very much if you could send me a technical bulletin on the Angelus 256 to include the proper placement of the date mechanism parts and part numbers for the parts for this movement.

Your help in providing me with information on odd cases in the past has been of a great help to me.

Robert A. Miller
Offutt AFB, Nebraska

A. The Angelus cal. 256 was a watch that was never imported formally in this country. The watch in question was most

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Address _____

City _____

State _____ Zip _____

likely brought into the USA by someone who purchased it abroad. As such, parts for this are not available, nor is technical material or notes to be had except for the parts sheet which we enclose.

I might suggest that you write to the Angelus people in Switzerland. Perhaps they may have some instructions for you. Angelus, S.A., LeLocle, Switzerland.

Wish we could be of more help. (SASE's make our volunteer job that much less difficult.)

Waterbury Duplex

Q. I received for repair a watch with the following markings on the movement: "Waterbury Watch Co.," "Series N" and "patent dates from 1874 to 1886." The escapement in this watch is unlike any I have ever seen. It has no pallet, but is not like the conventional cylinder escapement. The teeth on the escape wheel are pointed, with every other tooth bent up to 90 degrees. The balance staff has a "hook" which engages the escape wheel. The movement is about 6 size and has 4 jewels. The upper balance staff pivot is broken off. I would appreciate answers to the following questions.

Is the hook on the staff pressed on, or is the staff all one piece?

Is a replacement staff available?

The owner of this watch is very anxious to have the watch repaired, but I am inclined to tell her that the cost of repairing the watch would be prohibitive.

Any information regarding this watch would be greatly appreciated. I am a member of the Watchmaker's Associaton of Ohio, AWI Affiliation No. 4. Enclosed self-addressed stamped envelope for your reply.

W. Lindheimer
Columbus, Ohio

A. The escapement observed by you in the Waterbury watch is called the duplex escapement. *It is the only escapement other than the pin or jeweled lever used commercially in American watches. This was discontinued about 1900. About a million were made in various sizes. The impulse "hook" or finger is press-fit onto the staff. Parts are no longer available. My advice would be to repivot the staff or make a new one. The most difficult job would be to provide that thin, narrow slit which is used as the passing slot for the locking escape tooth, enabling it to escape every other beat. Some watchmakers overcome the task of milling this slot into the staff collar by providing a friction-fit slit-collar which they press-fit over the staff. The press-fitting should be so that the slit is rather narrow. A wide slit allows overbanking.*

Escapements like these are pictured in many books on escapement, Gazeley's and Chamberlain's, available to paid-up AWI members. May I urge you to join. The benefit pay for themselves many times over.

(continued on page 31)

WMJDA CONVENTION A ROUSING SUCCESS

CLOSE TIES INITIATED WITH AWI

The 1977 Annual Convention of the Watch Material and Jewelry Distributors Association was held March 22–26 at the Canyon Hotel in Palm Springs, California.



Newly elected officers, L to R: 1st V. Pres., John Cassedy; President, Morris Beresh; 2nd V. Pres, Bernie Nest; 3rd V. Pres., Karl Esslinger. Not shown: Treasurer, Harvey Berkey.



Board of directors from top left: Ray Harris, Mark Borel, John Cassedy, Morris Beresh, Ben Phillips, Robert Kilb, Max Fargotstein. Front Row: Dominic Priore, Ed Endman, Bernie Nest, Karl Esslinger, Art Bush, Ed Soergel, and Ken Weil. Not shown: Harvey Berkey, Skip Apple, Edward Kurtz, Mike Langert.

An innovative feature of the meeting was Round Table Group Discussions which permitted attendees to take part in six discussion topics: "Controlling Accounts Receivable," "Hiring, Training and Supervising Employees," "Re-

ducing Operating Costs," "Hiring, Training and Supervising a Sales Force," " Controlling Inventory," and "Developing New Markets."

Another event which drew praise from both Active and Associate Members was the "Associates' Tables" which provided an opportunity for manufacturers to meet with wholesalers and distributors to discuss their product lines, distribution policies, etc.

WMJDA elected to exchange memberships with AWI. AWI was granted an Associate Membership in WMJDA. WMJDA will apply for membership on AWI's Industry Advisory Board. Mr. Marvin Whitney, representing AWI, discussed the AWI cell disposal program plus the newly established museum in Cincinnati, Ohio.



Marvin Whitney, Co-Editor of Horological Times and Past President of AWI, addressing members of WMJDA.

The convention attracted a record attendance of 190 individuals representing 39 Active Member companies and 39 Associate Member companies.

HONORARY LIFE MEMBERSHIPS GRANTED

Honorary Life Membership in WMJDA has been granted to the following individuals:

Sid Prague; Prague Kurtz; Houston, TX
Ed Hendricks; Hamilton Watch Co.; Lancaster, PA
Louis Langert; Langert Bros.; Phoenix, AZ
Burt Lowe; Longines Wittnauer; New Rochelle, NY
Ted Lamphert; M.J. Lamphert; New York, NY

The honor of Life Membership was voted by the Board of Directors for the significant contribution made to the watch and jewelry industry by these people during their long and active careers.

MICRO FICHE PROGRAM IS UNDER WAY

WMJDA's Micro Fiche Program is now being offered to members. At present it consists of the following historical catalogues which have been filmed and put on fiche: Deuber-Hampden; Elgin, 1904 and 1927; Hamilton, 1920 and 1947; Howard & Standard; Illinois, 1923 and Supplement; Waltham, 1946, 1948, and 1958; New England; Seth Thomas; South Bend, Complete and No. 2; American Watch Movements, Swigart. There are approximately 65 catalogue pages per fiche. These ten catalogues are no longer in print, a fact which enhances the value of the fiche cards to anyone requiring the information they contain.



Mark Borel reports on Micro Fiche Program. Seated: Ken Weil.

Planned additions to the Micro Fiche Program include other historical catalogues, current catalogues and changes to current catalogues. Subscriptions are available through WMJDA.

B. Jadow & Sons of New York are presently involved in putting the "300 System" on Micro Fiche. This will complement the Association's Micro Fiche Program.



Micro Fiche viewer.

WMJDA members will benefit from group purchase rates on equipment and accessories. For information regarding either the WMJDA Micro Fiche Program or the "300 System" project by Jadow please contact WMJDA, 435 N. Michigan, Chicago, Illinois 60611, (312) 644-0828. □



Inside the Clock Shop

with James L. Tigner

PIVOT RESTORATION

Last month we concluded a three-part series of clock cleaning articles, focusing for the most part on a disassembled clock. The clock was taken apart, we said, because it was an old one, in need of bushing and, in all likelihood, pivot restoration. Before dismantling, we marked with x's the holes to be bushed, and with o's the holes to be closed.

Now that we have the clock apart and cleaned, we can examine each of the pivots, one by one, and determine which of them need attention, and of those that do, what sort of attention.

Run-of-the mill clocks, like the Sessions mantel we are working on, aren't exactly precision timepieces, and there is no reason to repair them as such. By this I mean that elaborate set ups for polishing pivots–center rests, pivot beds, and devices of this sort, even diamontine and polishing slips, which are time-consuming and messy–aren't mandatory. For the most part, all that is needed is a pivot file, a burnisher, and a little emery paper in two or three grits.

But to what extent and how these simple tools are used can make the difference between a clock's barely skinning through its one-year guarantee period (if that), or its running 2 years, 5, 10, 15, or longer, with no further attention or appreciable wear.

They tell us that a man is as young as his arteries. With equal aptness it can be said that a clock is as healthy as its pivots and pivot holes. It's in this area that the trouble will be found 80% of the time when a clock prematurely ceases to tick.

Instead of plugged arteries, a clock develops gummed pivot holes (a poor cleaning job, the wrong cleaner and/or rinse, bad oil). Instead of hardening of the arteries a clock experiences enlarged, roughened pivot holes, scored pivots, destructive friction (failure of the doctor to diagnose and properly treat his patient at his last check-up).

The philosophy and good judgement of each individual clockmaker will determine how he will cope with–or ignore!–the pivot problem. And since it never hurts to know how the other fellow does it, let me run through the procedure I follow. If you find nothing in it worthwhile, at least you can say, "This guy is nuts."

Basically, the way I look at it is this, the only reason for taking a clock apart is to make repairs; so while I've got it down, I'm going to do the best job I can, using the fastest methods I know of that will do the job. This way I can treat the clock as new when it returns (10 years, 15, sooner, later?), and clean it without disassembly.

Now to the particulars of pivot restoration. I examine each pivot in the clock both with a loupe and by running a finger nail over it. If there is the slightest roughness, I know it will get worse, not better, so I polish it. How? With emery paper cut up in little strips about ½ by 1½ inches. I fold them once, hold one of them around the pivot with a finger and thumb of the right hand, and twirl the arbor back and forth with a finger and thumb of the left hand. No lost time chucking and unchucking in the lathe.

Behr Manning emery paper is available in all the catalogs by the sheet (9 x 13¾ inches) and in all grits. The finest is 4/0. It produces a fast, bright finish, very nearly as high as the best that diamontine can do–probably just as high unless you are skilled in the use of diamontine.

I use 4/0 to polish out the very lightest of scratches, and 2/0 followed by 4/0 when the scoring is a little deeper but still not deep enough to require any perceptible removal of metal. After all, we're trying to save time, and our fingers can't compete with a lathe in removing metal. Polishing is all we can do.

After polishing, pivots are cleaned by pressing into pith buttons, or by twirling in a clean rag. The same when changing polishing papers from a low to a higher grit. Try to keep fingers clear of newly polished pivots. Remember, salt from your fingers is a good way to get yourself one of those random, mystifying oil failures that can stop a clock, even when occurring in only one pivot hole.

Let's take a look at some typical ways pivots can be badly scored, as shown in Figure 1. Consider the example shown at (c). Here we have three fairly deep grooves cut in the pivot, the rest of which is in good shape. Now we could chuck the wheel in the lathe, take out the grooves with a pivot file, burnish or polish the reduced pivot, and insert a new bushing. A first class job.

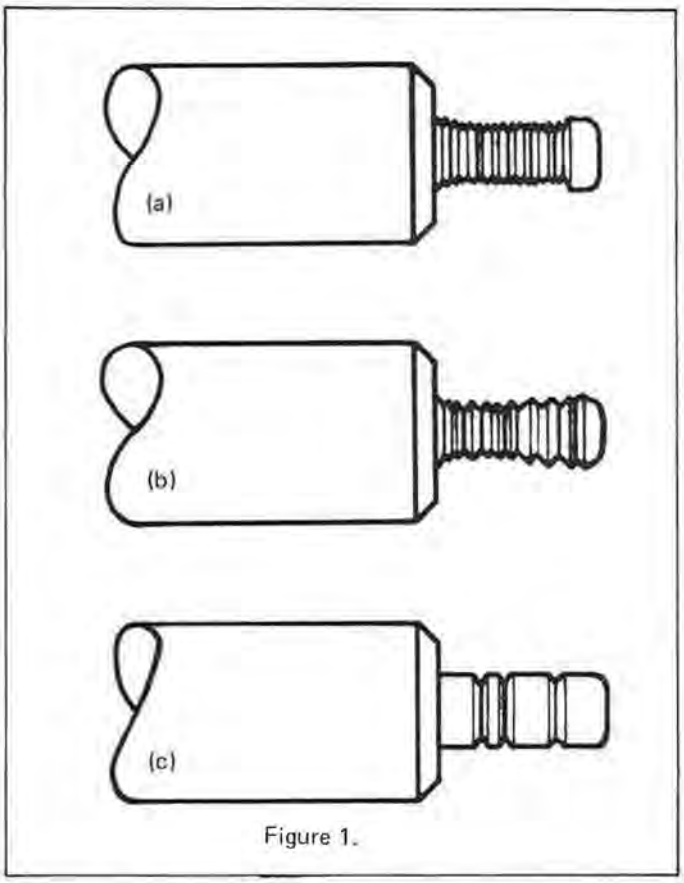


Figure 1.

But is all of that really necessary? Except for the three grooves, the pivot is cylindrical and still has plenty of good bearing surface. In all probability its hole isn't even worn.

Why not save the pivot simply by polishing it to remove the sharp edges that are likely around the grooves. This can be done in seconds by the twirling method just described. Use your thumbnail to press the paper into the grooves, which will smooth and round off any razor-like corners.

It might be said that while this treatment does leave the pivot polished and with a good amount of bearing surface remaining, still and all, some surface has been lost by the three grooves, and the pivot hole will wear that much sooner. True. But if we take the grooves out by reducing the pivot diameter, we also lose bearing surface. True also?

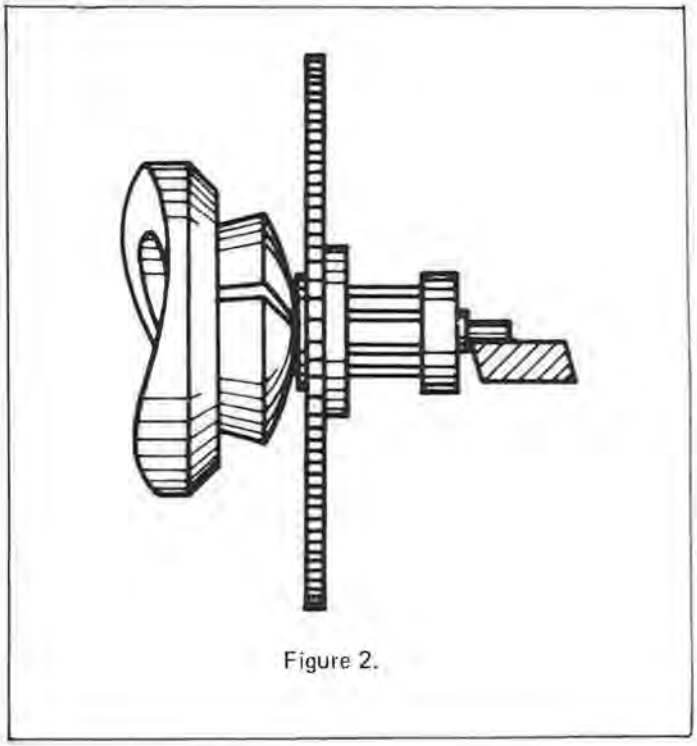
Consider Figure 1 (c) again. Those three grooves—how did they get there? Well, grit of some sort must have gotten into the pivot hole, and over a period of time did a nice grinding job on the pivot. Now run-of-the-mill clocks don't have jewels, and just because we cleaned the clock doesn't necessarily mean we removed the grit, supposing even that we had used ultrasonics. The soft brass walls of a pivot hole can become charged with grit, which even pegging may not remove. So it could be pretty much a waste of time to polish a pivot and put it back in such a hole.

Burnishing the hole with a smooth, round, oiled burnisher from both sides of the plate is the answer. It breaks up the grit, whatever it is, smooths and hardens the walls of the hole, leaving them olive-shaped like those of a balance jewel, and insuring a better retention of the oil at the pivot where it belongs. It does such a great job that I burnish routinely, as a finishing touch, to every pivot hole, including new bushings. I follow it up with a light pegging to remove the black metallic residue left from the burnishing.

Pivots (a) and (b) obviously can't be restored by the twirling method and will have to be chucked in the lathe and dressed down in some other way. For a job of this sort, a pivot file with safe edges and sharp, oblique corners is excellent. It gets in close to the shoulders and safely removes the rounded corner fillets shown in (a) and (b), leaving the shoulders clean and square, the sides of the pivot flat and parallel. Figures 2 and 3 show the position of the file in use.

These excellent little tools are becoming hard to find, but they are still available in the Vigor, Bestfit catalog. If you would like one, order the regular, right, No. FI-1510. If you don't have a sharp, oblique-cornered burnisher, a good one is the regular, right, No. FI-1650. Handles can be fitted to both of these tools, but I don't find them necessary. The tangs serve nicely.

Where there is a little overhang, as in Figure 2, the pivot should run true, and it requires no support. The job is quite simple here. The file is placed under the pivot, as shown, and moved forward and backward with a steady, even pressure. Tiny filings will accumulate on the file and must be removed every once in a while with an old watch brush. As the work progresses, a loupe should be used to make sure the sides of the pivot are developing straight and parallel, and the shoulder clean and square with no fillet. The file is held firmly between the first two fingers and thumb of the right hand, and tilted slightly to one side or the other whenever


Figure 2.

the pivot is seen to be drifting from a cylindrical shape. Your fingers develop a feeling for flatness, and before you know it, the filing is done.

Most of the file marks are removed by 2/0 emery paper. Fold a small piece of it around the pivot, and with the fingers slide the paper back and forth the length of the pivot, while the lathe turns. This takes only a few seconds, and the final finish is developed with a burnisher, which may require a little practice. If you have trouble at first, you can always do the final polishing with 4/0 emery paper, in the same way the 2/0 paper was used.

Because of the cross graining, a burnisher cuts like a very fine file at the same time it burnishes. The coarser the cross graining, the more the burnisher cuts and the less it burnishes. So the characteristics you want in your burnisher should determine the grit of abrasive you select in graining it. When I want a bright, hard finish, I grain my burnisher with No. 1 emery paper. When I want a faster cut, I grain it with No. 2 or even No. 3. No. 2 gives a pretty good all-purpose grain.

To grain your burnisher, cut a piece of emery paper slightly wider than your burnisher, not counting the tang. Stretch it tight and tack it over the ends of a flat ¾-in. wooden block of the same width and about 8 inches long. Grip the block in a vise, and using considerable downward pressure, slowly push the burnisher crosswise back and forth the length of the block, until you get a flat surface and a uniform grain.

In using the burnisher, considerable pressure must be applied as it is moved back and forth under the pivot in the same manner as the pivot file. Some people oil the burnisher, but I use it dry, stopping at frequent intervals, however, to wipe off the tiny filings from the burnisher with my fingers. If these filings aren't frequently removed, they will scratch the pivot and spoil its finish. If the pivot hasn't been filed perfectly flat, you will have to rock the burnisher slightly from side to side to bring a hard mirror finish to its entire surface. Should you get a lot of filings, but not much finish, you've probably grained your burnisher too coarsely.

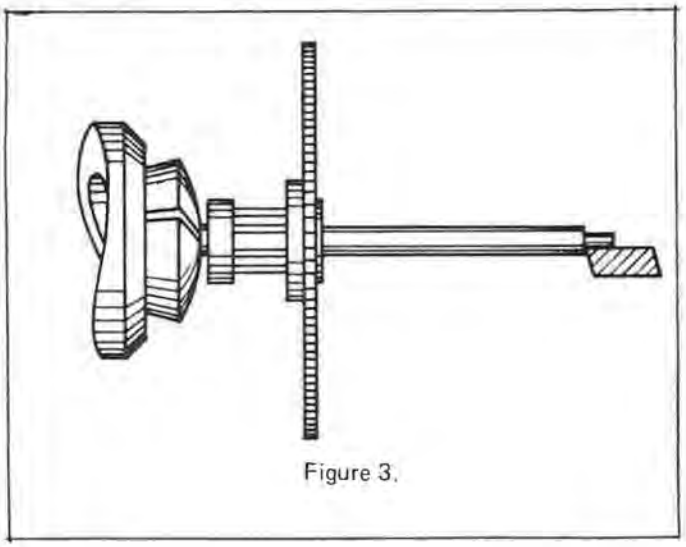


Figure 3.

Figure 3 presents more of a problem because of the long overhang. This is where a center rest, or a pivot bed of some sort is indicated. But as stated earlier, such devices can be dispensed with in work of this class, and we can get the job done faster without them.

Using the T-rest as a reference point, run the lathe to check whether the arbor runs reasonably true. If it doesn't, just bend it up or down in the lathe with your fingers until it does. If this were a French clock, I wouldn't try it, but the arbors and pivots of American clocks are soft iron and will take a lot of bending.

With the arbor running reasonably true it is quite simple to provide the needed support with the fingers of the left hand, while filing with the right. We must keep in mind, however, that in this case the wheel is chucked by its pivot, and if our finger-support of the arbor slips, a broken pivot will likely be the result. When possible, it's safer to chuck by the arbor.

In supporting the extended arbor, my left hand is positioned in back of the arbor, the index finger pushes up on the arbor from underneath, while the thumb pushes down from above. I seem to get better control when I can push down directly on the pivot with my thumbnail, while the index finger pushes up on the arbor. Little variations have to be made to suit the complications of the problem. Sometimes the finger support isn't strong enough to balance the pressure required in burnishing. In that case I eliminate the burnishing and do all the smoothing and polishing with emery paper, as described earlier, and which requires no back up.

Probably 80% of the pivot restoration jobs I do are done by this system. Nothing fancy, but it does a good, honest job, and it's fast. The other 20% we'll cover when we get into repivoting, some of the set ups for which can be used in pivot polishing.

Next month, the Shop reopens with hole closing and bushing. □

LAW ENFORCEMENT INQUIRY

As some of you may have heard, Gabe Pressman, a reporter for Channel 5 in New York, was knocked to the ground by an unknown assailant while trying to interview Premier Levesque of Quebec. The man dropped his watch, a 14 carat gold man's Hamilton, case no. S085495, caliber 982, movement 16288. Scratched inside the case were the following numbers: A39404F, A44016F, A45960F, and A47550F.

Any information about the owner of this watch will be appreciated and kept confidential. Contact AWI Central.

MAX SCHWARTZ

It is with deep sadness that the Horological Society of New York and the American Watchmakers Institute note the passing on of Max Schwartz. He died at the age of 74 years. Mr. Schwartz was associated with the Bulova Watch Company



for 25 years. He was senior instructor at the Bulova Watchmaking School when it opened. He was known to all watchmakers as one of the finest lecturers and was Technical Director at Bulova for 15 years before he retired to Florida. He is survived by his widow. May he rest in peace.

CHARLES SNOW

Charles Snow passed away on February 21, 1977. Charlie had been active in all phases of watch and clock activities ever since he started an apprenticeship under his father, who was a master craftsman in Bridgeport, Connecticut.

One of the early pioneers in horology, Charlie had an "Old Timer" number in the NACC–522. He was also a charter member of AWI. Charlie started a small business in Long Beach, California, and it became one of the largest repair shops on the west coast. At the same time, he became interested in antique watches and clocks. His collection grew along with his business, and he and his son opened another store in Lakewood, California, where a large portion of his splendid collection is now on display.

Charlie appeared on many TV shows and lectured to many groups and organizations. He was active in many horological organizations, including the Southeast Retail Jewelers Association, the 24 Karat Club, the California Horological Association, the former UHAA, the NAWCC, and the Horologist Society of England.

Charlie will be sorely missed in the Southern California area for many years to come.

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Understanding Electronic Timekeeping

By Tom M. Hyltin

EE

Part 5

THE LIQUID CRYSTAL WATCH

(all rights reserved by the author)

In this section, we will discuss the use of a liquid crystal display, as described in the previous section, in a digital electronic watch. Due to the dominance of the field effect display technology at the present time, only the field effect implementation will be considered, but watches using dynamic scattering, for example, are quite similar.

In order to make a watch from a liquid crystal display, we must provide the proper signals and voltage levels to the display. These are generally provided directly by the integrated circuit; and of course, there must be a means of connecting the display to the integrated circuit. Quite often with the liquid crystal display, there is the need for nighttime illumination. Finally, all of these components (plus the battery) must be assembled into one operating system and put into a watch case.

Electrical Requirements of the Display

The voltage required to drive a typical field effect liquid crystal display was discussed only briefly in the preceding section. To repeat, if a voltage is applied between the transparent electrodes on each side of the liquid crystal material, then the polarization is shifted and a dark character is formed on a light background. A liquid crystal display cell can, in fact, be driven directly from a flashlight battery and digits will appear. If it is operated for a length of time from a flashlight battery, it has been found that the passage of a direct current through the liquid crystal material causes a long term deterioration of the liquid. All of the liquid crystal displays built today, therefore, require an alternating current drive. For a liquid crystal display that is driven at 3 volts, the voltage applied between the electrodes on the two sides of the liquid should look as shown in Figure 1. This voltage, for example, applied to the front electrode would drive that electrode both plus and minus 3 volts, as compared to the back electrode. In a actual practice, both the front electrode and the back electrode as driven to reduce the voltage generated in the watch. As was shown in Figure 1, the voltage switches sharply at a rate of 32 Hz (cycles per second). All liquid crystal watches known to the author switch at this rate, and the switching can be picked up by an electrical sensor and used to indicate timing accuracy of the watch.

The current required by each segment (each terminal of the display) is in the order of a few hundredths of a micro-

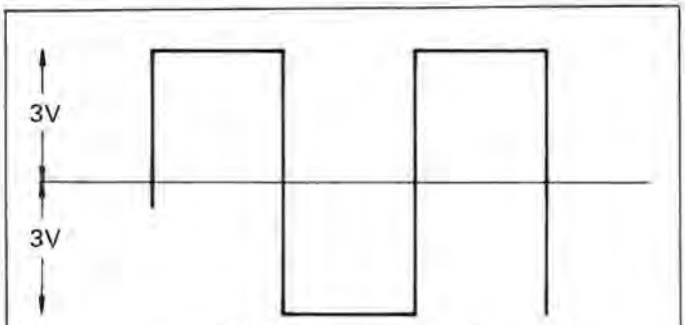


Figure 1. Idealized Drive Voltage for Display.

amp; this is 10–20 billionths of an ampere, and therefore the outputs of the integrated circuit that drive the display are not built for current capability. The voltage can be seen only using high input impedance oscilloscopes and similar test equipment.

Illuminating the Display

One of the early drawbacks in the use of field effect display was its low visibility in dim light, even as compared to the dynamic scattering displays. This problem has been solved in

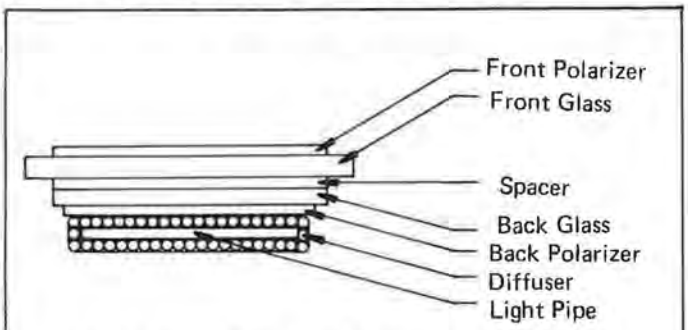


Figure 2. Cross Section of Lighted LCD Display.

two ways. The first solution to this problem was to use a miniature light bulb, powered by the watch battery. Early attempts to use these sub-miniature light bulbs involved only providing some peripheral lighting for the display itself, and this was generally unsuccessful. The present use of light bulbs requires the use of a "light pipe" across the back of the display to spread the light more or less evenly across the display. A cross section of such a lighted display is shown in Figure 2. Notice that the light diffusing panel is located behind the back polarizer of the display. The diffuser panel consists of, as previously stated, a light pipe, either of acrylic plastic or glass, which serves to conduct the light from the bulb across the display. Around this light pipe is a diffuser which serves to conduct light out of the light pipe when the light bulb is

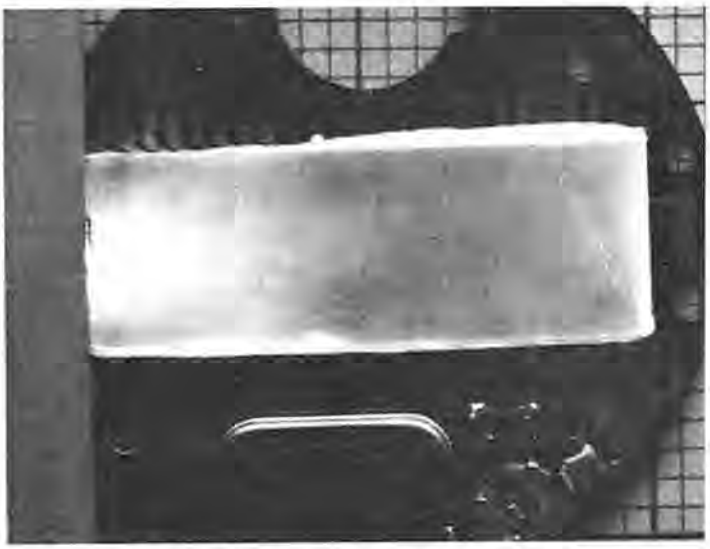


Figure 3. Light Distribution Panel for Use in LCD Watch.

used. This diffuser can either be a heavy etch in the case of glass, or a thin plastic foam in the case of an acrylic diffuser panel. Figure 3 shows a typical light bulb-diffuser panel combination used in a modern liquid crystal display watch, photographed in darkness with illumination only by the light bulb. This shows the relatively even distribution of light across a well-designed diffuser panel.

Recently there has been an alternative to the use of incandescent light–one which draws no electric power from the battery. This is the use of a radioactive gas, tritium, in digital watches. Tritium is a variation of the very common gas, hydrogen. The mechanization is very simple; light is generated the very same way that the picture on your television set is created; that is, electrons given off by the tritium gas strike a phosphor that coats the inside of a glass tube and a portion of the energy of the electron is converted into light. A cross section of a tritium tube is shown in Figure 4, and a photograph of an actual tube is shown in Figure 5.

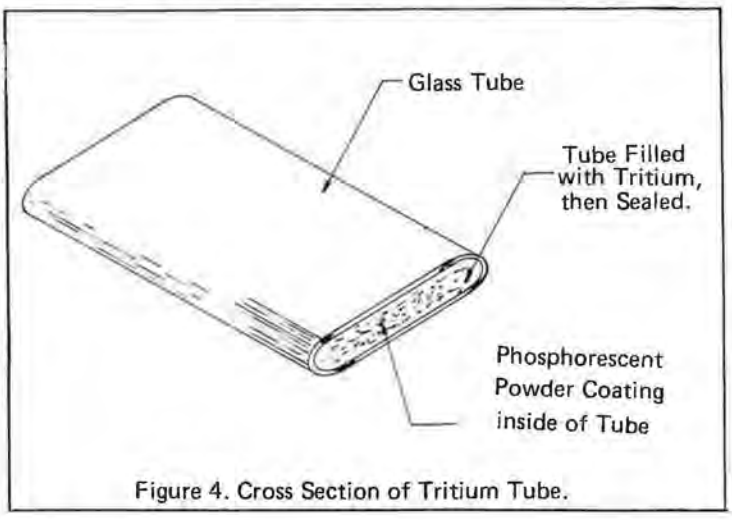


Figure 4. Cross Section of Tritium Tube.

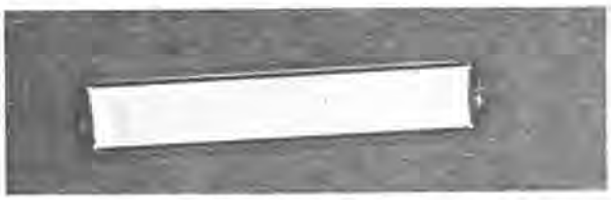


Figure 5. Photograph of Tritium Tube.

With any mention of radioactivity, there is always the lingering question: is it safe? This question can best be answered by again turning to our analogy of the television set. In a television set, electrons are "boiled off" of a heated cathode, then accelerated using a high voltage to a level of 15,000 to 24,000 volts energy level. Electrons in tritium are generated through the decomposition of gas and are sent on their way with a much less penetrating power of 5,900 volts energy. These electrons serve only to strike the phosphor that coats the inside of the glass tube (similar to the phosphor used in tritium tubes) and as a result of the low energy of the electrons and the complete glass enclosure, there is no radiation detectable with any radiation monitoring equipment from the tritium panel.

The small quantity of tritium gas enclosed in the tube is quite small, and even in the unlikely event of breaking 100 tritium tubes in a small closed room, the gas would dissipate and the concentration would not result in medical problems. A properly designed tritium illuminated watch can be easily seen in all lighting conditions, from bright sunlight through dusk to black dark, without pressing a button.

Making Connection to the LC Display

Liquid crystal displays are sheets of glass with conductors consisting of thin transparent layers deposited onto the glass. Normal techniques of interconnection like soldering or bonding, as were used in the LED watch, are not normally suited for making connection of this type. The first contacts used on liquid crystal displays were metal springs similar to those that have been used on other glass enclosed displays such as the plasma displays for calculators. Metal spring contacts were

adapted to some of the early liquid crystal display watches, as shown in Figure 6. The display was held down onto the spring by a plastic piece that forms the top of the module.

The low current of the liquid crystal display provided the opportunity for newer contact systems—the use of conductive plastics. There was the possibility of using the conductive plastic to achieve better contact over a larger area of the display at lower cost than was available with the springs. A photograph of this type of contact system is shown in Figure 7. In this photograph, the white area is a nonconductive plastic and the gray bumps sticking through on both top and bottom are a conductive plastic that is molded into the nonconductive plastic. This system could be made to work, but required close alignment of both the connector to the printed circuit board and the display to the connector.

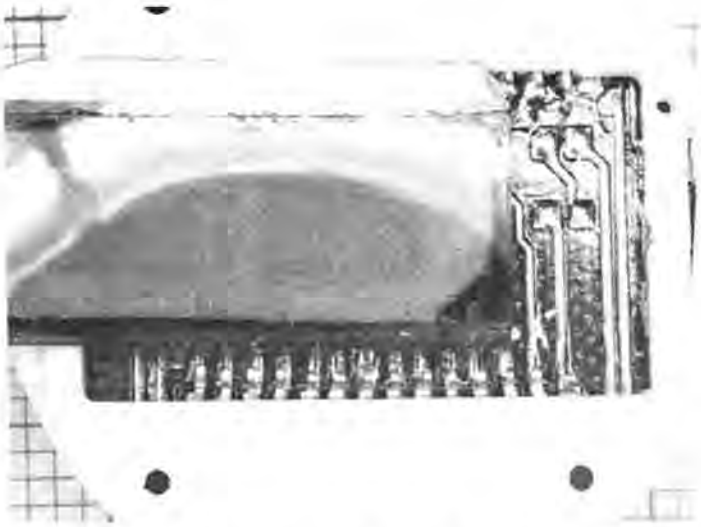


Figure 6. LCD Module Using Spring Contact to Display.



Figure 7. Plastic Connector with Conductive "Bumps".

A simpler lower cost system was devised which reduced the alignment problem, requiring only alignment between the display and the printed circuit board—no alignment involving the connectors. This sytem involved alternating layers of conductive and nonconductive plastic to form a conductive path between the display and the printed circuit board, as shown in Figure 8. With the alternating layers of black

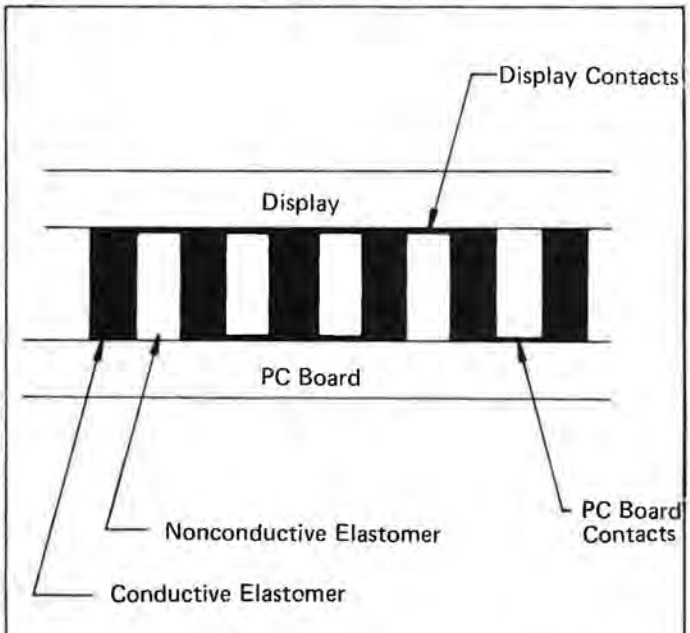


Figure 8. Drawing of "Zebra" Connector to LCD Display.

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conductive plastic and clear nonconductive plastic, it is easy to see how this type of connector was named Zebra.® (Zebra is a trademark of Technical Wire Products, Inc.) A photograph of a "Zebra" connector in a module is shown in Figure 9. This type of connector is the most widely used of all types at the present time.

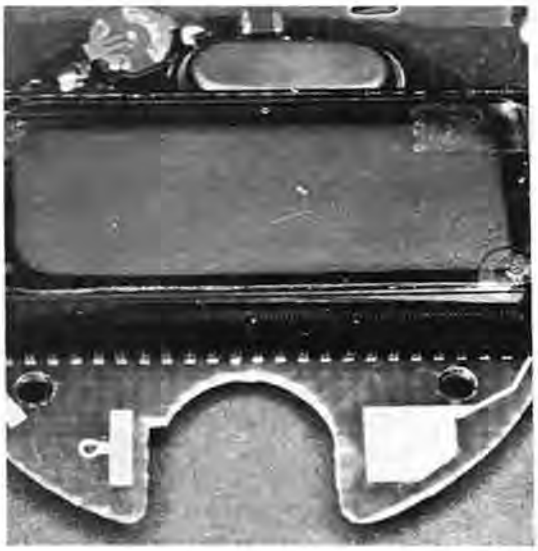


Figure 9. Photo of LCD Module Using "Zebra" Connector.

In earlier paragraphs, it was stated that connection between the integrated circuit and the LCD cannot normally be made by bonding. It is possible, by doing additional processing to the display (firing gold conductors onto the top of the usual thin film conductors) that an integrated circuit can be bonded to the liquid crystal display. An integrated circuit mounted by use of this technique directly onto the liquid crystal display is shown in Figure 10. In this example, the IC has been covered with plastic, the leads to the IC from the display are gold fired onto the glass substrate. Contacts from the IC to power and other electrical connections are made by spring loaded pins to the rectangular pad areas shown.



Figure 10. Photo of Display with Directly Bonded IC.

Mounting the integrated circuit directly onto the display results in an extremely compact package which can have very good reliability. The problem with this type of structure is cost. The IC and the liquid crystal display are the two highest cost components of the watch, and if there is

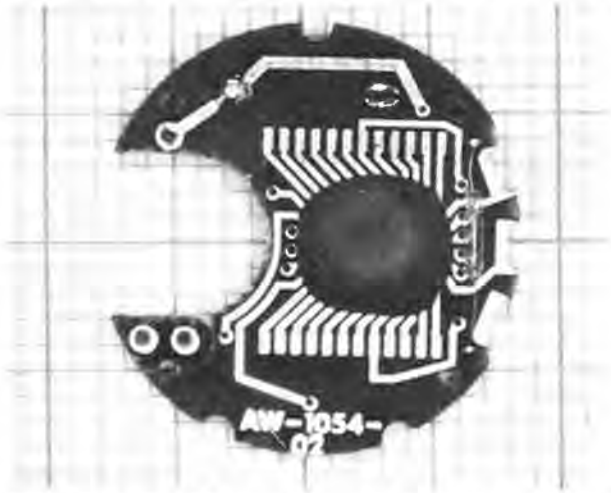


Figure 11. Photo of Front of Printed Circuit Board of Ladies Micro Display Systems LCD Module.

(continued on page 48)

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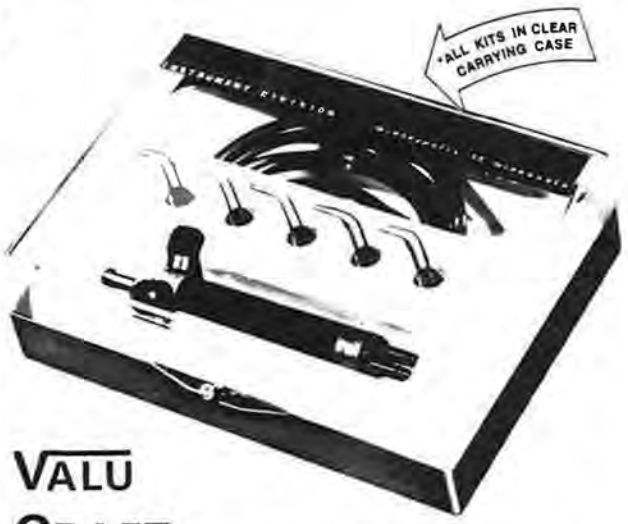


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THE GILBERT COLLECTIONS: MONUMENTAL SILVER AND THE ART OF MOSAICS

Roman and Florentine Micro-Mosaics Clocks

Did you know that Florentine and Roman micro-mosaics were used as decoration on clocks during the 17th and 18th century? The Raffaelli clock (a gift to Napoleon I) and the Foggini clock (from the Florentine Baroque period) are beautiful clocks inlaid with mosaic decoration. These clocks belong to Arthur Gilbert, who is a micro-mosaic collector, and they are being given to the Los Angeles County Museum of Art as a gift along with 200 other micro-mosaic works. This exhibition will opened on April 28, 1977 to the public at the Los Angeles County Museum of Art in conjunction with his Georgian silver collection. Following the exhibition at the Los Angeles County Museum of Art the collections will travel to The High Museum of Art, Atlanta, Georgia, and the Seattle Art Museum, Seattle, Washington.

Clock by Giacomo Raffaelli (Figure 1)

This clock measures 3 feet by 1 foot, 7½ inches. Given by Pius VII to Napoleon I in 1804 as a coronation present, the clock contains semi-precious stones and marbles from the various stone-producing provinces of Italy. According to the records of between 1804 and 1814 at the Bibliotheque National in Paris, it is in the inventory of Malmaison, and was taken to France by Napoleon and kept there.

The clock has a 4¾-inch enamel dial inscribed Breguet à Paris, with a calendar hand and engine-turned surround. The quarter-striking movement is numbered 304, and stamped IPCR with outside rack striking. Contained in an Italian case in the form of a triumphal arch, signed Giacomo Raffaelli Fece Anno 1804, the movement contained within the cresting is surmounted by eagles and a martial trophy. The arch is decorated with martial trophies in mosaic, and supported on four bluejohn columns above a moulded rectangular base,



with ormolu mounts including a Brucrania frieze. There are finely modelled capitals to the columns and beaded borders to the panels, with a figure in Roman uniform in the arch. The whole is constructed in a variety of marbles, agate and lapis lazuli.

Giacomo Raffaelli (1753-1836) master mosaic worker and stone engraver, was named Principal of the School of Mosaic at Milan in 1804. The School was formed under the aegis of The Cisalpine Republic, founded by Napoleon in the same year, which became the Kingdom of Italy in 1895.

Napoleon is said to have presented the clock to Marshal Bernadotte, later King of Sweden, one of whose descendants gave it to Sir Alexander Kleinwort in acknowledgement of financial advice. It passed to his son, Sir Cyril Kleinwort, and then to H. Burton Jones, and then to A. Gifford-Scott Esq. In 1976 it entered the Gilbert collection.



Clock by Giovanni Battista Foggini (Figure 2)

This clock has an overall height of 39 1/4 inches; overall width of 39 1/8 inches; panel height of 18 7/8 inches; and a panel width of 14 3/8 inches.

The clock was made in the Grand Ducal Workshop in Florence by Giovanni Battista Foggini (1652-1725), first sculptor to the Grand Duke Cosimo III, for Cosimo's daughter Anna Maria Luisa de'Medici, Electress Palatine. According to Alvar Gonzales-Palacios, distinguished Cuban historian of decorative arts, this clock represents the quintessential achievement of the Florentine Baroque, and reflects the somber and grandiose artistic taste of the court of Cosimo III."

It was given to her by her father while she was living in Düsseldorf. Later the clock was in the hands of Sir George Lindsey of Holford, England, and thereafter it went to Le Petit Musée in Montreal. Finally it entered the Gilbert collection. □

QUESTIONS AND ANSWERS

(continued from page 18)

ESA 9154-12 Hour Stopper

Q. I have a problem with an ESA 9154 movement. This watch runs for days and will stop at three minutes to 3:00. I have checked it and can't find anything. I have cleaned and it does the same–stops at three minutes to 3:00. Is there anything I am overlooking?

Please advise. Any help you may give me will be appreciated. Thank you.

Ted C. Niofsky
Lowell, Indiana

A. In reference to your ESA 9154 that stops at three minutes to 3:00. Any watch that stops at the same time every day is telling you that the trouble must be in the dial train, or in the case of a calendar, it could be in the calendar mechanism.

In your case, it would seem very likely that the problem would be in the date indicator driving wheel (the wheel with alternately deep and shallow notches in which the finger underneath the minute wheel engage), since the finger engages and rotates the wheel one notch at about 3:00.

Be sure that the finger underneath the minute wheel drops in the deep notch of the calendar driving wheel and not in the shallow V-shaped notch.

It is most likely that the date indicator driving wheel is not turning freely. If the shoulder screw which holds it in place has been tightened excessively it may be binding just enough to stop the watch.

Other possible causes would be a damaged tooth in the minute wheel where it engages with the cannon pinion. If this were not a calendar watch it would not necessarily come at the same time every day as it is here.

Hopefully this has given you some help.

(Answer provided by Robert Nelson.)

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AS 1902-03

Q. A Waltham AS-ST 1902-03 came in running *fast*, the outer loop of the hairspring caught on the stud. After releasing it, the watch runs slow, very slow, 30 minutes less in 24 hours. So I cleaned it, and after reassembly, checked for freedom of the train, slight touch of the crown and the train spurs and reverses, showing it is perfectly free. Yet when the pallet and balance are installed it is still 30 minutes slow! I have polished the pivots and examined the jewel (Incabloc) settings and I can see nothing to cause this problem. Have you any suggestions?

Thank you for any and all help you can give me on the above problems.

Fred Hillmann
Boerne, Texas

A. In regard to your AS 1902-03, this is one of the types in which both calibres 1902 and 1903 are 21,600 vibrations an hour. At first it would appear that you might have had another escape wheel replaced with the wrong pinion count, but that would affect your timing much more than 30 minutes daily.

Actually, there is no valid explanation of your watch going that slow without personal examination, which we do not encourage. However, if I should have a watch that behaved like that, I would try to find out if any of the wheels were loose on their pinions, cannon pinion slippage, etc. However, if after I had exhausted all means of detection of this fault and the loss was a consistent 30 minutes daily, I would merely shorten the hairspring accordingly and regulate it out faster, recenter the hairspring and be done with it. The technical sheets on this calibre do not reveal anything that would place the blame on any operational or wheel tooth count difference. Again, my suggestion is to shorten the spring about a fifth of a turn and observe the rate. Wish that we could have come up with something more dramatically revealing but frankly we can't.

Tiffany Neverwind

Q. I have in for repair a Tiffany Neverwind Clock, National Magnet Clock Corp., Buffalo, New York.

This is a battery-operated clock in a dome, similar in appearance to a 400 day clock, has a patent date of 1898 on it.

First question: is there a new suspension spring for the pendulum available anywhere? Does anything Charles Terwilliger makes for 400 day clocks come close to fitting?

Second question: what voltage battery do I need to make up for it? If it is a 4.5 volt battery, is it better to use three size D cells in series, or 6 size C cells in series-parallel, or 9 penlite cells in series-parallel.

I have always written to Jesse Coleman for this information but since he was called to his home in eternity I sure am glad you folks put together a technical committee to help us out at headquarters.

Thank you in advance for any help you can give me.

Clay H. Johnson Jr.
O'Neill, Nebraska

A. My own Tiffany Neverwind clock has a suspension spring of 0.08 mm and it is 1.0 mm wide. However, the Horolovar suspension spring that measures 0.114 mm (.0045 in.)will do perfectly for it. Their springs are narrower and the thicker suspension spring compensates for it perfectly well. As for batteries, I believe that it works on a 4½ volt battery. Mine is without the battery so that I cannot tell. However, I remember that it did require a flat, black, rectangular or square battery with that voltage. If you have one of those handy "power-packs" which convert 115V into selective DC, you can hook this variable instrument into your repaired clock and by upping the voltage from zero until its solenoids or magnetic coils operate the indexing and impulse the torsion pendulum, you will verify the correct voltage required. I do not think that hooking small batteries to obtain the 4½ volts is advisable as you must have a beginning package that has sufficient ampere hours capacity to sustain the electrical needs for at least a year and the smaller size cells simply will not be able to do that.

Movement Identification

Q. Could you identify a watch for me. It is 6x7¼ ligne. It has a U-55 stamped on pillar plate under the balance bridge.

Thank you.

Robert C. Markley
Pennsylvania

A. The U-55 6x7¼ ligne which you wrote on the note is a Cuppilard (JC) 55. This is a French movement but parts are available from most material dealers.

Stamped pre-addressed envelopes make my volunteer job that much easier and are appreciated.

Ingraham Victorian

Q. I would like any information you can provide me about the Victorian eight day alarm clock made by the Ingraham Co., Bristol, Connecticut.

John S. Lowen
San Diego, California

A. I have searched through all my Ingraham older catalogues and fail to come up with an alarm with the name "Victoria." The company, started 1841, is no longer in business, having ceased only recently, I believe–about year or so. They are no longer listed among buyer's guides of this industry. If you will send a photo of the clock and let us know just what it is you'd like to know about it, perhaps we can help.

CANADIAN REPAIR AGENCY

A. Reymond, S.A., Tramelan, Switzerland, recently announced that they have named Saskatoon Watch Repair as official repair agents for Hoga, Arsa, and Damas watches. Their address is P.O. Box 1743, Saskatoon, Saskatchewan 57K351.

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THE LED WATCH MODULE ©

by Louis A. Zanoni

What Is It? How Does It Work? How to Service It?

Electronic digital watches are scientific instruments which will enrich the lives of the owners in the fourth quarter of the twentieth century as the pocket watch did in the nineteenth century. The electronic timepiece has vast potential for supplying useful information to its owner. In 1976 we have seen only the tip of this new instrument. We have experienced time accuracy never before available to the man on the street. We have seen timepieces combined with calculators and alarm systems which alert the busy executive of an important meeting, and remind the medical patient to take his medication. The future developments are limitless. Systems that are already in the early stages of development are the information memory watch which can store a limited number of telephone numbers or anniversary dates as well as your checkbook balance and even a paging system which can inform you of what telephone number to call.

Mr. Louis A. Zanoni is founder and President of Zantech, Inc., an Instrumentation and Consulting Firm dedicated to the quartz watch industry. Zantech is presently manufacturing troubleshooting equipment for digital watches.

In 1970, Mr. Zanoni served as cofounder of Optel Corp., Princeton, where the first liquid crystal watch was made. Louis A. Zanoni was instrumental in the development of liquid crystal displays and their application to the watch industry. From 1973 to 1976, he was Director of Digital Watch and Display Manufacturing Engineering.

Prior to Optel, Mr. Zanoni was a member of the Research Staff of RCA Laboratories, Princeton, for 13 years, during which time he received the David Sarnoff Outstanding Achievement Award in Science (highest scientific award of the corporation) for "Basic Studies of Liquid Crystals and Imaginative Application to Practical Displays."

While at RCA and Optel, he has published a variety of papers and was issued numerous patents in the field of electro-optic devices and circuits.

The electronic digital watch presently exists in two basic forms: (1) the LED (Light Emitting Diode) type, and (2) the LCD (Liquid Crystal Display) type. The primary difference between these two is the type of display. The term display is used in the electronic industry to describe a device which transforms electrical information into visual information. For example, the picture tube of a TV set is a display, an electronic scoreboard is a display. Therefore, the device in the watch which transforms electrical information into visual information is the display. As I stated previously, the watch uses at least one display and on occasion both types will be used. This article will describe the LED type of watch. Other types will be discussed in future articles.

No matter how complicated or versatile the LED watch becomes, it consists of only a few basic components. With the knowledge and understanding of these few components, a trained watchmaker will be able to provide service to this new breed of watches. The watch or wrist computer consists of six basic electronic components:

1. Energy Source (Battery)
2. Frequency Standard (Quartz Crystal Oscillator)
3. Computer (Integrated Circuit, Brains)
4. Display (Light Emitting Diode)
5. Substrate (Inter-Connecting Means and Support Structure)
6. The Case

Each of these subjects will be described in detail in future articles. A brief description of each component and its interrelationship in an LED watch module is the subject of this article. In principle, all LED modules are the same. There exists a number of variations in design configuration due to the type of integrated circuit (IC) which happened to be available at the time of the module design. Although there is a wide variety of physical configuration, the electronic cir-

cuit is basically the same.

All LED modules have been designed to use two 1.58 V (commonly known as 1.5 V) battery cells for one basic reason. The light emitting diode (LED) display requires large amounts of power to cause them to glow red. For example, to light one digit of the watch to form the number eight would require approximately 12 milliamps (.012 amps). To operate the entire timekeeping circuit (quartz crystal and computer oscillator) of the same watch requires only five microamps (.000005 amps). The average current drain of an LED module when displaying the time is 50 milliamperes. If the display were constantly on, the life of a Union Carbide 357 type battery rated at 190 MAH (milliampere hours) would be about two hours. If the display were never activated, the life expectancy of a 357 in a module, which drains five microamps, would be more than two years. For this reason the LED watch can only be practical when activated as required and not be allowed to display the time continuously. Therefore, *energy* is an important factor in watch design.

Frequency Standard

In order to transform the DC energy of a battery into time information, it is necessary to generate precisely timed one-second pulses. This is accomplished by a quartz crystal oscillator circuit (see Figure 1). When a DC voltage is applied to a quartz crystal which is in parallel with a transistor amplifier, it begins to oscillate at its natural mechanical resonant fre-

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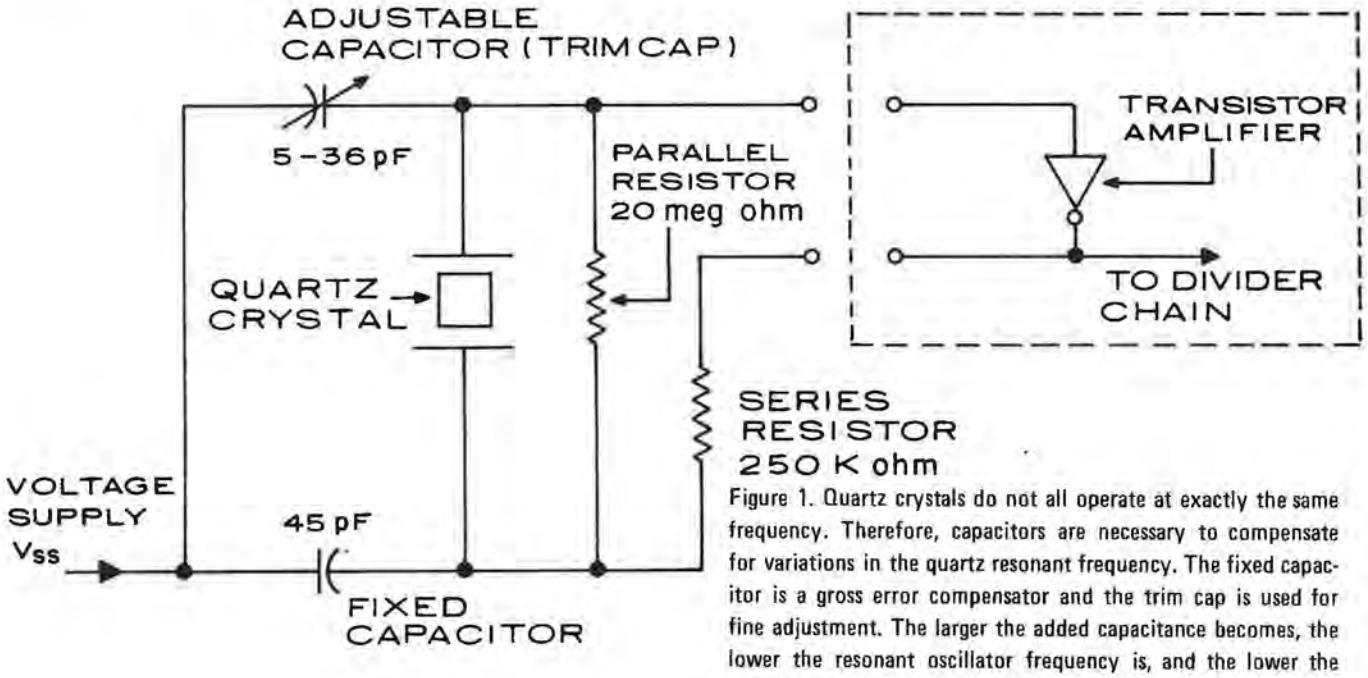
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OSCILLATOR CIRCUIT

Figure 1. Quartz crystals do not all operate at exactly the same frequency. Therefore, capacitors are necessary to compensate for variations in the quartz resonant frequency. The fixed capacitor is a gross error compensator and the trim cap is used for fine adjustment. The larger the added capacitance becomes, the lower the resonant oscillator frequency is, and the lower the capacitance, the higher the resonant frequency. If the oscillator is either too high or too low and the trim cap cannot adjust to the desired frequency, the fixed cap can be changed with a little silver epoxy and a lot of care.

quency. In order to have some control over the rate at which the quartz will oscillate, capacitors are added in the circuit; two are normally used; one is a fixed value, the other is variable. The variable capacitor is known as the trip cap (trimmable or adjustable capacitor). (See Figure 2.) The adjustment of this trim cap is the adjustment reqired to set the accuracy of the watch.



Figure 2. Back side substrate of ESA 9380 LED module, courtesy of The Watchmakers of Switzerland Information Center, Inc. The trim cap is a screwdriver adjustment which is used to adjust the watch to the proper timing frequency. Trim caps usually rotate 360° continuously, making a complete frequency adjustment every 180°. Therefore, every 360° rotation passes through the adjustable frequency range twice. If the first 180° rotation does not pass through the desired frequency, the second 180° will not either.

Due to the fact that there is no quartz crystal which can oscillate at one pulse per second, most watch oscillators oscillate at 32,768 Hz (Hz is the abbreviation for hertz, which is the international term for cycles or pulses per second). Some watch companies have chosen crystals which oscillate at other frequencies, such as 786,432 Hz and 49,152 Hz. Whatever the oscillator frequency is, it is necessary to transform it to one pulse per second so that the time of the watch will change once every second. This is accomplished by the use of an electronic divider circuit. In the case of 32,768 Hz, it is divided by two (2) fifteen times to achieve one pulse per second. (See Figure 3.) Note that 786,432 Hz must be divided by three (3) once and by two (2) seventeen times to achieve the required one (1) pulse per second. Also, note that additional work is required to achieve one pulse per second from 786,432 Hz. These added functions require additional energy; therefore this type of module consumes more power than the oscillator which is running at 32,786 Hz. The reasons for choosing either of these frequencies is related to size, accuracy, and economics, the details of which will be the subject of future articles.

32 768 Hz		49 152 Hz		786 432 Hz	
÷ 2 =	16 384	÷ 3 =	16 384	÷ 2 =	393 216
÷ 2 =	8 192	÷ 2 =	8 192	÷ 3 =	131 072
÷ 2 =	4 096	÷ 2 =	4 096	÷ 2 =	65 536
÷ 2 =	2 048	÷ 2 =	2 048	÷ 2 =	32 768
÷ 2 =	1 024	÷ 2 =	1 024	÷ 2 =	16 384
÷ 2 =	512	÷ 2 =	512	÷ 2 =	8 192
÷ 2 =	256	÷ 2 =	256	÷ 2 =	4 096
÷ 2 =	128	÷ 2 =	128	÷ 2 =	2 048
÷ 2 =	64	÷ 2 =	64	÷ 2 =	1 024
÷ 2 =	32	÷ 2 =	32	÷ 2 =	512
÷ 2 =	16	÷ 2 =	16	÷ 2 =	256
÷ 2 =	8	÷ 2 =	8	÷ 2 =	128
÷ 2 =	4	÷ 2 =	4	÷ 2 =	64
÷ 2 =	1	÷ 2 =	1	÷ 2 =	32
				÷ 2 =	16
				÷ 2 =	8
				÷ 2 =	4
				÷ 2 =	2
				÷ 2 =	1

COUNT DOWN DIVISION TABLE

Figure 3. Count down division of three popular watch frequency circuits. The IC manufacturer has the option to use any point in the divide chain as a test point or to drive other circuits such as alarms.

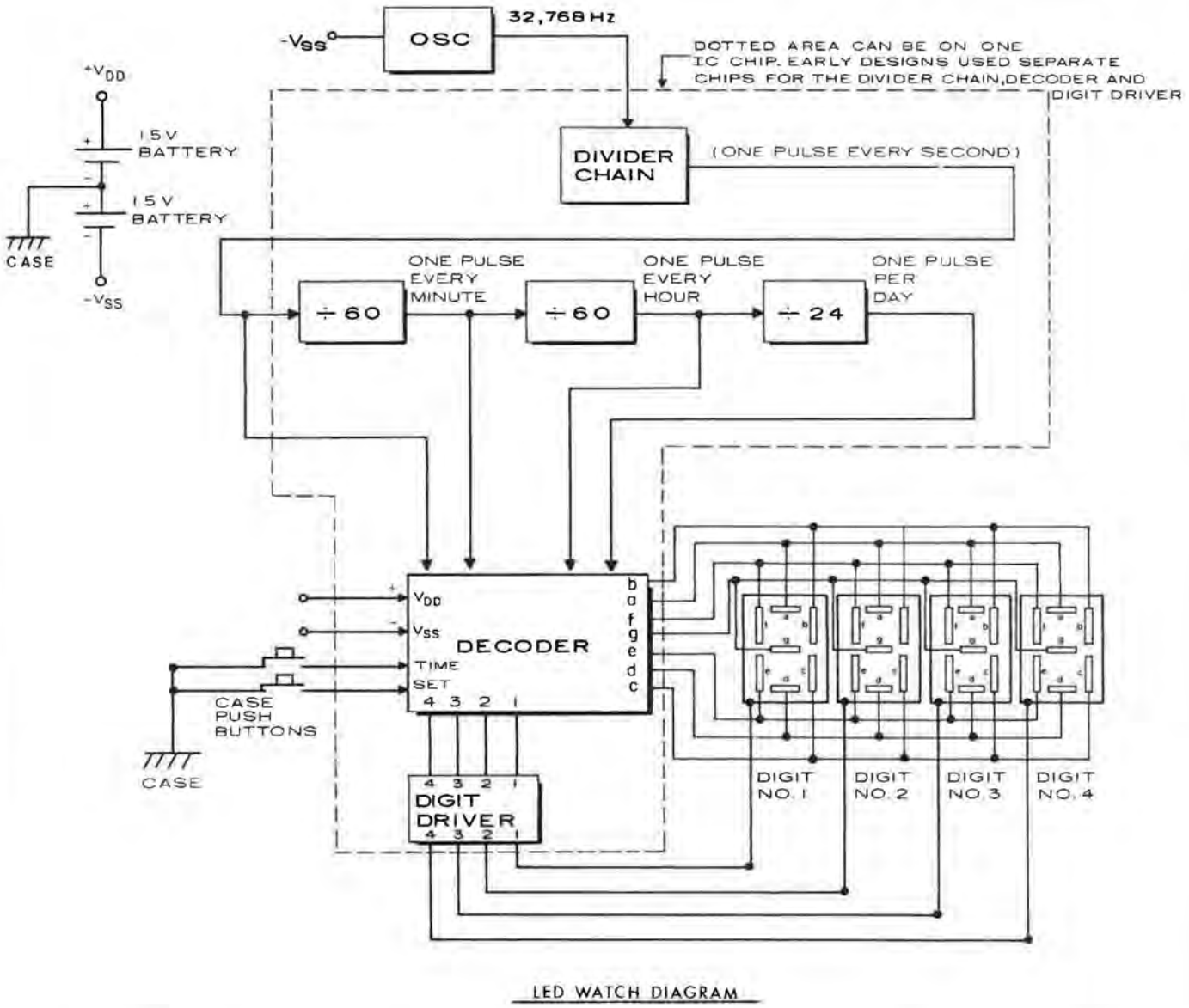
Computer

The computer is the brains of the watch. It is the portion which remembers to change the minutes after it has received sixty one-second pulses and change the hours after it has received 3600 one-second pulses. How is this accomplished? It is accomplished by simple division. (See Figure 4.) We have already discussed the oscillator and the divider chain, so we will begin with one pulse per second or 1 Hz. The 1 Hz (signal) is injected into an integrated circuit which provides one output pulse for every sixty it receives. Therefore, the output pulse from this circuit becomes the signal that occurs precisely every minute and sends that information to the display to change it each minute. The one pulse per minute is also injected into another integrated circuit which provides one output pulse every sixty minutes which signals the decoder to change the display every hour. This one pulse every hour is injected into an integrated circuit which provides one output

pulse to the decoder every day (24 hours) which changes the date. These signals while feeding the divider chain are also injected into the decoder as illustrated in Figure 4. The *decoder* is the circuit which transforms the signal pulses received every second, minute, hour, and day into visual information by providing a complex array of on and off voltages to the display.

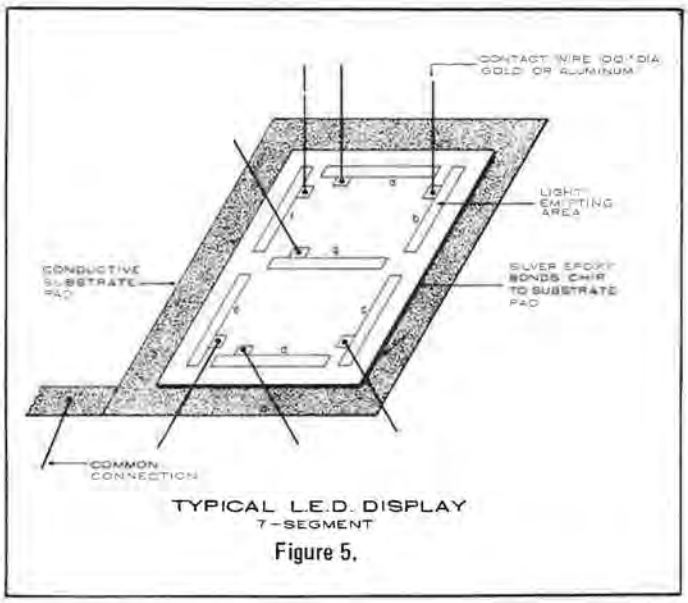
Display

The display of the LED watch module consists of at least four digits. Each digit is a separate silicon chip about .110 in. high and .80 in. wide and .010 in. thick. This silicon chip has been processed so as to have at least seven light-emitting diode bars about .045 in. long and .015 wide on it (illustrated in



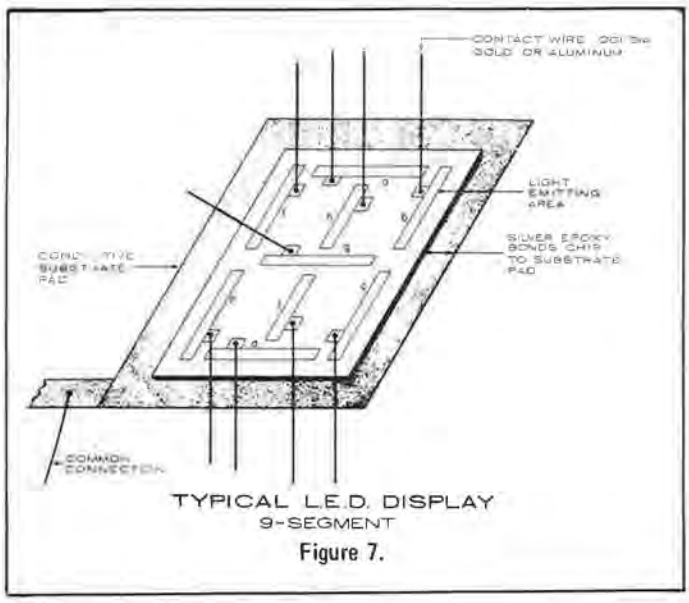
LED WATCH DIAGRAM

Figure 4. This diagram is a fundamental block diagram of an LED watch circuit. During the past few years, many packaging and design methods have been used to form this circuit into a working and saleable watch. The earliest designs combined separate IC packages for each divide section as well as digit and segment drivers. Each circuit was separately packaged and soldered to a common substrate. It will be technically feasible soon to combine all electrical circuits on one IC chip. Therefore, it will be necessary for the service personnel to recognize all of the packaging variations of this circuit so he or she can provide efficient service.



TYPICAL L.E.D. DISPLAY
7-SEGMENT

Figure 5.

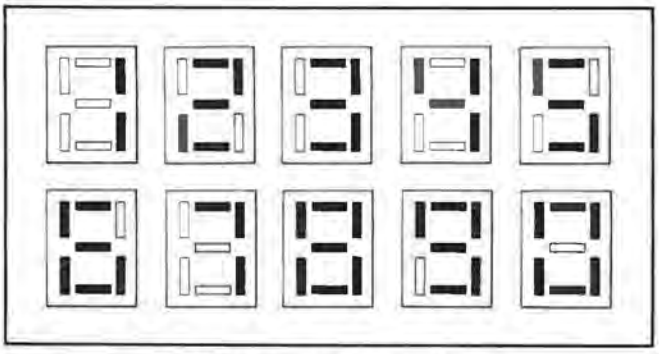


TYPICAL L.E.D. DISPLAY
9-SEGMENT

Figure 7.

Figure 5). The red light of the diode emanates from the area adjacent to the aluminum bar when a voltage is applied to the aluminum pad adjacent to it. It is possible, therefore, to form all numbers from 0 to 9 by lighting the various combinations of diode bars as illustrated in Figure 6. When four digits are mounted adjacent to each other on a substrate it is possible to display numbers from 00:00 to 99:99. Since the telling of time on a twelve-hour watch requires numbers only up to 12:59, the first digit generally is not completely connected, only the b and c segments are used (see Figure 5). When a watch is required to display the date and seconds simultaneously, for example: 31:59, it is therefore necessary to use a silicon display chip with nine segments (as in Figure 7) to form all the days of the week. Figure 8 illustrates the activated segments which form the day of the week on a nine-segment display. The colon usually consists of two separate LED chips.

In order for the computer (decoder portion) to form all the possible numbers and letters of a timepiece, it is necessary to interconnect each segment of each display to the computer. It is common knowledge that two wires are required to complete any electrical circuit. In order for current to flow through any circuit it is necessary to have one forward path, and one return path. In the LED type of display the forward path wire is connected to each diode segment of the chip and the return path wire is connected to the back side of the chip. The back side contact is the return current path for all segments. It is referred to as the common connection (see Figures 5 and 7). This connection is made to the back side of the chip by cementing it to a conductive metal pad on the substrate with a conductive silver epoxy. The conducting pad of the substrate is then wire-bonded to the digit driver chip. The purpose of the digit driver is revealed later in this article.

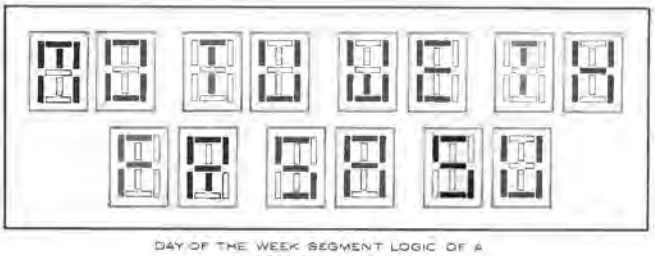


7-SEGMENT NUMERIC FONT

Figure 6.

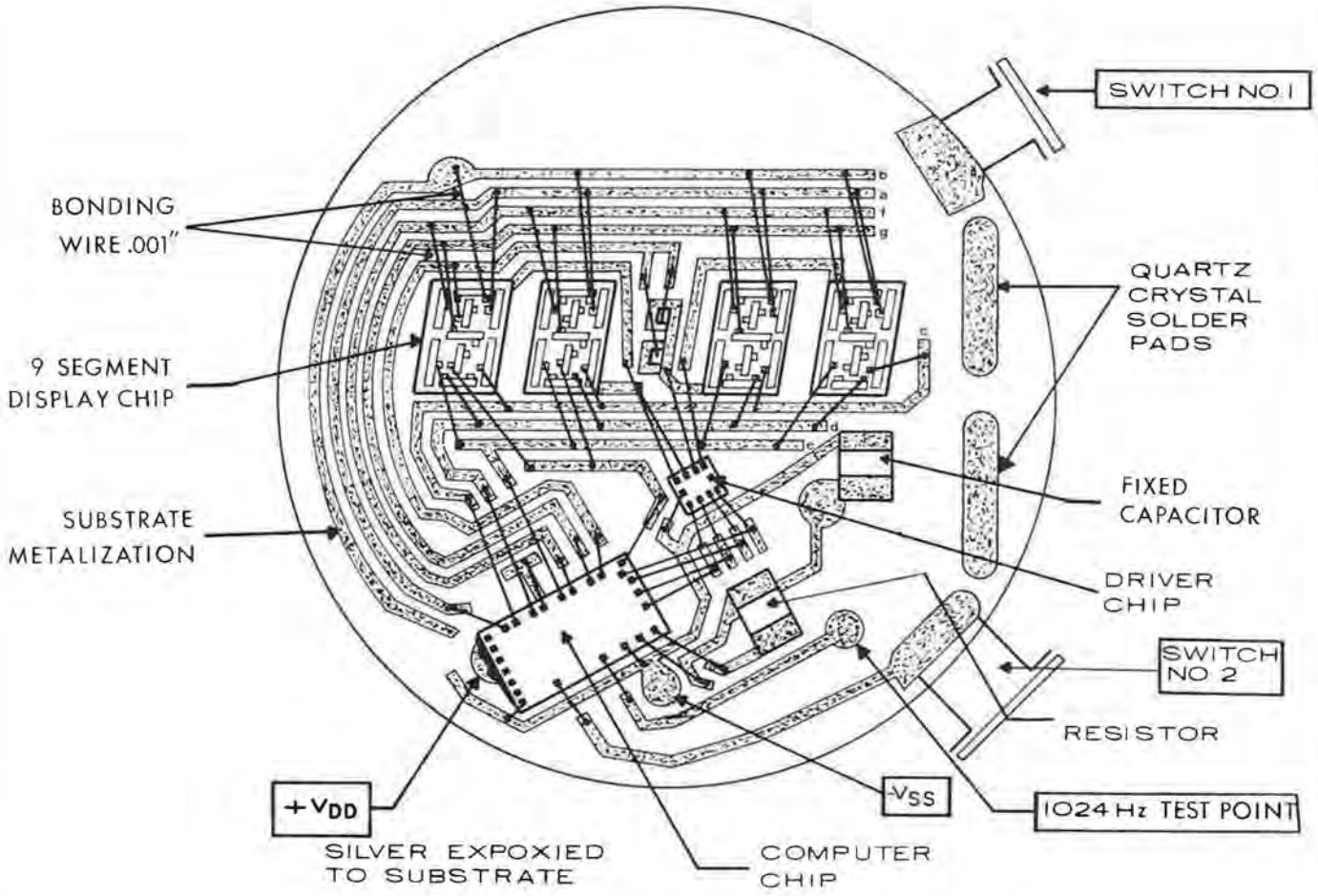
Substrate

In order to discuss the interconnection of all the above-mentioned components, it is necessary to examine the substrate. The substrate is a rigid wafer of either ceramic, plastic, or printed circuit board material with selectively deposited con-



DAY OF THE WEEK SEGMENT LOGIC OF A
9-SEGMENT DISPLAY

Figure 8.



WIRE BONDING DIAGRAM – TOP SUBSTRATE

Figure 9. This diagram illustrates the top side of a completely wire-bonded LED module. Interconnections to the back side of the substrate are made by means of conductively plated through holes. An example of the back side of a typical LED module is illustrated in Figure 2. A two-sided conductive substrate has the advantage of interconnecting two remotely placed contacts without using jumper wires. The connection is made via a plated through hole along the back and through another hole up to the front side. That is why all interconnections are not visible in this diagram. The 1024 Hz test point is designed to facilitate factory testing of the oscillator frequency. It is impossible to measure the 32,768 Hz signal by making contact to the quartz crystal terminal. Any test probe which contacts it has an effect on the frequency. Therefore, a point in the count down chain from 32,768 to 1 Hz (Figure 3) is selected and brought out to a pad on the substrate where a test probing can be made without affecting the oscillator frequency. In this module 1024 Hz was chosen.

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ductive lines and pads on either side of it. Both sides are interconnected by conductively plated holes through the board. The main purpose of the substrate is to support and interconnect each and every one of the components of the watch. As the printed circuit board is required to interconnect all the components of a transistor radio, so it is required in the watch.

Examine Figure 9. Note that all "a" segments of each digit are connected together by one conducting line on the substrate. The same is true for all other segments of the display (b, c, d, e, f, g, h, j). You must be wondering by now why all the digits don't display the same number if they are connected together. The reason is that each digit has a separate return path, and "only one digit return path is open at one time." Although it appears that all four digits are lit simultaneously, only one digit is on at any instant in time. Each digit is being turned on and off so rapidly that they all appear to be on at the same time; something like a moving picture effect.

The sequence of events required to display the time of 12:59 is as follows: the driver chip is the circuit which determines which digit is being activated, and only one is on at a time. The driver chip's primary function is to apply power to each digit sequentially. As the driver chip is receiving a signal from the computer chip (decoder portion) to turn on digit number 1, the computer chip is sending a signal to the display segment lines to form the number 1 by activating segments a and b. Since the only path for current flow is through the digit driver and only digit number 1's return path is open, digit number 1 forms the number 1. Next, the computer sends a signal to the digit driver to turn off digit number 1 and turn on digit number 2. At the same time the decoder is changing the information on the segment lines to form the number 2. Since the only digit that is on is digit number 2, digit number 2 displays the number 2, and so on to digits 3 and 4, forming the numbers 5 and 9, and starting over again at digit number 1. This occurs so rapidly that the human eye cannot see the flicker. In addition to reducing the number of output pads from the decoder, this scheme (which is known as strobing or time sharing) reduces the power required to activate four digits by 75%, because current drain is only through one digit at a time. It also has the effect of reducing the total brightness. If all digits were on simultaneously, the power requirements would be prohibitive.

The substrate is usually mounted in a *movement ring*, which in most new modules is molded plastic, shaped to fit into a case. The movement ring is a retainer for the batteries as well as a means of interconnecting the substrate to the case. In some designs a protective cover over the IC portion of the substrate is part of the movement ring. The movement ring and the protective cover combined act as a clamp between the substrate and the switch contacts so as to interface the substrate with the case. Be alert for all possible contact points between the substrate, movement ring, switches, and the case. They are all potential problems.

Case

The case is an integral part of the electrical circuit of most watches. Although some designs only use the case for mechanical contact to the module, most use it to complete the electrical circuit of the watch. For example, the interconnection between the batteries is accomplished through the case back. Since the batteries are in series, and case contact is made at the center point between them (see Figure 4), the case has a voltage potential of 1.5 V. Therefore, when the push-button of the case contacts a conductive pad of the module, it applies 1.5 V to the switch contact which is connected to the computer chip. (See Figure 9, Switch No. 2). When the computer receives a signal from either switch it is programmed to perform a specific function, such as turning on the display, setting the time, etc. Note that it is possible to tell the computer to do many things with simple repeated voltage pulses within a specific time period.

When examining an unfamiliar module, take note of all interconnections between the substrate, batteries, switch, and case. There are many methods to achieve the interconnections between the module and the case. A thorough examination of each new module is necessary prior to testing. It is very easy to overlook a side contact in the battery cavity and finger contact on the perimeter of the movement ring which contacts the case. It is possible for a battery shorting bar to be taped to the inside of the back without making electrical contact to the case back. Be alert for shorts to the case. Remember the case is part of the electrical circuit of the watch.

Servicing the LED Watch

It is simple enough to provide minor service to an LED watch by replacing the batteries and modules, but to provide quality service at a fair price requires an understanding of the operation of the device. In my estimate, 50% of all faulty modules replaced by untrained personnel are in reality good modules that require additional service.

The primary difference between the failure mode of electronic and mechanical watches is that one is visible and the other is not. In most cases, the problems associated with

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the failure of a mechanical watch are visible with a loupe or microscope. Although a fair share of visual problems occurs in the electronic watch, most are invisible to the human eye and require the use of electronic test instruments to locate the problem.

The electronic test equipment requirements of the electronic watch need not be any more expensive or sophisticated than the instruments and tools used to service a mechanical watch. As a matter of fact, the electronic test equipment which is required to adequately service electronic watches is less expensive than the equipment required to service the mechanical watches. I also contend it requires less training and equipment to establish an electronic watch service center than it does to set up a mechanical watch service center. Electronic watch service is simpler and easier, therefore, more profitable.

Although watches are timing devices, and proper adjustment of the timing mechanism is essential, current drain, voltage levels, circuit continuity and switch functions are equally important to the efficient operation of the electronic timepiece.

When a watch is dead (no visual information) and replacing the cells does not revive it, do you replace the module? By all means, NO! You wouldn't replace the movement of an Accutron if the cell didn't revive it, and you shouldn't do it for the LED. You should determine the exact cause of the problem and then decide to repair or replace. DON'T WORK BLIND. Know the exact cause of the problem before you decide to replace or repair.

An infinite number of failure analysis methods exists for any sophisticated device, and the electronic watch module is no exception. I think each service person should develop his or her own failure analysis techniques, after he or she has learned the fundamentals of its operation.

As an aid to developing your own technique, I will outline one elementary approach to determining the cause of a so-called dead module. That is, no response when pressing the command or set buttons.

Step 1. Remove the module from the case. Use caution and care as with any mechanical movement. Be alert for free floating components which may have broken loose, such as resistors, capacitors, switch contacts, etc.

Step 2. Examine for physical damage or corrosion. Remove *all–all–all* battery acid corrosion. If it is not all removed it will continue to cause problems. Use a solution of baking soda diluted in water if necessary. A pencil eraser is very useful. Do not remove gold plating if possible. It is a protective coating.

Step 3. Repair any obvious physical damage. Resolder any poor solder contacts. Use conductive silver epoxy (room temperature cure) to replace any loose or broken component. In many instances, it is a good substitute for solder. Examine the substrate carefully to determine whether the contacts of the original assembly are epoxied or soldered. Solder will not adhere to a surface that has a residue of epoxy. Epoxy on epoxy is acceptable.

Step 4. Apply power to the module with an instrument which can measure the current flow. Measuring the current flow is similar to a physician listening to a heart beat. High currents mean one thing, low currents and erratic current mean another, as does no current at all. Each is a separate indicator. No current at all is a dead end road. Until it is determined where the open circuit is, it is fruitless to proceed. Whenever no current is measured, check your testing procedure first. I suggest as a procedure to test the credibility of the test instrument and your method the testing of a good module, one similar to the faulty one.

Keep samples of good modules on hand at all times. Establish a foolproof test procedure, using the known good module as a standard. When you know that the test is being performed properly and all the proper connections to the module are intact, proceed to determine where the circuit is open. When using an ohm meter, be sure it is a low voltage type, no higher than 3 volts for LED, and 1.5 V for LCD.

Step 5. When it is determined that a reasonable amount of quiescent current flow is present, attempt to activate the display from a center tap of 3.1 V supply. (Quiescent current is the current that continuously flows through the module, keeping time. Two to ten microamps is normal, while some units function well at 15 microamps. The higher the current, the greater the energy consumption from the cell.)

Step 6. If the module functions properly, examine the case and its relationship to the module for defects. When you know the module works properly out of the case, the problems are usually mechanical and are related to the module case interface.

Step 7. If the quiescent current is normal and no display appears when activating the switch contacts, place the module next to the sensor of a frequency monitor with the proper voltage applied to the module. If the module is oscillating at the correct frequency of approximately 32,768 Hz or 786,432 Hz, the instrument will sense it and indicate such. If the instrument does not receive a signal, chances are the oscillator is not functioning. It is possible for an oscillator of a watch module to be oscillating so far off the standard frequency that the frequency monitoring equipment will indicate no oscillation. If this occurs, and the module appears

(continued on page 48)

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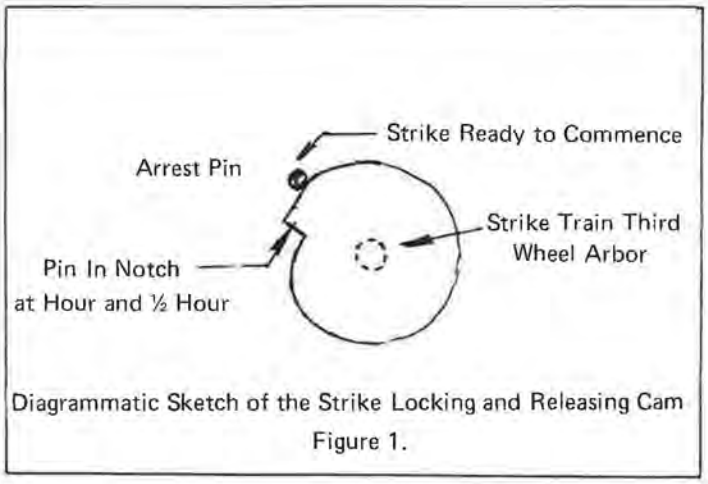
by Sean C. "Pat" Monk
CMW

THE SETH THOMAS MANTEL STRIKE
Part XXII (circa 1910)

Jack Dawson, my head clockmaker and I, have discussed this clock as being one of the best of the American striking mechanisms. Also, whereas we have labelled our particular model as "circa 1910," these mechanisms were made both before and after that date, for a good many years. Moreover, although they are purely American, they have been successfully exported to the far corners of the world.

One point before we proceed with our clock discussion is that I have tried to conform my nomenclature to that used in the past. Sometimes this has been difficult. Sometimes, perhaps, I have used language not current in the old books. Where this has occurred I have at least attempted to make my description(s) understandable to the average bench mechanic. There is no intention to change the system and neither would I be so presumptuous as to try.

With this particular clock, we shall concern ourselves primarily with the strike mechanism. The "going" train (on the right-hand side as you face the clock) is virtually little different from the going trains of other clocks of similar purpose. The going train has the usual four wheels, plus an escape wheel. The latter operates in conjunction with the anchor or pallet.



Diagrammatic Sketch of the Strike Locking and Releasing Cam
Figure 1.

The strike train is not unusual in the number of wheels contained therein. First, there is a main or great wheel, then a second wheel, combining the hour count wheel and the pin wheel (for hour striking), on a common arbor. The third wheel carries a cam (Figure 1) for locking and releasing the strike in conjunction with the count wheel. Finally, there is a fourth wheel meshing with the pinion of the strike fan.

If one observes the center arbor of the going (time) train, it will be observed that this arbor carries two steel pins, set 180 degrees from each other. It will be observed that at the hour, one of these pins frees the count hook (c) from the hour-count wheel (a). (Figure 2). The latter is the wheel on the outside, clearly marked in the photo. The other pin on the center arbor (180 degrees from the other pin) has the simple purpose of lifting a lever attached to the hammer. This permits the hammer to strike once at the ½-hour.

At the hour strike, the hour-strike lift pin (situated on the clock's lowest arbor) frees the count hook (c), permitting the

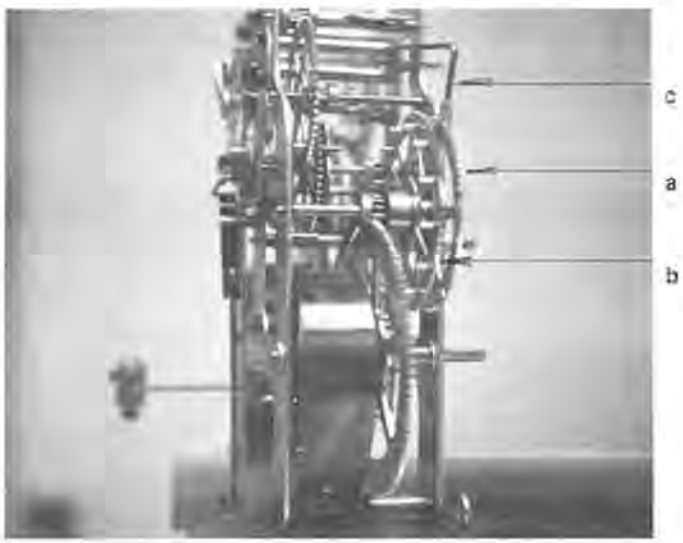


Figure 2.

count wheel (a) to turn free. The latter will then turn and the clock will strike the hours, as determined by the count wheel. In the meantime, the pin wheel (b) has been released and the designated number of hours is struck. At the end of the strike the count hook has dropped into its designated long tooth (slot) in the count wheel.

At the end of the hour strike, a strong helical spring-loaded kick-pin (set on the lowest arbor of the clock) locks against an appropriate brass pin on the pin wheel. The hammer arm itself is also attached to this lowest arbor and, therefore, is unable to move until the kick-pin itself is released. The spring-loaded kick-pin is, of course, that which triggers the strike.

The cam (strike locking and releasing) shown in Figure 1 is permanently fixed to the third strike train wheel. Normally it is locked by a steel arrest pin from the lower strike-operating arbor. The arrest pin (Figure 1) itself is set against a notch in the cam at the conclusion of the strike sequence. However, this cam has one flat side (shown in sketch). This flat side is cut above the notch and commences to move as the hour strike comes into play. When the strike is finally released, the pin resting on the cam is free to move over the cam's periphery and continues to do so until the hours are counted by the count wheel. After this operation, it is allowed to fall back into its locking position in the cam's slot.

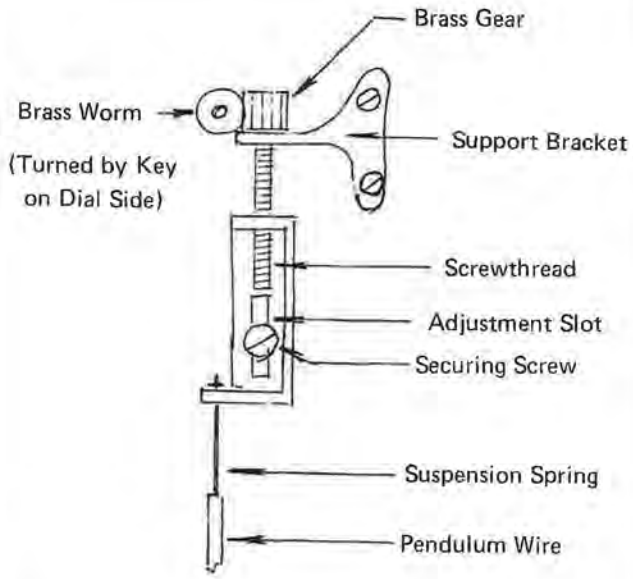
It should be noted, at this point, that there exist two U-shaped lifting wires which work in contact with the lift pins referred to for the hour and the ½-hour strike. These lifting wires are shaped in such a way that, if necessary, they may be bent to adjust the position of the minute hand at the hour, or at the ½-hour. Usually, if this must be done, it is a very small adjustment.

The strike fan, the last item in the strike train, is made of brass. It is mounted on a steel arbor and is slightly adjustable (for strike speed) by bending, if necessary. However, a too-rapid strike is usually the result of a too-strong strike spring, fan too small, or loose on arbor. In any event, check the fan for tightness and pivot-freedom first.

The two mainsprings are usually of closely-related strengths and dimensions. This gives the clock a balanced look. However, it is recommended that they should not be interchanged during the clock's reassembly.

Marking of the effective length of the pendulum. If one will observe the lower left-hand corner of the back plate of these Seth Thomas movements, this pendulum length is marked in inches. In our model it is 3 5/8 inches.

The height of the pendulum is adjusted from the dial side, just over the 12 o'clock. Here exists the squared end of an arbor which runs between the two clock plates, holding a brass worm-gear outside the rear plate. The squared end at the top of the dial can be turned with the small end of the double-ended key provided for the clock. Turning the key, therefore, will turn the brass worm-gear. The latter, in turn, rotates a cylindrical brass gear. The latter, in turning, rotates a screw thread which is capable of moving the suspension bracket up or down. The overall length of the pendulum can thereby be changed for timing adjustment. (See Figure 3.)



Diagrammatic Sketch of Pendulum Wire Adjustment

Figure 3.

Figures 4 and 5 on page 52 depict the front and rear-plate views of the clock movement, respectively.

(continued on page 52)

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SCHOLASTICALLY SPEAKING

by Gerald G. Jaeger CMW

Chairman, Research and Education Council

Mr. Harold Herman, co-editor of HOROLOGICAL TIMES, has indicated his desire to me that the Research and Education Council of AWI use the HOROLOGICAL TIMES as the vehicle to report REC activities to both AWI members and REC members.

In this, the initial article, I might take just a moment to update some of our newer members as to just where REC fits into the overall scheme of AWI. Article XXIV of the AWI Constitution establishes REC as an integral part of AWI and sets forth the purpose of REC. The purpose of REC is to give assistance to the Officers, Directors, and general membership of the Institute on any research and education projects undertaken by the Institute. Section XXIV furthermore directs that REC make recommendations to and advise the Officers, Directors, and the Executive Secretary on any subject for the betterment of the Institute, its members, or the research and educational activities of related organizations.

REC has met these challenges, and, within the confines of the AWI Constitution, has broadened the scope of its activity. The very make-up of REC dictates that we channel much of our effort to working with and for instructors of Horology in the many schools in the United States and Canada.

THE REC annual meeting is held in Cincinnati and has been scheduled to follow closely after AWI's annual meeting. The meeting this year will be held prior to AWI's. The dates have been confirmed as June 20, 21, 22, and 23. Complete details of the meeting and workshops will appear in next month's edition of HT.

The National Roster of Watchmaking Schools published by AWI lists 48 schools, and 39 of the schools listed are members of the Research and Education Council of AWI. This is certainly a creditable representation but we hope to improve on it. Our plans are to work with the AWI Affiliate Chapters in the areas where there are schools which do not belong to REC.

Most of the young people entering our profession are introduced to AWI at the Schools of Horology which are REC members. This is why it is so important that our Affiliate Chapters get involved with the schools in the locales of non-member schools. The Schools of Horology also have much to offer to the journeyman watchmakers. Many of the schools are part of the junior colllege system or the vocational-technical system in their states. The mission of these schools is continuing education, and our industry should work to make these facilities and the expertise of their faculties available to us. I do not know of a case where schools of Horology, when called on by the industry, have not cooperated to the fullest of their ability.

Hopefully, through these articles we can acquaint the AWI membership with the activities of REC. We will call on various instructors throughout the U.S. and Canada to put forth some of their ideas, and we will all get a better insight into our educational system as it relates to Horology.

U.S. INSTRUCTORS TO HEAR SWISS ENGINEER

Through the cooperation of Jean Pierre Savary and Alvin I. Rudnick of Watchmakers of Switzerland Information Center, New York, a comprehensive program will be presented for watchmaking instructors in the United States. WOSIC and Ebauches SA have arranged to bring Mr. Remy Waelchli to the United States to conduct a seminar for watchmaking school instructors who are members of the American Watchmakers Institute's Research and Education Council. They will meet in Cincinnati, Ohio, June 20–23.



Mr. Waelchli was born in Saint-Imier in the mountains of Switzerland in 1935. After attending the watchmaking school in that city, he was hired by the Longines watch factory. Interested in working in foreign countries, he carried out several assignments in places such as Italy, Spain, and England.

In 1964, he went to Japan on behalf of the Swiss watch industry and eventually became director of the technical center in that country.

Currently, Mr. Waelchli is in charge of the Training Center of Ebauches SA. Each year this center trains more than 1000 watchmakers who come to learn the latest information and techniques in the servicing of new products manufactured by Ebauches SA.

ORVILLE R. HAGANS VISITS PARIS JUNIOR COLLEGE

While returning from a recent American Watchmakers Institute Executive Committee meeting, Orville R. Hagans, 2nd Vice President of AWI and curator of AWI Educational, Library and Museum Charitable Trust, visited Paris Junior College, Texas, to tour and inspect the school, "one of America's largest, oldest, and best equipped watchmaking and jewelry repair schools."

"I was greatly impressed," Hagans said. "This school has a highly professional approach to instructing the art of modern watch repair."

"All the instructors," he reported, "are keenly alert to horological technology, including the very latest models of quartz-crystals and digitals. They are all well educated in the liberal arts, attuned to the ambitions of their youthful students, and they are themselves experienced craftsmen and enthusiastic members of AWI."

In the clean, modern, well-equipped classrooms, Hagans observed over 40 students engaged in learning watch repair. In an adjacent department 67 more students were learning the skills of jewelry repair. Don Nafus, department



L to R: Robert Hornell, Orville Hagans, Don Nafus

head, explained to Hagans that most of the 107 energetic students were sons and daughters of jewelry store owners.

"They come here from all over the U.S.," Nafus said, "and most will train in both watchmaking and jewelry repair–as well as in other academic courses such as gemology, jewelry design, salesmanship and window and counter display." At Paris College students may specialize in either watch repair, jewelry repair, or take a full comprehensive course with academic subjects oriented specifically to jewelry store operation.

While at Paris College, Hagans, famed "Dean of American Watchmakers" and former president of the American Academy School of Horology, had a lengthy conference with Paris Junior College President Dr. Louis B. Williams.

"I just wish the repair classes were larger," Hagans commented.

Williams explained that due to the extremely crowded classrooms at the 2,400-student college, the school cannot accommodate another 100 or so candidates awaiting to



L to R: Louis B. Williams, President PJC; Orville Hagans; William L. Hindman, Dean Applied Sciences; Paul Clayton, Division Chairman, Horology and Jewelry Technology.

enroll in the watch and jewelry repair courses. "We want to construct a special building for our jewelry courses as soon as possible," he said.

In 1975 a project was initiated by some members of the jewelry industry to join Paris College in a cooperative effort to fund the construction of a brand new $500,000 facility on the campus to be devoted exclusively to jewelry education. But from the jewelry industry's end the fund raising is presently in a stalemate. The agreement was that if the jewelry industry would contribute $250,000, Paris College would match that amount to build the facility. The college would maintain the structure, provide the staff and pay all future operating expenses. Tuition for all out-of-state students would be the same as for local residents–a low $50 per month, and the facility would be available to every segment of the American jewelry industry exclusively.

Taxpayers of Paris, Texas, approved a special quarter-million dollar bond issue to provide the school's share of the money. The American jewelry industry, however, has not yet provided its share for training students who could come to Paris College for education, then return to their home communities. A non-profit organization called National Professional Jewelers Center, Inc., initiated by the Dallas, Texas volunteers, launched a campaign but met with industry indifference and some resistance. Because of insufficient operating funds, the project was suspended after six months.

As conceived, the program would have enabled Paris College to graduate 500 craftsmen and professional store personel annually. Besides the vocational skills of watch and jewelry repair, the school would also have enlarged its jewelry oriented professional training department in salesmanship,

(continued on page 52)

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

Our column this month is devoted to AWI's annual election. Each year the AWI membership elects five of its members to serve a three-year term on the AWI's fifteen member Board of Directors. At the annual Affiliate Chapter meeting, the delegates select a sixteenth member to serve on the Board of Directors for one year as the Affiliate Chapter Director. During the annual Board of Directors meeting, the sixteen active Directors then meet to select the five executive officers who fill the offices of President, 1st Vice President, 2nd Vice President, Secretary, and Treasurer for one year.

Ballots and voting instructions will be received by each active member eligible to vote via first class mail. Ballots are to be marked and sent in their official ballot return envelope to the Certified Public Accountant who is charged with the responsibility of counting the ballots. All ballots must be postmarked on or before May 31, 1977 to be eligible. They must be returned in an official ballot return envelope. Members will note that each ballot return envelope is numbered. The Certified Public Accountant will separate your ballot from the numbered envelope to insure the anonymity of your vote. By using numbered envelopes, AWI is assured that no bogus ballots will be submitted during the election.

Perhaps the single most important ingredient of AWI's success in recent years has been the quality of the members who have been selected to serve as AWI Directors. Each of the candidates this year would make an excellent Director. As a voting member, you are requested to study each candidate's resumé; if you need additional information on a candidate's qualifications, we will try to supply it for you. Voting is a duty and privilege; we urge each member eligible to vote to return his ballot before the deadline of May 31, 1977.

Only ballots are to be sent to the CPA. Do not include any notes or requests. The CPA keeps all materials received during the election in his custody until the final vote is tabulated. To include notes and requests in with ballots will only delay our answering them until sometime after June 10th, when the official tally is in. Each year we make this request, and each year we receive an average of twenty to thirty notes when the ballots are turned over to us in June by the accountant.

The recent AWI annual Executive Committee meeting was attended by the entire committee. Members of this committee include: President, James H. Broughton; 1st Vice President, Gene Kelton; 2nd Vice President, Orville R. Hagans; Secretary, Dorothy M. Aderman; Treasurer, Gerald G. Jaeger; and, Executive Secretary, Milton C. Stevens.

Six Past Presidents also attended this meeting: Clinton E. Aderman, Henry B. Fried, Gerald G. Jaeger, Marvin E. Whitney, Robert A. Nelson, and Harold J. Herman.

The committee expended two days of concentrated work on improvements and new programs being perfected and readied for AWI members and affiliates.

A complete report will be released soon to enable members and committees to take further action at the meeting of Directors, on June 24–26, in Cincinnati, Ohio.



AWI Executive Committee and Past Presidents at meeting. L to R: Henry B. Fried, Past President; Milton C. Stevens, Executive Secretary; Dorothy M. Aderman, Secretary; Orville R. Hagans, 2nd V. President; James H. Broughton, President; Gene Kelton, 1st V. President; Robert A. Nelson, Past President; Gerald G. Jaeger, Treasurer, Past President; Marvin E. Whitney, Past President; Clinton Aderman, Past President.

(candidates for election listed on pages 50 and 51)

(continued from page 4)

LOUISIANA

On Sunday February 13, AWI conducted a state meeting and workshop. The bench workshop was "Repair of ESA 9181 Quartz" conducted by Gerald G. Jaeger, and attended by over 30 watchmakers. As a result of this meeting, plans are being made to reestablish the Louisiana State Watchmakers Association.



Gerald G. Jaeger

NEW JERSEY

At the March 8 meeting, the Watchmakers Association of New Jersey heard Henry Frystak, Accutron Instructor at the Bulova Watch factory, present Part Two of a two-part series on Accutrons and the quartz analog model 242. He brought with him large working models of the 221, 230, 218, and 214 Accutrons.

At the April 12 meeting, Mr. Louis A. Zanoni of Zantech presented methods for analyzing, testing, and timing digital watches. Mr. Zanoni is co-inventor of the liquid quartz crystal. This meeting will be held in Clark, New Jersey, as part of the rotating meeting locations service of the association.

At the May 10 meeting, the Perna Agency will present an attorney who will speak on wills and taxation.

Bill Armstrong and Joe Biancola are coordinating plans for a dinner-dance, tentatively set for October 22.

ILLINOIS

At the March 17 meeting of the Central Illinois Watchmaker Association, Professor Paul Miller of Illinois State University, spoke on "It's About Time,"–a program dealing with the measurement of time since the beginning.

VIRGINIA

The HAV-Potomac Guild held a meeting on March 8, with a program on "Home Energy Audit," developed by the Washington Gas Light Company's Consumer Information Department. Ms. Ellen L. Coren was speaker for this presentation. At the April 12 meeting, the Guild heard a presentation by Dick Ward on the proper use of a watchmaker's lathe.

The Tri-City Guild held a meeting on March 15, and on April 3, a Seiko Quartz workshop on the stepping motor was held. Completion of this course entitled the members to a certificate of achievement.

OHIO

The annual WAO Convention will be held on July 29-31 at the Marriott Inn in Columbus, Ohio. This year's theme will be a more relaxed atmosphere with a Bulova slide/tape presentation on the latest Bulova Accutron and Bulova Quartz watches. Mr. I.T. Saldi, President of Integrated Display Systems, will present a program on their digital watches. After-dinner speaker will be Francis Siebert of Defiance, Ohio. On May 15, the WAO will present a seminar on the ESA 9158-9200 electric watches in Marietta, Ohio. Jim Broughton will conduct the bench course.

COLORADO

The Spring Seminar of UWCAC-AWI was held recently at the Continental Denver Motor Hotel. Two separate educational programs were conducted at the same time, one on watches, and one for the clockmakers. The Seiko Quartz bench course was presented for the watchmakers, with the clockmakers' program consisting of two slide/tape presentations from AWI Headquarters, a demonstration of 400-day clock servicing by Larry Burnworth of Colorado Springs, and a slide show by Wes Van Every on the restoration of the Daniels and Fisher Tower Clock. Les Smith, representing AWI, and Maury Norrell of the American Horologist and Jeweler, were guests.



Larry Burnworth

Three new 3-year directors were elected by UWCAC members via mail: Larry E. Burnworth, Emery Brittenham, and Orville R. Hagans. New officers include Pres., Eldon Ramsel; V. Pres., Emery Brittenham; and Secy-Treas., Larry E. Burnworth. A committee was appointed to revise the Constitution and By-Laws.

ONTARIO

The Annual Meeting of the Ontario Watchmakers Association was held on April 24 in Toronto. The President, Treasurer, and Committee Chairman gave reports of the past year's activities. Officers were elected. A technical seminar, including a lecture by a representative of Union Carbide on batteries

(continued on page 52)

THE LED WATCH MODULE

(continued from page 41)

to be functioning properly, set the watch to the correct time and check it again in 24 hours. If the time is significantly off, I suggest the quartz crystal be replaced and set to the proper frequency. If this does not work, check the other components in the oscillator circuit.

The oscillator can be faulty for a number of reasons. Most prevalent is the quartz crystal itself. A faulty quartz can be determined in a number of ways:

a. Replace it with a known functional quartz. This is time-consuming, troublesome, and may cause unnecessary damage to old and new quartz by too many soldering and desolderings.
b. Inject a signal, similar to the original frequency of the module, into the circuit. *Be sure it is the proper frequency for that module.* If the module begins to function properly, then you can replace the quartz with some confidence that it is truly at fault. It may be necessary when proving the quartz to activate the switch contacts to test for proper operation.

Step 8. Open display segments and digits. Three types of display failures are prevalent:

a. One non-functioning segment of only one digit (open segment)
b. One non-functioning digit (open digit)
c. The same segment of each digit is not functioning (open segment line)

A single *open segment* is usually indicative of an open wire bond at the display or the substrate. Remember, each digit is silver epoxied to the substrate, therefore, examine the bonds of the faulty segment. They can be seen clearly under a 30 power microscope.

Using a very fine pointed needle probe, push on the wire at the height of its arc, between the substrate and the chip; if one end is loose it will move. Be careful not to damage good wire bonds; they are very delicate. When a wire is found to be poorly bonded to the substrate, a drop of conductive silver epoxy can be used to rebond the contact. If the break is at the chip, it also can be rebonded with epoxy, but with much less success. The bonding pad of the IC is very small, usually .010 in. square. Unless you are absolutely sure that the bond is broken at the chip, I would not suggest an attempt to repair it. On the other hand, if it is the only problem with the module, and your only alternative is to replace it, nothing will be lost if your attempt to repair it is unsuccessful. The practice will lead to future successful techniques.

If the display chip and its bonding wires are coated with a protective coating, it is almost impossible to repair.

A single *open digit* is indicative of an open line in the digit common connection (see Figures 5 and 7), digit driver, or computer chip (see Figure 9). Note that four lines are coming from the computer chip through the driver chip to each of the common connections of each digit. If any one of these connections is broken, it will manifest itself as an open digit. Therefore, determine which digit is in trouble and proceed to locate the weak connection. Note that it is possible that the computer or driver chip can be at fault, but if the wire bonds are poor, repair them by using the method described for repairing the segment lines.

An *open segment line*: If the same segment of each display is not functioning, it is known as an open segment line. To determine the location of the open line, follow the conductive line of the substrate that interconnects the faulty segment to the IC which is driving that segment. As illustrated in Figure 9, the segment line returns directly to the computer chip IC, therefore, the suspected problem would be the wire bond from this chip to the substrate. Other watch designs use a segment driver chip which is separate from the computer chip, similar to the digit driver. It is easily identified because it will have seven bonding wires connecting it to the computer chip and seven bonds connecting it to each of the segment lines. It must also have one power supply connection, usually –Vss.

The purpose of this article has been to introduce the mechanical watch service person to the fundamentals of an LED watch module and a few elementary service tips. It is impossible to inform you of every possible design variation and the potential problems with it in one short article. Therefore, I intend to follow up this article with more detailed information of each component used in the watch so that you will have a thorough understanding of its operation. This information should allow you to provide top quality service to the public and the electronic industry. Without your help the electronic watch industry will not survive. □

THE LIQUID CRYSTAL WATCH

(continued from page 27)

either a bad IC or a bad display the entire assembly must be discarded. As a result, this construction is extremely expensive, and will probably be used only by a small number of manufacturers on premium priced products.

Assembly into a Module

Although all modules contain somewhat the same components, the means of putting them together can be completely different. Figure 11 shows the printed circuit board assembly of a ladies module manufactured by Micro Display Systems. This is the side with the integrated circuit covered by the black plastic. The lines of contacts above and below the IC make contact to the display through the Zebra connector. Figure 12 is a photograph of the reverse side of the printed circuit board, showing the quartz, the trimmer capacitor and the chip component required for the IC operation. An overall view of the completed module is shown in Figure 13.

A different approach to module manufacturing is

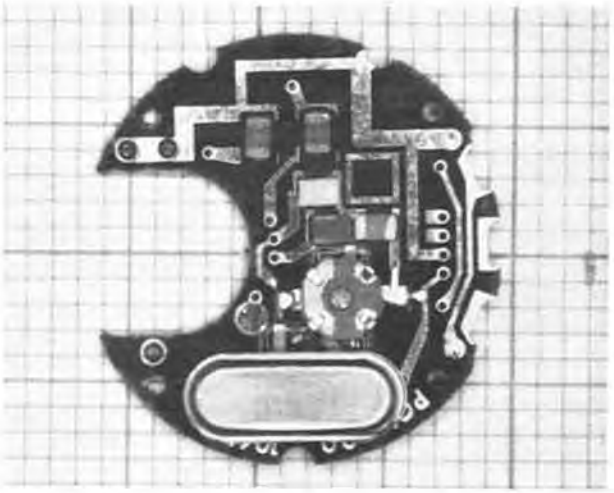


Photo of Back of Micro Display Systems LCD Module.

Figure 12.

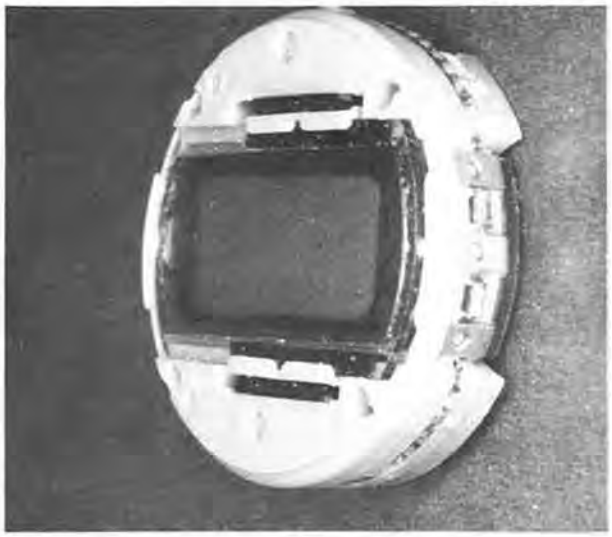


Figure 13. Photo of Complete Ladies Micro Display Systems Module.

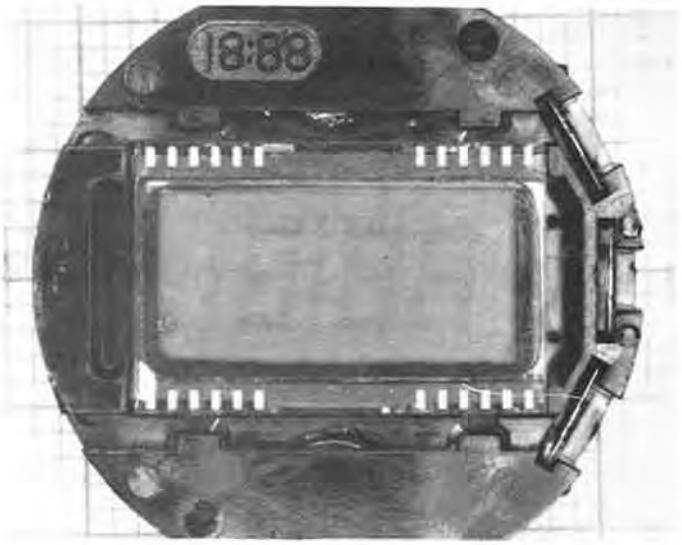


Figure 14. Photo of Front of Microma Module.

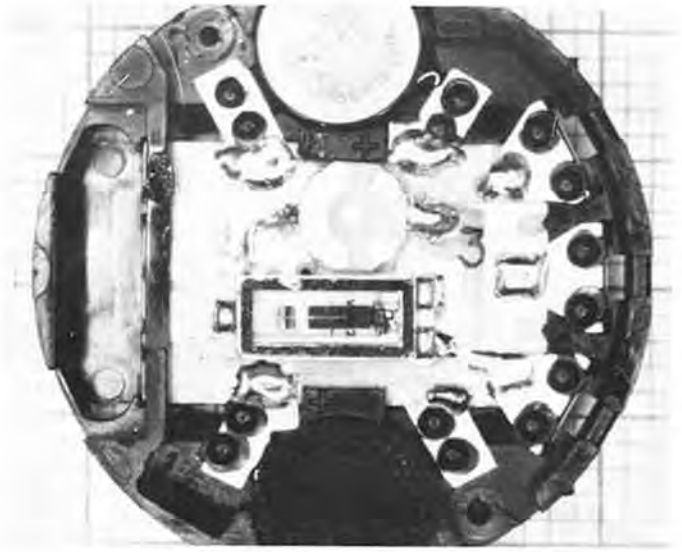


Figure 15. Photo of Back of Microma Module.



Figure 16. Front of Seiko Module.

shown in a module manufactured by Microma. This uses a ceramic substrate instead of a printed circuit board substrate. Figure 14 shows the front view of the module with display in place. Figure 15 shows the back view of the module. Here, the ceramic onto which all components are mounted is clearly visible (it is the white square). Contact to the pushbuttons is made by a pad soldered to the right-hand side of the module. A quartz in a package with a transparent window is shown right below the trimmer capacitor.

Modules manufactured by mechanical watch manufacturers look distinctly different than those manufactured by digital watch manufacturers. An example of this is a module manufactured by Seiko, as shown in Figure 16. This is the

front view of the module, showing the display held onto the metal frame of the module by two screws upper and two screws lower. Figure 17 is the reversed side of this module, showing only location for battery and access to the trimmer.



Figure 17. Back of Seiko Module.

Liquid Crystal Display Watch Trends

There is no doubt that great strides have been taken toward solving the numerous early problems of liquid crystal display watches, including display reliability and reliability of contact between the integrated circuit and the display. There is still the limitation on display complexity that results from the need of one contact per display segment. Even this problem may be solved through the recent advances that have been made in multiplexal displays. In this environment, we are seeing the liquid crystal display watches establishing a solid position in the marketplace in the middle and upper price ranges. The manufacturing costs will continue to be more than the manufacturing costs of LED modules, and there is no question that mechanical watches will continue to have styling advantages over any of the digital timepieces. Within these areas of constraint, however, the liquid crystal watch is still in a rapidly expanding market. □

DID YOU KNOW?

Diamond prices have increased over 600% in the last 40 years, and over 100% in the last five years.

AWI DIRECTOR CANDIDATES

(related article on page 46)

Listed in alphabetical order



Charles Barnes is a full-time watchmaker and is self-employed in his own tradeshop. He has served AWI on the Economic Study Committee and Membership Committee. Mr. Barnes is a past President of the former Michigan Horological Association and is a past President of the Michigan Watchmaker's Guild.

Mr. Barnes has served the Michigan watchmakers as a Legislative Representative and as Chairman of the By-laws Committee. He is extremely active in service clubs and is a Past District Governor of the Lions Club.

Charlie lives in St. Johns, Michigan. He has attended a number of AWI national meetings in which he represented the Michigan Watchmakers Guild.



Fred S. Burkhardt entered the trade as an errand boy. He worked several years in jewelry casting, then completed the Senior diploma course in watchmaking at the Philadelphia College of Horology. He worked in his native Philadelphia, then in 1957 moved back to Texas where he joined Harold's Jewelers in Fort Worth; later he opened his own trade shop.

Mr. Burkhardt has served as President of the Texas Watchmakers Association, also as President of the Fort Worth Watchmakers & Jewelers Guild–he is currently serving as secretary/treasurer of this guild. Mr. Burkhardt was active in the Texas watchmakers drive for a state license which was defeated by just one vote in the Senate.

Fred presently works for Deeds Jewelers in Fort Worth. He is active in his church and serves a member of the advisory committee of Paris Junior College. An Air Force veteran, he is presently working for a gemologist's diploma from the GIA.



Karl Buttner, Albuquerque, New Mexico, graduated in 1949 as a Certified Watch and Clockmaker after attending watchmaking school and completing a 3-year apprenticeship in Germany. After working in a German watch factory, Mr. Buttner moved to Canada in 1958 where he worked in a jewelry store as manager of the watch repair department. In 1971 he was hired by the Bulova Watch Co. as a watchmaker-inspector, and later he operated a tradeshop on Long Island.

In 1972 Karl moved to Albuquerque, where he began his own business, Quality Watch Service & Fine Jewelry. In 1973 he was elected President of the New Mexico Watchmakers Association and a Director of the New Mexico Retail Jewelers Association. He is a Certified Master Watchmaker of AWI, and presently is Chairman of AWI's Economic Study Committee, and an instructor in AWI's Clock Course.



Giacomo "Cappy" Cappabianca graduated from Quincy Senior High in Quincy, Massachusetts. He received his horological training at the Massachusetts Trade School for Horology and has been an active bench watchmaker for 29 years.

Mr. Cappabianca has been a member of the Massachusetts Watchmakers Association since 1961 and held various offices in this association until 1974 when he became President–an office he has held for 2 years. Presently he is Chairman of the Board for MWA and is Honor Awards Committee Chairman for AWI. For the past 3 years, Mr. Cappabianca has represented MWA at the AWI National meeting.

Cappy operates his own business, the Carlton Jewelry Store, in Braintree, Mass. He has operated this store continuously for the past 22 years. He resides with his wife in Quincy. During WW II he served in the Navy in the European theater.



George B. Doty graduated from the American School of Watchmaking, Los Angeles, in 1948. He has become a Certified Accutron Technician, and earned the Registered Jeweler title from the American Gem Society. Mr. Doty has had a wide span of experience in watch repair, resulting in an awareness of problems that can exist that area.

Mr. Doty was a member of the United Horological Society of America and presently is a member of the Horological Association of California, AWI, and served as President of the San Diego Watchmakers Guild before it became an Affiliate Chapter of AWI. While living in Ohio, he was a member of the Toledo Watchmakers Guild, the Watchmakers Association of Ohio, and the Ohio Guild of the American Gem Society.

George is married and lives in Escondido, California. He is actively engaged in watchmaking, and works in a AGS retail store.



Jerry Harris, CMW, became interested in watchmaking at the age of 9 when he started to tinker with watches. He attended the Oregon Technical Institute in 1946, and since has studied at Bulova and Frank Wiggens Trade School. Since completing his formal studies in watchmaking, Mr. Harris has earned the AWI CMW title and has become a Certified Accutron Technician. He has also trained several watchmakers during the years.

Mr. Harris was an active member of the Iowa watchmakers guilds prior to moving to Idaho. He has been active in church and service clubs, and finds time to coach Little League and basketball. His hobbies include collecting antique pocketwatches, carpentry, and working on cars.

Jerry is in business in Rupert, Idaho, operating Ray and Jerry's Jewel Box and Trade Shop in that city.



Ewell D. Hartman, CMW, Richmond, Virginia, received his watchmaking education at the Bowman Technical School, Lancaster, Pa. He operated his own store in Virginia, then became associated with Schwarzschild Brothers Jewelers in Richmond, Va. He presently serves that firm in a supervisory capacity, but still finds time to repair watches and especially enjoys restoring antiques. Mr. Hartman served the Horological Society of Virginia in many capacities which included the presidency and editorship of their publication, "Loupes & Tweezers."

Mr. Hartman joined the Board of Directors of AWI and also served as President of AWI. While President, he pioneered the bench course concept of watchmaker training when he developed the first AWI bench course for the ESA 9150 and 9154 watch movements. While President of AWI, Mr. Hartman became widely known as both a technical and motivational speaker.

Ewell traveled the entire country speaking and teaching for AWI. During his presidency, AWI experienced a phenomenal growth. He is a member of NAWCC.



Charles H. Mann, Tacoma, Washington, is serving AWI as a Director. He was the Washington State Watchmakers Association delegate to AWI's Annual Board Meeting in 1971 and 1972, and served as Affiliate Chapter Director.

Mr. Mann is Immediate Past President of the Washington State Watchmakers Association. In 1971 he received the WSWA achievement award, inscribed, "Washington's Most Active Watchmaker." Mr. Mann graduated from Bradley School of Horology in 1946, after completing military service in the U.S. Army, where he served as an instructor in medical laboratory sciences. Before entering the Army, Mr. Mann attended the University of California, Berkeley. Presently, he is a full-time watchmaker at Tubbin Jewelry, in Puyallup, Washington.

Charlie is presently the Chairman of AWI's Watch Distributor Liaison Committee which he has chaired since its formation 3 years ago.



Robert A. Nelson, Minneapolis, Minnesota, is an AWI Certified Master Watchmaker, as well as a licensed watchmaker in the State of Minnesota. He served 20 years as a bench watchmaker, 10 years in a retail store, and 15 years operating a tradeshop. Mr. Nelson studied electronics while in the Navy. He is nationally known for his many lectures on electronics in watch repair, and traveled for several years with AWI's ESA 9154 Bench Course.

Robert Nelson has served the Minnesota Watchmaker Association in numerous capacities which include a 2-year term as President. He represented the watchmakers and jewelers of Minnesota in the State Department of Taxation, establishing a workable interpretation of that state's sales tax law. He is a member of the Minnesota Board of Examiners in Watch Repair.

Mr. Nelson is Chairman of AWI's Visual Aids Committee which is responsible for the production of the fine slide and tape programs enjoyed by so many watchmakers at conventions and guild meetings.

Bob is the Immediate Past President of AWI. Through his initiative and steady guidance, AWI was able to purchase and renovate its present permanent headquarters–AWI Central.



Leslie L. Smith, CMW, Cincinnati, Ohio, began his watchmaker training as an apprentice in 1944. In 1953 Mr. Smith became a Certified Master Watchmaker by successfully completing the UHAA examination. Today he is an AWI Certified Master Watchmaker and a Registered Jeweler of the American Gem Society. He presently operates his own jewelry store, L.L. Smith Jewelers.

Les Smith, a charter member of AWI, was chairman of the steering committee which reactivated the Cincinnati Watchmakers Guild in 1959; he served the Guild as President in 1959, 1960, and again in 1966-67. He was also instrumental in preparing successful arguments for AWI's use in AWI's "waterproof" presentation to the FTC. He pioneered the current method of ultrasonic cleaning method, and shared the method he developed through lectures and demonstrations before watchmaker groups. Mr. Smith also finds time to serve his community in church work, scouts, and service clubs.

Today, Les is widely known for the popular bench course he conducts for AWI on the Seiko Quartz Analog watch. This course has taken him to all corners of the U.S. and Canada.

IMPORTANT ANNOUNCEMENT

It has come to our attention that our former American distributor, Edward Trauner Inc., of Elmsford, New York, which is now in liquidation, may have assembled watches without our authorization which carry the "Zodiac" label but do not include movements provided by us.

The Zodiac name and trademark are owned and registered in the United States by us and we cannot be responsible for the repair or replacement of any watches assembled without our authorization.

–ZODIAC S.A.–SWITZERLAND

THE SETH THOMAS MANTEL STRIKE

(continued from page 43)

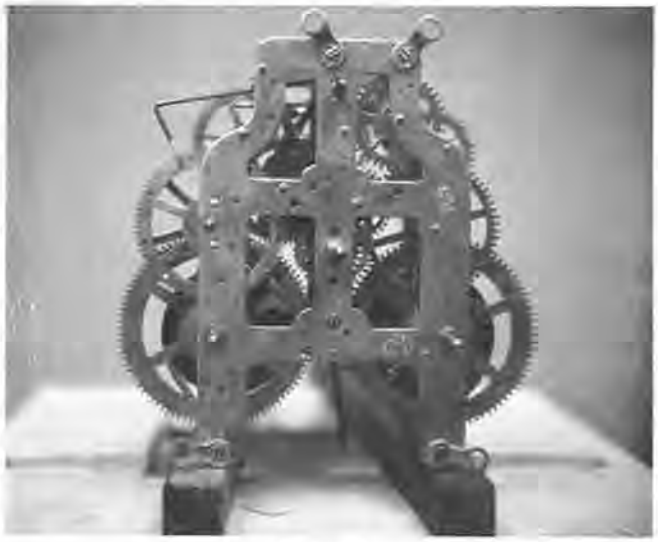


Figure 4.

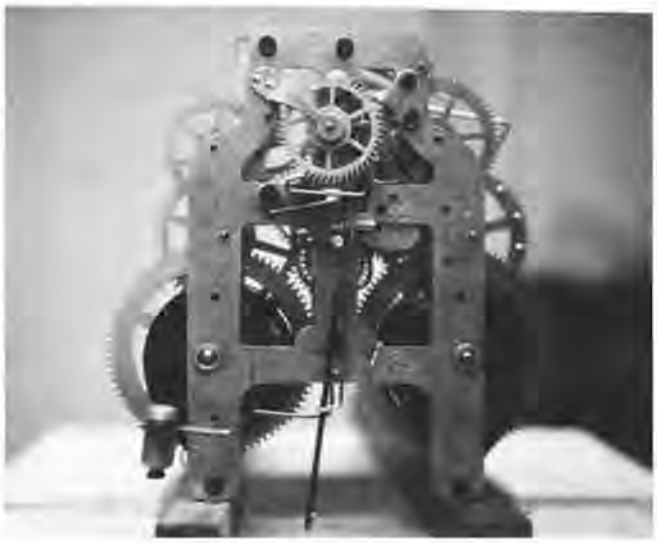


Figure 5.

□

SCHOLASTICALLY SPEAKING

(continued from page 45)

gemology, business administration, etc. In addition, the Center as conceived would have provided a central place in a "neutral" academic atmosphere for gathering authorized product information from the highly qualified experts associated with all American watch and jewelry manufacturers. Such accurate information relating to the sales and servicing of jewelry products would be dispensed from the Jewelers Educational Center to all associations, schools, and trade magazines.

The "concept" was the brainchild of Pat Eskew, former jewelry trade magazine publishers. Eskew, who has since retired from all connection with the jewelry industry to enter another field, commented to Hagans, "I finally came to the conclusion that while the rank and file individuals of the jewelry industry desperately want and need accurate, reliable product knowledge that only the manufacturing experts can supply, the concept of mutual cooperation was just too simple a solution for the high-strung competitive manufacturers and suppliers to accept at this time." □

NEWS FROM ALL AROUND

(continued from page 47)

as they apply to the watch industry, and a slide lecture by Francois Girardet, Technical Instructor of WOSIC, was given. A cocktail hour, courtesy of Ebauches SA of Switzerland was held, and the Annual President's Banquet was featured.

RHODE ISLAND

The March meeting of the RIWA was held at the Holiday Inn in Providence on the 7th. The chairman of the nominating committee, Bernard Jacobson, read the names of his suggested slate of officers: President, Walter Smith; Vice President and Secretary, Lora Clemence; Financial Secretary and Treasurer, Frank Lanowy; AWI Representative, Hamilton E. Pease; Program Director, Edward Walker. Vincent DeAngelis, Program Director, reported contacting the Howard Clock Company at Waltham, Massachusetts, regarding the annual June outing. Arrangements have been made for June 6. A slide program was then given, including slides of various members. □

BANK CREDIT CARDS

One way of countering the increasing trends to bank credit cards among the country's retailers, according to Merchant's News Letter: the Federal Reserve Board backed a Congressional act allowing retailers to offer discounts up to 5% to consumers who prefer paying cash to using credit cards. The law exempts merchants who offer the 5% for cash discounts from making finance-charge disclosures and also exempts them from coming under state usury or general credit laws. But the statute does not exempt merchants from disclosure when they add a 5% surcharge on credit-card use.

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 indebtedness.

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.

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JEWELRY STORE DISPLAY KITS AVAILABLE BY MAIL

A special new service for jewelers, introduced by RJA at its 1977 Spring Trade Fair & Conference, is now available by mail order.

To help jewelers promote their spring business, RJA has created a jewelry store display package–a kit complete with a unique set of easy-to-assemble trimmings that can be used in store windows, on counter tops, and in strategic locations throughout a jewelry store.

The package, which features an eye-catching unique mobile that focuses attention on Spring and jewelry, gives retailers a valuable chance to use the bright colors and promotional theme from RJA's 1977 Spring Trade Fair to promote their own store's name and image.

Included in this unique kit: a mobile unit featuring large colorful discs spotlighting the major gift-giving spring occasions; several decorative units designed to be used as counter displays, gift tags, envelope stuffers or any other pertinent spring promotions; and, coordinated newspaper and layouts in varying sizes.

This package will enable a jeweler to bring a spring atmosphere into his store and create attractive, but inexpensive, displays and promotions. The cost is $15.00

Send your check with your order to RJA, 10 Rooney Circle, West Orange, New Jersey 07052.

NEW PRODUCTS

Portescap has introduced two new tools for the servicing of watches equipped with the Incabloc® shock absorber. The Genuine Incabloc® Tweezers facilitate the handling of Incabloc jewels. A notch cut out at the end of each arm ensures perfect holding of the Incabloc jewel setting during the cleaning with a pin, thus avoiding any risk of loss. Manufactured in Switzerland from high-quality stainless steel, these tweezers are 13.5 centimeters long.

In recent years, the fixing of the shock absorber by bolt or screw has been replaced in practically all cases by the



driving method. As the assortments for staking tools available to watchmakers do not generally include the punches and stakes required, Portescap has provided a special assortment for this function covering all types of Incabloc shock absorbers. The Genuine Incabloc® Assortment for the Fitting of Shock Absorbers is made up of six punches and seven stakes and can be used with all current staking tools used in the watch industry. The maintenance operation avoids all risk of damage to or distortion of the balance cock or plate.

These two tools will be made available for sale to all watch material dealers. For information please call Portescap U.S. at 212/245-7715, 730 Fifth Avenue, New York, NY 10019.

New Seiko Illuminated Digital Quartz Window Display

Seiko Time Corporation introduced recently a new illuminated Digital Quartz Window Display designed to hold four Seiko digital watches.

The display (WD007) describes the highlights of Seiko LC digitals, including an LC Digital Chronograph, and an LC Digital Dual Zone Timer. The individual descriptions automatically light sequentially. The black velvet tray, which



holds the watches, is removable—so that it can be easily taken from the window for safekeeping at the close of each day. The empty tray area then displays in bold letters the invitation to "Come in and see our complete collection of Seiko LC Digital watches."

The new display, measuring 16 in. x 13 in. x 8 in., is available to jewelry and fine department stores through Seiko's nationwide network of distributors. □

BENCH TIP

How often have you pushed in a precoiled T end mainspring in a barrel, only to find it had slid a fourth of the circumference past the hole? So you gauge the next one 90° clockwise past the hole in the barrel so that when it is pushed out of its retainer ring, the T will luckily stop over the hole in the barrel. Not too much luck with that either?

Try this. Align the T of the mainspring about 5° clockwise past the hole in the barrel. Carefully push the mainspring partially down into the barrel, but not so much that it will spring out of the retainer ring. Then when all is ready and aligned, make the final push of the mainspring *180° from the T* (directly across from the T). Then push the T end down into the barrel.

Many times the T will be in the hole, and if not, only a couple of degrees away from the hole. From that slight distance, it can easily be maneuvered into position. □

Classified

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THE TRADESMAN

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

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.

Accutron Repair. Electric and step motor quartz. Tick Tock Antique Clocks, RD No. 3, Cazenovia, New York 13035. 315-655-3283.

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Wheels, pinions, barrels or whatever, repaired or made new. Repivot arbors. Parts made to order. Ken-Way Inc., 311 Chestnut, Addison, Illinois 60101.

WANTED TO BUY

Antique Watches with unusual escapements, repeaters, enamels, solid gold hunters, French carriage clocks. Top cash. H. Guedalia, 29 Abeel Street, Yonkers, NY 10705.

Cleaning cup ultrasonic McKenna Kleaner, Model CH17. Stine Jewelers, 220 East Main St., Fairfield, Ill. 62837.

Roll top watchmaker's bench. State price and condition. J.F. Payne, 2228 Barbara Drive, Clearwater, Florida 33516.

FOR SALE

Members. 4 original stems 1.00. L.B. Tate, POB 774, Greenville, Ms. 38701.

Lathe, bench, light, staking, jeweling, and hand tools. Copies of AH&J. Wanted to buy: horological tools, books, etc. Don D. Evans, 4236 East 25th, Joplin, Mo. 64801, 417-624-6447.

Collets, new, No. 3 & 4, $8.00 each. No. 5 thru 80, $5.00 each. Wheel chucks 1 thru 5, $8.00 each. Specify WW Boley or Mosely pattern. Service charge of $1.00 on orders under $25.00. Certified check or money order. J.C. Van Dyke, CMW/CMC, 1039 Rt. 163, Oakdale, Conn. 06320.

AWI member, Mrs. Thelma Y. (Niki) Bricker finds it necessary because of illness to sell the business she has operated in Bartow, Florida for the past 23 years. This is a small jewelry and watch repair shop with an excellent reputation. Contact her at P.O. Box 1596, Bartow, FL 33830.

HELP WANTED

Experienced watchmaker for all phases of repair. Good salary, working conditions, 5½ day week. Send photo and resume to Mr. Barry N. Martin, Martin's Jewelry, 117 W. Carolina Ave., Hartsville, S.C. 29550.

Guild-type store. To assist Master Watchmaker soon to retire. Write or call Mr. Butler, Deister and Butler, 119 North Main, Elmira, NY 14901 (607) 734-4181.

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.

Young, competent, and efficient watchmaker seeks employment, preferably in Arizona, Colorado, Oklahoma. For resume write Emmett Hurt, 1132 California S.E. Apt. B, Albuquerque, New Mexico 87108.

Southwest State Technical College watchmaker graduate competent in all phases of watch repair. Has worked part time at the bench. Prefer Northwest Florida. H. L. Collins, Jr., 4510 Calhoun Rd., Mobile, Alabama 36619.

Calendar

MAY

1–Cincinnati Watchmakers Guild Spring Seminar; Cincinnati, Ohio.

2–Horological Society of New York; Regular Meeting, New York, New York.

8–AWI Tour Returns from Europe.

10–Watchmakers' Association of New Jersey, Regular Meeting.

13-15–North Carolina Watchmakers Association; Annual Meeting; Bordeau Convention Center; Fayetteville, North Carolina.

13-15–Horological Association of Virginia Convention; Holiday Inn; Virginia Beach, Virginia.

15–AWI ESA 9158-9200 Bench Course; Instructor: James Broughton; Watchmakers Association of Ohio-AWI; Marietta, Ohio.

15-16–Maryland-Delaware-DC Jewelers Association Annual Convention; Sheraton Fontainbleu Hotel; Ocean City, Maryland.

16-17–Virginia-North Carolina Retail Jewelers Association Annual Convention; The New Cavalier; Virginia Beach, Virginia.

17-Massachusetts Watchmakers Association; Regular Meeting; Cambridge, Massachusetts.

22–AWI Seiko Quartz Bench Course; Instructor: Les Smith; Watchmakers Association of Ohio-AWI; Marietta, Ohio.

29-June 3–National Wholesale Jewelers Association, Annual Convention; Greenbrier-White Sulpher Springs, West Virginia.

JUNE

5–Horological Society of New York; Regular Meeting, New York, New York.

6–Rhode Island Watchmakers Association; Annual Outing; Howard Clock Company; Waltham, Massachusetts.

12–Watchmakers Association of Indiana; Executive Meeting.

14–Watchmakers' Association of New Jersey; Members-only meeting.

15-19–National Association of Watch & Clock Collectors Convention; Chicago, Illinois.

20-23–Research & Education Council of AWI Meeting and In-Service Workshop; Sponsors: Watchmakers of Switzerland Information Center, REC–AWI; Diamond Oaks Campus; Cincinnati, Ohio.

21–Massachusetts Watchmakers Association, Regular Meeting.

24–Affiliate Chapters Meeting–AWI; Greater Cincinnati Airport, Cincinnati, Ohio.

25-26–Board of Directors Meeting–AWI; Greater Cincinnati Airport; Cincinnati, Ohio.

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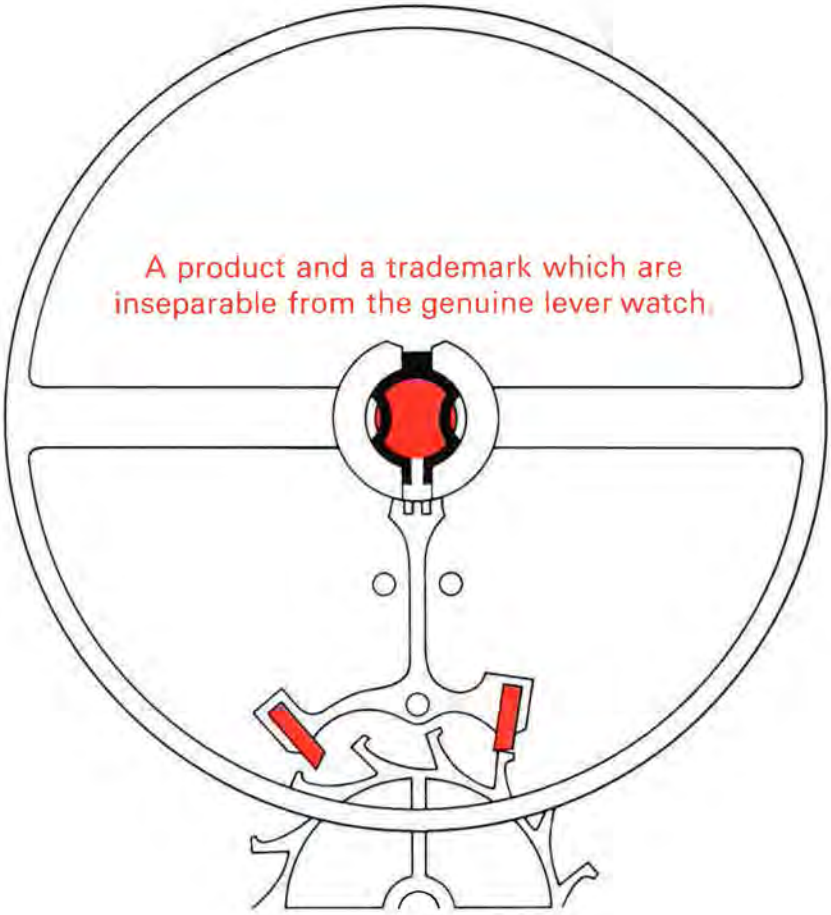
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